

Prüfbericht-Nr.: Test report no.:	ULR-TC568820300000059F	Auftrags-Nr.: Order no.:	166495275 0010	Seite 1 von 47 Page 1 of 47
Kunden-Referenz-Nr.: Client reference no.:	NA	Auftragsdatum: Order date:	2020-11-02	
Auftraggeber: Client:	Bradford White Corporation 200 Lafayette St. Middleville, MI. 49333 Phone: 616-610-6432			
Prüfgegenstand: Test item:	Bradford White Connect Adapter			
Bezeichnung: Identification:	BWCADAPTER			
Auftrags-Inhalt: Order content:	Testing and Issue of FCC & ISED grant certificate			
Prüfgrundlage: Test specification:	FCC Part 15 Subpart C (15.247, 15.207) RSS 247 Issue2 & RSS Gen Issue 5			
Wareneingangsdatum: Date of sample receipt:	2020-11-03			
Prüfmuster-Nr & Serien-Nr.: Test sample no & serial no.:	A002942060-002 & A002942060-003 & 1610014323788			
Prüfzeitraum: Testing period:	2020-11-03 - 2020-11-09			
Ort der Prüfung: Place of testing:	Wireless laboratory, Bangalore			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (India) Pvt.Ltd., 27/B, 2nd Cross, Electronic City Phase1 Bangalore -560 100, India FCC Test site registration number: 496599 ISED Test site registration number: 3466E-1			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:	genehmigt von: authorized by:			
Datum: Date: 2020-11-03			Ausstellatum: Issue date: 2020-12-30	
Stellung / Position:	Srinivasa BR Engineer	Stellung / Position:	Mahammadgouse Kaladagi Assistant Manager	
Sonstiges / Other:	FCC ID: 2AX6A - BWCADAPTER IC:26687- BWCADAPTER			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut 2 = good P(ass) = passed a.m. test specification(s)	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n) 3 = satisfactory F(ail) = failed a.m. test specification(s)	4 = ausreichend N/A = nicht anwendbar 4 = sufficient N/A = not applicable
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good 2 = good P(ass) = passed a.m. test specification(s)	3 = satisfactory F(ail) = failed a.m. test specification(s)	5 = mangelhaft N/T = nicht getestet 5 = poor N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

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TEST SUMMARY

Test Item	Applicable Standard		Result
	FCC	ISED	
Maximum conducted (Peak & average) output power	FCC 15.247(b)(3)	RSS 247 Issue 2, Section 5.4 (d)	Pass
Maximum Power Spectral Density	FCC 15.247(e)	RSS 247 Issue 2, Section 5.2 (b)	*N/T
DTS Bandwidth	FCC 15.247(a)(2)	RSS 247 Issue 2, Section 5.2 (a)	*N/T
Emissions in non-restricted frequency bands	FCC 15.247(d)	RSS 247 Issue 2, Section 5.5	*N/T
Spurious Radiated Emissions and Restricted Bands of Operation	FCC 15.209 / FCC 15.205	RSS-Gen Issue 5, Section 8.9 /8.10	Pass
Conducted Emissions on a.c Power Lines	FCC 15.207	RSS-Gen Issue 5, Section 8.8	Pass
Antenna requirement	FCC 15.203	-	Pass

Product Category: Electronics Testing
Test Discipline: EMC Test Facility

Note:

*N/T-

- These test cases are not tested, the product uses certified RF module ESP-WROOM-32D from ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD, having FCC ID: 2AC7Z-ESPWROOM32D & IC: 21098-ESPWROOM32D
- Conducted RF output power verification is performed and maximum average output power is within the module test results authorized under the FCCID: 2AC7Z-ESPWROOM32D, hence validity of the test results reported are verified and only Radiated spurious emission and band edge test are performed to confirm that the product **Bradford White Connect Adapter** meets all the applicable FCC & ISED spurious emission limits.

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REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
ULR-TC568820300000059F	01	Initial issue of report	2020-11-26
ULR-TC568820300000059F	02	Updated reviewer comments	2020-12-09
ULR-TC568820300000059F	03	Updated reviewer comments	2020-12-30

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1 GENERAL REMARKS

1.1 Attachments

All attachments are part of this test report and are issued in separate document

1. TEST SETUP PHOTOS
2. EUT EXTERNAL PHOTOS
3. EUT INTERNAL PHOTOS
4. FCC LABEL AND LABEL LOCATION
5. BLOCK DIAGRAM
6. SPECIFICATION OF EUT
7. SCHEMATIC DIAGRAMS
8. BILL OF MATERIAL
9. USER MANUAL
10. MAXIMUM PERMISSIBLE EXPOSURE INFORMATION

2 TEST SITES

2.1 Testing Facilities

- | | |
|--|---|
| <p>1. TÜV Rheinland (India) Pvt.Ltd.,
27/B, 2nd Cross,
ElectronicCityPhase1
Bangalore – 560 100,
India</p> | <p>2. TUV Rheinland (India) Private Limited
108 , Beside ISBR Business School,
Electronic city Phase I
Bangalore - 560 100.
India</p> |
|--|---|

2.2 List of Test and Measurement Instruments

Table 1: List of test and measurement instruments

Equipment	Manufacturer	Model Name	Serial Number	Firmware Versions	Calibration Due Date	Periodicity	Test Facility
EMI Receiver	Rohde & Schwarz	ESU 40	100288	4.73 SP5	09.06.2021	Yearly	Radiated Spurious Emission
Active loop antenna	Schwarzbeck	FMZB 1519 B	1519B-00111	-	31.01.2021	Yearly	
Biconical Antenna	Schwarzbeck	VHBB -9124/ BBA9106	01028	-	16.01.2021	Yearly	
Log - Periodical Antenna	Schwarzbeck	VUSLP 9111B	9111B-111	-	17.01.2021	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-0904	-	29.01.2021	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-1944	-	30.01.2021	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	Antenna-Port Conducted test
USB Peak power sensor	Boonton	55006	10231	FW 3.2.4.0	09.01.2021	Yearly	
Spectrum Analyser	Agilent	E4407B	US4119 2772	-	28.08.2021	Yearly	
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100811	-	04.08.2021	Yearly	Conducted AC Power line Test
LISN	Rohde & Schwarz	ENV216	100022	-	04.09.2021	Yearly	
ESW44	Rohde & Schwarz	ESW44	101732	-	10.12.2020	Yearly	

Table 2: Instrument application Software versions

SL. No.	Test Type	Application software	Version
1	Radiated spurious emission measurement in SAC	EMC 32	10.60.00
2	Radiated spurious emission measurement in FAC	EMC 32	10.60.00

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

Bradford White Connect Adapter system is a smart home/commercial system that will enable residential and commercial water heaters and boilers to be smart, which mean the user can control the heater, monitor the energy consumption, and receive alerts whenever the heater runs into any flaw. The Bradford White Connect Adapter device is one of the critical components in the system which will allow controlling the smart water heaters using a mobile application.

3.2 Ratings and System Details of Equipment under Test

Table 3: Ratings and System Details as declared by Client*

Radio Protocol	Wi-Fi 2.4GHz	BLE
Operating Frequency Range	2412MHz to 2462MHz	2402MHz to 2480MHz
No. of Channels	11 (Refer Table 5)	40 (Refer Table 6)
Channel Spacing	5MHz	2MHz
Maximum Measured conducted power	17.92 dBm	-11.47dBm
Modulation	DSSS & OFDM	GFSK
Wi-Fi 2.4GHz operating modes	802.11b : DSSS 802.11g : OFDM 802.11n(20MHz): OFDM *	NA
Data rates	802.11b : 1Mbps to 11Mbps 802.11g : 6Mbps to 54 Mbps 802.11n(20MHz): MCS0 to MCS7 *	1Mbps
Number of antennas	One	
Antenna Gain	3.7dBi	
Antenna Type	Inverted F - PCB Trace Antenna	
Supply Voltage to Product	5 VDC through adaptor (Adaptor model: TRE06S050-A)	
Environmental conditions	Storage temp: -20°C to +80°C	
	Operating temp: -20°C to +65°C	
EUT Dimension (L X W)	(184.3 x 88) mm	

Note: The RF module support 802.11 n (40MHz bandwidth), which is disabled and not used in the product

***Disclaimer:** The information/data is supplied by the client and the same is considered to arrive at the final value. Any changes made apart from the specified specification, can directly impact on the tests results. Refer the products user manual for more details

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Note: Product Bradford White Connect Adapter has multiple protocols. All the supported wireless protocols and their respective test results are issued in separate test reports, refer clause 4.6 Report references

3.3 Measurement Uncertainty:

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$

Table 4: Measurement Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	$\pm 5 \%$
RF output power, conducted	$\pm 1.5 \text{ dB}$
Power Spectral Density, conducted	$\pm 3 \text{ dB}$
Unwanted Emissions, conducted	$\pm 3 \text{ dB}$
All emissions, radiated	$\pm 6 \text{ dB}$
Temperature	$\pm 3 \text{ }^{\circ}\text{C}$
Supply Voltages	$\pm 3 \%$
Time	$\pm 5 \%$

Note: The Listed Measurement Uncertainties are the worst-case uncertainty, for the respective test cases. Above Table is for reporting purpose only and not used in determining Final Pass/Fail verdict.

4 TEST SET-UP AND OPERATION MODE

4.1 Principle of Configuration Selection

Transmission was enabled with highest possible duty cycle transmission on low, mid and high channel.

4.2 Test Operation and Test Software

Hardware Version : Rev4.0
Hardware Version Identification Number(s) (HVIN): BWCAHR4

Software Version : Rev2.0.0
Software Version Identification Number(s) (FVIN): BWCASR2

4.3 Special Accessories and Auxiliary Equipment

- Test laptop, UART cable, Ethernet cable & Bradford White Water Heater

4.4 Countermeasures to achieve EMC Compliance

- None

4.5 List of frequencies

Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
2412 – 2462	1	2412
	2	2417
	3	2422
	4	2427
	5	2432
	6	2437
	7	2442
	8	2447
	9	2452
	10	2457
	11	2462

Table 5: List of Wi-Fi 2.4GHz center Frequencies

Channel used for Wi-Fi testing

Channel Bandwidth 20MHz

Channel low : 2412MHz

Channel mid : 2437MHz

Channel high : 2462MHz

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Frequency Band (GHz)	Channel No.	Frequency (MHz)
BLE (2.4-2.4835)	0	2402
	1	2404
	2	2406
	3	2408
	:	:
	:	:
	18	2438
	19	2440
	20	2437
	:	:
	:	:
	36	2474
	37	2476
	38	2478
	39	2480

Table 6: List of BLE Center frequencies

Channel used for BLE testing

Channel low : 2402MHz

Channel mid : 2440MHz

Channel High : 2480MHz

Note:

TUV Sample Identification number : A002942060-003 –Radiated test Sample
A002942060-002 – Conducted test Sample

4.6 Report references

Note: Product **Bradford White Connect Adapter** has multiple protocols. All the supported wireless protocols and their respective test results are issued in separate test reports, following table lists the report numbers.

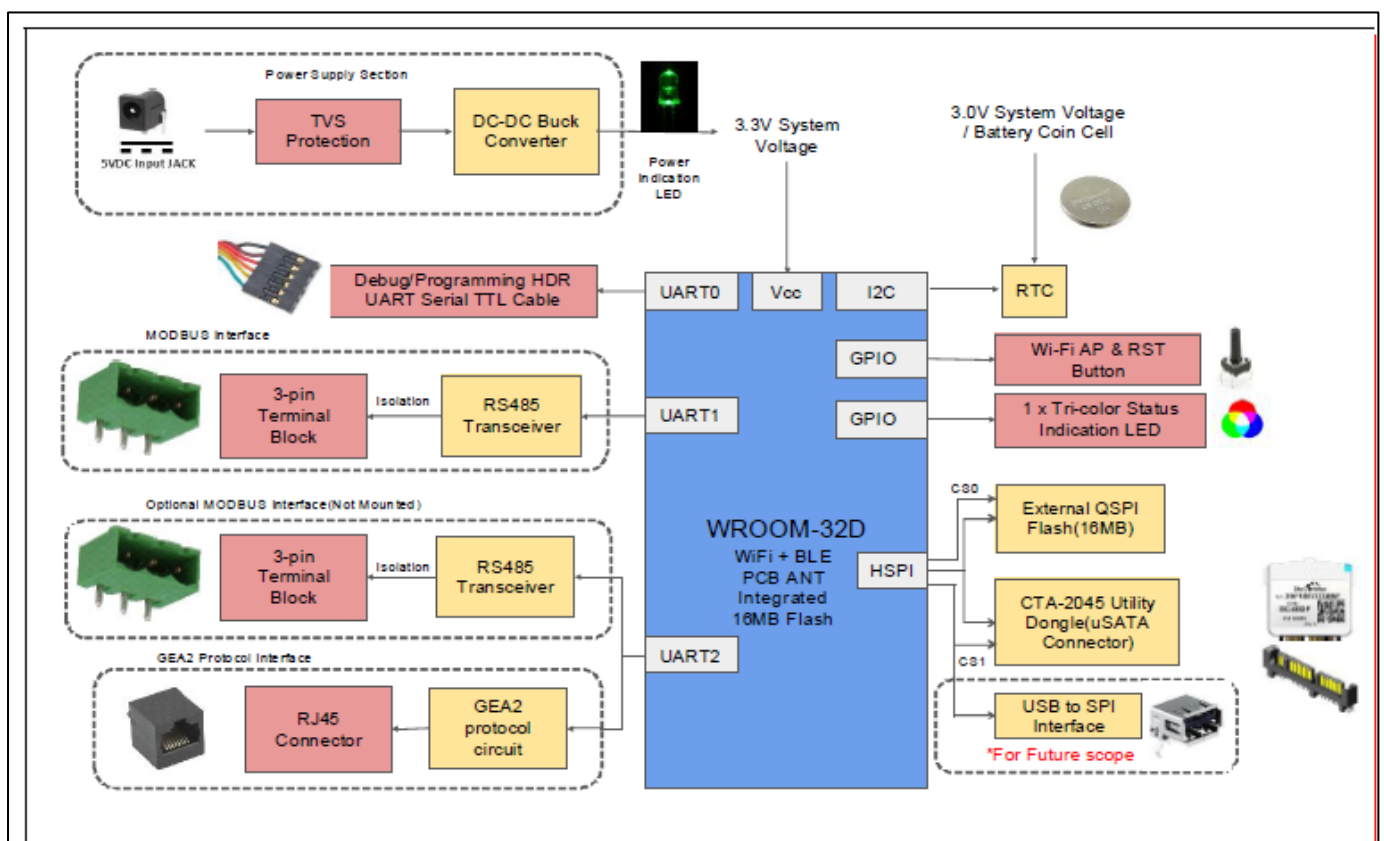
Radio Protocol	Report Number
RF test report for Wi-Fi (2.4GHz) & BLE (2.4GHz) – (This report)	ULR-TC568820300000059F
RF test report for BT (2.4GHz)	ULR-TC568820300000060F

5 Operational Description

"Bradford White Connect Adapter system is a smart home/commercial system that will enable residential and commercial water heaters and boilers to be smart, which mean the user can control the heater, monitor the energy consumption, and receive alerts whenever the heater runs into any flaw.

