

Prüfbericht – Produkte
Test Report - Products

Prüfbericht-Nr.: Test report no.:	IN23FG6K 001	Auftrags-Nr.: Order no.:	146742971 0010	Seite 1 von 55 Page 1 of 55
Kunden-Referenz-Nr.: Client reference no.:	2119359	Auftragsdatum: Order date:	2022-12-06	
Auftraggeber: Client:	1.HONEYWELL INTERNATIONAL INC,Honeywell Safety and Productivity Solutions 9680 OLD BAILES RD, FORT MILL, SC 29707, USA			
Prüfgegenstand: Test item:	HWBPM11AX-PRTM	Product Type	Wi-Fi BT Module	
Bezeichnung: Identification .:	HWBPM11AX-PRT			
Auftrags-Inhalt: Order content:	Testing and issue of Test Report and Grant Certificate			
Prüfgrundlage: Test specification:	FCC Part 15 Subpart C 15.247, 15.207, 15.205 & 15.209 RSS 247 Issue 2 and RSS GEN Issue 5			
Wareneingangsdatum: Date of sample receipt:	2022-12-07			
Prüfmuster-Nr & Serien-Nr.: Test sample no & serial no.:	A003385546-022 & A003385546-04 2022120701 & 2022120702			
Prüfzeitraum: Testing period:	2022-12-07 - 2023-01-06			
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: 2023-01-09	Ausstellatum: Issue date: 2023-02-09			
Stellung / Position:	Likhithesh M D Senior Engineer	Stellung / Position:	Madhu K.N Senior Engineer	
Sonstiges / Other:	FCC ID: HD5-PM11AX IC: 1693B-PM11AX			
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 F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory F(ail) = failed a.m. test specification(s)	4 = sufficient N/A = not applicable
5 = N/T = nicht 5 = poor N/T = not				
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) output power	FCC 15.247(b)(1)	RSS 247 Issue 2, Section 5.4 (b)	Pass
Maximum Power Spectral Density	FCC 15.247(e)	RSS 247 Issue 2, Section 5.2 (b)	NA
DTS Bandwidth	FCC 15.247(a)(iii)	RSS 247 Issue 2, Section 5.1 (b)	Pass
Channel Frequency Separation	15.247(a)(1)	RSS 247 Issue 2, Section 5.1 (b)	Pass
Number of Hopping Channels	15.247(a)(iii)	RSS 247 Issue 2, Section 5.1 (d)	Pass
Time of Occupancy(Dwell Time)	15.247(a)(iii)	RSS 247 Issue 2, Section 5.1 (d)	Pass
Emissions in non-restricted frequency bands	FCC 15.247(d)	RSS 247 Issue 2, Section 5.5	Pass
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

Product Category: Electronics Testing
Test Discipline: EMC Test Facility

Compliance statement for Part 15.203:

"THE ANTENNA WITH A STANDARD CONNECTOR (RP-SMA) AND (U.FL) USED, WITH NO POSSIBILITY OF REPLACEMENT WITH A NON-APPROVED ANTENNA BY THE END-USER. THEREFORE, THE EUT IS CONSIDERED TO COMPLY WITH THIS PROVISION."

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REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
IN23FG6K 001	01	Initial Issue of Test Report	01-02-2023
IN23FG6K 001	02	Reviewer comments updated	09-02-2023

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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 DIAGRAM

8: BILL OF MATERIAL

9: USER MANUAL

10: MAXIMUM PERMISSIBLE EXPOSURE INFORMATION

2 TEST SITES

2.1 Testing Facilities

1. TÜV Rheinland (India) Pvt.Ltd.,
27/B, 2nd Cross,
ElectronicCityPhase1
Bangalore – 560 100,
India

2. TUV Rheinland (India) Pvt.Ltd.,
108 , Beside ISBR Business School,
Electronic city Phase I
Bangalore - 560 100.
India

Radiated Measurement site type :
Fully anechoic chamber (used for above 1 GHz
measurements)

Radiated Measurement site type :
Semi anechoic chamber (used for below 1 GHz
measurements)

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	ESW 44	101732	4.73 SP5	04.08.2023	Yearly	Radiated Spurious Emission
Active loop antenna	Frankonia	LAX-10	LAX-10-800	-	31.01.2023	Yearly	
Baloon and Biconical Antenna	Schwarzbeck mess-elektronik	VHBB-9124 / BBA-9106	01028	-	03.02.2023	Yearly	
Log-Periodic Antenna	Schwarzbeck mess-elektronik	VUSLP-9111B	9111B-111	-	26.01.2023	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-01944	-	11.10.2023	Yearly	
EMI Test Receiver	Rohde & Schwarz	ESW44	101773	1.72.SP1	12.02.2023	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	
Spectrum Analyzer	Agilent	E4407B	US41192772	A.14.07	21-12-2023	Yearly	Conducted Test Parameters
10dB Attenuator	H+S Electronics Pvt. Ltd	6810.17.A	770041	-	19-03-2023	Yearly	
Signal Analyser	Rohde & Schwarz	FSV7	101644	FW 3.40	25-01-2023	Yearly	
Signal Analyser	Anritsu Corporation	MS2830A	6261983953	-	18-10-2023	Yearly	
EMI Receiver	Rohde & Schwarz	ESR7	101133	3.48 SP3	22.07.2023	Yearly	Conducted AC Power line Test
Line Impedance Stabilization Network	Rohde & Schwarz	ENV 216	101434	-	11.04.2023	Yearly	
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100811	-	12.07.2023	Yearly	

Table 2: Instrument application Software versions

SL. No.	Test Type	Application software	Version
1	Radiated spurious emission measurement in 10mtr-SAC	BAT EMC	3.20.0.17
2	Radiated spurious emission measurement in FAC	EMC 32	10.60.20

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

HWBPM11AX-PRTM is a carrier board with System on Module. The module to be used inside the Honeywell Products. The Module has Dual Band WIFI (2.4GHz & 5GHz) and BLUETOOTH radio interface. This module communicates with external host using SDIO interface for WIFI and UART for BLUETOOTH.

This Module supports 802.11a/b/g/n/ac/ax for WIFI and Supports BT (Basic , EDR & BLE) The module will act as Access Point / Master only in NON - DFS bands. In the DFS band, the Module acts as Slave /Station device which do not have Radar detection functionality.

Powered with BCM43752, **HWBPM11AX-PRTM** achieve the best possible connectivity and performance in RF Environment.

This Module will be used to provide the WIFI & BLUETOOTH wireless connectivity for Honeywell Products

3.2 Ratings and System Details of Equipment under Test

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

Radio Protocol		Bluetooth	
Operating Frequency Range		2402MHz to 2480MHz	
No. of Channels		79	
Channel Spacing		1MHz	
Transmitting Power Level		Refer clause 11	
Maximum Measured Power (e.i.r.p)		<u>MAF94367 (Omni Directional Antenna)</u> 19.73 dBm(1 Mbps 2440MHz)	
		<u>1001932PT(Flex/PCB Antenna)</u> 19.88 dBm(1 Mbps 2440MHz)	
		<u>FPA3020-10A (Flex/PCB Antenna)</u> 21.61 dBm(1 Mbps 2440MHz)	
Modulation		GFSK, pi/4-DQPSK,8-DPSK	
Number of antennas		3	
Antenna Type & Gain		MAF94367 (Omni Directional Antenna)	2.35dBi
		1001932PT(Flex/PCB Antenna)	2.50dBi
		FPA3020-10A (Flex/PCB Antenna)	4.23dBi
Supply Voltage to Product		5.0VDC through AC/DC Adapter , <1A	
Environmental conditions	Storage	-20degC to +70degC Relative Humidity <95%	
	Operating	-20degC to +60degC Relative Humidity <95%	
EUT Dimension		8.0 x 3.7 x 0.5 CM (L x W x H)	

***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 **HWBPM11AX-PRTM** has multiple protocols. All the supported wireless protocols and their respective test results are issued in separate test reports, refer clause 4.7 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 on low, mid and high channels

4.2 UUT Operation and Software

Hardware Version Identification number (HVIN) : 3011-2325-001
Software version : 18.35.387.23.1301.62

4.3 Special Accessories and Auxiliary Equipment

Test laptop (Tera Term VT ver 4.105),
LAN cable

4.4 Simultaneous Transmission

This product supports Simultaneous transmission

4.5 Countermeasures to achieve EMC Compliance

- None

4.6 List of frequencies

Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
2400 – 2483.5 BT(BDR+EDR)	0	2402
	1	2403
	2	2404
	3	2405
	:	:
	:	:
	:	:
	37	2439
	38	2440
	39	2441
	40	2442
	:	:
	:	:
	:	:
	74	2476
	75	2477
	:	:
	:	:
	78	2480

Table 5: List of Bluetooth center Frequencies

Channel used for Bluetooth testing

Channel low : 2402MHz

Channel mid : 2440MHz

Channel high : 2480MHz

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Note:

TUV Sample Identification number : A003385546-022 – Radiated test Sample
A003385546-04 – Conducted test Sample

4.7 Report references

Note: Product **HWBPM11AX-PRTM** 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)	IN23WDIF 001
RF test report for Bluetooth (2.4GHz) → This Report	IN23FG6K 001
RF test report for Wi-Fi (5GHz)	IN23ESPY 001

5 Operational Description

This **HWBPM11AX-PRTM** module is a Wi-Fi, BT system on module which will be placed inside the Honeywell products like printers, barcode scanners, RFID readers etc. to enable wireless connectivity.

This module includes MAC & physical layer of 802.11a/b/g/n/ac/ax and the Bluetooth modem.

This module operates on 5.0V DC Power supply with internal on-board regulation to generate 3.3v for powering ON all the circuits.

The module uses internal power amplifier and LNA for 2.4GHz frequency band and an external front end chip for 5GHz frequency band.

All filters and diplexers are included in the module to ensure maximum power flatness and optimum VSWR.

The module has one antenna chain for 2X2 output for Wi-Fi.

The module shall use WM-BAX-BM-57 USI SiP module with Broadcom BCM43752 chipset which includes LNA, switch, and internal power amplifier (iPA) for small form factor and optimum performance. All filters and diplexers will be included in the module to ensure maximum power flatness and optimum VSWR. The module will perform with all legacy hardware having data rates as low as 1Mbps. When running 802.11 ac in 2 x 2 MIMO mode, data rates are expected to reach 1200 Mbps or more.

This chipset also supports concurrent operation of Bluetooth (Version 5.1) for wireless connectivity during browsing or other device applications. Along with both standard and high speed (HS) Bluetooth data rates, Bluetooth low energy modes are also supported.

Hardware WAPI acceleration engine, AES, TKIP, WPA and WPA2 are supported to provide the latest security requirement on your network

The Device communicates with HOST using SDIO interface for WIFI and UART interface for BLUETOOTH..

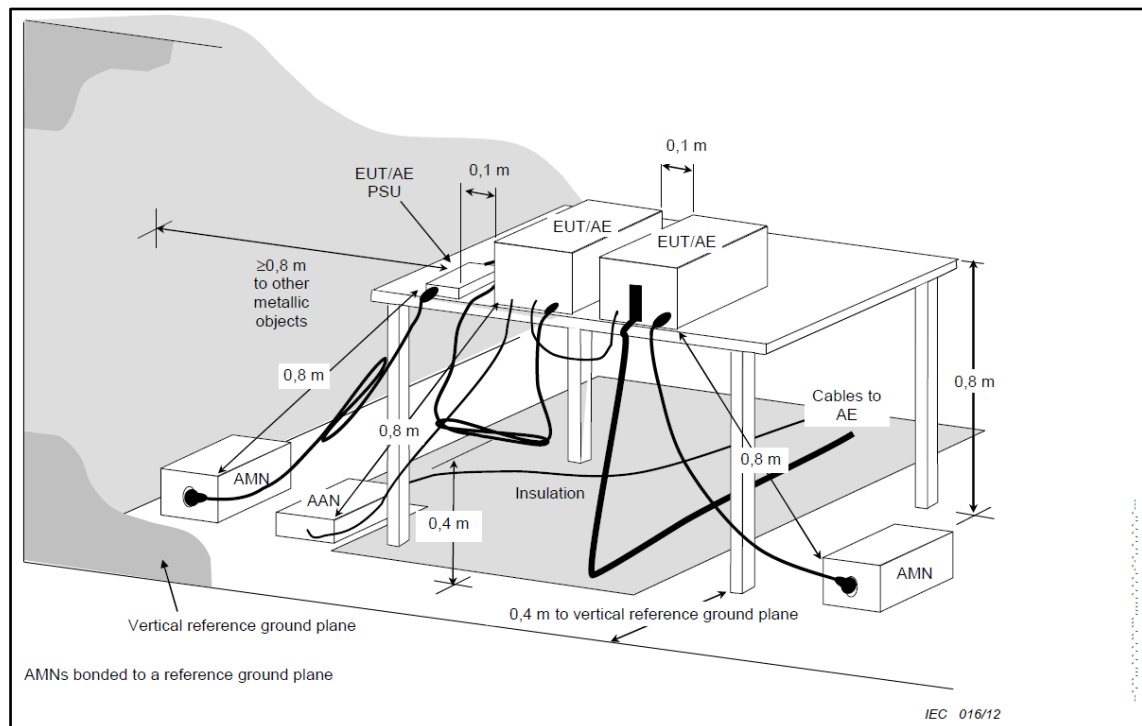
6 TEST METHODOLOGY

6.1 Conducted Spurious Emission Test on AC Power Line

Measured levels of ac power-line conducted emission across the 50Ω LISN port (to which the EUT is connected). All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer.

The device is placed on the test table, raised 80cm above the reference ground plane. The vertical conducting plane is located 40cm to the rear of the device. AC Conducted emission measurement is made over frequency range from 150kHz to 30MHz, this measurement was performed with EUT powered with an AC adaptor with 110V AC 60Hz supply.

6.1.1 Test Setup Configuration



6.2 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

6.2.1 Test Setup Configuration

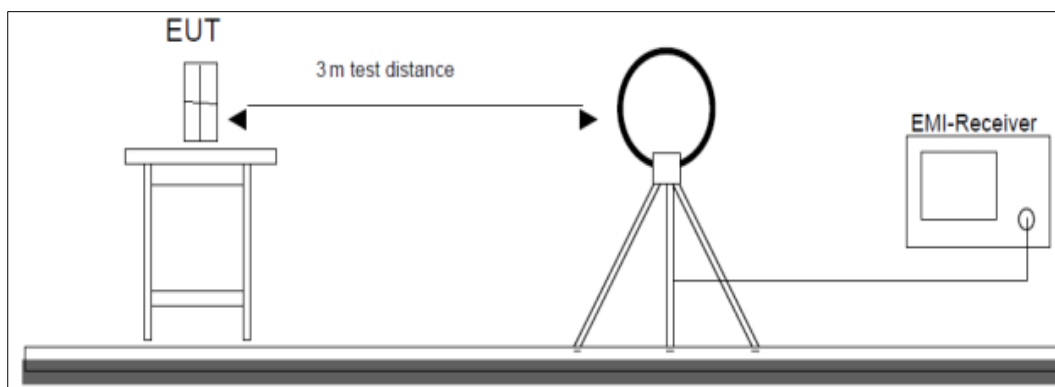


Figure 1: Frequency Range 9 kHz - 30 MHz

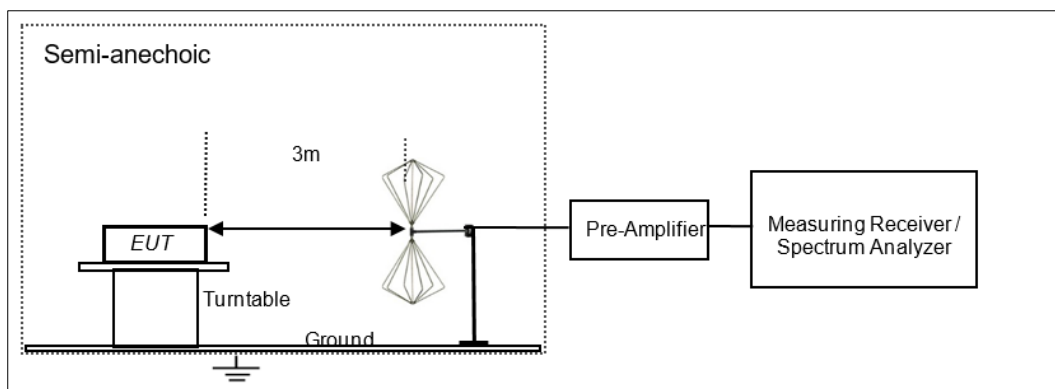


Figure 2: Frequency Range 30 MHz - 200 MHz

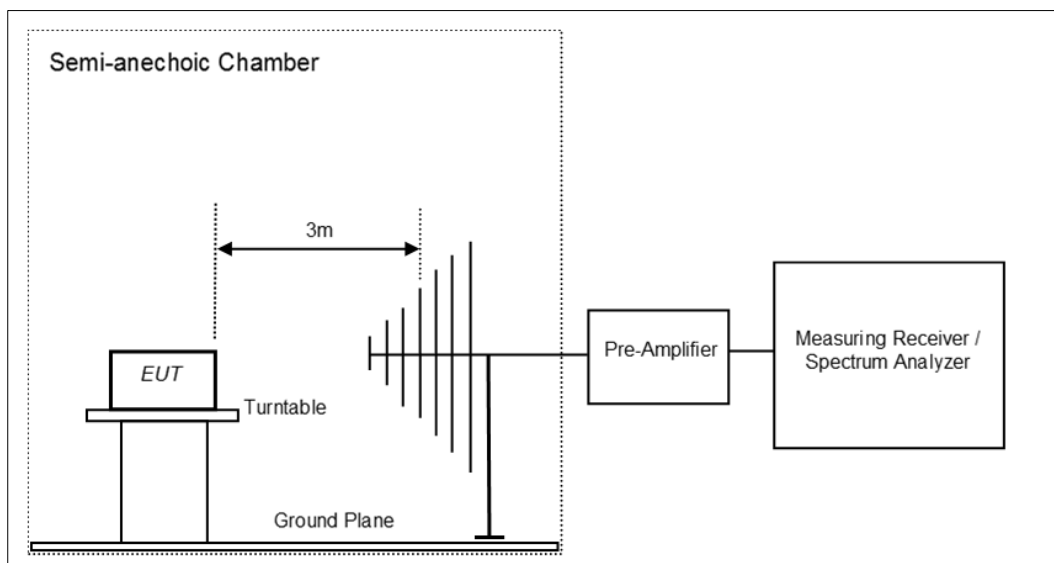


Figure 3: Frequency Range 200 MHz - 1GHz

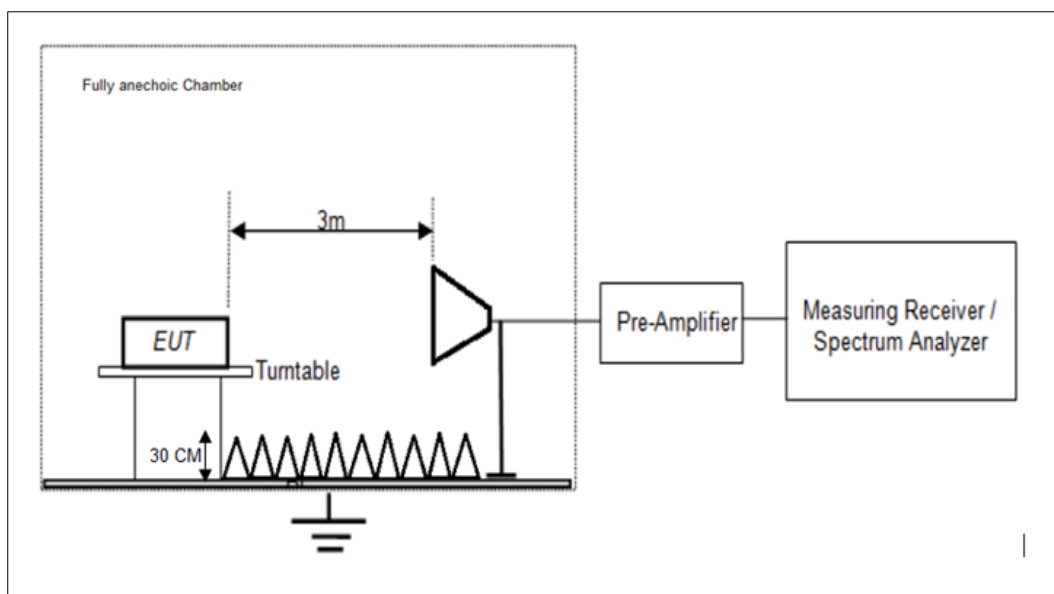


Figure 4: Frequency Range above 1 GHz

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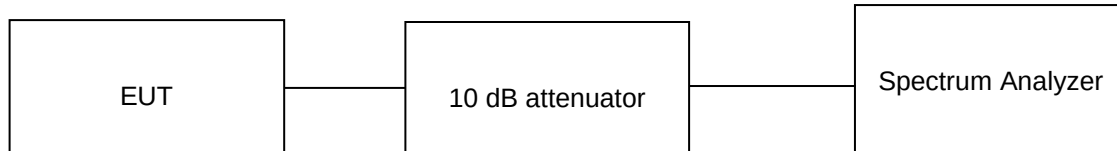
7 TEST RESULTS FOR BLUETOOTH

7.1 Maximum Peak Conducted Output Power

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (b)(1) / RSS 247 Issue 2, Section 5.4 (b)
Test Method	Subclause 7.8.5 of ANSI C63.10
Measurement Bandwidth	1MHz & 3MHz
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) = + 22.6 °C Voltage = 5.0V AC to DC Adaptor Relative humidity: 62%

KDB Guidelines applied:

Measurements were made as per section 9 b) 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 Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (10dB) + Cable loss (1.4dB)

Antenna Type	Data Rate (Mbps)	Channel Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	Maximum (e.i.r.p)	Power Limit (dBm)	Limit (e.i.r.p)
Omni Directional Antenna RPSMA	1	2402	16.35	18.70	30.00	36.00
		2440	17.38	19.73	30.00	36.00
		2480	16.96	19.31	30.00	36.00
	2	2402	11.88	14.23	30.00	36.00
		2440	12.40	14.75	30.00	36.00
		2480	11.91	14.26	30.00	36.00
	3	2402	12.06	14.41	30.00	36.00
		2440	12.62	14.97	30.00	36.00
		2480	12.30	14.65	30.00	36.00
1001932PT PCB/Flex Antenna	1	2402	16.35	18.85	30.00	36.00
		2440	17.38	19.88	30.00	36.00
		2480	16.96	19.46	30.00	36.00
	2	2402	11.88	14.38	30.00	36.00
		2440	12.40	14.90	30.00	36.00
		2480	11.91	14.41	30.00	36.00
	3	2402	12.06	14.56	30.00	36.00
		2440	12.62	15.12	30.00	36.00
		2480	12.30	14.80	30.00	36.00
FPA3020-10A PCB/Flex Antenna	1	2402	16.35	20.58	30.00	36.00
		2440	17.38	21.61	30.00	36.00
		2480	16.96	21.19	30.00	36.00
	2	2402	11.88	16.11	30.00	36.00
		2440	12.40	16.63	30.00	36.00
		2480	11.91	16.14	30.00	36.00
	3	2402	12.06	16.29	30.00	36.00
		2440	12.62	16.85	30.00	36.00
		2480	12.30	16.53	30.00	36.00

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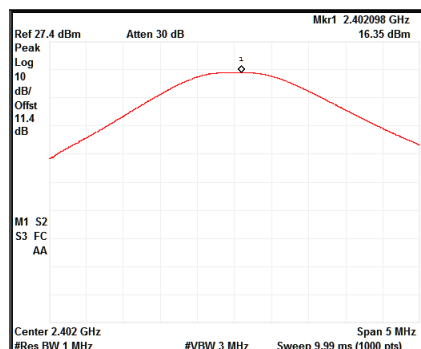
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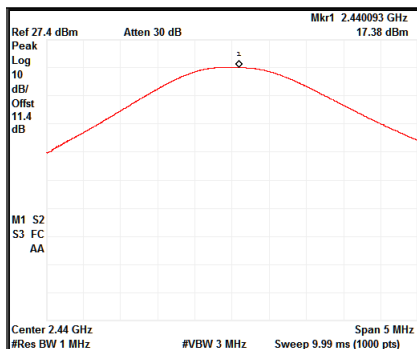
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Test Plots:

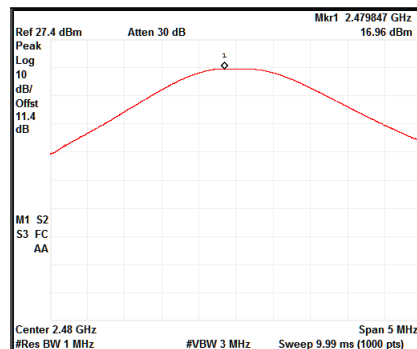
Data Rate: 1Mbps



Channel Frequency:2402MHz

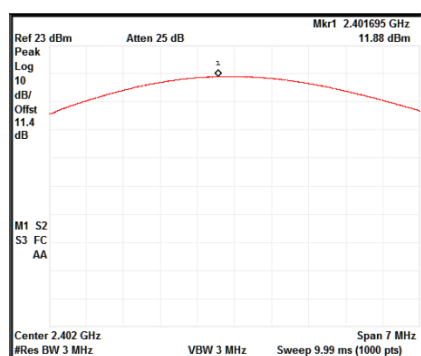


Channel Frequency:2440MHz

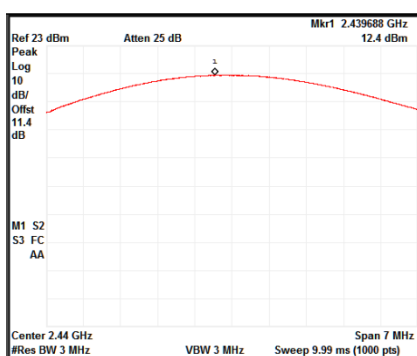


Channel Frequency:2480MHz

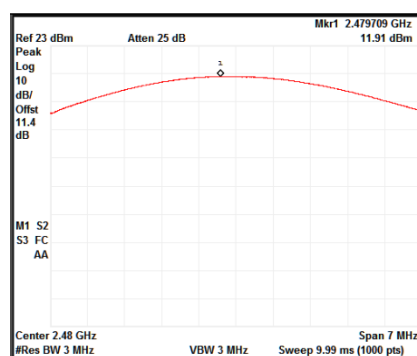
Data Rate: 2Mbps



Channel Frequency:2402MHz

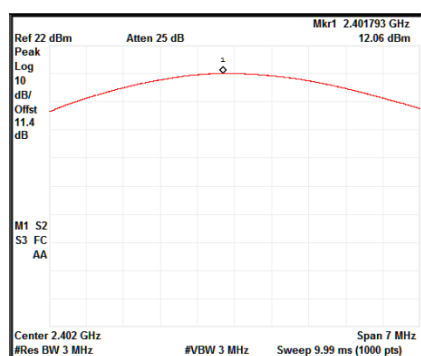


Channel Frequency:2440MHz

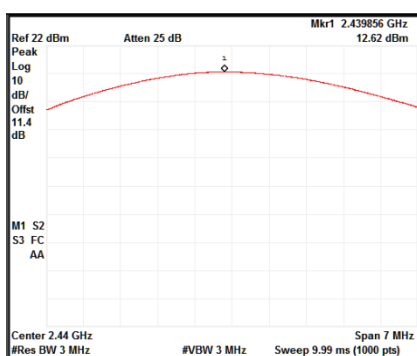


Channel Frequency:2480MHz

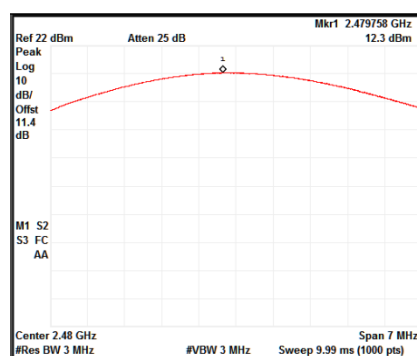
Data Rate: 3Mbps



Channel Frequency:2402MHz



Channel Frequency:2440MHz



Channel Frequency:2480MHz

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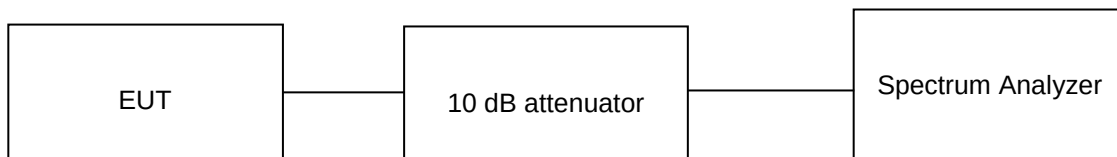
7.2 20dB Bandwidth & 99% Bandwidth

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (a) (i) / RSS 247 Issue 2, Section 5.1 (b)
Test Method	Subclause 7.8.7 of ANSI C63.10
Measurement Bandwidth	30 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	The bandwidth of frequency hopping channel is the 20 dB emission bandwidth ,measured with the hopping stopped. The system RF bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near-term distribution of frequencies appears random , with sequential hops randomly distributed in both direction and magnitude of change in the hopset while the long-term distribution appears evenly distributed.

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 22.3°C Voltage = 5.0V AC to DC Adaptor Relative humidity: 62 %

KDB Guidelines applied:

Measurements were made as per section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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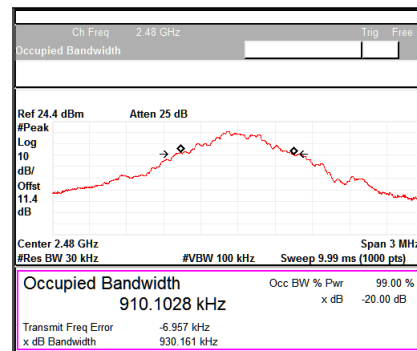
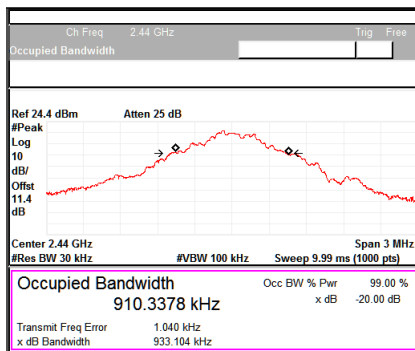
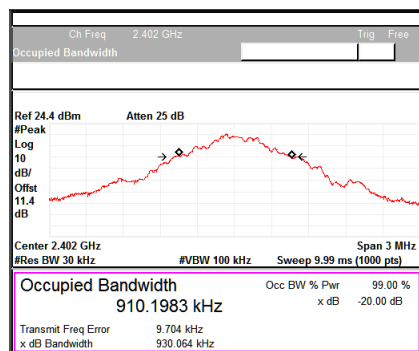
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Test results:

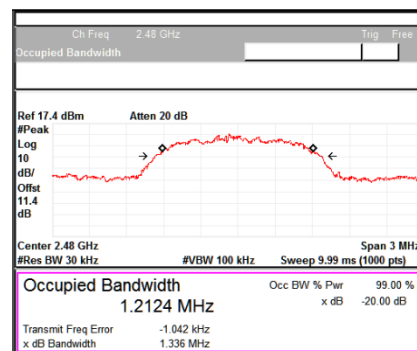
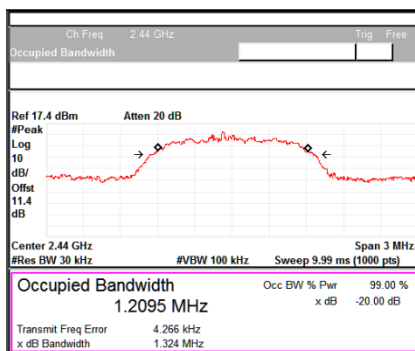
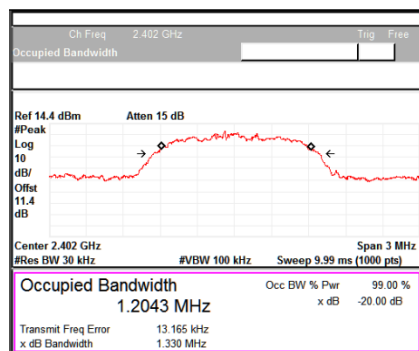
1. All the losses are included during measurement and final values are mentioned in the test report.