The Bradford White Connect Adapter device is one of the critical components in the system which will allow controlling the smart water heaters using a mobile application."

6 Block Diagram



7 TEST METHODOLOGY

7.1 Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.10-2013. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable for below 1 GHz & 1.5 m height for above 1 GHz measurement, and the EUT is 3 meters far from the measuring antenna. The turntable was rotated 360° for obtaining the maximum emission. The height of the measuring antennas was scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained. The measurement above 1000 MHz was performed by horn antenna, The measurement below 30 MHz was performed by loop antenna, Measurement from 30 MHz to 200 MHz was performed by Baloon and Biconical Antenna, and measurement from 200 MHz to 1 GHz was performed by Log-Periodic Antenna.

The EUT was rotated around the X-, Y-, and Z-Axis and the results from worst case axis are recorded

7.1.1 Test Setup Configuration

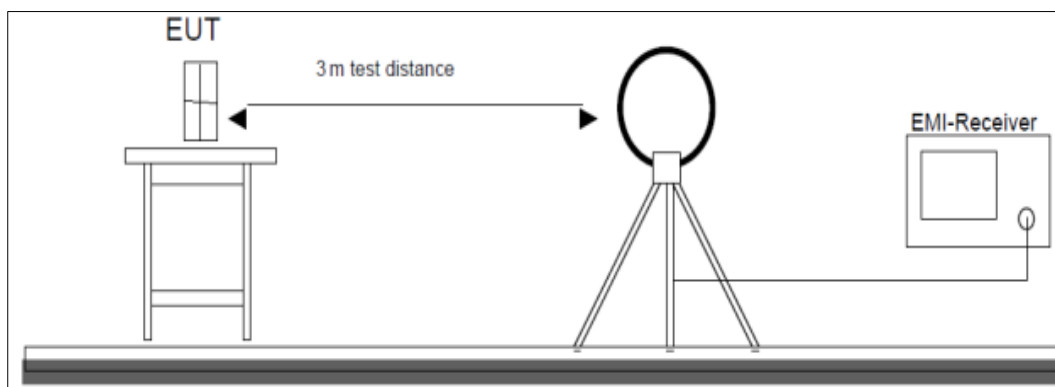


Figure 1: Frequency Range 9 kHz- 30 MHz

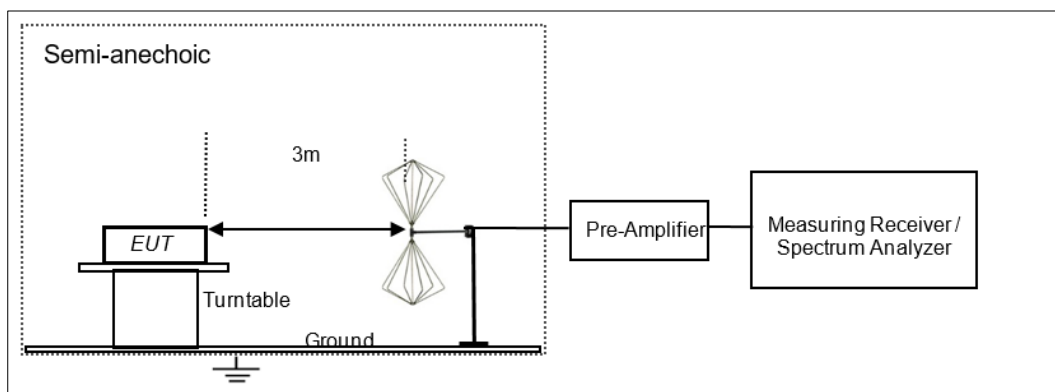


Figure 2: Frequency Range 30 MHz – 200 MHz

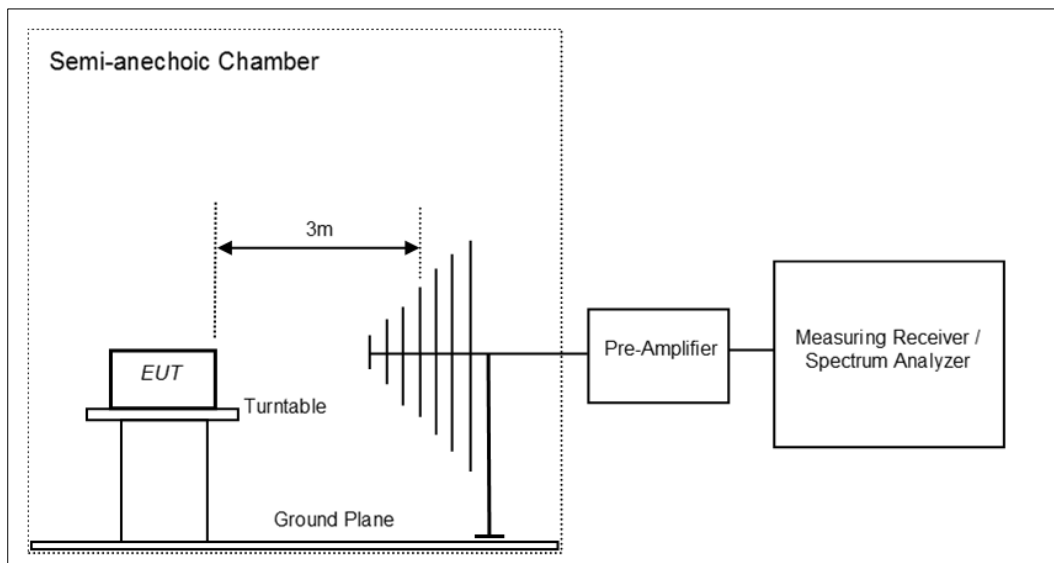


Figure 3: Frequency Range 200 MHz - 1GHz

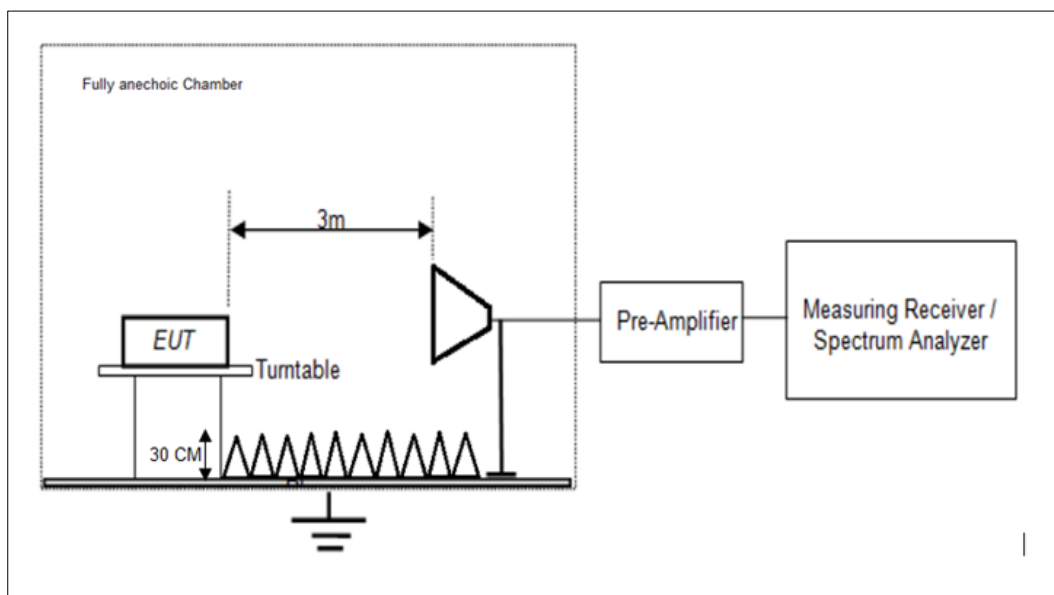


Figure 4: Frequency Range above 1 GHz

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8 TEST RESULTS FOR Wi-Fi

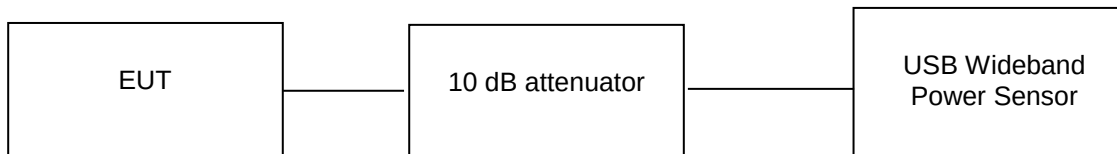
8.1 Maximum conducted (average) output power

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (b)(3) / RSS 247 Issue 2, Section 5.4 (d)
Test Method	Subclause 11.9.2.3 of ANSI C63.10
Detector	Average
Port of testing	Antenna port
Requirement	Power ≤ 1 W (30 dBm) & e.i.r.p ≤ 4 W (36 dBm)

Test Method



Test Condition

Environmental and Test conditions:

Normal Temperature = +23.8 °C Voltage (V norm) = 5VDC through Adapter Relative Humidity = 64 %

KDB Guidelines applied:

Measurements were made as per section 8.3.2.3 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report
2. Total Average Output power (dBm) = Measured Average power (dBm) + Attenuator factor (10dB) + Cable loss (0.6dB) + Duty cycle correction factor (dB)
3. This product do not support additional beamforming gain / directional gain, it uses signal antenna and hence directional gain of the single antenna is 3.7 dBi
4. Maximum (e.i.r.p) = Maximum Average output power (dBm) + antenna gain (3.7 dBi)

Modulation: 802.11b

Transmitted power level: + 18 dBm

Mode	Data rate (Mbps)	Frequency (MHz)	Measured Average power (dBm)	Duty cycle (%)	Duty Factor	Final Measured Average power (dBm)	Limit (dBm)	Maximum e.i.r.p (dBm)	e.i.r.p Limit (dBm)
b	1	2412	17.33	100	0	17.33	30	21.03	36
		2437	17.18	100	0	17.18	30	20.88	36
		2462	17.07	100	0	17.07	30	20.77	36
	11	2412	17.92	100	0	17.92	30	21.62	36
		2437	17.39	100	0	17.39	30	21.09	36
		2462	17.38	100	0	17.38	30	21.08	36

Modulation: 802.11g

Transmitted power level: + 18 dBm

Mode	Data rate	Frequency (MHz)	Measured Average power (dBm)	Duty cycle (%)	Duty Factor	Final Measured Average power (dBm)	Limit (dBm)	Maximum e.i.r.p (dBm)	e.i.r.p limit (dBm)
g	6	2412	16.26	100	0	16.26	30	19.96	36
		2437	16.08	100	0	16.08	30	19.78	36
		2462	16.02	100	0	16.02	30	19.72	36
	24	2412	14.33	100	0	14.33	30	18.03	36
		2437	14.13	100	0	14.13	30	17.83	36
		2462	14.25	100	0	14.25	30	17.95	36
	54	2412	12.2	100	0	12.20	30	15.90	36
		2437	12.2	100	0	12.20	30	15.90	36
		2462	12	100	0	12.00	30	15.70	36

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Modulation: 802.11n-20MHz

Transmitted power level: + 18 dBm

Mode	Data rate	Frequency (MHz)	Measured Average power (dBm)	Duty cycle (%)	Duty Factor	Final Measured Average power (dBm)	Limit (dBm)	Maximum e.i.r.p (dBm)	e.i.r.p limit (dBm)
n-20 MHz	MCS0	2412	16.12	100	0	16.12	30	19.82	36
		2437	16.09	100	0	16.09	30	19.79	36
		2462	15.92	100	0	15.92	30	19.62	36
	MCS4	2412	14.5	100	0	14.50	30	18.2	36
		2437	14.26	100	0	14.26	30	17.96	36
		2462	14.24	100	0	14.24	30	17.94	36
	MCS7	2412	11.31	100	0	11.31	30	15.01	36
		2437	11.05	100	0	11.05	30	14.75	36
		2462	11.15	100	0	11.15	30	14.85	36

8.2 Spurious Radiated Emissions & Restricted Bands of Operation

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (d) / (15.209 & 15.205) / IC RSS-GEN, Section 8.9 and 8.10
Test Method	ANSI C63.10
Measurement Location	Semi Anechoic Chamber 30MHz - 1 GHz Fully Anechoic Chamber 1 GHz - 40GHz
Measurement Bandwidth	100 kHz for frequency range < 1GHz 1 MHz for Frequency range >1GHz
Detector	Refer remarks below
Measuring Distance	3 m
Requirement	As per the limits mentioned in the below table
Test setup	Refer 7 TEST METHODOLOGY

Table 7: Transmitter limits for Radiated emission

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Distance of Measurement (m)
0.009 – 0.490	2400/F(kHz)	48.50 – 13.80	300*
0.490 – 1.705	24000/F(kHz)	33.80 – 23.00	30*
1.705 -30	30	29.54	30*
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Remark: * The limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30MHz is at 300 meter, 30 meter and 30 meter range respectively, which corresponds to 128.51 – 93.80, 73.80 – 62.96 and 69.54 dBμV/m at 3m range by extrapolation calculation and the measurement of loop antenna.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

Test Conditions:

Temperature (Norm) = + 23.5 °C Voltage = 110 VAC, 60 Hz supply to adaptor Relative humidity = 62 %

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Test results:

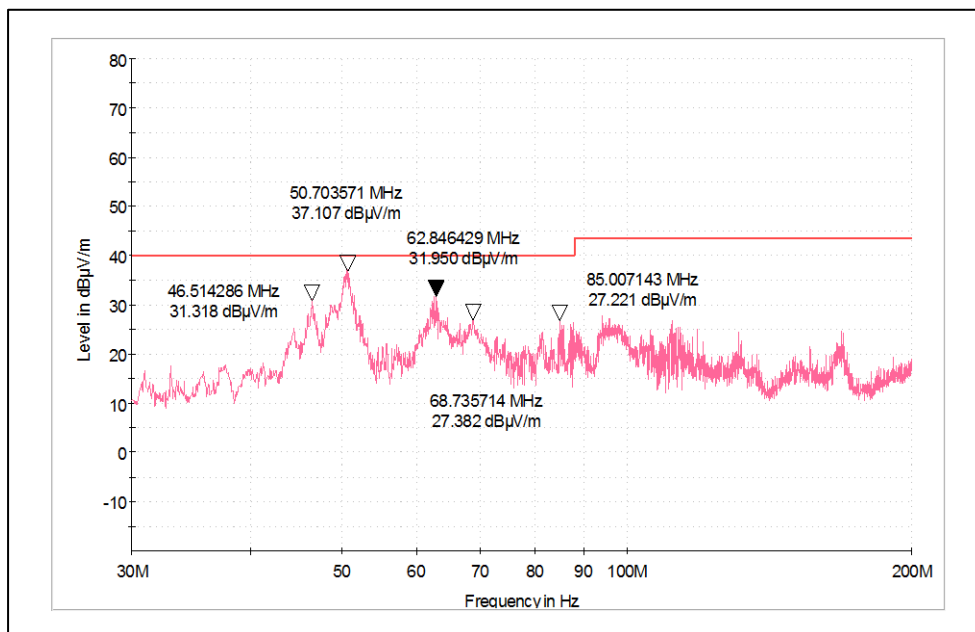
Note: All the losses are included during measurement and final values are mentioned in the test report. Refer 7 TEST METHODOLOGY for more details