Data Rate (Mbps)	Channel Frequency (MHz)	20 dB Bandwidth (MHz)	99% OBW (MHz)
1	2402	0.930	0.910
	2440	0.933	0.910
	2480	0.930	0.910
2	2402	1.20	1.33
	2440	1.20	1.32
	2480	1.21	1.33
3	2402	1.20	1.30
	2440	1.21	1.30
	2480	1.22	1.31

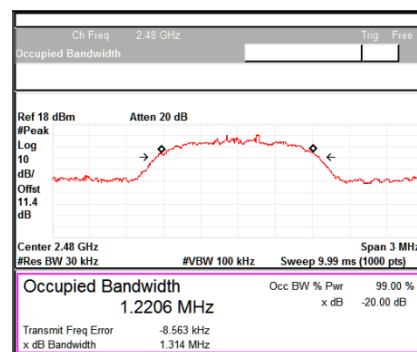
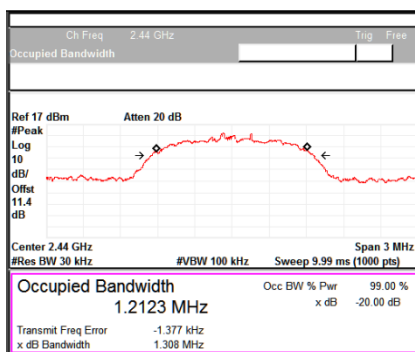
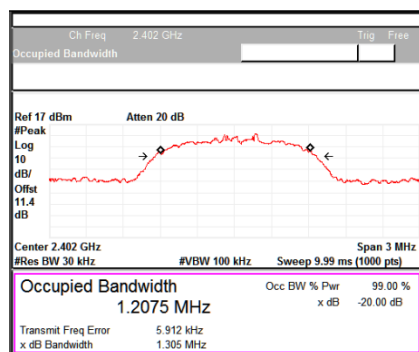
Data Rate: 1Mbps



Data Rate: 2Mbps



Data Rate: 3Mbps



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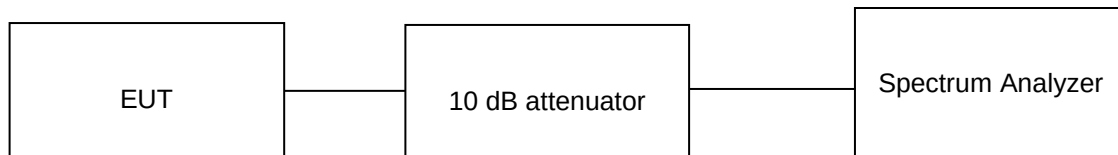
7.3 Number of Hopping Channels

Result

Pass

Test Specification	FCC Part 15 Subpart C Section 15.247 (a) (i) / RSS 247 Issue 2, Section 5.1 (d)
Test Method	Subclause 7.8.3 of ANSI C63.10
Measurement Bandwidth	100 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 25 °C Voltage = 5.0V AC to DC Adaptor Relative humidity: 62 %

KDB Guidelines applied:

Measurements were made as per section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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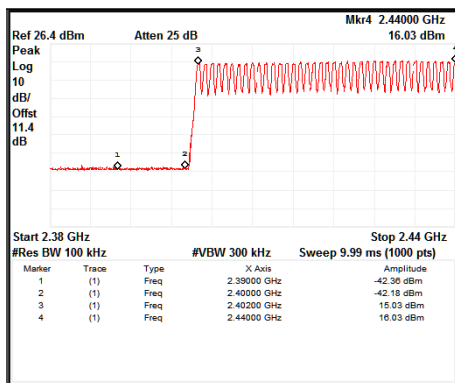
Test results:

Note:

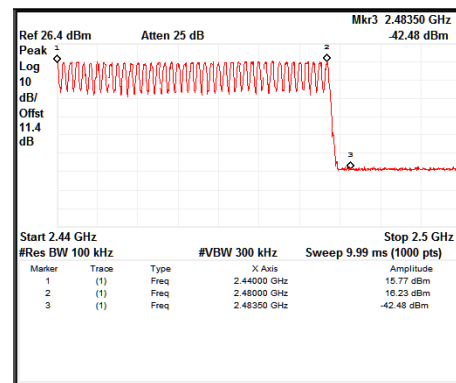
- All the losses are included during measurement and final values are mentioned in the test report.

Test Plots:

Data Rate: 1Mbps

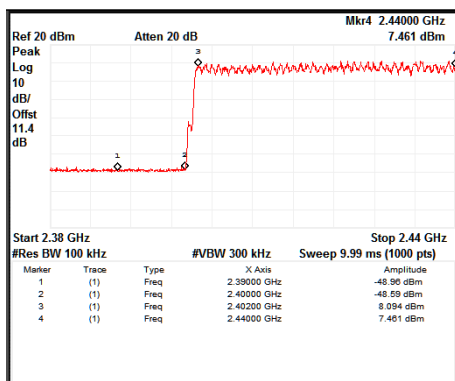


Frequency range: 2380MHz to 2440MHz

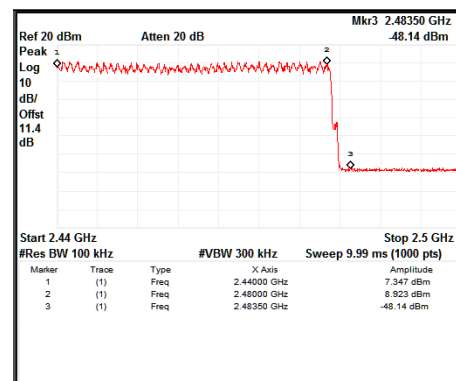


Frequency range: 2440MHz to 2500MHz

Data Rate: 2Mbps

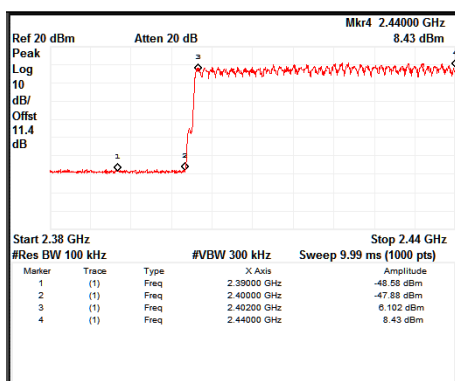


Frequency range: 2380MHz to 2440MHz

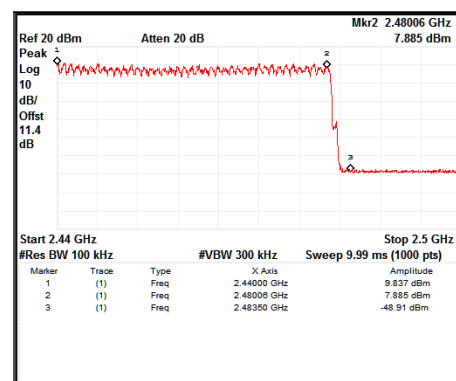


Frequency range: 2440MHz to 2500MHz

Data Rate: 3Mbps



Frequency range: 2380MHz to 2440MHz



Frequency range: 2440MHz to 2500MHz

Number of Hopping frequencies for all data rates = 79

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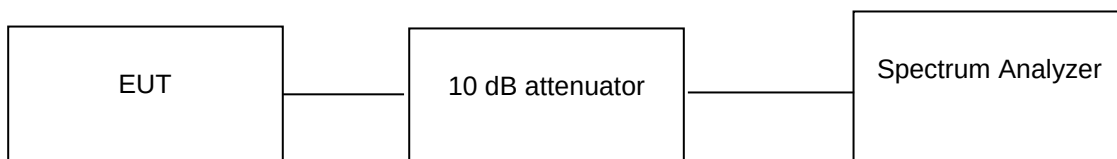
7.4 Carrier Frequency Separation

Result

Pass

Test Specification	FCC Part 15 Subpart C Section 15.247 (a) (1) / RSS 247 Issue 2, Section 5.1 (b)
Test Method	Clause 7.8.2 of ANSI C63.10
Measurement Bandwidth	300 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	Frequency hopping systems shall have hopping channel carrier frequency separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 25 °C Voltage = 5.0V AC to DC Adaptor Relative humidity: 62%

KDB Guidelines applied:

Measurements were made as per section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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Test results:

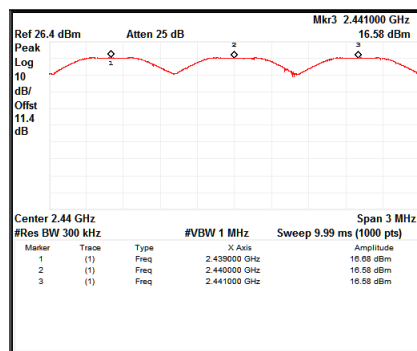
Note:

1. All the losses are included during measurement and final values are mentioned in the test report.

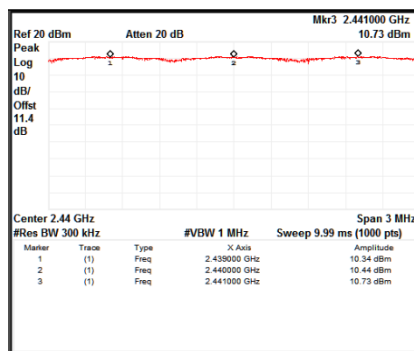
Data rate (Mbps)	Channel Frequency (MHz)	Channel spacing Observed (MHz)	20 dB Bandwidth (MHz)
1	2439	1	0.930
	2440	1	0.933
	2441	1	0.930
2	2439	1	1.33
	2440	1	1.32
	2441	1	1.33
3	2439	1	1.30
	2440	1	1.30
	2441	1	1.31

Test Plots:

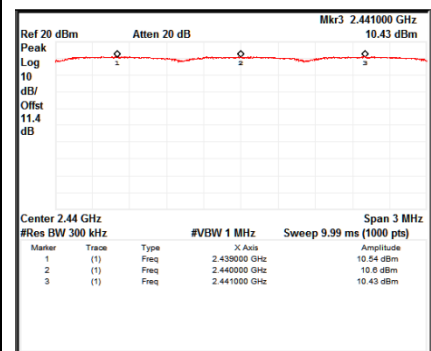
Data rate:1Mbps



Data rate:2Mbps



Data rate:3Mbps



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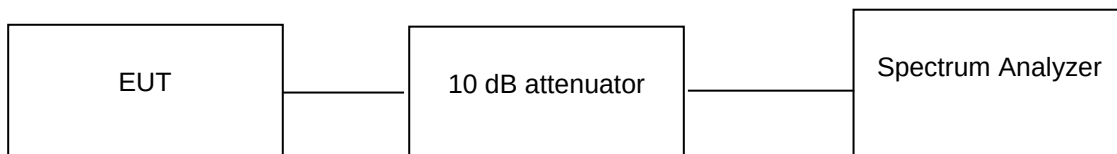
7.5 Time Of Occupancy(Dwell Time)

Result

Pass

Test Specification	FCC Part 15 Subpart C Section 15.247 (a) (i) / RSS 247 Issue 2,Section 5.1 (d)
Test Method	Clause 7.8.4 of ANSI C63.10
Measurement Bandwidth	100 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 25 °C Voltage = 5.0V AC to DC Adaptor Relative humidity: 62%

KDB Guidelines applied:

Measurements were made as per section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02

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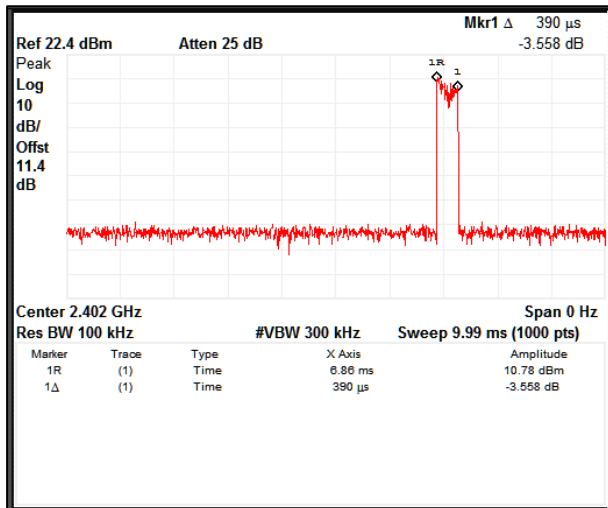
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Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report
2. Testing is performed for all the applicable data rates only worst case graphs are reported (DH5)

Data Rate: DH5



Dwell time



No. of Bin Calculation

Single Burst	390	μs
Measured Span (Seconds)	31.6	sec
No. Of Bins/Bursts in Measured Span	166	No.
Observation Period (79 hop ch x0.4s) - Seconds	31.6	sec
Total Burst in 31.6sec	64.74	ms
Limit	400.00	ms

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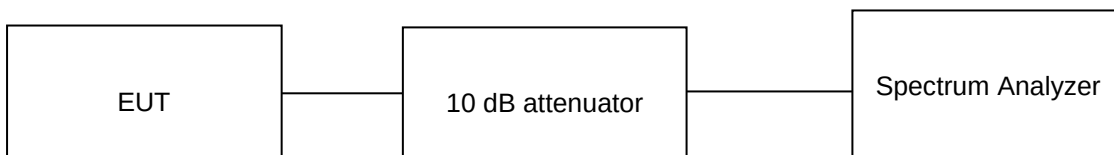
7.6 Emissions in non-restricted frequency bands and Conducted Spurious Emission

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (d) / RSS 247 Issue 2, Section 5.5
Test Method	Subclause 11.11 of ANSI C63.10
Measurement Bandwidth	100 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = +25 °C Voltage = 5.0V AC to DC Adaptor Relative humidity: 62 %

KDB Guidelines applied:

Measurements were made as per section 8.5 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

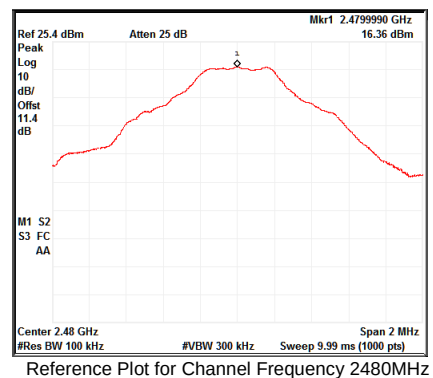
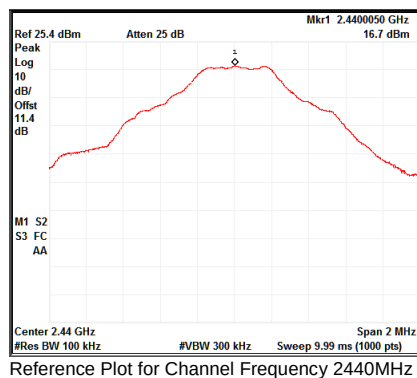
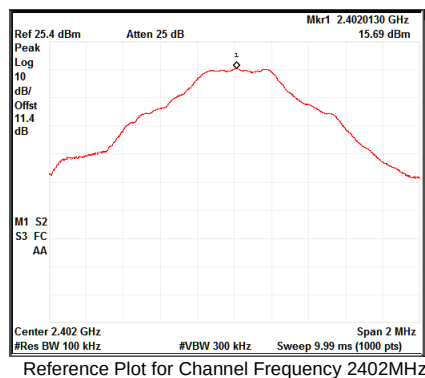
Test results:

Note:

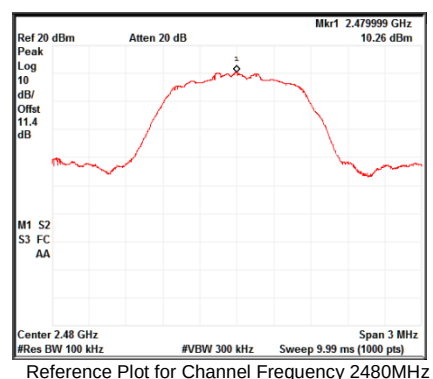
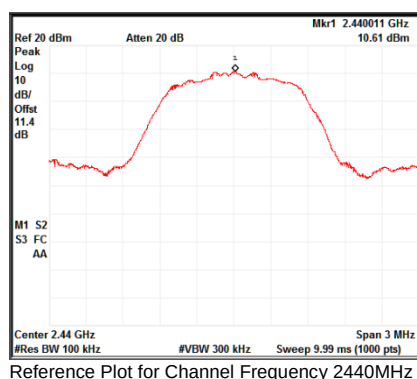
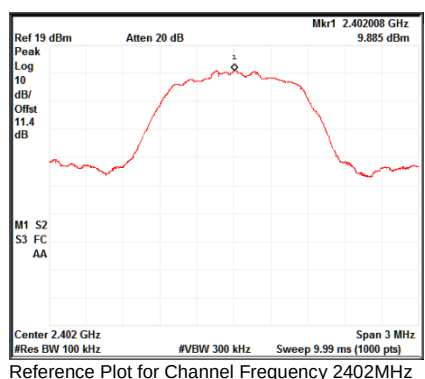
1. All the losses are included during measurement and final values are mentioned in the test report.
2. Final Value (dBm) = Measured Value (dBm) + Attenuator factor (10dB) + Cable loss (0.5dB)
3. This product do not support additional beamforming gain / directional gain, it uses signal antenna and hence directional gain of the single antenna is 2.35 dB

7.6.1 Reference plots

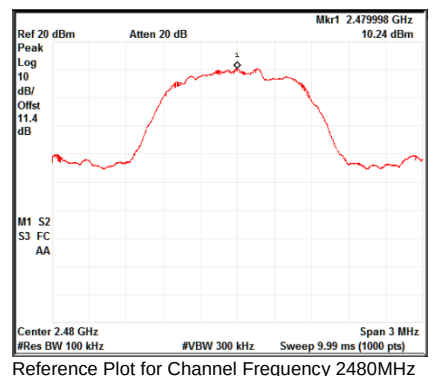
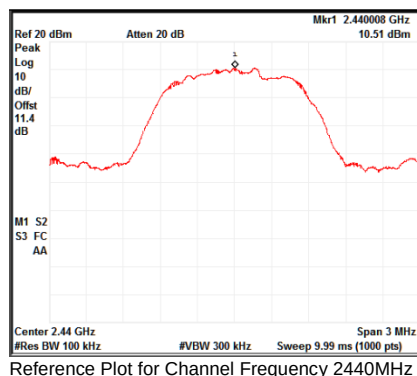
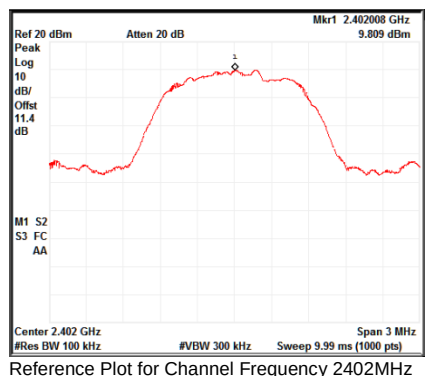
Data Rate: 1Mbps



Data Rate: 2Mbps

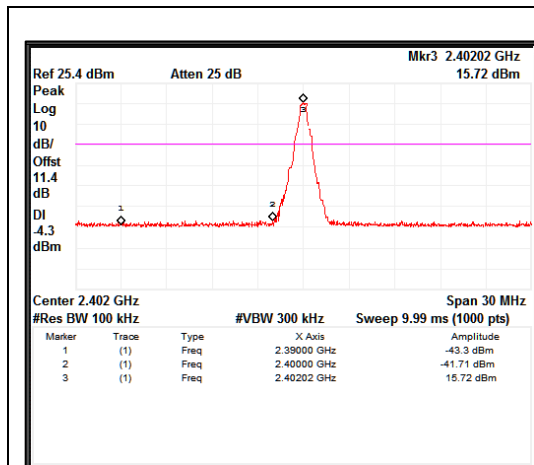


Data Rate: 3Mbps



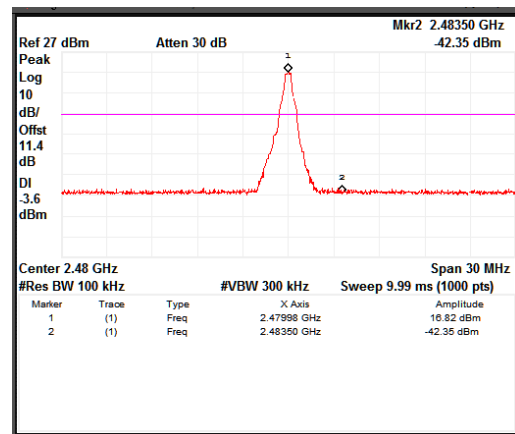
7.6.2 Band Edge

Data rate	Channel Frequency (MHz)	Band edge frequency (MHz)	Value at band edge (A) (dBm)	Reference value (B) (dBm)	A-B (dBc)	Minimum Limit (dBc)
1Mbps	2402.00	2400.00	-41.71	15.69	-57.40	-20
	2480.00	2483.50	-42.35	16.36	-58.71	-20
2Mbps	2402.00	2400.00	-47.20	9.88	-57.08	-20
	2480.00	2483.50	-49.32	10.26	-59.58	-20
3Mbps	2402.00	2400.00	-45.48	9.80	-55.28	-20
	2480.00	2483.50	-47.74	10.24	-57.98	-20



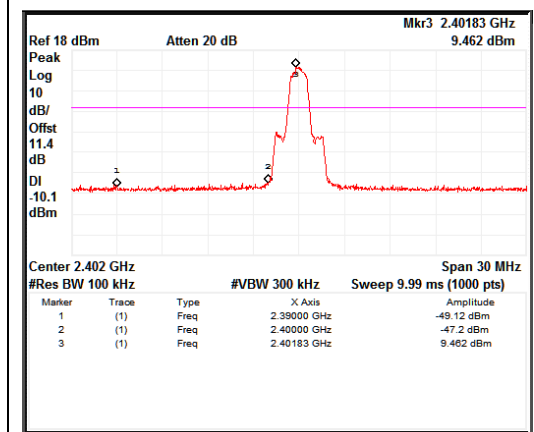
Data rate: 1Mbps

Channel Frequency 2402MHz



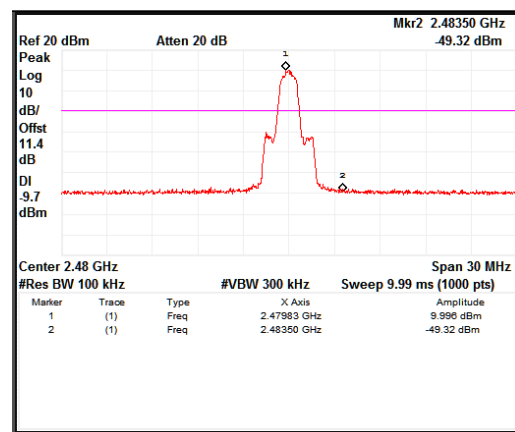
Data rate: 1Mbps

Channel Frequency 2480MHz



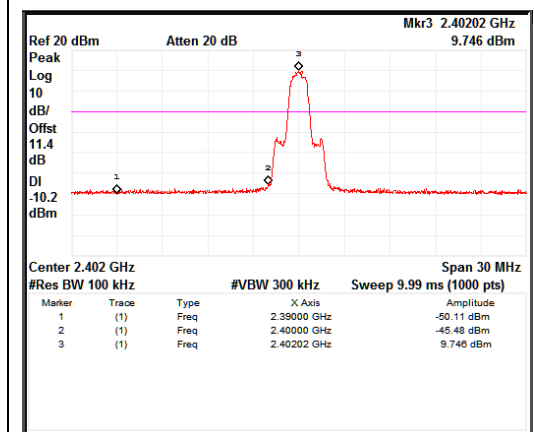
Data rate: 2Mbps

Channel Frequency 2402MHz



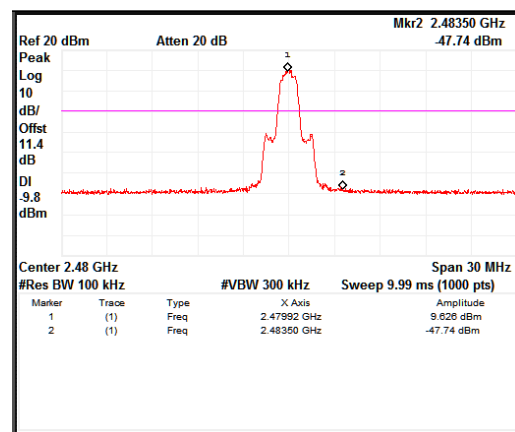
Data rate: 2Mbps

Channel Frequency 2480MHz



Data rate: 3Mbps

Channel Frequency 2402MHz



Data rate: 3Mbps

Channel Frequency 2480MHz

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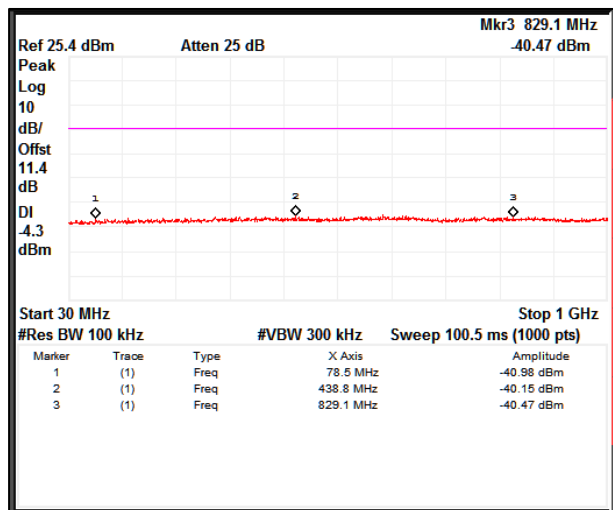
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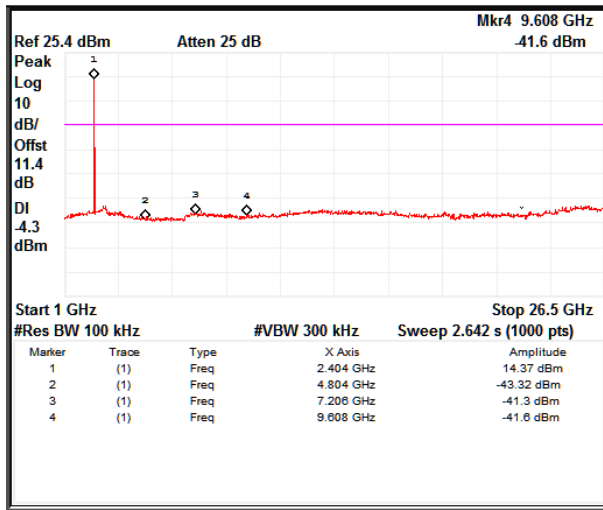
7.6.3 Out-Of-Band Emissions

Data Rate: 1Mbps



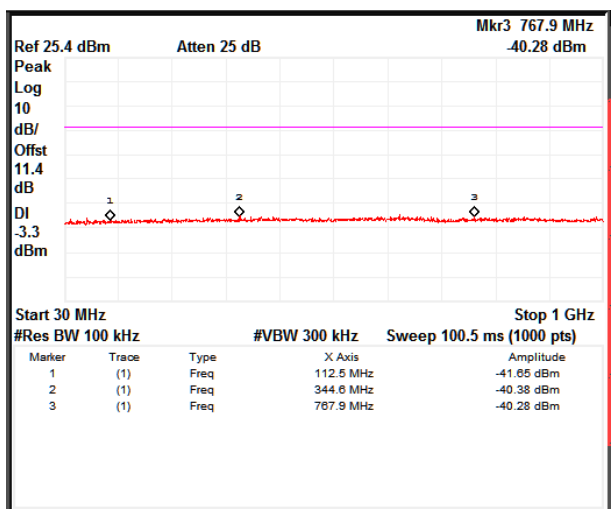
Channel Frequency 2402MHz

Frequency Range 30 MHz – 1GHz



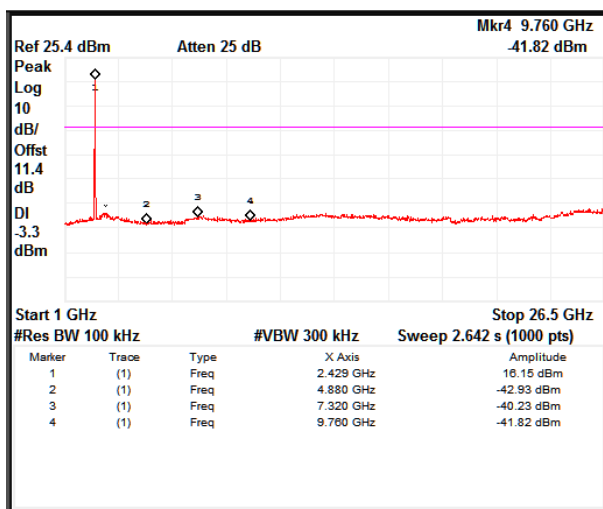
Channel Frequency 2402MHz

Frequency Range 1 GHz – 26.5GHz



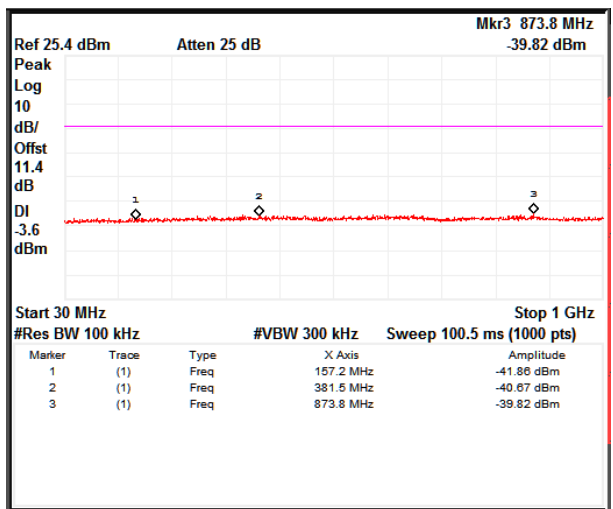
Channel Frequency 2440MHz

Frequency Range 30 MHz – 1GHz



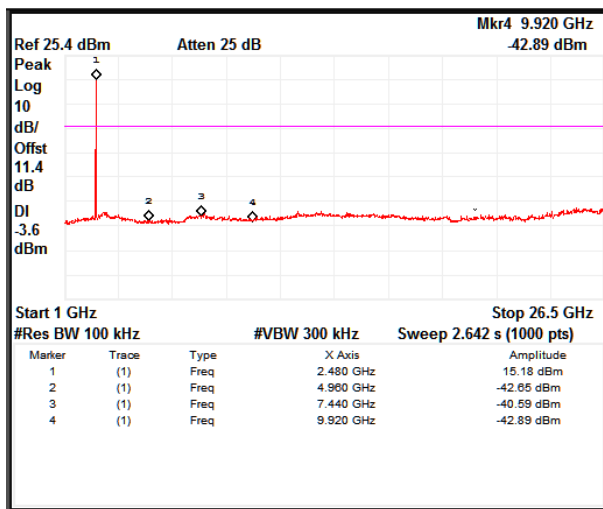
Channel Frequency 2440MHz

Frequency Range 1 GHz – 26.5GHz



Channel Frequency 2480MHz

Frequency Range 30 MHz – 1GHz



Channel Frequency 2480MHz

Frequency Range 1 GHz – 26.5GHz

Prüfbericht - Nr.:

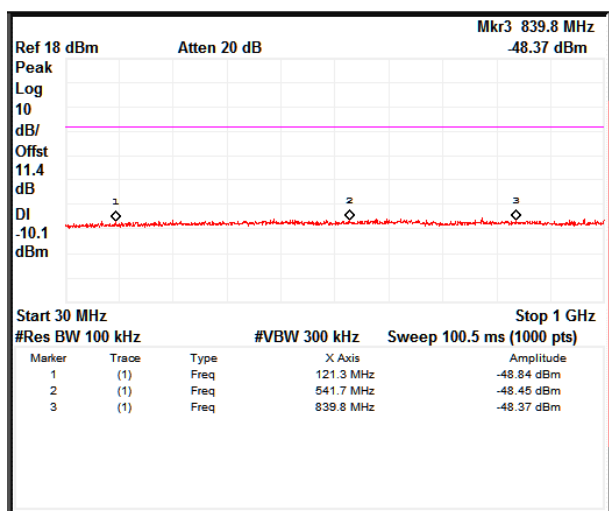
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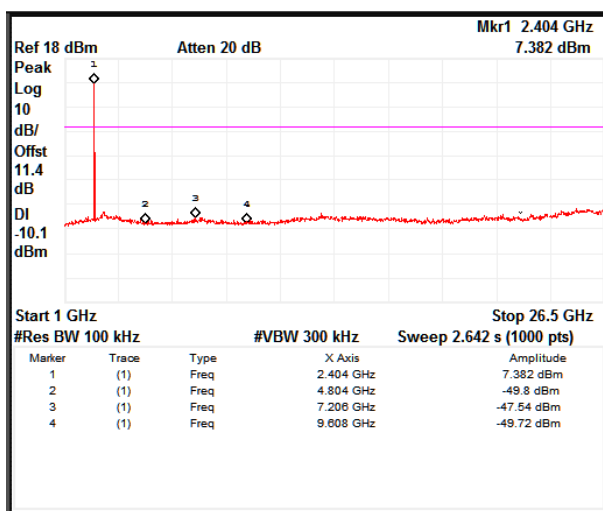
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Data Rate: 2Mbps



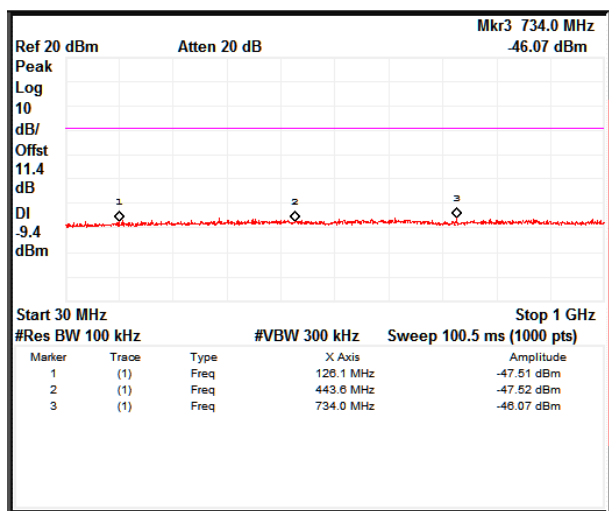
Channel Frequency 2402MHz

Frequency Range 30 MHz – 1GHz



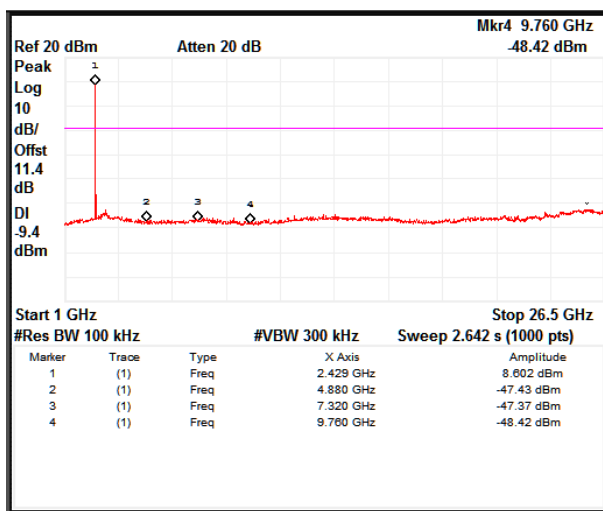
Channel Frequency 2402MHz

Frequency Range 1 GHz – 26.5GHz



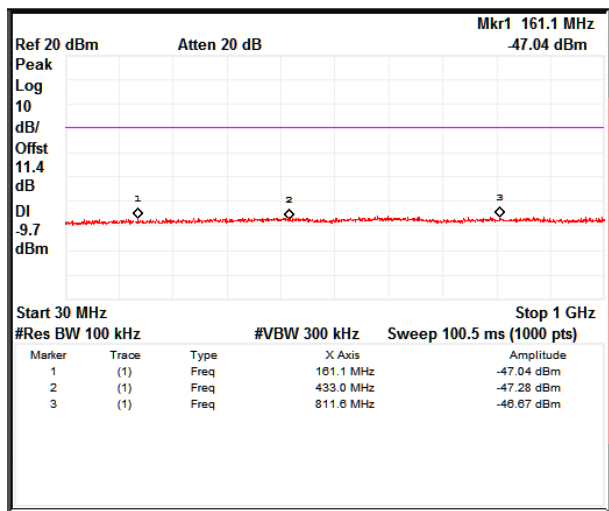
Channel Frequency 2440MHz

Frequency Range 30 MHz – 1GHz



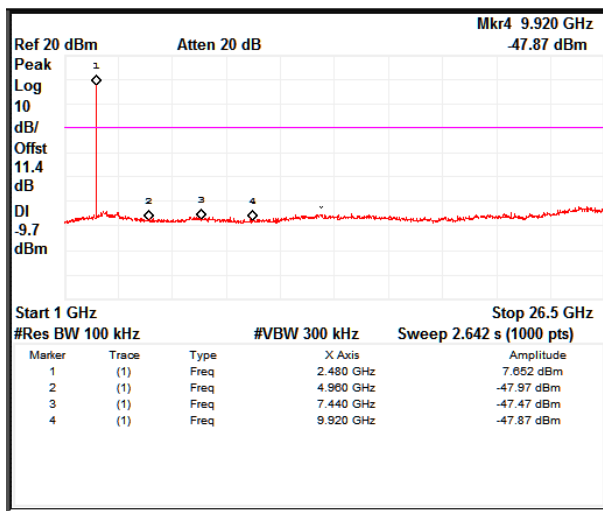
Channel Frequency 2440MHz

Frequency Range 1 GHz – 26.5GHz



Channel Frequency 2480MHz

Frequency Range 30 MHz – 1GHz



Channel Frequency 2480MHz

Frequency Range 1 GHz – 26.5GHz

Prüfbericht - Nr.:

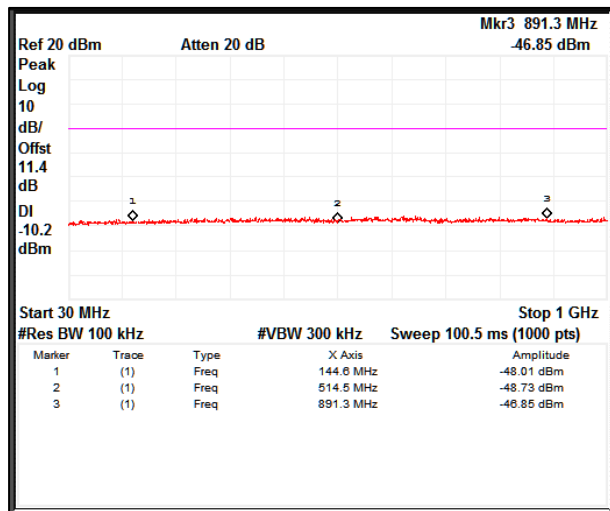
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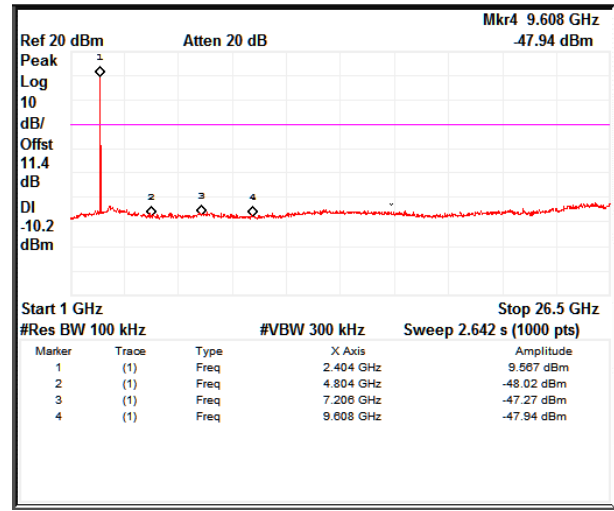
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Data Rate: 3Mbps



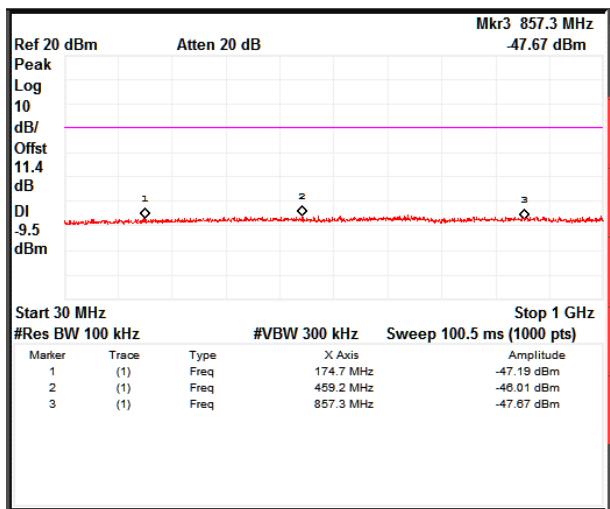
Channel Frequency 2402MHz

Frequency Range 30 MHz – 1GHz



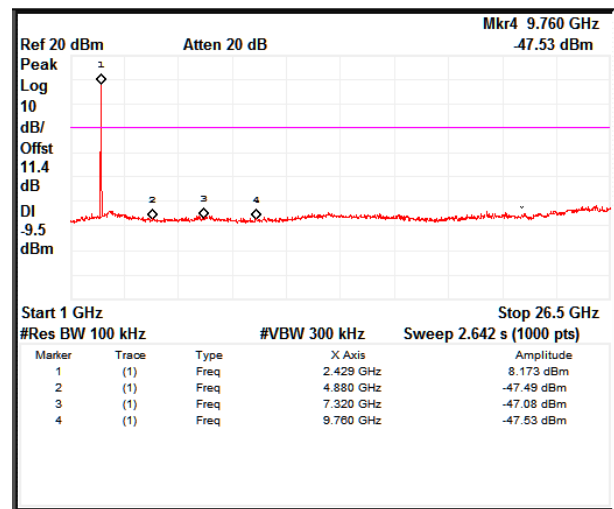
Channel Frequency 2402MHz

Frequency Range 1 GHz – 26.5GHz



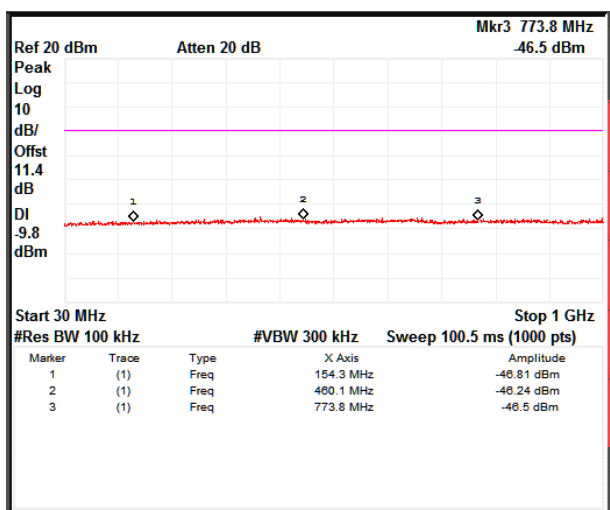
Channel Frequency 2440MHz

Frequency Range 30 MHz – 1GHz



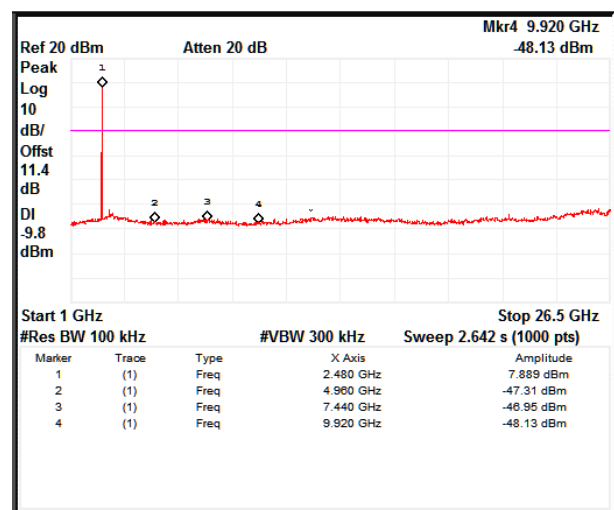
Channel Frequency 2440MHz

Frequency Range 1 GHz – 26.5GHz



Channel Frequency 2480MHz

Frequency Range 30 MHz – 1GHz



Channel Frequency 2480MHz

Frequency Range 1 GHz – 26.5GHz

7.7 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 6: 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) = + 21.6 °C

Voltage = 5.0V AC to DC Adaptor

Relative humidity = 62 %

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Test results:

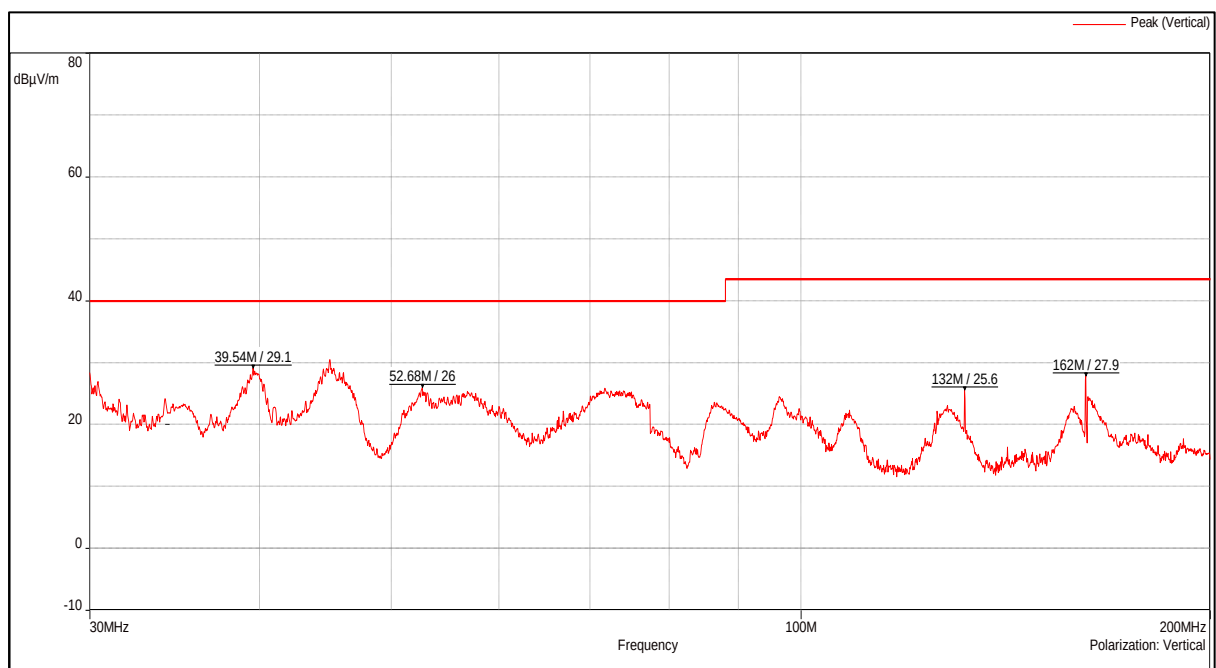
Note: All the losses are included during measurement and final values are mentioned in the test report. Refer TEST METHODOLOGY for more details

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 – 1GHz

Antenna Polarization	Measured Frequency (MHz)	Measured Value (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Vertical	39.54	29.10	40.00	-10.90
	52.68	26.00	40.00	-14.00
	132.00	25.60	43.50	-17.90
	162.00	27.90	43.50	-15.60
	238.64	9.99	46.00	-36.01
	395.99	12.90	46.00	-33.10
	653.45	14.90	46.00	-31.10
Horizontal	39.63	16.20	40.00	-23.80
	57.06	16.60	43.50	-26.90
	127.95	27.00	43.50	-16.50
	157.98	33.93	43.50	-9.57
	263.99	3.93	46.00	-42.07
	395.99	18.70	46.00	-27.30
	659.84	14.20	46.00	-31.80



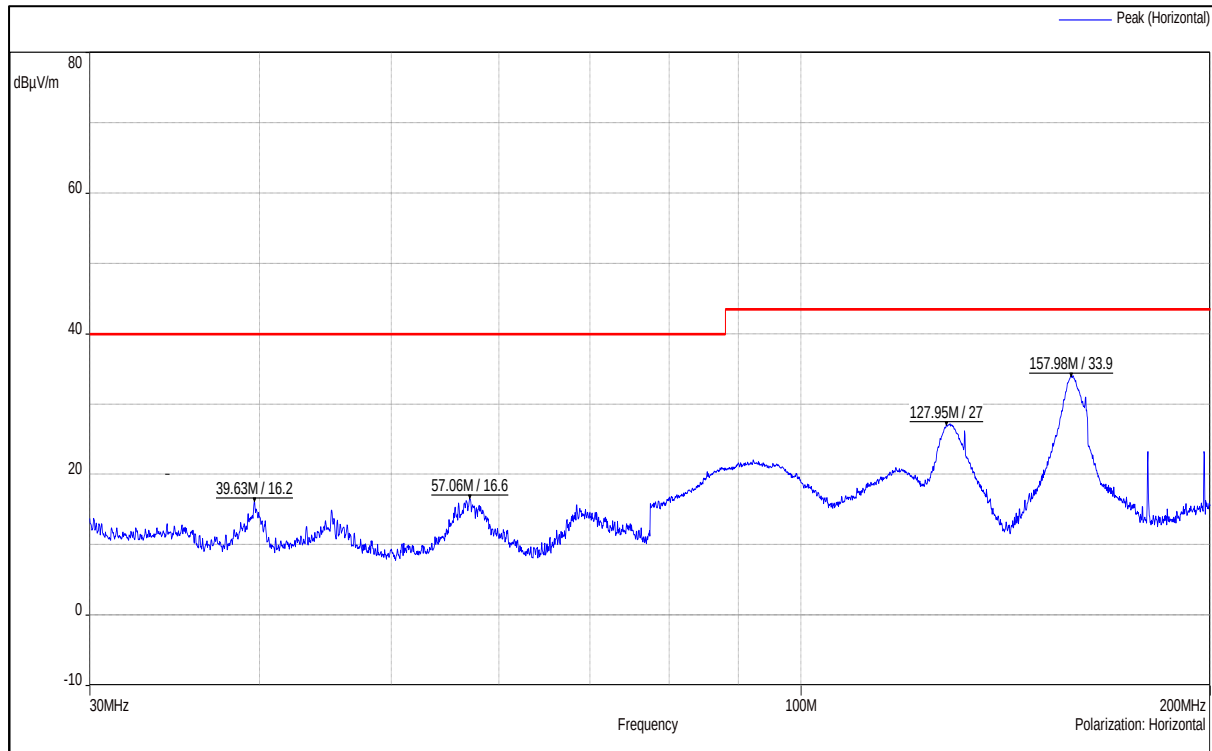
Channel Frequency 30MHz – 200MHz

Polarization Vertical

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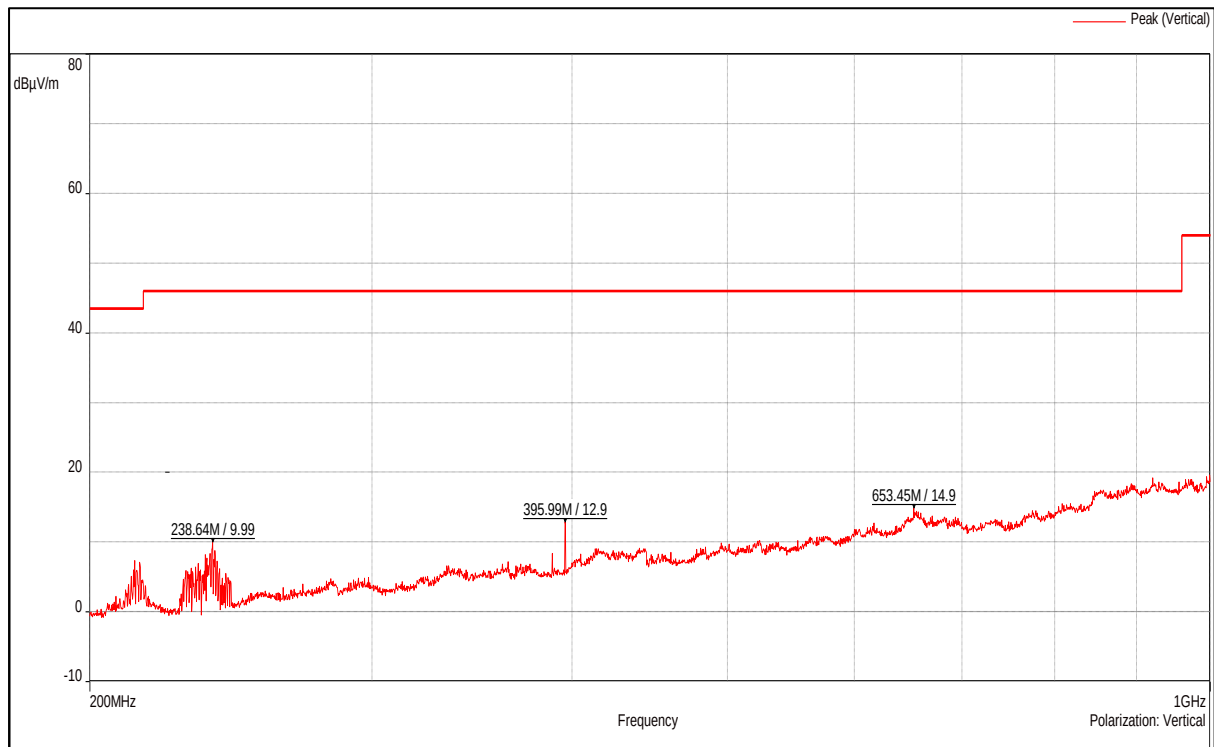
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Channel Frequency 30MHz – 200MHz