Test results for frequency range 9kHz – 30MHz

No emissions found in frequency range 9 kHz to 30 MHz, and measured levels are below 20dB from the limit line, hence not reported

Test results for frequency range 30MHz – 200MHz

Antenna Polarization	Measured Frequency (MHz)	Measured Spurious Emission level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	46.51	31.31(Pk)	40.00	-8.69
	50.59	37.24(Qp)	40.00	-2.76
	62.84	31.95(Pk)	40.00	-8.05
	68.73	27.38(Pk)	40.00	-12.62
	85.00	27.22(Pk)	40.00	-12.78
Horizontal	50.21	13.99(Pk)	40.00	-26.01
	68.06	11.31(Pk)	40.00	-28.69
	99.15	11.99(Pk)	43.50	-31.51
	170.79	19.33(Pk)	43.50	-24.17



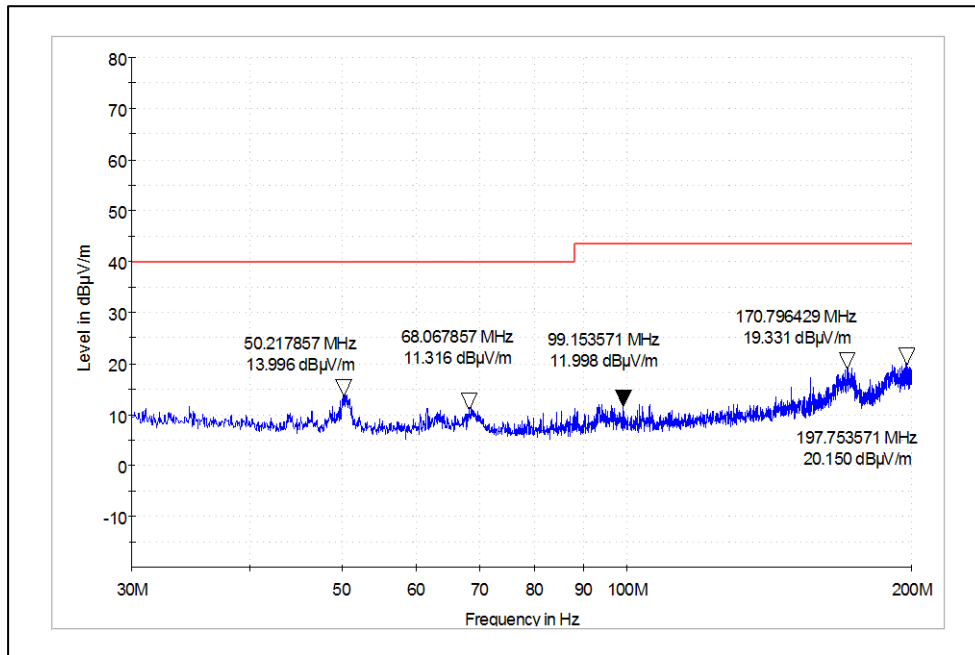
Channel Frequency 30MHz – 200MHz

Polarization Vertical

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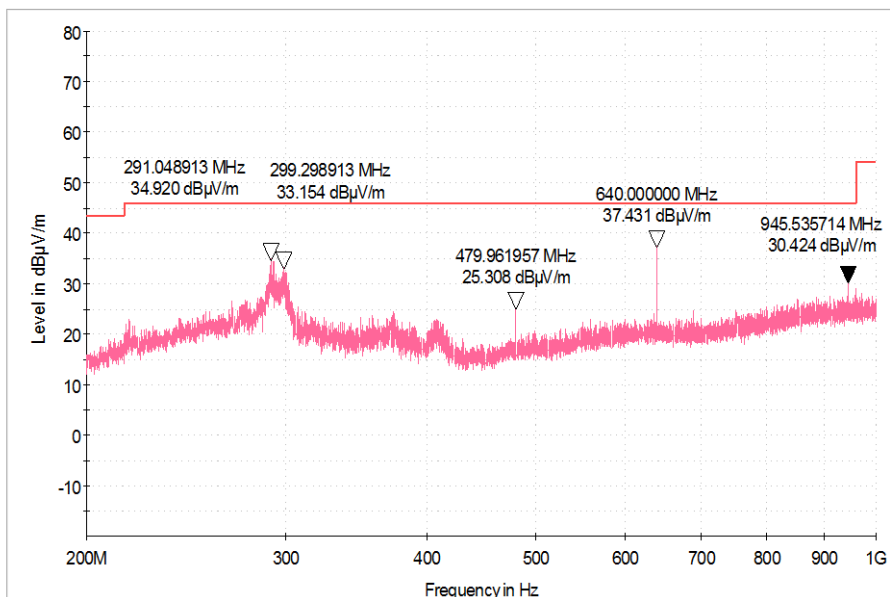
Channel Frequency 30MHz – 200MHz

Polarization Horizontal

Test results for frequency range 200MHz – 1GHz

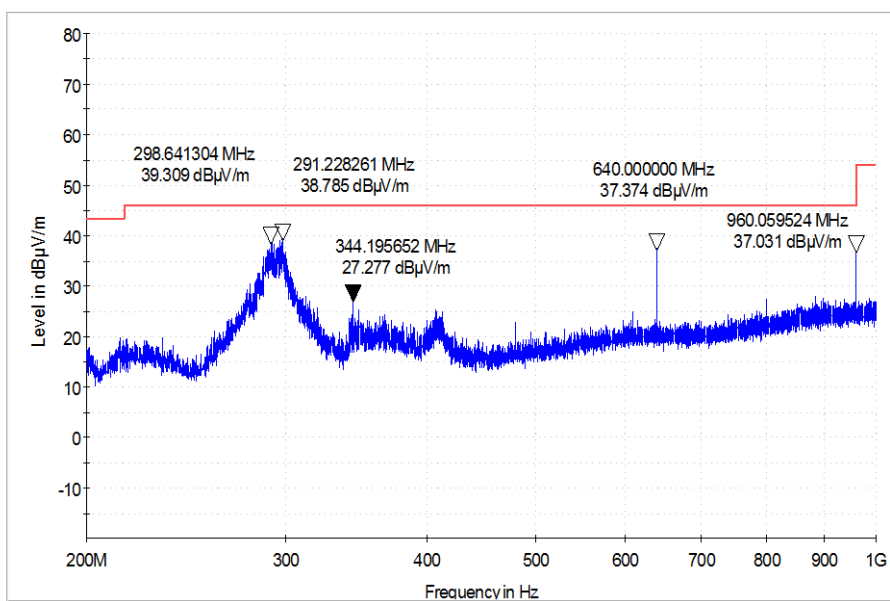
Antenna Polarization	Measured Frequency (MHz)	Measured Spurious Emission level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	291.04	34.92(Pk)	46.50	-11.58
	299.29	33.15(Pk)	46.50	-13.35
	479.96	25.30(Pk)	46.50	-21.2
	640.00	37.43(Pk)	46.50	-9.07
	945.53	30.42(Pk)	46.50	-16.08
Horizontal	298.64	39.30(Pk)	46.50	-7.2
	291.22	38.78(Pk)	46.50	-7.72
	344.19	27.27(Pk)	46.50	-19.23
	640.00	37.37(Pk)	46.50	-9.13
	960.05	37.03(Pk)	46.50	-9.47

Note: (Pk)- Peak detector
(Qp)- Quasi peak detector



Channel Frequency 200MHz – 1GHz

Polarization Vertical



Channel Frequency 200MHz – 1GHz

Polarization Horizontal

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Test results for the frequencies in the range 1 GHz to 26.5 GHz

Modulation: 802.11b

Data Rate: 1Mbps

Mode	Data rate (Mbps)	Channel	Polarization	Frequency (MHz)	Emission level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
b	1	Low	Vertical	2390(pk)	40.01	74*	-33.99
				2390(Av)	28.19	54*	-25.81
				2412(pk)	98.18	-	-
				2412(Av)	88.88	-	-
				4824(pk)	53.52	74	53.52
				4824(Av)	44.56	54	44.56
				7236(Pk)	No Harmonics found		
				7236(av)			
			Horizontal	2390(pk)	47.42	74*	-26.58
				2390(Av)	34.62	54*	-19.38
				2412(pk)	107.13	-	-
				2412(Av)	97.83	-	-
				4824(pk)	48.50	74	-25.50
				4824(Av)	38.31	54	-15.69
				7236(Pk)	No Harmonics found		
				7236(av)			
		Mid	Vertical	2437(Av)	100.2	-	-
				2437(Av)	90.7	-	-
				4874(Pk)	54.67	74	-19.33
				4874(Av)	45.47	54	-8.53
				7311(pk)	No Harmonics found		
				7311(Av)			
			Horizontal	2437(Pk)	52.06	-	-
				2437(Av)	42.03	-	-
				4874(Pk)	52.06	74	-21.94
				4874(Av)	42.03	54	-11.97
				7311(pk)	No Harmonics found		
				7311(Av)			
		High	Vertical	2462(Pk)	102.1	-	-
				2462(Av)	92.8	-	-
				2483.5(Pk)	49.16	74*	-24.84
				2483.5(Av)	36.31	54*	-17.69
				4924(Pk)	51.38	74	-22.62
				4924(Av)	42.13	54	-11.87
				7386(Pk)	No Harmonics found		
				7386(Av)			
			Horizontal	2462(Pk)	107.13	-	-
				2462(Av)	97.81	-	-
				2483.5(Pk)	54.24	74*	-19.76
				2483.5(Av)	40.54	54*	-13.46
				4924(Pk)	50.66	74	-23.34
				4924(Av)	40.87	54	-13.13
				7386(Pk)	No Harmonics found		
				7386(Av)			

* : Indicate restricted band of operation §15.205
Pk: Peak Detector; Av: Average Detector

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Modulation: 802.11g

Data Rate: 6Mbps

Mode	Data rate(Mbps)	Channel	Polarization	Frequency (MHz)	Emission level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
g	6	Low	Vertical	2390(pk)	50.41	74*	-18.69
				2390(Av)	37.08	54*	-11.47
				2412(pk)	95.12	-	-
				2412(Av)	88.29	-	-
				4824(pk)	53.94	74	-22.77
				4824(Av)	41.36	54	-15.47
				7236(Pk)	No Harmonics found		
				7236(av)			
			Horizontal	2390(pk)	55.31	74*	-18.69
				2390(Av)	42.53	54*	-11.47
				2412(pk)	101.05	-	-
				2412(Av)	92.55	-	-
				4824(pk)	51.23	74	-22.77
				4824(Av)	38.53	54	-15.47
				7236(Pk)	No Harmonics found		
				7236(Av)			
		Mid	Vertical	2437(Av)	95.63	-	-
				2437(Av)	86.64	-	-
				4874(Pk)	51.94	74	-22.06
				4874(Av)	39.73	54	-14.27
				7311(pk)	No Harmonics found		
				7311(Av)			
			Horizontal	2437(Pk)	100.24	-	-
				2437(Av)	92.54	-	-
				4874(Pk)	49.57	74	-24.43
				4874(Av)	36.13	54	-17.87
				7311(pk)	No Harmonics found		
				7311(Av)			
		High	Vertical	2462(Pk)	96.87	-	-
				2462(Av)	88.58	-	-
				2483.5(Pk)	57.35	74*	-16.65
				2483.5(Av)	44.79	54*	-9.21
				4924(Pk)	49.57	74	-24.43
				4924(Av)	36.13	54	-17.87
				7386(Pk)	No Harmonics found		
				7386(Av)			
			Horizontal	2462(Pk)	100.87	-	-
				2462(Av)	93.2	-	-
				2483.5(Pk)	61.66	74*	-12.34
				2483.5(Av)	49.16	54*	-4.84
				4924(Pk)	49.49	74	-24.51
				4924(Av)	37.2	54	-16.80
				7386(Pk)	No Harmonics found		
				7386(Av)			

* : Indicate restricted band of operation §15.205
Pk: Peak Detector; Av: Average Detector

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Modulation: 802.11n_20MHz
Data Rate: MCS0

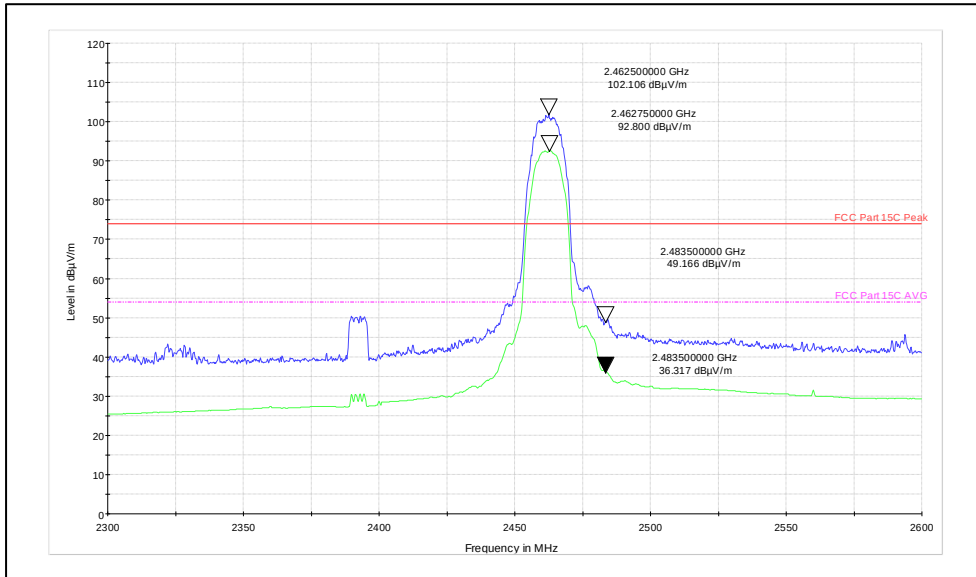
Mode	Data rate (Mbps)	Channel	Polarization	Frequency (MHz)	Emission level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
n(20)	MCS0	Low	Vertical	2390(pk)	51.57	74*	-18.46
				2390(Av)	37.94	54*	-11.52
				2412(pk)	98.09	-	-
				2412(Av)	88.53	-	-
				4824(pk)	53.45	74	-22.36
				4824(Av)	39.81	54	-16.36
				7236(Pk)	No Harmonics found		
				7236(av)			
			Horizontal	2390(pk)	55.54	74*	-23.96
				2390(Av)	42.48	54*	-34.79
				2412(pk)	100.52	-	-
				2412(Av)	91.79	-	-
				4824(pk)	51.64	74	-22.36
				4824(Av)	37.64	54	-16.36
				7236(Pk)	No Harmonics found		
				7236(av)			
		Mid	Vertical	2437(Av)	97.96	-	-
				2437(Av)	88.79	-	-
				4874(Pk)	51.85	74	-22.15
				4874(Av)	38.22	54	-15.78
				7311(pk)	No Harmonics found		
				7311(Av)			
			Horizontal	2437(Pk)	102.04	-	-
				2437(Av)	92.39	-	-
				4874(Pk)	49.74	74	-24.26
				4874(Av)	36.80	54	-17.20
				7311(pk)	No Harmonics found		
				7311(Av)			
		High	Vertical	2462(Pk)	98.42	-	-
				2462(Av)	88.73	-	-
				2483.5(Pk)	57.92	74*	-16.08
				2483.5(Av)	44.11	54*	-9.89
				4924(Pk)	48.35	74	-25.65
				4924(Av)	35.34	54	-18.66
				7386(Pk)	No Harmonics found		
				7386(Av)			
			Horizontal	2462(Pk)	103.86	-	-
				2462(Av)	94.32	-	-
				2483.5(Pk)	63.38	74*	-10.62
				2483.5(Av)	49.42	54*	-4.58
				4924(Pk)	48.18	74	-25.82
				4924(Av)	34.44	54	-19.56
				7386(Pk)	No Harmonics found		
				7386(Av)			