Polarization Horizontal



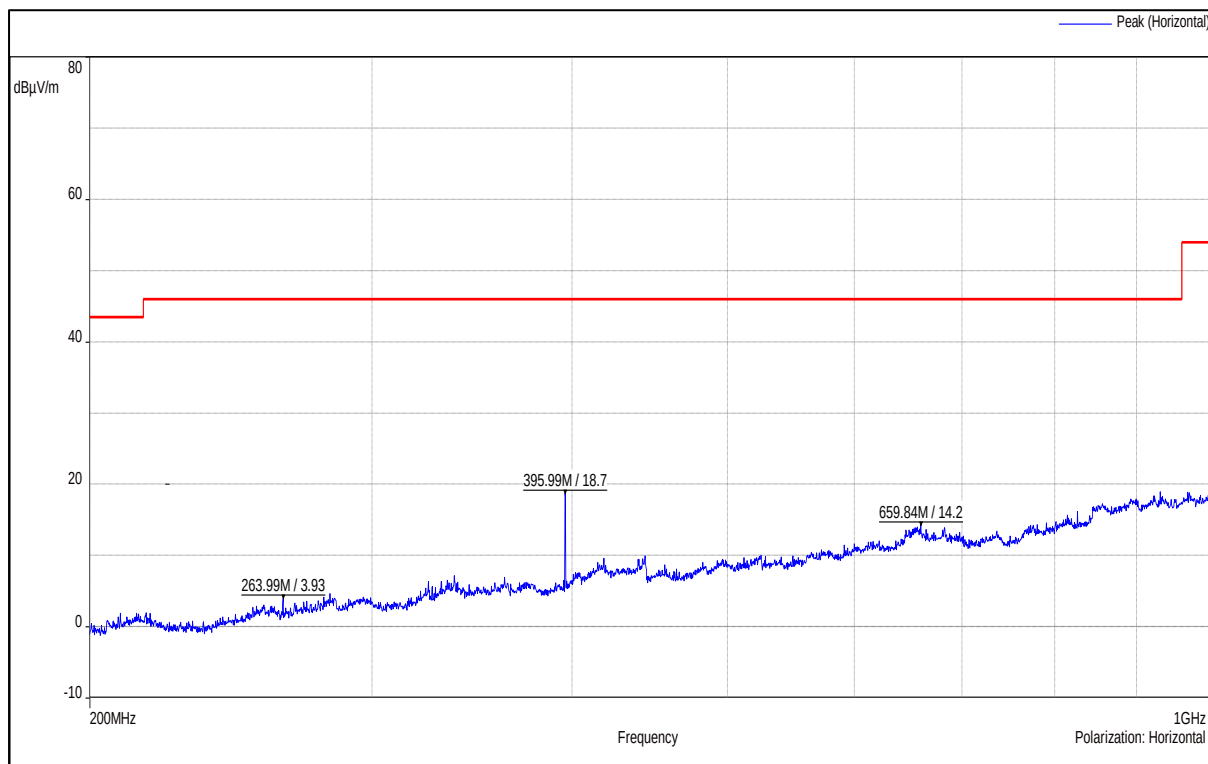
Channel Frequency 200MHz – 1GHz

Polarization Vertical

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Channel Frequency 200MHz – 1GHz

Polarization Horizontal

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Test results for the frequencies above 1GHz

Antenna Type: (Omni Directional Antenna) RPSMA Results

Data rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1	2402	2390(Pk)	Vertical	40.77	74.00*	-33.23
		2390(Av)		26.51	54.00*	-27.49
		2402(Pk)		107.74	-	-
		2402(Av)		94.79	-	-
		4804(Pk)		41.91	74.00	-32.09
		4804(Av)		29.83	54.00	-24.17
		7206(Pk)		47.31	74.00	-26.69
		7206(Av)		35.28	54.00	-18.72
		2390(Pk)	Horizontal	38.29	74.00*	-35.71
		2390(Av)		25.03	54.00*	-28.97
		2402(Pk)		102.23	-	-
		2402(Av)		89.26	-	-
		4804(Pk)		41.53	74.00	-32.47
		4804(Av)		29.59	54.00	-24.41
		7206(Pk)		49.31	74.00	-24.69
		7206(Av)		35.21	54.00	-18.79
	2440	2440(Pk)	Vertical	107.95	-	-
		2440(Av)		94.93	-	-
		4880(Pk)		43.88	74.00	-30.12
		4880(Av)		31.14	54.00	-22.86
		7320(Pk)		46.68	74.00	-27.32
		7320(Av)		35.14	54.00	-18.86
		2440(Pk)	Horizontal	103.17	-	-
		2440(Av)		90.15	-	-
		4880(Pk)		41.42	74.00	-32.58
		4880(Av)		29.63	54.00	-24.37
		7320(Pk)		48.18	74.00	-25.82
		7320(Av)		35.22	54.00	-18.78
	2480	2480(Pk)	Vertical	107.12	-	-
		2480(Av)		94.43	-	-
		2483.5(Pk)		51.37	74.00*	-22.63
		2483.5(Av)		29.83	54.00*	-24.17
		4960(Pk)		46.03	74.00	-27.97
		4960(Av)		32.99	54.00	-21.01
		7440(Pk)		47.37	74.00	-26.63
		7440(Av)		35.22	54.00	-18.78
		2480(Pk)	Horizontal	102.73	-	-
		2480(Av)		90.05	-	-
		2483.5(Pk)		47.00	74.00*	-27.00
		2483.5(Av)		28.02	54.00*	-25.98
		4960(Pk)		42.05	74.00	-31.95
		4960(Av)		29.73	54.00	-24.27
		7440(Pk)		47.42	74.00	-26.58
		7440(Av)		35.18	54.00	-18.82

* : Indicate restricted band of operation §15.205

- : Fundamental Frequency

Pk: Peak Detector; Av: Average Detector

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Data rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2	2402	2390(Pk)	Vertical	39.61	74.00*	-34.39
		2390(Av)		26.88	54.00*	-27.12
		2402(Pk)		107.17	-	-
		2402(Av)		100.20	-	-
		4804(Pk)		41.77	74.00	-32.23
		4804(Av)		30.05	54.00	-23.95
		7206(Pk)		47.86	74.00	-26.14
		7206(Av)		35.08	54.00	-18.92
		2390(Pk)	Horizontal	37.71	74.00*	-36.29
		2390(Av)		25.20	54.00*	-28.80
		2402(Pk)		101.47	-	-
		2402(Av)		94.46	-	-
		4804(Pk)		41.33	74.00	-32.67
		4804(Av)		29.48	54.00	-24.52
		7206(Pk)		47.57	74.00	-26.43
		7206(Av)		35.04	54.00	-18.96
	2440	2440(Pk)	Vertical	107.28	-	-
		2440(Av)		100.25	-	-
		4880(Pk)		43.28	74.00	-30.72
		4880(Av)		31.74	54.00	-22.26
		7320(Pk)		47.41	74.00	-26.59
		7320(Av)		35.05	54.00	-18.95
		2440(Pk)	Horizontal	102.70	-	-
		2440(Av)		95.68	-	-
		4880(Pk)		41.47	74.00	-32.53
		4880(Av)		29.86	54.00	-24.14
		7320(Pk)		47.30	74.00	-26.70
		7320(Av)		35.36	54.00	-18.64
	2480	2480(Pk)	Vertical	106.96	-	-
		2480(Av)		100.19	-	-
		2483.5(Pk)		51.05	74.00*	-22.95
		2483.5(Av)		32.13	54.00*	-21.87
		4960(Pk)		47.21	74.00	-26.79
		4960(Av)		36.85	54.00	-17.15
		7440(Pk)		47.31	74.00	-26.69
		7440(Av)		35.36	54.00	-18.64
		2480(Pk)	Horizontal	102.49	-	-
		2480(Av)		95.75	-	-
		2483.5(Pk)		46.37	74.00*	-27.63
		2483.5(Av)		29.60	54.00*	-24.40
		4960(Pk)		41.82	74.00	-32.18
		4960(Av)		29.75	54.00	-24.25
		7440(Pk)		48.12	74.00	-25.88
		7440(Av)		35.29	54.00	-18.71

* : Indicate restricted band of operation §15.205

- : Fundamental Frequency

Pk: Peak Detector; Av: Average Detector

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Data Rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
3	2402	2390(Pk)	Vertical	39.63	74.00*	-34.37
		2390(Av)		26.90	54.00*	-27.10
		2402(Pk)		106.35	-	-
		2402(Av)		100.47	-	-
		4804(Pk)		41.74	74.00	-32.26
		4804(Av)		29.85	54.00	-24.15
		7206(Pk)		47.08	74.00	-26.92
		7206(Av)		35.26	54.00	-18.74
		2390(Pk)	Horizontal	38.25	74.00*	-35.75
		2390(Av)		25.21	54.00*	-28.79
		2402(Pk)		100.93	-	-
		2402(Av)		95.04	-	-
		4804(Pk)		41.59	74.00	-32.41
		4804(Av)		29.55	54.00	-24.45
		7206(Pk)		47.13	74.00	-26.87
		7206(Av)		35.18	54.00	-18.82
	2440	2440(Pk)	Vertical	107.26	-	-
		2440(Av)		101.37	-	-
		4880(Pk)		45.25	74.00	-28.75
		4880(Av)		34.21	54.00	-19.79
		7320(Pk)		47.14	74.00	-26.86
		7320(Av)		35.20	54.00	-18.80
		2440(Pk)	Horizontal	102.56	-	-
		2440(Av)		96.67	-	-
		4880(Pk)		42.21	74.00	-31.79
		4880(Av)		30.08	54.00	-23.92
		7320(Pk)		47.01	74.00	-26.99
		7320(Av)		35.16	54.00	-18.84
	2480	2480(Pk)	Vertical	106.83	-	-
		2480(Av)		101.17	-	-
		2483.5(Pk)		49.73	74.00*	-24.27
		2483.5(Av)		32.49	54.00*	-21.51
		4960(Pk)		45.95	74.00	-28.05
		4960(Av)		35.24	54.00	-18.76
		7440(Pk)		47.56	74.00	-26.44
		7440(Av)		35.29	54.00	-18.71
		2480(Pk)	Horizontal	102.21	-	-
		2480(Av)		96.55	-	-
		2483.5(Pk)		45.41	74.00*	-28.59
		2483.5(Av)		29.30	54.00*	-24.70
		4960(Pk)		44.57	74.00	-29.43
		4960(Av)		31.03	54.00	-22.97
		7440(Pk)		47.31	74.00	-26.69
		7440(Av)		35.18	54.00	-18.82

* : Indicate restricted band of operation §15.205

- : Fundamental Frequency

Pk: Peak Detector; Av: Average Detector

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Antenna Type: 1001932PT (PCB/Flex) MIMO Antenna Results

Data rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1	2402	2390(Pk)	Vertical	37.01	74.00*	-36.99
		2390(Av)		24.94	54.00*	-29.06
		2402(Pk)		100.83	-	-
		2402(Av)		87.99	-	-
		4804(Pk)		42.66	74.00	-31.34
		4804(Av)		29.51	54.00	-24.49
		7206(Pk)		46.89	74.00	-27.11
		7206(Av)		35.15	54.00	-18.85
		2390(Pk)	Horizontal	38.73	74.00*	-35.27
		2390(Av)		26.21	54.00*	-27.79
		2402(Pk)		105.30	-	-
		2402(Av)		92.47	-	-
		4804(Pk)		41.88	74.00	-32.12
		4804(Av)		29.78	54.00	-24.22
		7206(Pk)		46.59	74.00	-27.41
		7206(Av)		35.08	54.00	-18.92
	2440	2440(Pk)	Vertical	101.30	-	-
		2440(Av)		88.62	-	-
		4880(Pk)		41.44	74.00	-32.56
		4880(Av)		29.80	54.00	-24.20
		7320(Pk)		47.25	74.00	-26.75
		7320(Av)		35.13	54.00	-18.87
		2440(Pk)	Horizontal	105.38	-	-
		2440(Av)		92.73	-	-
		4880(Pk)		44.34	74.00	-29.66
		4880(Av)		31.27	54.00	-22.73
		7320(Pk)		47.67	74.00	-26.33
		7320(Av)		35.12	54.00	-18.88
	2480	2480(Pk)	Vertical	101.67	-	-
		2480(Av)		89.72	-	-
		2483.5(Pk)		54.98	74.00*	-19.02
		2483.5(Av)		31.55	54.00*	-22.45
		4960(Pk)		42.53	74.00	-31.47
		4960(Av)		29.30	54.00	-24.70
		7440(Pk)		47.58	74.00	-26.42
		7440(Av)		35.34	54.00	-18.66
		2480(Pk)	Horizontal	108.47	-	-
		2480(Av)		96.52	-	-
		2483.5(Pk)		61.51	74.00*	-12.49
		2483.5(Av)		37.35	54.00*	-16.65
		4960(Pk)		49.62	74.00	-24.38
		4960(Av)		35.43	54.00	-18.57
		7440(Pk)		48.13	74.00	-25.87
		7440(Av)		35.62	54.00	-18.38

* : Indicate restricted band of operation §15.205

- : Fundamental Frequency

Pk: Peak Detector; Av: Average Detector

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Data rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2	2402	2390(Pk)	Vertical	36.63	74.00*	-37.37
		2390(Av)		25.02	54.00*	-28.98
		2402(Pk)		99.81	-	-
		2402(Av)		92.89	-	-
		4804(Pk)		41.27	74.00	-32.73
		4804(Av)		29.49	54.00	-24.51
		7206(Pk)		46.77	74.00	-27.23
		7206(Av)		35.10	54.00	-18.90
		2390(Pk)	Horizontal	38.48	74.00*	-35.52
		2390(Av)		26.32	54.00*	-27.68
		2402(Pk)		104.57	-	-
		2402(Av)		97.67	-	-
		4804(Pk)		42.21	74.00	-31.79
		4804(Av)		29.96	54.00	-24.04
		7206(Pk)		47.30	74.00	-26.70
		7206(Av)		35.11	54.00	-18.89
	2440	2440(Pk)	Vertical	103.08	-	-
		2440(Av)		96.43	-	-
		4880(Pk)		42.29	74.00	-31.71
		4880(Av)		29.52	54.00	-24.48
		7320(Pk)		47.55	74.00	-26.45
		7320(Av)		35.14	54.00	-18.86
		2440(Pk)	Horizontal	107.54	-	-
		2440(Av)		100.90	-	-
		4880(Pk)		44.41	74.00	-29.59
		4880(Av)		33.14	54.00	-20.86
		7320(Pk)		47.42	74.00	-26.58
		7320(Av)		35.17	54.00	-18.83
	2480	2480(Pk)	Vertical	100.83	-	-
		2480(Av)		94.64	-	-
		2483.5(Pk)		52.77	74.00*	-21.23
		2483.5(Av)		35.46	54.00*	-18.54
		4960(Pk)		42.02	74.00	-31.98
		4960(Av)		29.38	54.00	-24.62
		7440(Pk)		47.61	74.00	-26.39
		7440(Av)		35.52	54.00	-18.48
		2480(Pk)	Horizontal	107.39	-	-
		2480(Av)		101.20	-	-
		2483.5(Pk)		59.42	74.00*	-14.58
		2483.5(Av)		41.38	54.00*	-12.62
		4960(Pk)		48.29	74.00	-25.71
		4960(Av)		38.65	54.00	-15.35
		7440(Pk)		48.85	74.00	-25.15
		7440(Av)		36.05	54.00	-17.95

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

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Data Rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
3	2402	2390(Pk)	Vertical	37.50	74.00*	-36.50
		2390(Av)		24.99	54.00*	-29.01
		2402(Pk)		100.22	-	-
		2402(Av)		94.51	-	-
		4804(Pk)		41.44	74.00	-32.56
		4804(Av)		29.59	54.00	-24.41
		7206(Pk)		47.75	74.00	-26.25
		7206(Av)		35.29	54.00	-18.71
		2390(Pk)	Horizontal	39.80	74.00*	-34.20
		2390(Av)		26.38	54.00*	-27.62
		2402(Pk)		105.23	-	-
		2402(Av)		99.55	-	-
		4804(Pk)		41.85	74.00	-32.15
		4804(Av)		30.25	54.00	-23.75
		7206(Pk)		47.12	74.00	-26.88
		7206(Av)		35.20	54.00	-18.80
	2440	2440(Pk)	Vertical	103.32	-	-
		2440(Av)		97.81	-	-
		4880(Pk)		41.62	74.00	-32.38
		4880(Av)		29.53	54.00	-24.47
		7320(Pk)		47.48	74.00	-26.52
		7320(Av)		35.12	54.00	-18.88
		2440(Pk)	Horizontal	108.07	-	-
		2440(Av)		102.55	-	-
		4880(Pk)		43.96	74.00	-30.04
		4880(Av)		32.61	54.00	-21.39
		7320(Pk)		47.29	74.00	-26.71
		7320(Av)		35.15	54.00	-18.85
	2480	2480(Pk)	Vertical	100.87	-	-
		2480(Av)		95.84	-	-
		2483.5(Pk)		54.43	74.00*	-19.57
		2483.5(Av)		36.64	54.00*	-17.36
		4960(Pk)		41.81	74.00	-32.19
		4960(Av)		30.45	54.00	-23.55
		7440(Pk)		48.09	74.00	-25.91
		7440(Av)		36.13	54.00	-17.87
		2480(Pk)	Horizontal	107.36	-	-
		2480(Av)		102.35	-	-
		2483.5(Pk)		60.44	74.00*	-13.56
		2483.5(Av)		42.84	54.00*	-11.16
		4960(Pk)		47.90	74.00	-26.10
		4960(Av)		38.93	54.00	-15.07
		7440(Pk)		47.33	74.00	-26.67
		7440(Av)		35.55	54.00	-18.45

* : Indicate restricted band of operation §15.205

- : Fundamental Frequency

Pk: Peak Detector; Av: Average Detector

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Antenna Type: FPA3020-10A (PCB/Flex) MIMO Antenna Results

Data Rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1	2402	2390(Pk)	Vertical	37.37	74.00*	-36.63
		2390(Av)		24.95	54.00*	-29.05
		2402(Pk)		103.15	-	-
		2402(Av)		90.22	-	-
		4804(Pk)		41.51	74.00	-32.49
		4804(Av)		29.61	54.00	-24.39
		7206(Pk)		48.22	74.00	-25.78
		7206(Av)		35.28	54.00	-18.72
		2390(Pk)	Horizontal	39.22	74.00*	-34.78
		2390(Av)		26.20	54.00*	-27.80
		2402(Pk)		106.30	-	-
		2402(Av)		93.36	-	-
		4804(Pk)		41.93	74.00	-32.07
		4804(Av)		29.68	54.00	-24.32
		7206(Pk)		48.05	74.00	-25.95
		7206(Av)		35.25	54.00	-18.75
	2440	2440(Pk)	Vertical	106.28	-	-
		2440(Av)		93.81	-	-
		4880(Pk)		41.63	74.00	-32.37
		4880(Av)		29.88	54.00	-24.12
		7320(Pk)		46.94	74.00	-27.06
		7320(Av)		35.39	54.00	-18.61
		2440(Pk)	Horizontal	107.35	-	-
		2440(Av)		94.85	-	-
		4880(Pk)		45.01	74.00	-28.99
		4880(Av)		32.39	54.00	-21.61
		7320(Pk)		46.67	74.00	-27.33
		7320(Av)		35.34	54.00	-18.66
	2480	2480(Pk)	Vertical	104.41	-	-
		2480(Av)		92.44	-	-
		2483.5(Pk)		57.61	74.00*	-16.39
		2483.5(Av)		33.39	54.00*	-20.61
		4960(Pk)		43.24	74.00	-30.76
		4960(Av)		30.28	54.00	-23.72
		7440(Pk)		50.78	74.00	-23.22
		7440(Av)		36.60	54.00	-17.40
		2480(Pk)	Horizontal	105.98	-	-
		2480(Av)		94.02	-	-
		2483.5(Pk)		59.01	74.00*	-14.99
		2483.5(Av)		34.57	54.00*	-19.43
		4960(Pk)		47.63	74.00	-26.37
		4960(Av)		34.72	54.00	-19.28
		7440(Pk)		47.04	74.00	-26.96
		7440(Av)		35.47	54.00	-18.53

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

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Data Rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2	2402	2390(Pk)	Vertical	37.69	74.00*	-36.31
		2390(Av)		25.00	54.00*	-29.00
		2402(Pk)		102.77	-	-
		2402(Av)		95.82	-	-
		4804(Pk)		42.09	74.00	-31.91
		4804(Av)		29.72	54.00	-24.28
		7206(Pk)		47.63	74.00	-26.37
		7206(Av)		35.30	54.00	-18.70
		2390(Pk)	Horizontal	38.21	74.00*	-35.79
		2390(Av)		26.34	54.00*	-27.66
		2402(Pk)		105.77	-	-
		2402(Av)		98.87	-	-
		4804(Pk)		42.09	74.00	-31.91
		4804(Av)		29.90	54.00	-24.10
		7206(Pk)		47.22	74.00	-26.78
		7206(Av)		35.30	54.00	-18.70
	2440	2440(Pk)	Vertical	105.81	-	-
		2440(Av)		99.27	-	-
		4880(Pk)		42.56	74.00	-31.44
		4880(Av)		30.15	54.00	-23.85
		7320(Pk)		47.28	74.00	-26.72
		7320(Av)		35.45	54.00	-18.55
		2440(Pk)	Horizontal	107.72	-	-
		2440(Av)		101.23	-	-
		4880(Pk)		43.25	74.00	-30.75
		4880(Av)		30.96	54.00	-23.04
		7320(Pk)		47.28	74.00	-26.72
		7320(Av)		35.34	54.00	-18.66
	2480	2480(Pk)	Vertical	104.10	-	-
		2480(Av)		98.07	-	-
		2483.5(Pk)		56.82	74.00*	-17.18
		2483.5(Av)		38.53	54.00*	-15.47
		4960(Pk)		43.47	74.00	-30.53
		4960(Av)		30.49	54.00	-23.51
		7440(Pk)		49.62	74.00	-24.38
		7440(Av)		38.38	54.00	-15.62
		2480(Pk)	Horizontal	105.61	-	-
		2480(Av)		99.56	-	-
		2483.5(Pk)		58.07	74.00*	-15.93
		2483.5(Av)		39.76	54.00*	-14.24
		4960(Pk)		42.76	74.00	-31.24
		4960(Av)		30.28	54.00	-23.72
		7440(Pk)		47.10	74.00	-26.90
		7440(Av)		35.56	54.00	-18.44

* : Indicate restricted band of operation §15.205

- : Fundamental Frequency

Pk: Peak Detector; Av: Average Detector

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Data Rate (Mbps)	Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
3	2402	2390(Pk)	Vertical	37.63	74.00*	-36.37
		2390(Av)		25.05	54.00*	-28.95
		2402(Pk)		102.46	-	-
		2402(Av)		96.63	-	-
		4804(Pk)		41.67	74.00	-32.33
		4804(Av)		29.64	54.00	-24.36
		7206(Pk)		48.44	74.00	-25.56
		7206(Av)		35.25	54.00	-18.75
		2390(Pk)	Horizontal	39.13	74.00*	-34.87
		2390(Av)		26.36	54.00*	-27.64
		2402(Pk)		105.27	-	-
		2402(Av)		99.45	-	-
		4804(Pk)		41.41	74.00	-32.59
		4804(Av)		29.80	54.00	-24.20
		7206(Pk)		47.46	74.00	-26.54
		7206(Av)		35.27	54.00	-18.73
	2440	2440(Pk)	Vertical	105.62	-	-
		2440(Av)		100.22	-	-
		4880(Pk)		42.64	74.00	-31.36
		4880(Av)		30.06	54.00	-23.94
		7320(Pk)		47.78	74.00	-26.22
		7320(Av)		35.50	54.00	-18.50
		2440(Pk)	Horizontal	107.46	-	-
		2440(Av)		102.01	-	-
		4880(Pk)		41.41	74.00	-32.59
		4880(Av)		30.02	54.00	-23.98
		7320(Pk)		47.00	74.00	-27.00
		7320(Av)		35.29	54.00	-18.71
	2480	2480(Pk)	Vertical	103.88	-	-
		2480(Av)		99.05	-	-
		2483.5(Pk)		57.77	74.00*	-16.23
		2483.5(Av)		40.40	54.00*	-13.60
		4960(Pk)		41.95	74.00	-32.05
		4960(Av)		30.46	54.00	-23.54
		7440(Pk)		50.49	74.00	-23.51
		7440(Av)		38.05	54.00	-15.95
		2480(Pk)	Horizontal	105.57	-	-
		2480(Av)		100.74	-	-
		2483.5(Pk)		59.25	74.00*	-14.75
		2483.5(Av)		41.96	54.00*	-12.04
		4960(Pk)		43.43	74.00	-30.57
		4960(Av)		31.99	54.00	-22.01
		7440(Pk)		47.08	74.00	-26.92
		7440(Av)		35.36	54.00	-18.64

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

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Simultaneous Opertaion:

Combination of Wi-Fi 2.4GHz and Bluetooth 2.4GHz:

Data Rate (Mbps)	Channnel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	2412	4824(Pk)	Vertical	50.33	74	-23.67
		4824(Av)		46.97	54	-7.03
		7236(Pk)		49.24	74	-24.76
		7236(Av)		38.40	54	-15.60
	2480	4960(Pk)		55.77	74	-18.23
		4960(Av)		43.79	54	-10.21
		7440(Pk)		48.56	74	-25.44
		7440(Av)		35.42	54	-18.58
	2412	4824(Pk)	Horizontal	42.96	74	-31.04
		4824(Av)		34.18	54	-19.82
		7236(Pk)		47.52	74	-26.48
		7236(Av)		34.35	54	-19.65
	2480	4960(Pk)		40.51	74	-33.49
		4960(Av)		30.30	54	-23.70
		7440(Pk)		46.39	74	-27.61
		7440(Av)		34.32	54	-19.68

Prüfbericht - Nr.:

Test Report No.:

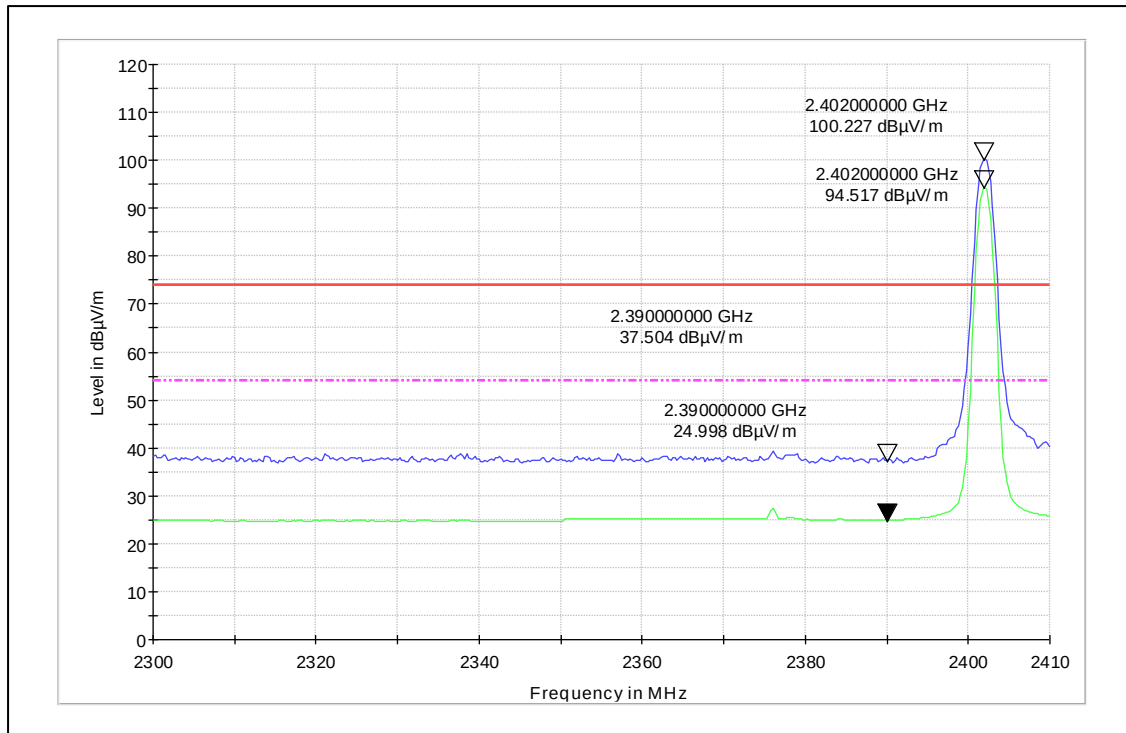
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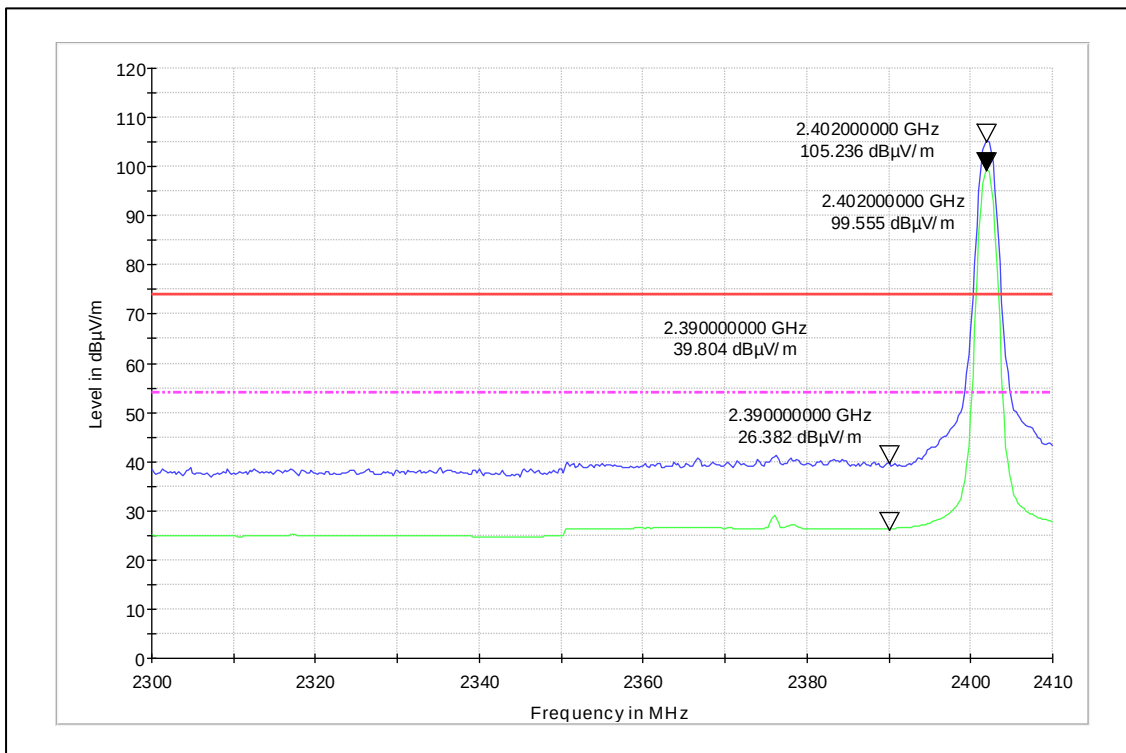
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Worst Case Plots Reported

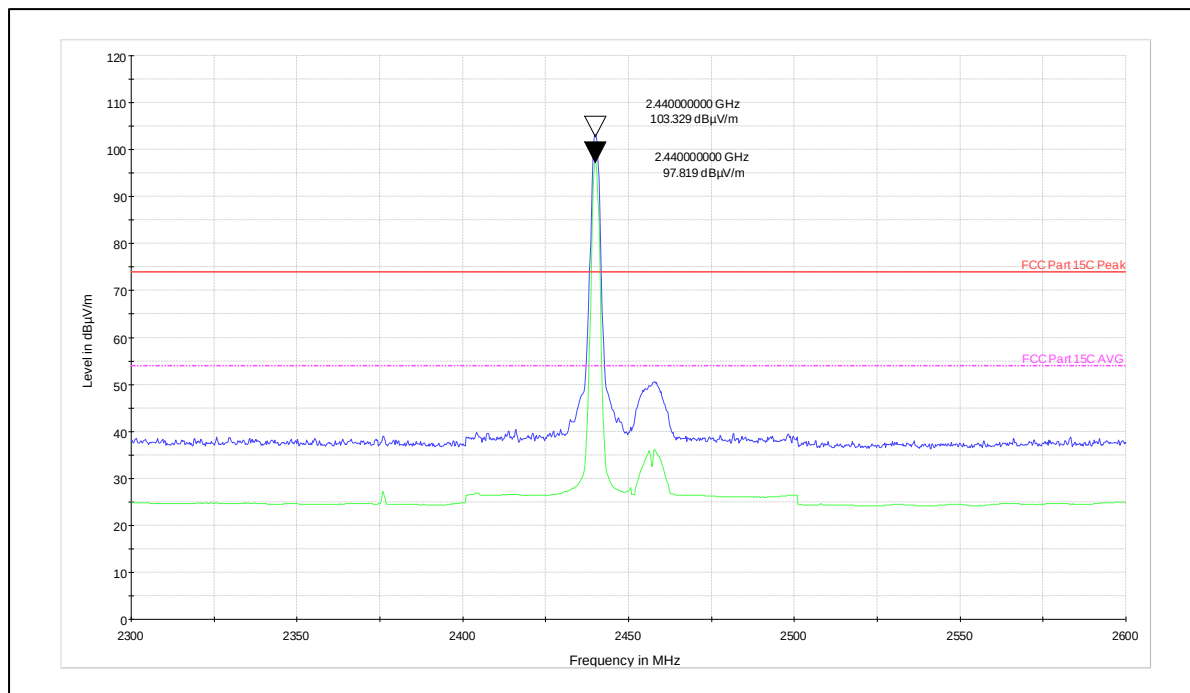
Channel Frequency -2402MHz_Vertical Polarization