* : Indicate restricted band of operation §15.205
Pk: Peak Detector; Av: Average Detector

Worst case Plots

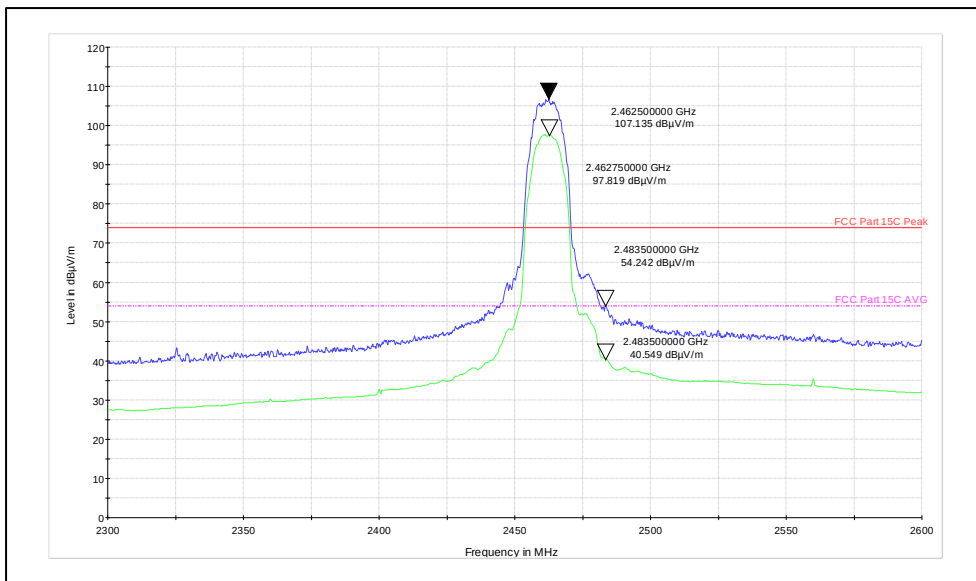
Data Rate: 1Mbps

Channel Frequency 2462MHz



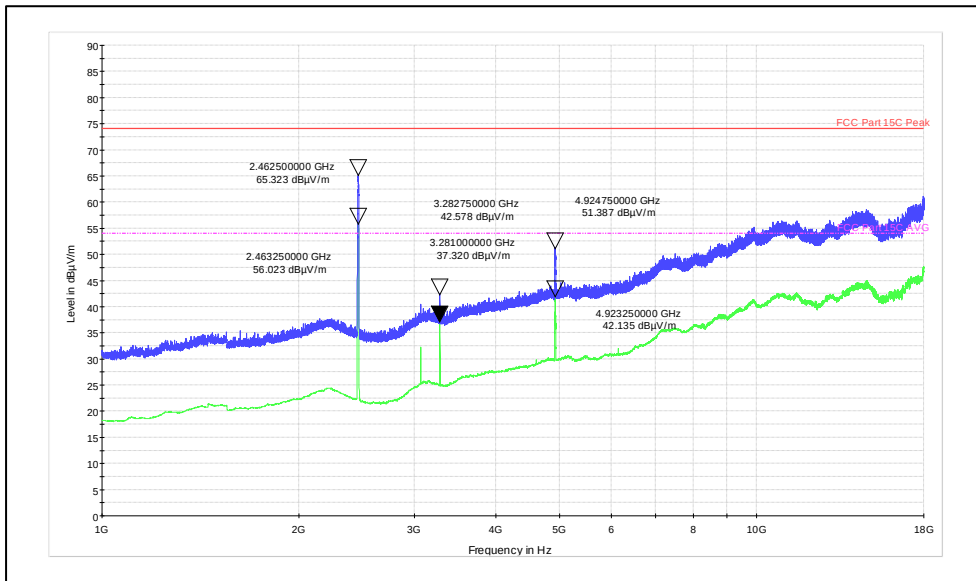
Channel Frequency: 2462MHz

Polarization: Vertical



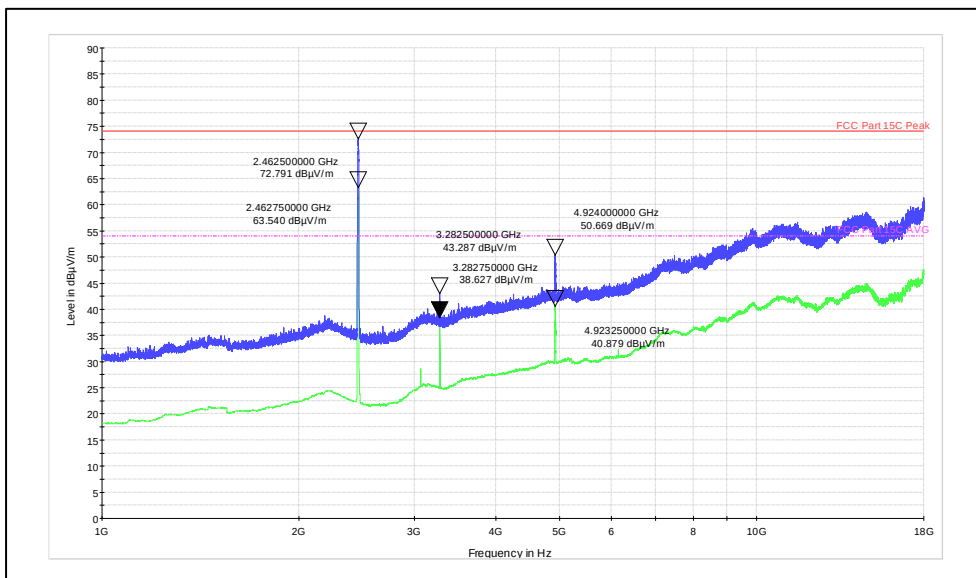
Channel Frequency: 2462MHz

Polarization: Horizontal



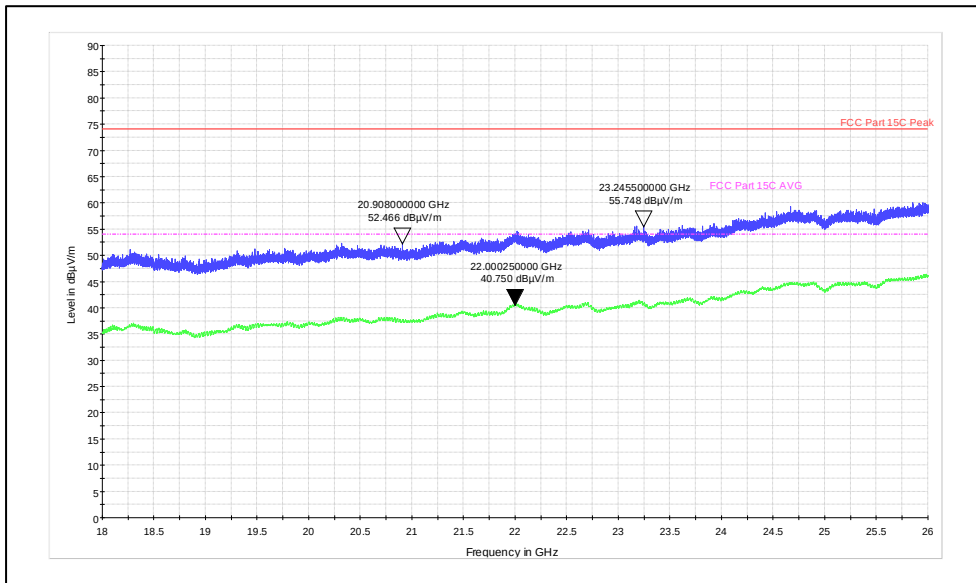
Channel Frequency: 1 - 18 GHz

Polarization: Vertical



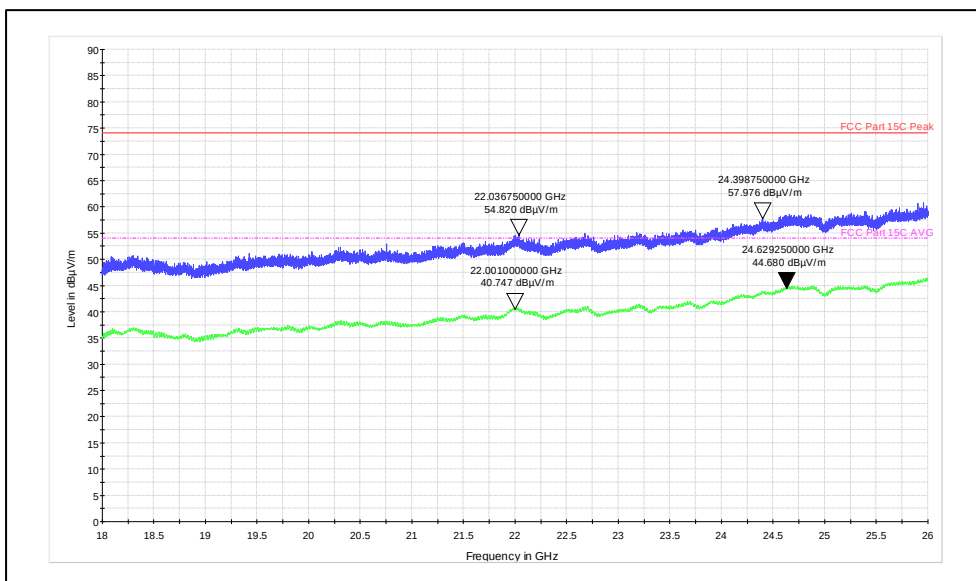
Channel Frequency: 1 - 18 GHz

Polarization: Horizontal



Channel Frequency: 18 - 26 GHz

Polarization: Vertical



Channel Frequency: 18 - 26 GHz

Polarization: Horizontal

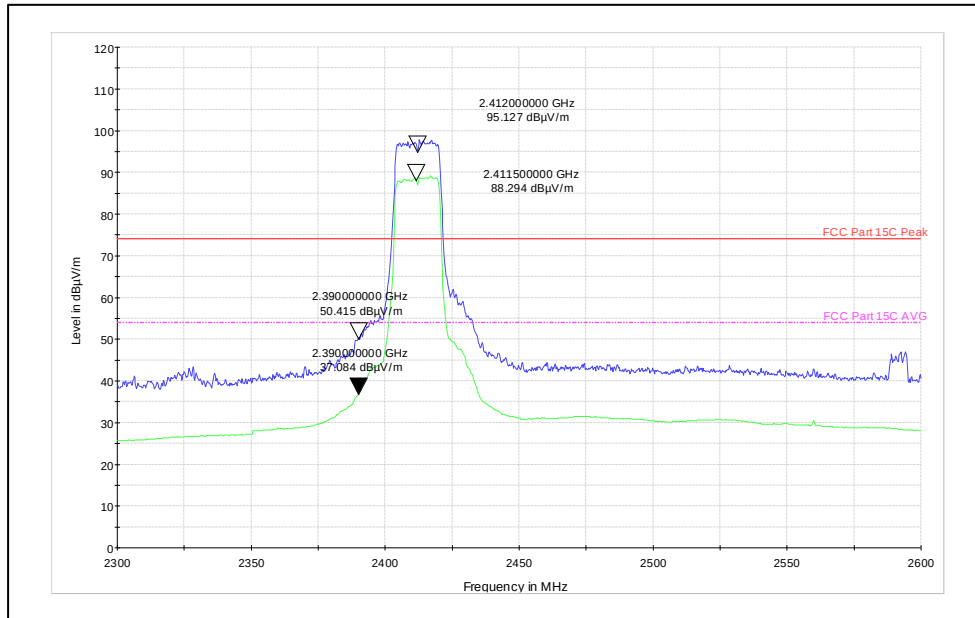
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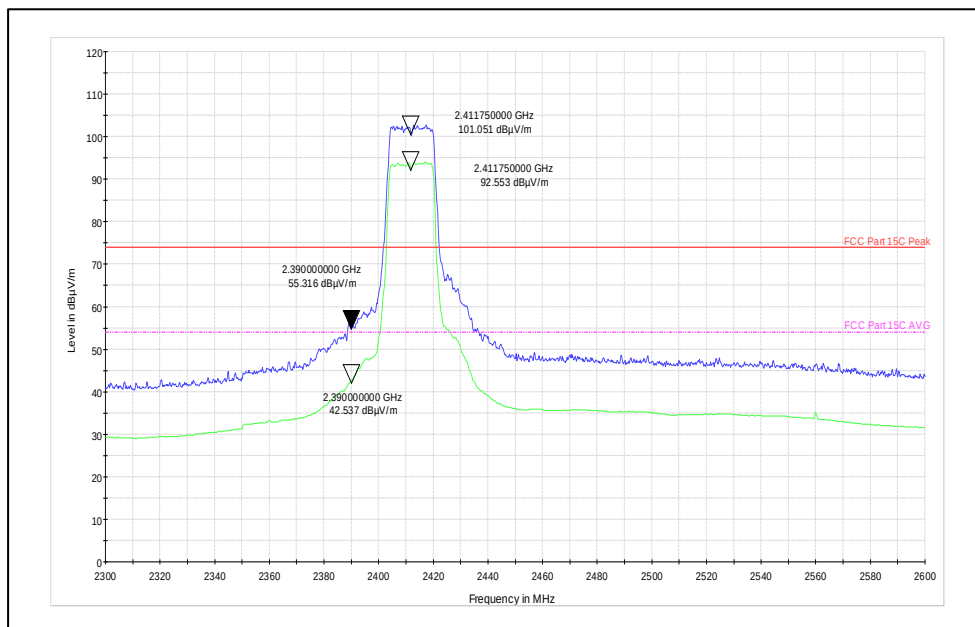
Data Rate: 6Mbps

Channel Frequency 2412MHz



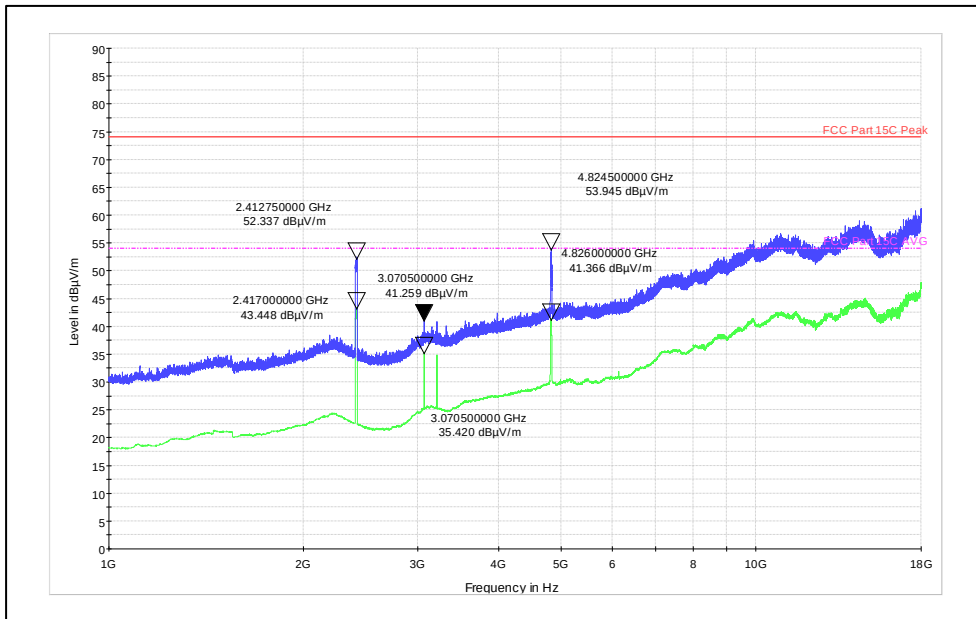
Channel Frequency: 2412MHz

Polarization: Vertical



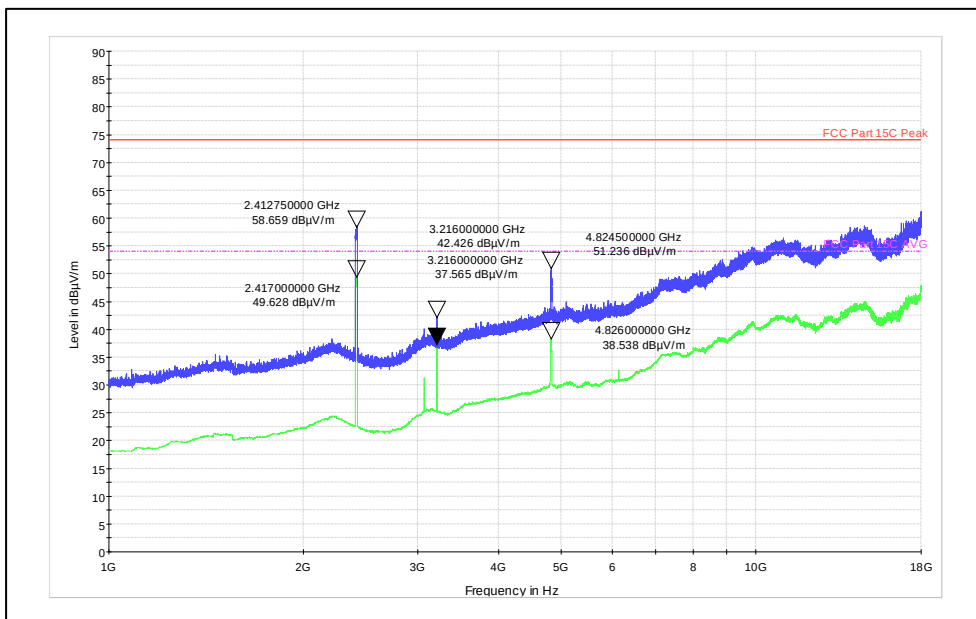
Channel Frequency: 2412MHz

Polarization: Horizontal



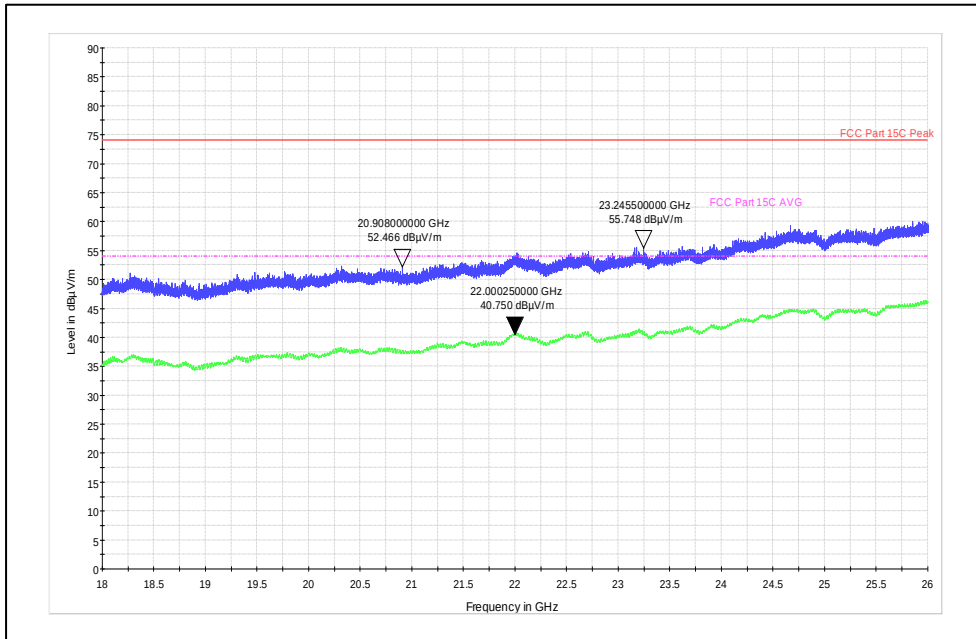
Channel Frequency: 1 - 18 GHz

Polarization: Vertical



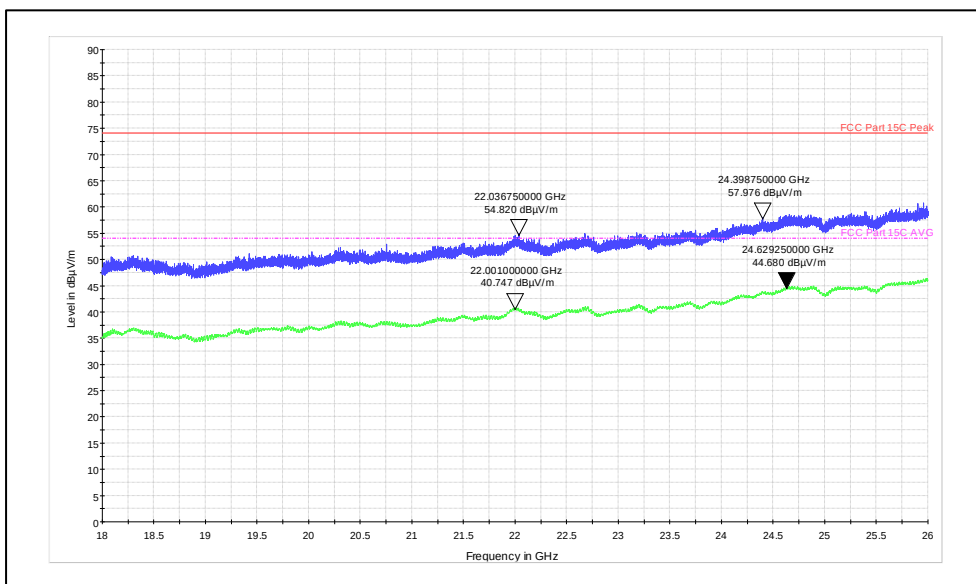
Channel Frequency: 1 - 18 GHz

Polarization: Horizontal



Channel Frequency: 18-26GHz

Polarization: Vertical

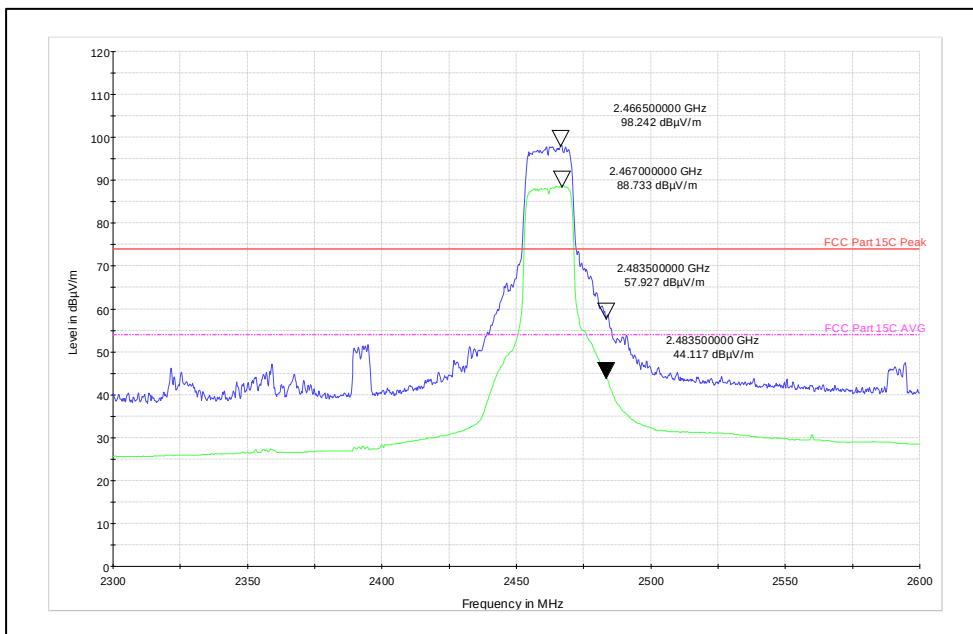


Channel Frequency: 18-26 GHz

Polarization: Horizontal

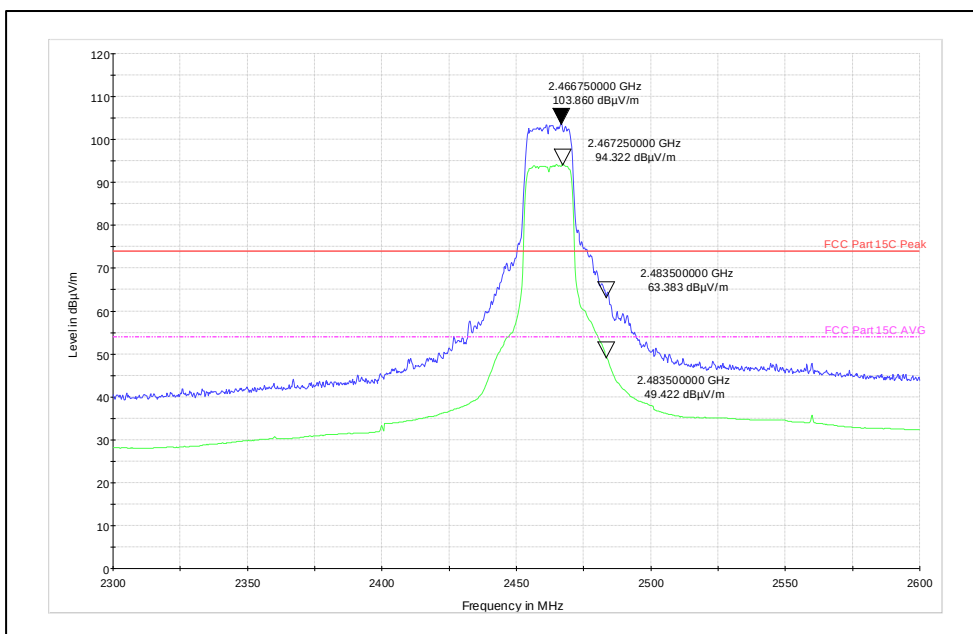
Data Rate: MCS0_n Mode 20MHz

Channel Frequency 2462MHz



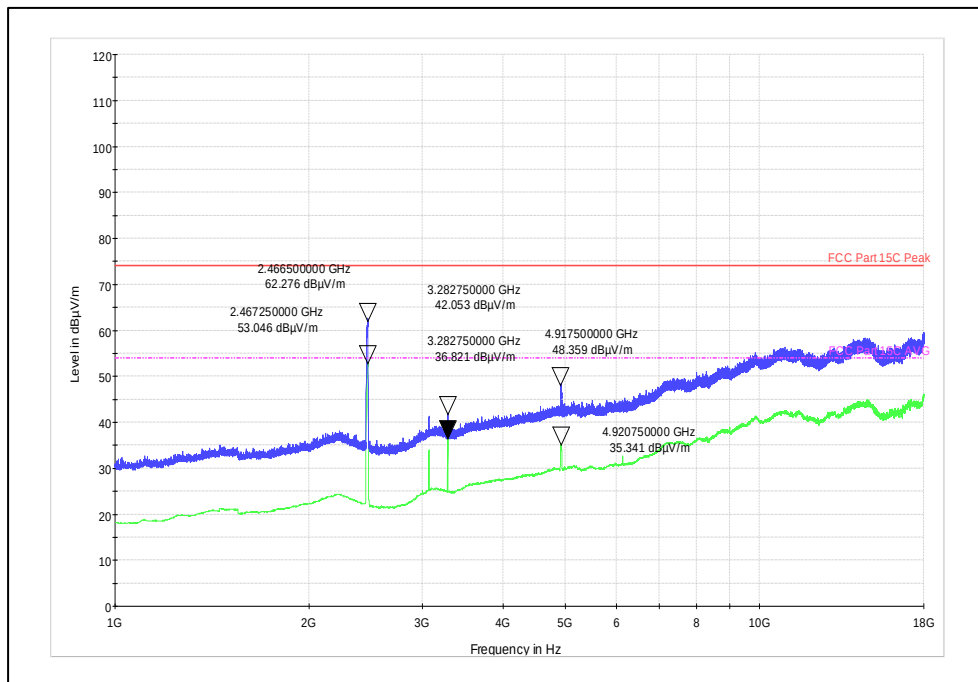
Channel Frequency: 2462MHz

Polarization: Vertical



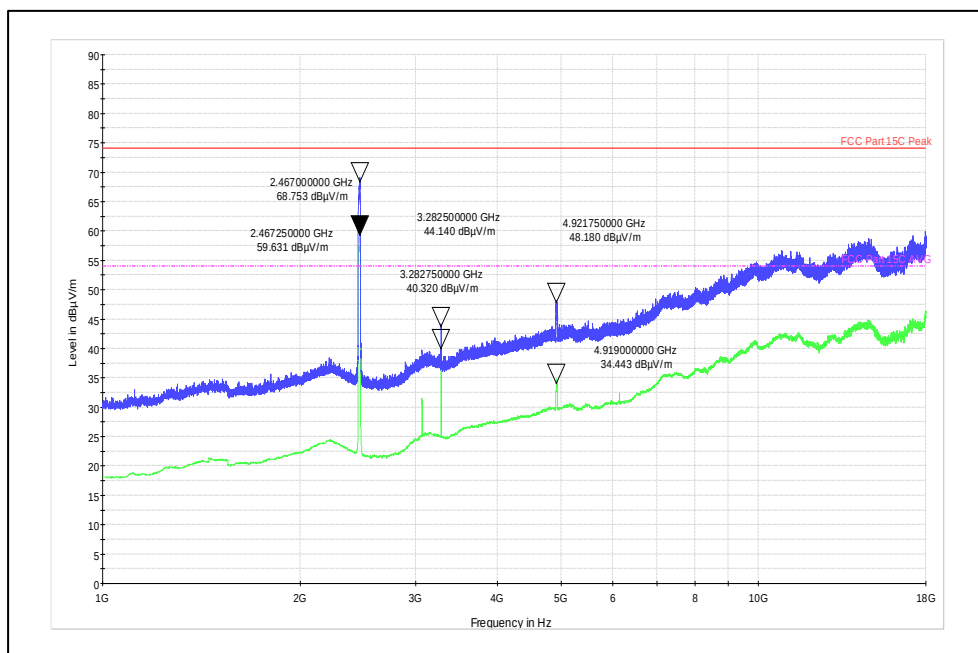
Channel Frequency: 2462MHz

Polarization: Horizontal



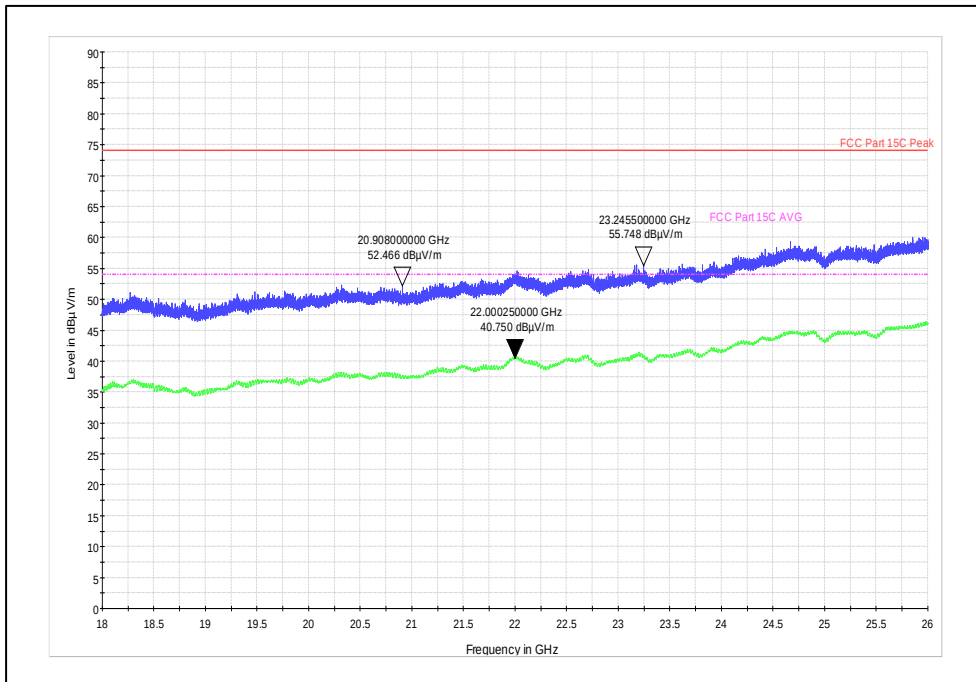
Channel Frequency: 1 - 18 GHz

Polarization: Vertical



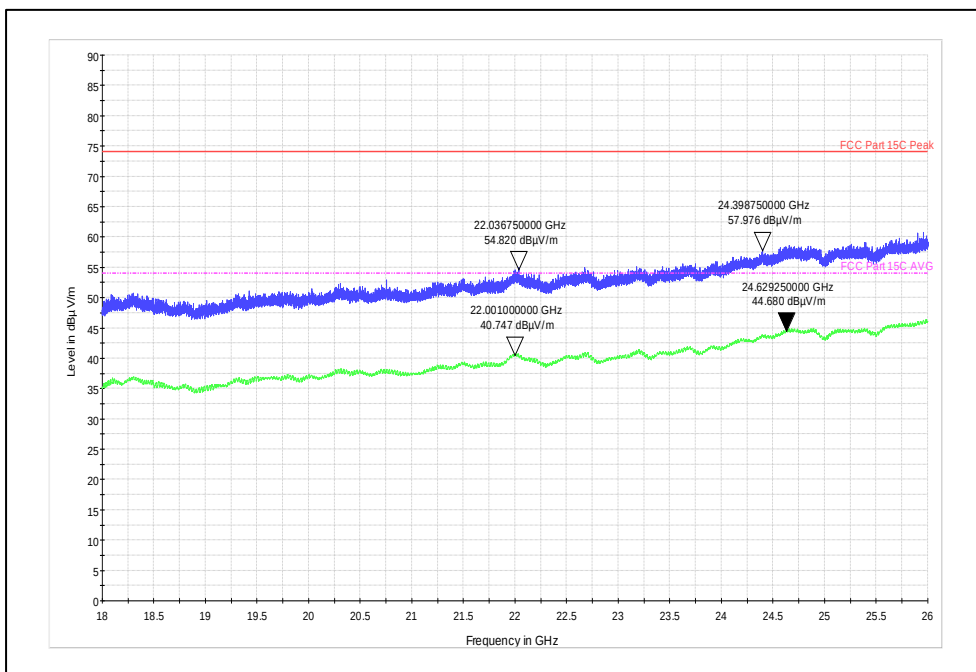
Channel Frequency: 1 - 18 GHz

Polarization: Horizontal



Channel Frequency: 18 -26GHz

Polarization: Vertical



Channel Frequency: 18-26GHz

Polarization: Horizontal

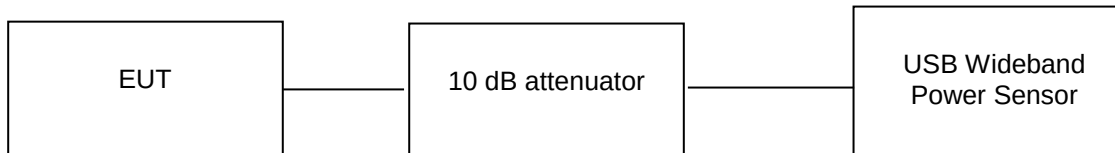
9 TEST RESULTS FOR BLUETOOTH LOW ENERGY

9.1 Maximum conducted (Peak) output power

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (b)(3) / RSS 247 Issue 2, Section 5.4 (d)
Test Method	Subclause 11.9.1.1 of ANSI C63.10
Detector	Peak
Port of testing	Antenna port
Requirement	Power ≤ 1 W (30 dBm) & e.i.r.p ≤ 4 W (36 dBm)



Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.8 °C Voltage = 5VDC through Adapter Relative humidity: 64%

KDB Guidelines applied:

Measurements were made as per section 8.3.1.1 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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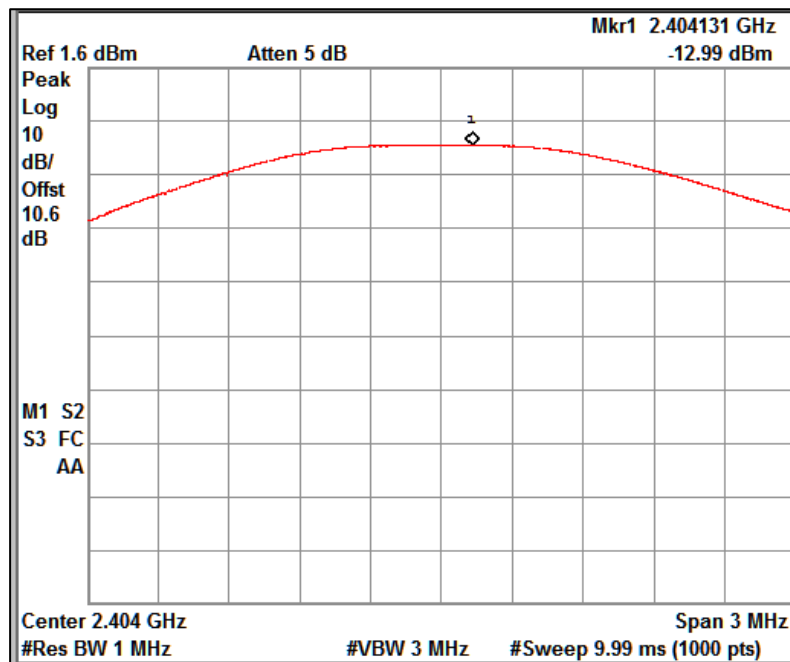
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Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Average Output power (dBm) = Measured Average power (dBm) + Attenuator factor (10dB) + Cable loss (0.6dB) + Duty cycle correction factor (dB)
3. This product do not support additional beamforming gain / directional gain, it uses signal antenna and hence directional gain of the single antenna is 3.7dBi
4. Maximum (e.i.r.p) = Maximum Average output power (dBm) + antenna gain (3.7 dBi)

Data Rate (Mbps)	Channel Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	Power Limit (dBm)	e.i.r.p (dBm)	e.i.r.p Limit (dBm)
1	2402	-12.99	30	-9.29	36
	2440	-12.37	30	-8.67	36
	2480	-11.47	30	-7.77	36



Channel Frequency: 2402MHz

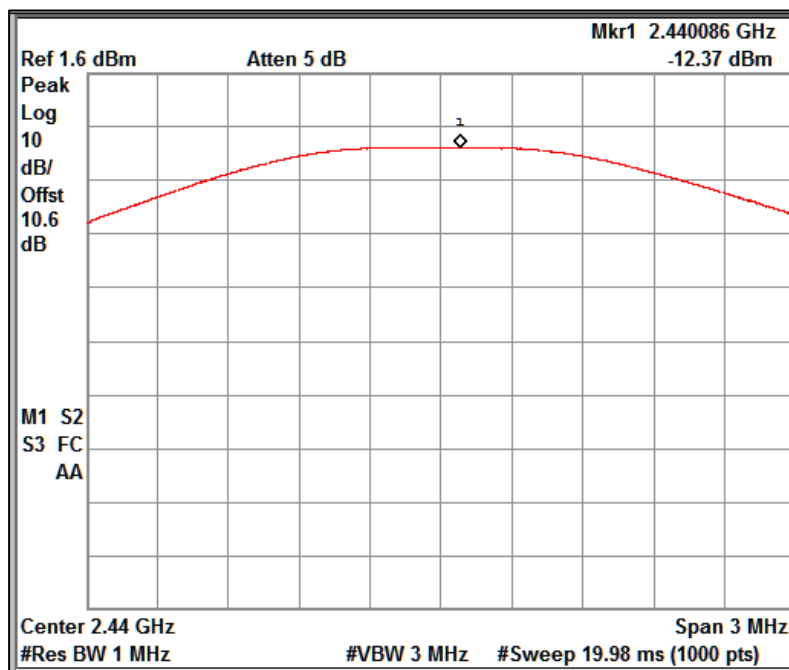
Prüfbericht - Nr.:

Test Report No.:

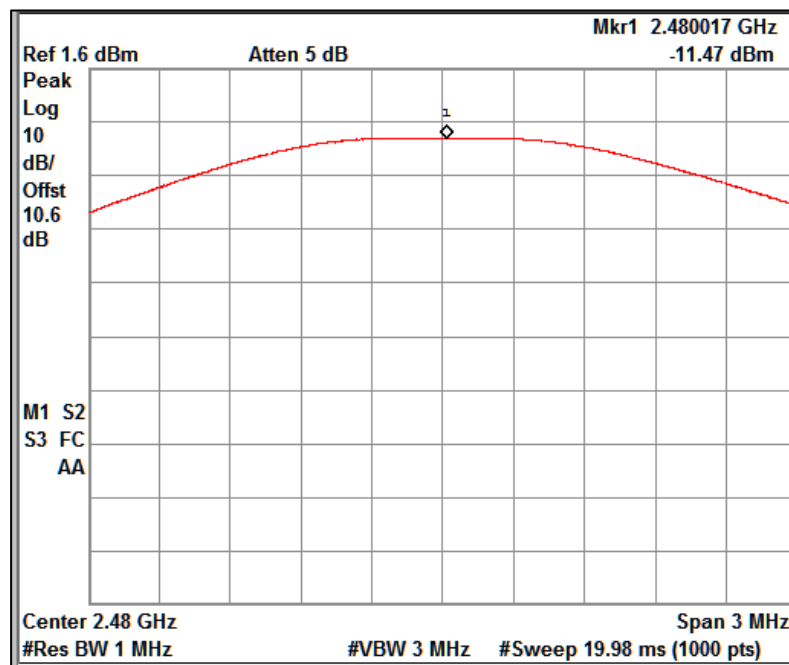
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Channel Frequency: 2440MHz



Channel Frequency: 2480MHz

9.2 Spurious Radiated Emissions & Restricted Bands of Operation

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (d) / (15.209 & 15.205) / IC RSS-GEN, Section 8.9 and 8.10
Test Method	ANSI C63.10
Measurement Location	Semi Anechoic Chamber 30MHz - 1 GHz Fully Anechoic Chamber 1 GHz - 40GHz
Measurement Bandwidth	100 kHz for frequency range < 1GHz 1 MHz for Frequency range >1GHz
Detector	Refer remarks below
Measuring Distance	3 m
Requirement	As per the limits mentioned in the below table
Test setup	Refer TEST METHODOLOGY

Table 8: Transmitter limits for Radiated emission

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Distance of Measurement (m)
0.009 – 0.490	2400/F(kHz)	48.50 – 13.80	300*
0.490 – 1.705	24000/F(kHz)	33.80 – 23.00	30*
1.705 -30	30	29.54	30*
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Remark: * The limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30MHz is at 300 meter, 30 meter and 30 meter range respectively, which corresponds to 128.51 – 93.80, 73.80 – 62.96 and 69.54 dBμV/m at 3m range by extrapolation calculation and the measurement of loop antenna.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

Test Conditions:

Temperature (Norm) = + 23.5 °C Voltage = 110VAC, 60Hz supply to adaptor Relative humidity = 64 %

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Test results:

Note: All the losses are included during measurement and final values are mentioned in the test report. Refer TEST METHODOLOGY for more details

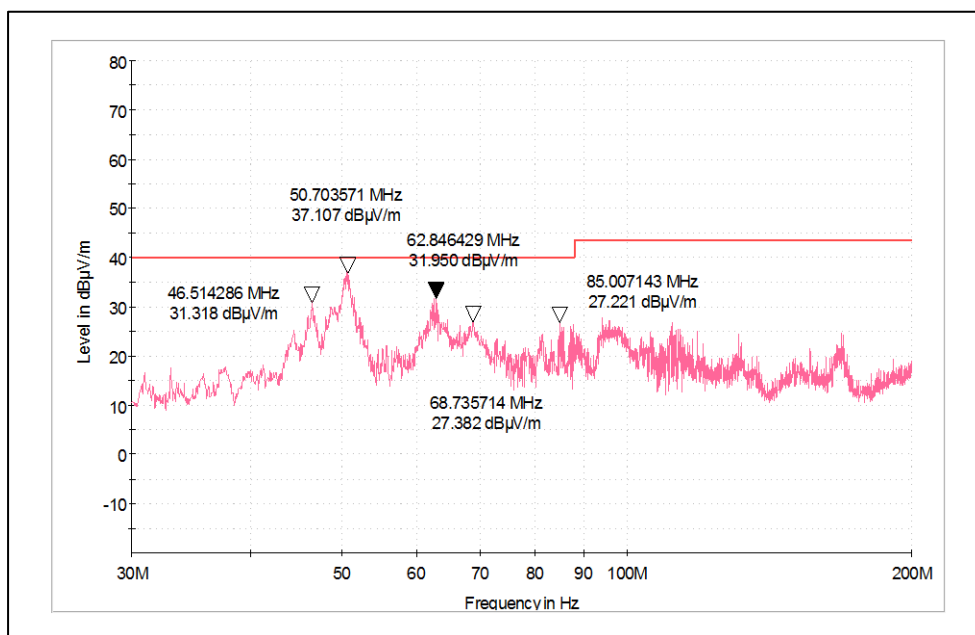
Test results for frequency range 9kHz – 30MHz

No emissions found in frequency range 9 kHz to 30 MHz, and measured levels are below 20dB from the limit line, hence not reported

Test results for frequency range 30MHz – 200MHz

Antenna Polarization	Measured Frequency (MHz)	Measured Spurious Emission level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	46.51	31.31(Pk)	40.00	-8.69
	50.59	37.24(Qp)	40.00	-2.76
	62.84	31.95(Pk)	40.00	-8.05
	68.73	27.38(Pk)	40.00	-12.62
	85.00	27.22(Pk)	40.00	-12.78
Horizontal	50.21	13.99(Pk)	40.00	-26.01
	68.06	11.31(Pk)	40.00	-28.69
	99.15	11.99(Pk)	43.50	-31.51
	170.79	19.33(Pk)	43.50	-24.17

Note: (Pk)- Peak detector
(Qp)- Quasi peak detector



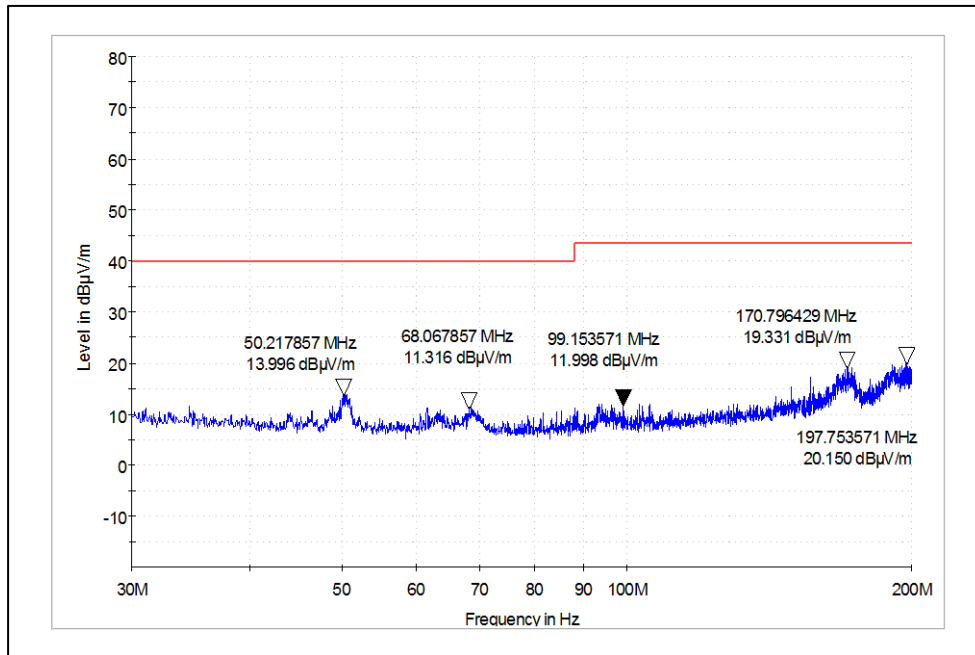
Channel Frequency 30MHz – 200MHz

Polarization Vertical

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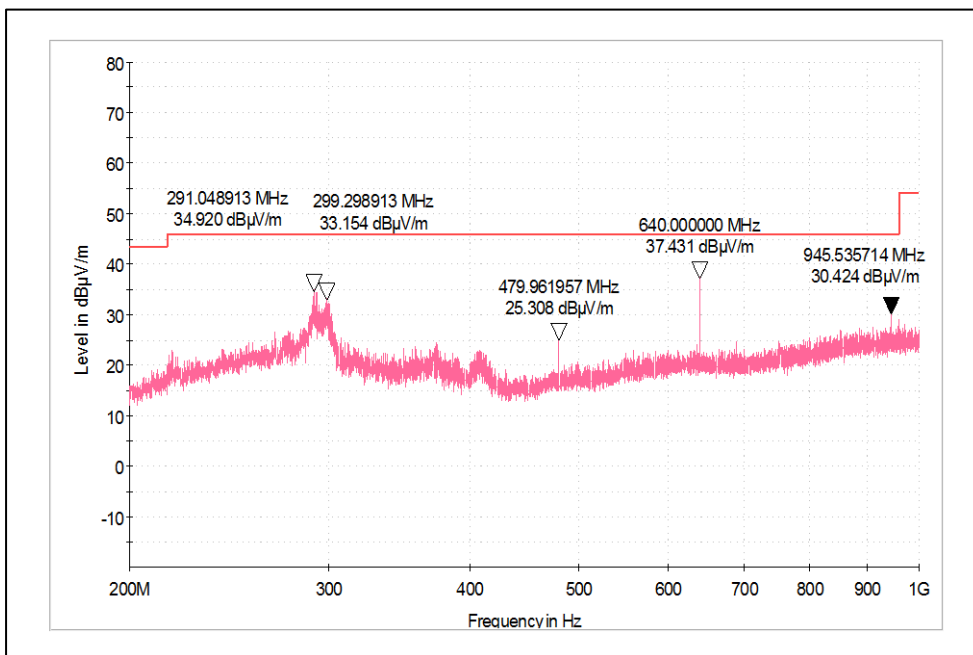
Channel Frequency 30MHz – 200MHz

Polarization Horizontal

Test results for frequency range 200MHz – 1GHz

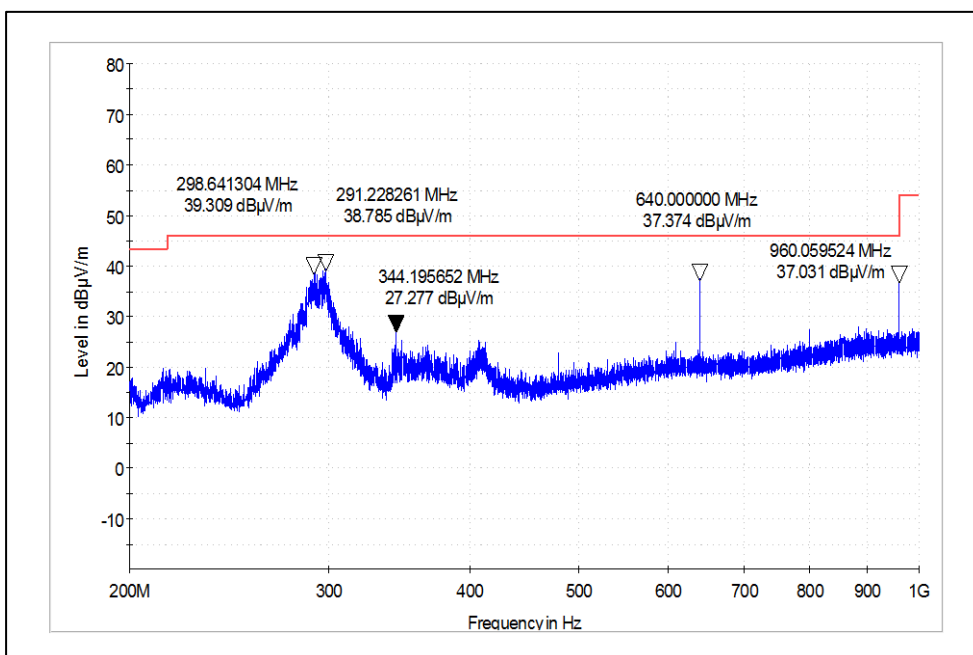
Antenna Polarization	Measured Frequency (MHz)	Measured Spurious Emission level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	291.04	34.92(Pk)	46.50	-11.58
	299.29	33.15(Pk)	46.50	-13.35
	479.96	25.30(Pk)	46.50	-21.2
	640.00	37.43(Pk)	46.50	-9.07
	945.53	30.42(Pk)	46.50	-16.08
Horizontal	298.64	39.30(Pk)	46.50	-7.2
	291.22	38.78(Pk)	46.50	-7.72
	344.19	27.27(Pk)	46.50	-19.23
	640.00	37.37(Pk)	46.50	-9.13
	960.05	37.03(Pk)	46.50	-9.47

Note: (Pk)- Peak detector
(Qp)- Quasi peak detector



Channel Frequency 200MHz – 1GHz

Polarization Vertical



Channel Frequency 200MHz – 1GHz

Polarization Horizontal

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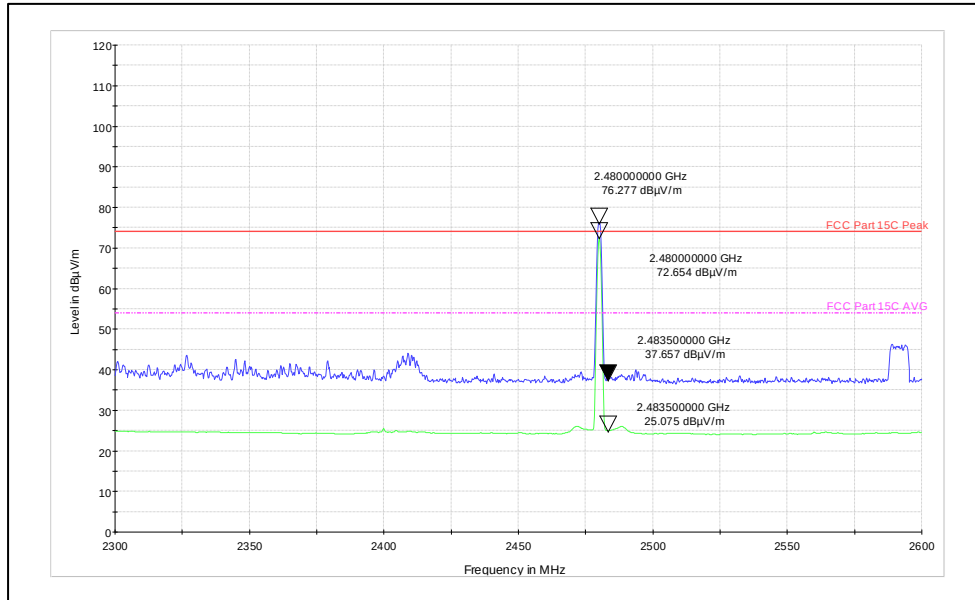
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Test results for the frequencies above 1GHz

Data rate(Mbps)	Channel	Polarization	Frequency (MHz)	Emission level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	Low	Vertical	2390(Pk)	38.59	74*	-35.41
			2390(Av)	24.69	54*	-29.31
			2404(Pk)	70.54	-	-
			2404(Av)	66.92	-	-
			4808(Pk)	42.03	74	-31.97
			4808(Av)	29.88	54	-24.12
			7212(Pk)	No Harmonics found		
			7212(Pk)			
		Horizontal	2390(Pk)	36.95	74*	-37.05
			2390(Av)	24.27	54*	-29.73
			2404(Pk)	74.95	-	-
			2404(Av)	71.65	-	-
			4808(Pk)	42.16	74	-31.84
			4808(Av)	29.86	54	-24.14
			7212(Pk)	No Harmonics found		
			7212(Pk)			
	Mid	Vertical	2440(Pk)	72.54	-	-
			2440(Av)	69.36	-	-
			4880(Pk)	41.9	74	-32.1
			4880(Av)	29.8	54	-24.20
			7320(Pk)	No Harmonics found		
			7320(Pk)			
		Horizontal	2440(Pk)	77.81	-	-
			2440(Av)	74.42	-	-
			4880(Pk)	42.33	74	-31.67
			4880(Av)	29.83	54	-24.17
			7320(Pk)	No Harmonics found		
			7320(Pk)			
	High	Vertical	2480(Pk)	76.27	-	-
			2480(Av)	72.65	-	-
			2483.5(Pk)	37.65	74*	-36.35
			2483.5(Av)	25.07	54*	-28.93
			4960(Pk)	49.69	74	-24.31
			4960(Av)	29.58	54	-24.42
			7440(Pk)	No Harmonics found		
			7440(Pk)			
		Horizontal	2480(Pk)	80.58	-	-
			2480(Av)	77.33	-	-
			2483.5(Pk)	38.98	74*	-35.02
			2483.5(Av)	26.51	54*	-27.49
			4960(Pk)	41.64	74	-32.36
			4960(Av)	29.6	54	-24.40
			7440(Pk)	No Harmonics found		
			7440(Pk)			

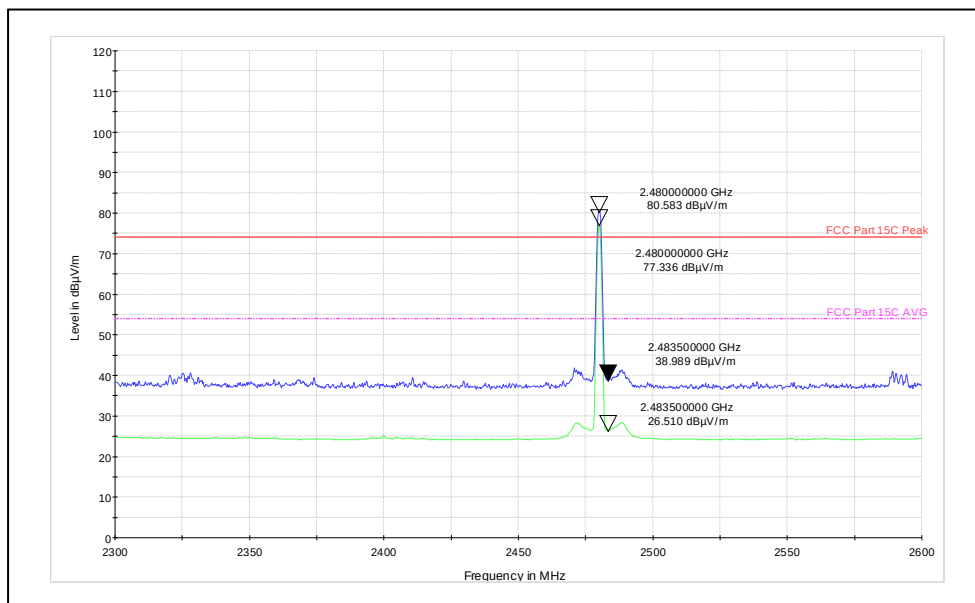
* : Indicate restricted band of operation §15.205
Pk: Peak Detector; Av: Average Detector

Worst case Plots
Channel Frequency 2480MHz



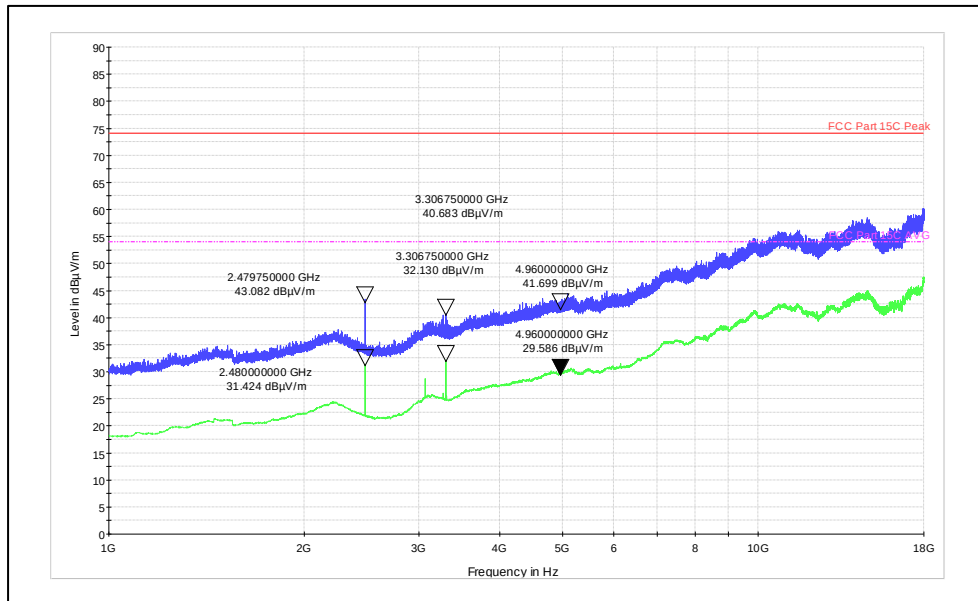
Channel Frequency: 2480MHz

Polarization: Vertical



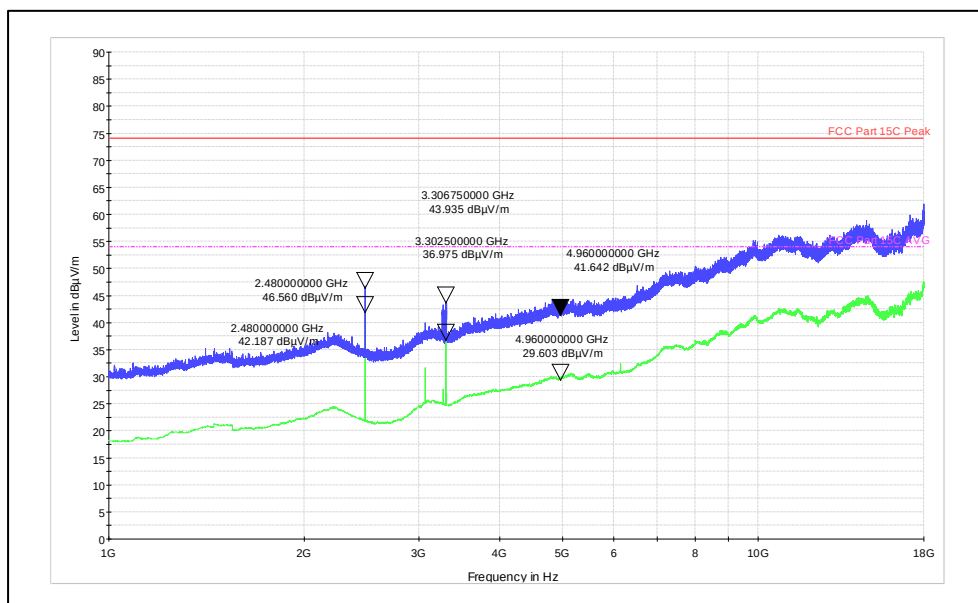
Channel Frequency: 2480MHz

Polarization: Horizontal



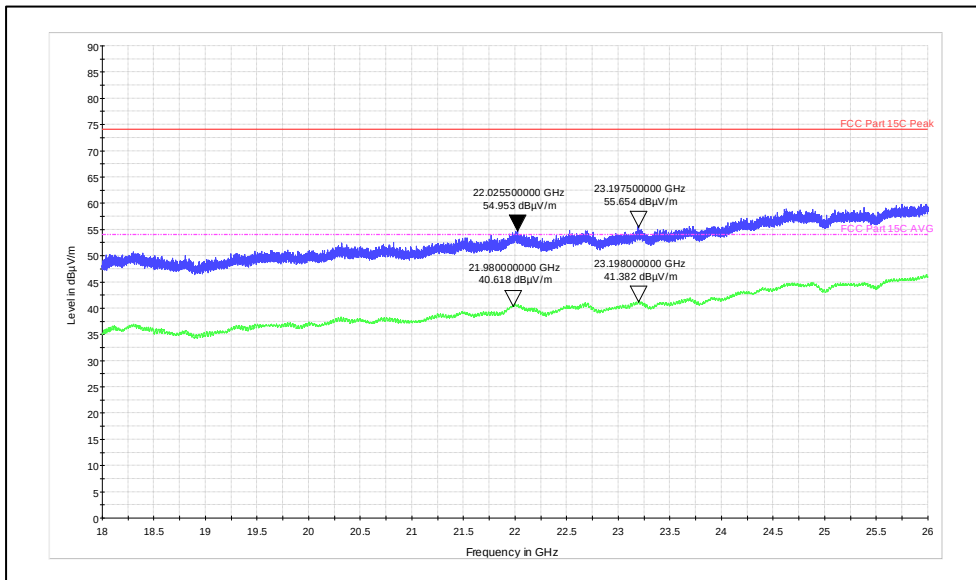
Channel Frequency: 1-18GHz

Polarization: Vertical



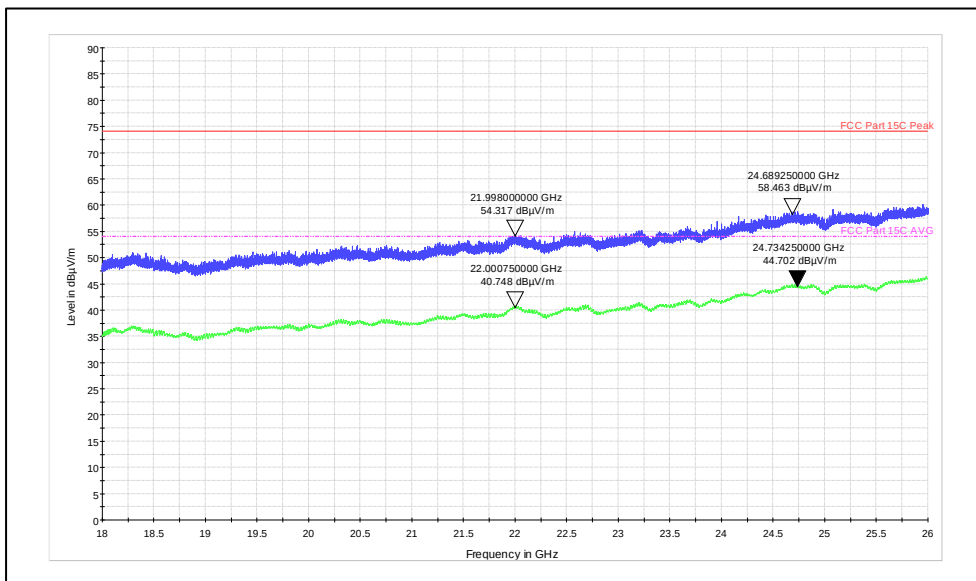
Channel Frequency: 1-18GHz

Polarization: Horizontal



Channel Frequency: 18GHz-26GHz

Polarization: Vertical



Channel Frequency: 18GHz-26GHz

Polarization: Horizontal

Prüfbericht - Nr.:
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10 Conducted Spurious Emission Test on AC Power Line

Result

Pass

Test Specification : FCC Part 15 Section 15.207 / RSS Gen Issue 5 Section 8.8
Test Method : ANSI C 63.10-2013
Testing Location : Screened room
Measurement Bandwidth : 9kHz
Frequency Range : 150kHz – 30MHz
Supply Voltage : 110VAC,60Hz
Test Method : Refer TEST METHODOLOGY

Limits of section 15.207

Frequency of emission (MHz)	QP Limit (dBµV)	AV Limit (dBµV/m)
0.15 – 0.5	66 – 56*	56 – 46*
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency

Test Conditions:

Normal Temperature = +24°C

Voltage (V norm) = 110V AC, 60Hz supply to adaptor

RH = 64 %

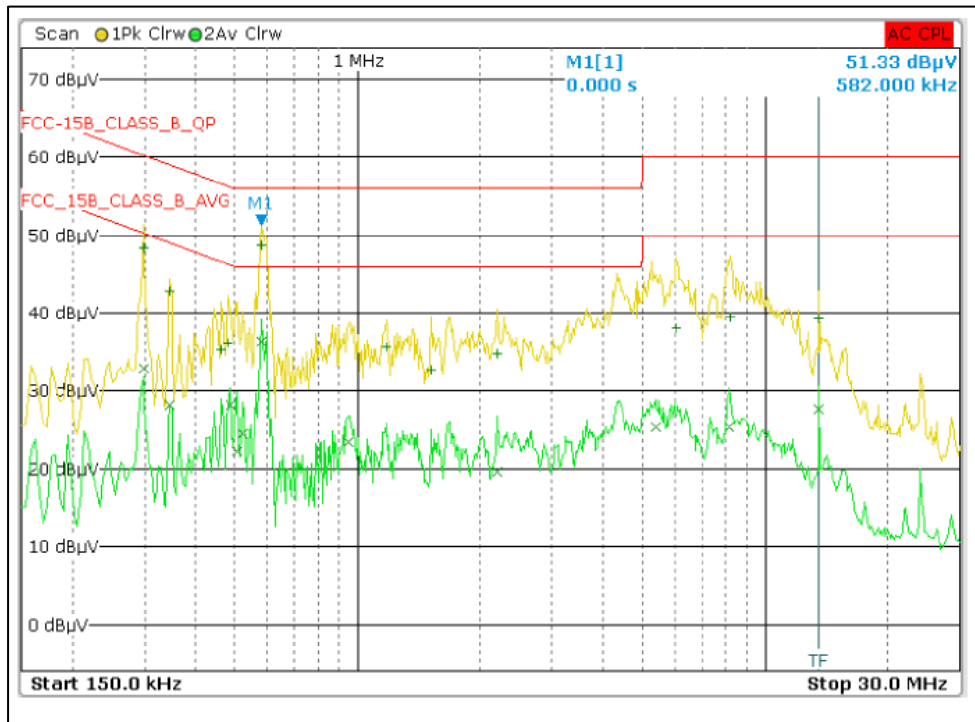
Prüfbericht - Nr.:
Test Report No.:

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Test Results:

Power: 110VAC_60Hz-Line



Graph:Line

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	582.000000000 kHz	48.80		Quasi Peak	-7.20
2	582.000000000 kHz	36.37		Average	-9.63
1	298.000000000 kHz	48.35		Quasi Peak	-11.95
1	346.000000000 kHz	42.86		Quasi Peak	-16.20
2	298.000000000 kHz	32.91		Average	-17.39
2	486.000000000 kHz	28.09		Average	-18.15
1	482.000000000 kHz	36.23		Quasi Peak	-20.07
1	1.174000000 MHz	35.73		Quasi Peak	-20.27
1	8.234000000 MHz	39.49		Quasi Peak	-20.51
1	13.558000000 MHz	39.24		Quasi Peak	-20.76
2	346.000000000 kHz	28.19		Average	-20.87
1	2.206000000 MHz	34.70		Quasi Peak	-21.30
1	462.000000000 kHz	35.33		Quasi Peak	-21.33
2	522.000000000 kHz	24.47		Average	-21.53
1	6.054000000 MHz	38.10		Quasi Peak	-21.90
2	13.562000000 MHz	27.71		Average	-22.29
2	946.000000000 kHz	23.37		Average	-22.63
1	1.518000000 MHz	32.66		Quasi Peak	-23.34
2	506.000000000 kHz	22.23		Average	-23.77
2	8.174000000 MHz	25.43		Average	-24.57
2	5.378000000 MHz	25.29		Average	-24.71
2	2.206000000 MHz	19.61		Average	-26.39

Prüfbericht - Nr.:

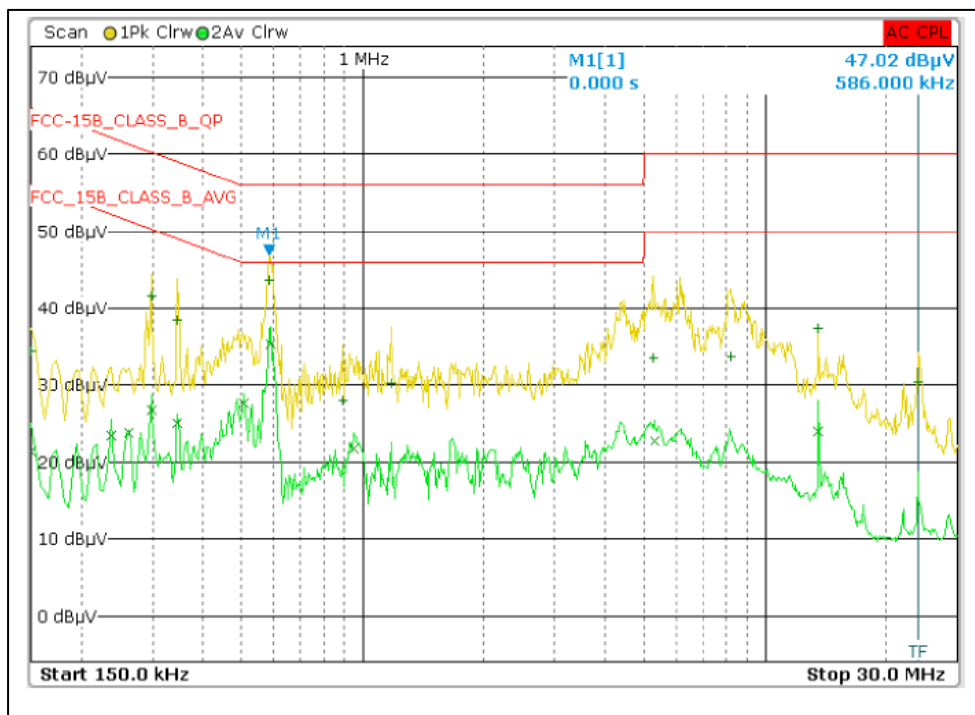
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Power: 110VAC_60Hz-Nuetral



Graph:Nuetral

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
2	590.000000000 kHz	35.39		Average	-10.61
1	586.000000000 kHz	43.67		Quasi Peak	-12.33
2	506.000000000 kHz	27.67		Average	-18.33
1	298.000000000 kHz	41.61		Quasi Peak	-18.69
1	346.000000000 kHz	38.37		Quasi Peak	-20.69
1	13.562000000 MHz	37.47		Quasi Peak	-22.53
2	298.000000000 kHz	26.74		Average	-23.56
2	346.000000000 kHz	24.95		Average	-24.11
2	946.000000000 kHz	21.74		Average	-24.26
1	1.174000000 MHz	30.30		Quasi Peak	-25.70
2	13.562000000 MHz	23.91		Average	-26.09
1	8.218000000 MHz	33.77		Quasi Peak	-26.23
1	5.290000000 MHz	33.57		Quasi Peak	-26.43
2	5.298000000 MHz	22.68		Average	-27.32
2	262.000000000 kHz	23.83		Average	-27.54
1	894.000000000 kHz	27.95		Quasi Peak	-28.05
2	238.000000000 kHz	23.52		Average	-28.65
1	24.038000000 MHz	30.45		Quasi Peak	-29.55
1	150.000000000 kHz	34.49		Quasi Peak	-31.51
2	150.000000000 kHz	21.41		Average	-34.59

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*******END OF TEST REPORT*******