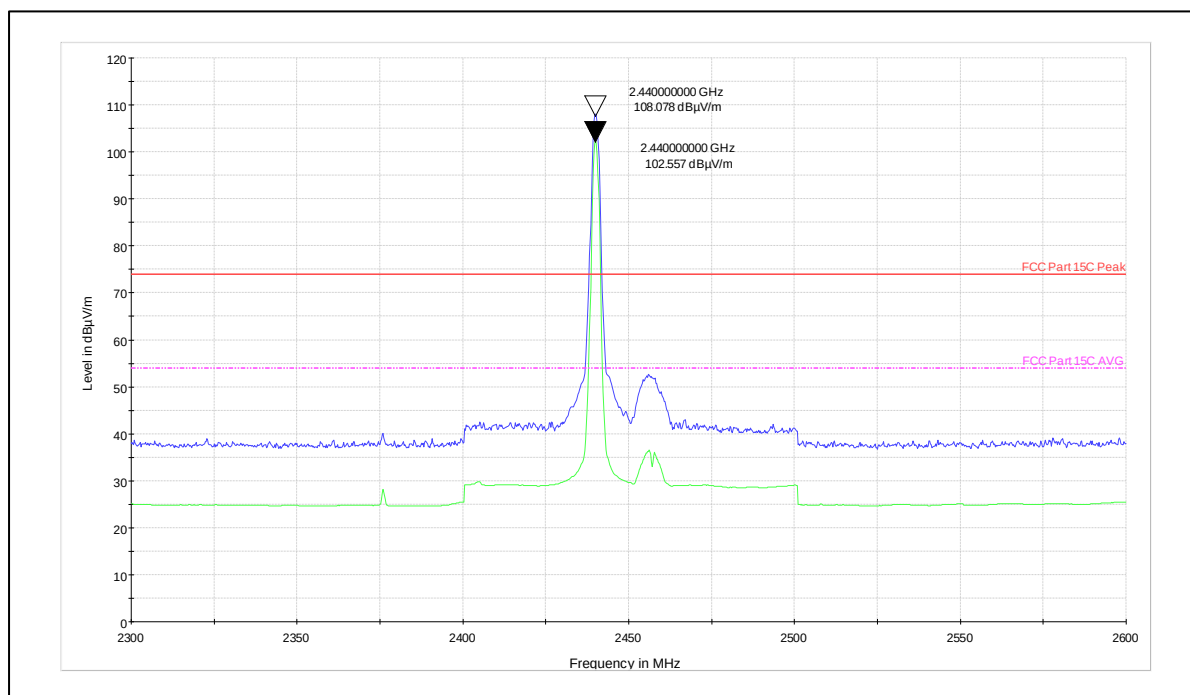
Channel Frequency -2440MHz_Horizontal Polarization



Channel Frequency -2440MHz_Vertical Polarization



Channel Frequency -2440MHz_Horizontal Polarization



Prüfbericht - Nr.:

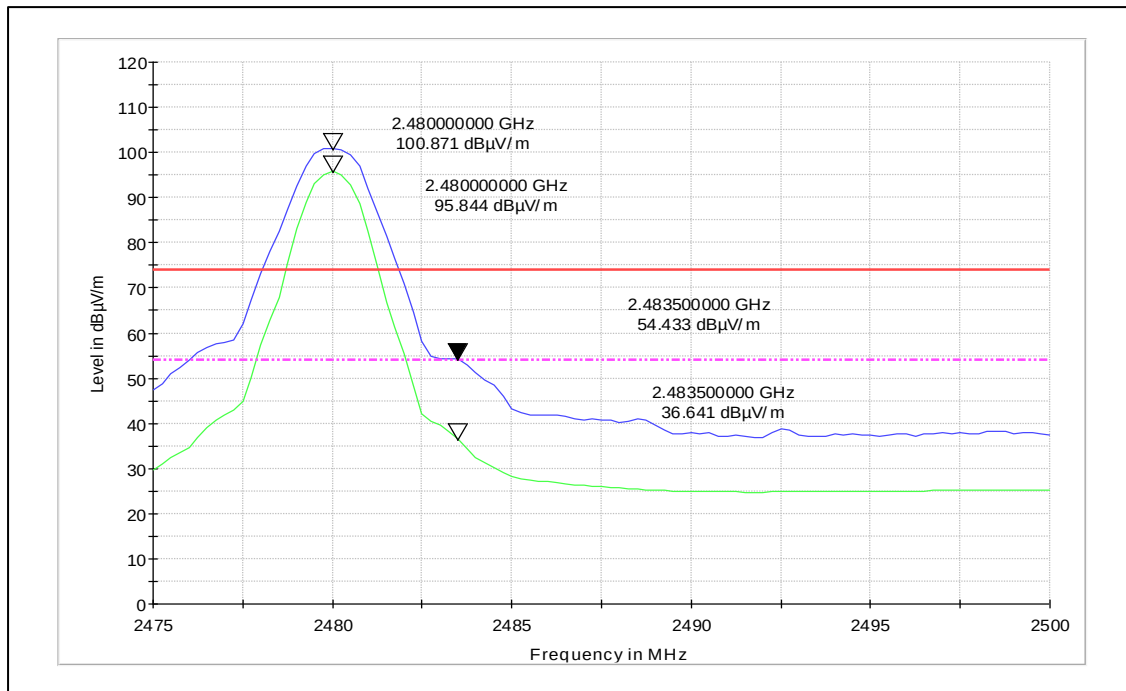
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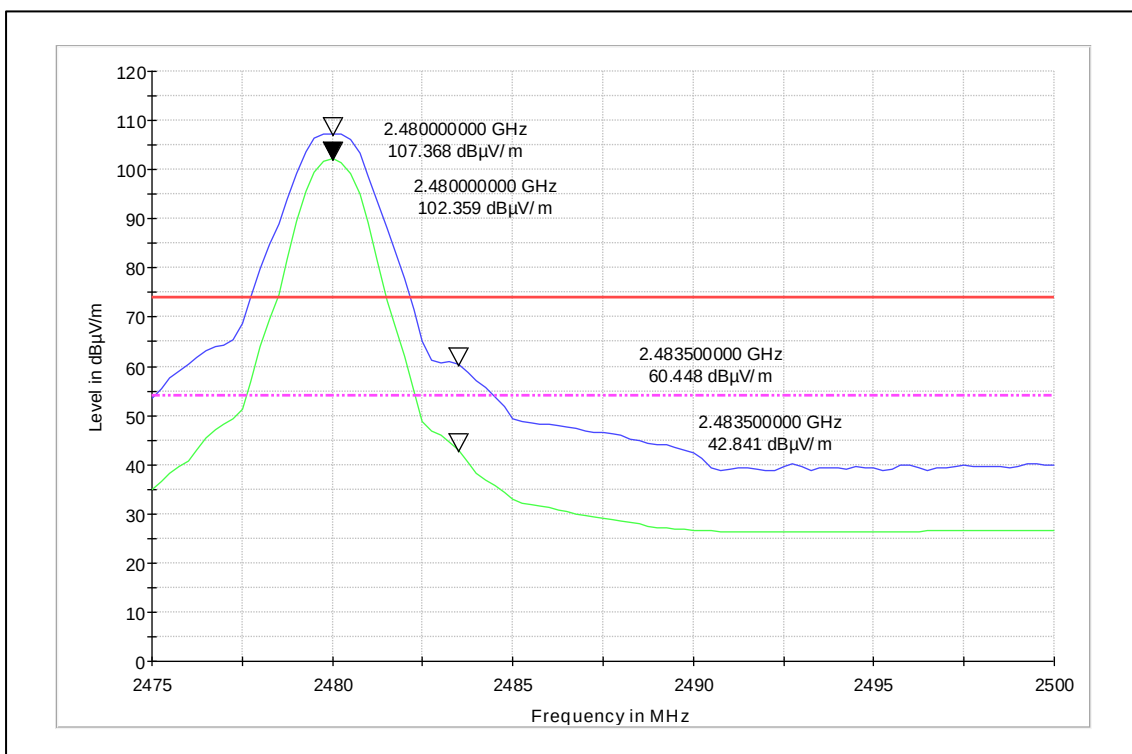
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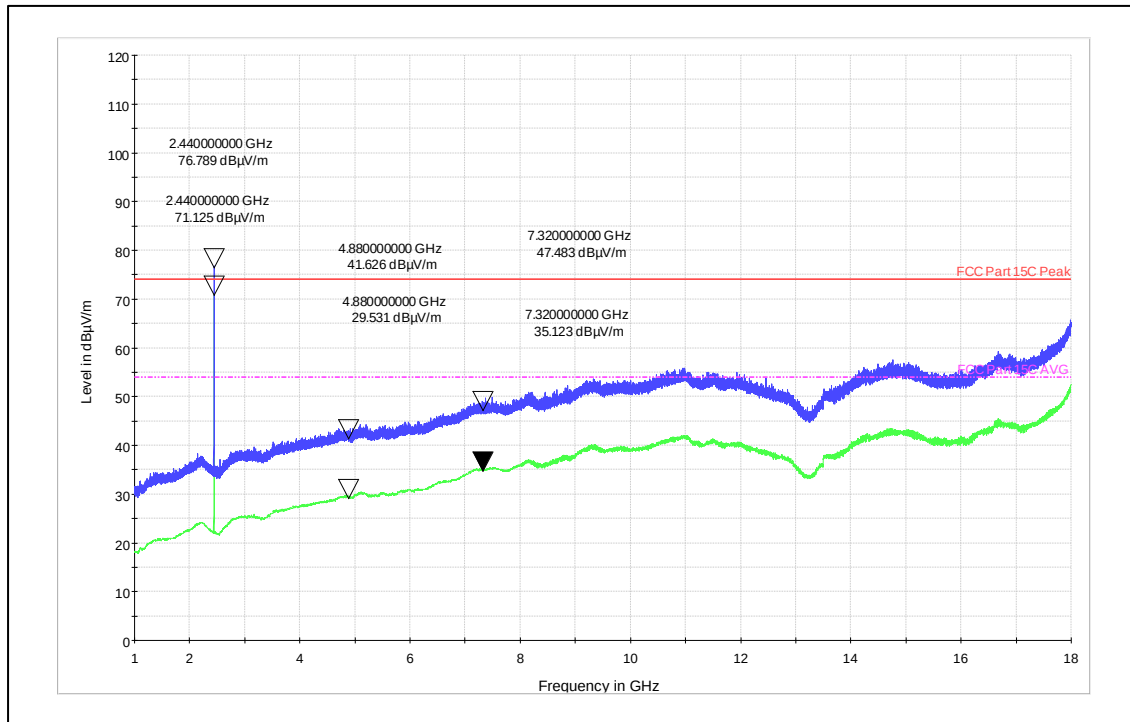
Channel Frequency -2480MHz_Vertical Polarization



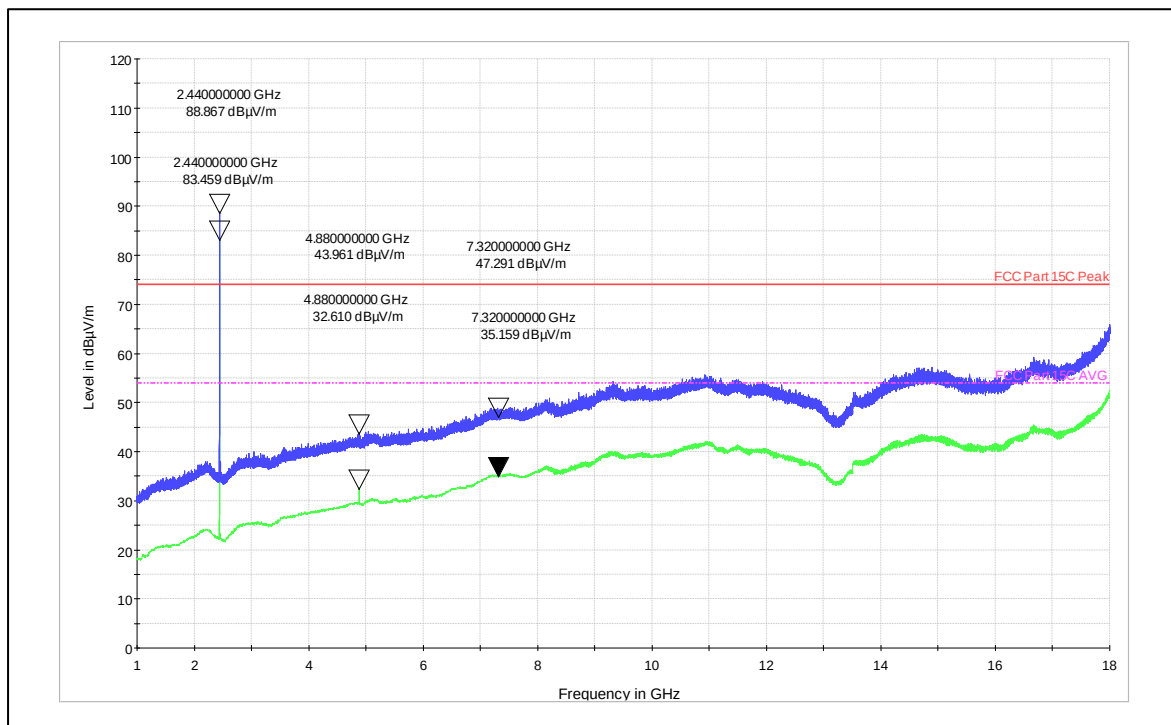
Channel Frequency -2480MHz_Horizontal Polarization



Channel Frequency -2440MHz_Vertical Polarization _1-18GHz

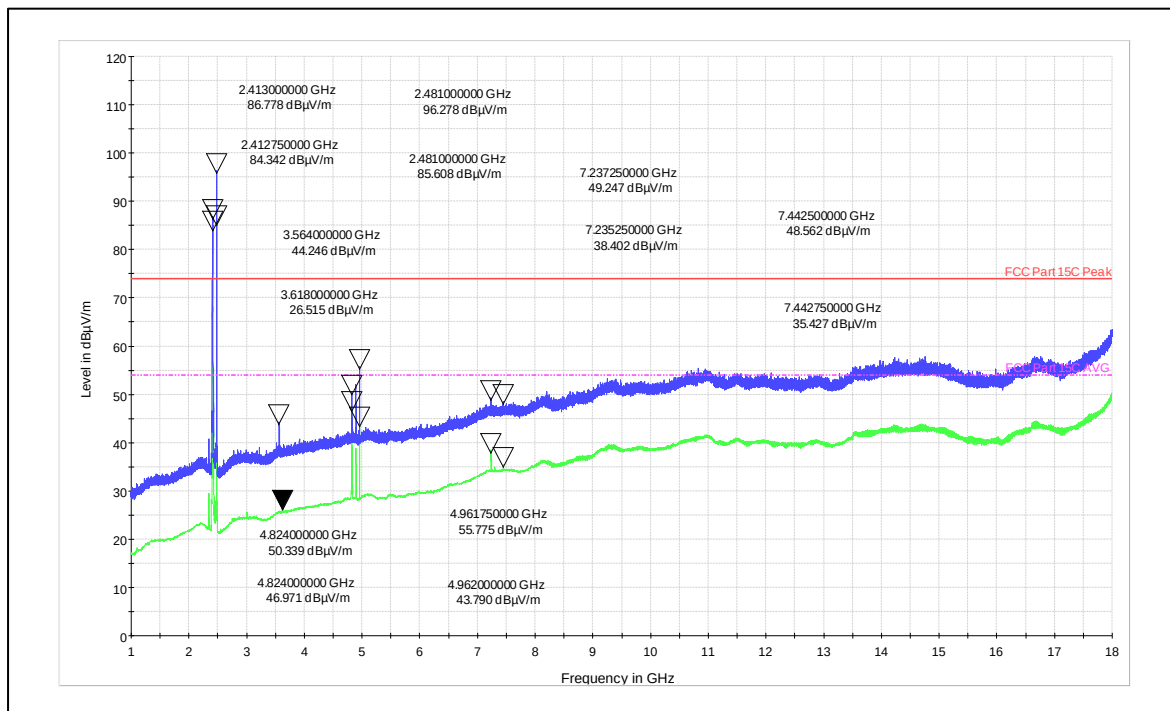


Channel Frequency-2440MHz_Horizontal Polarization _1-18GHz

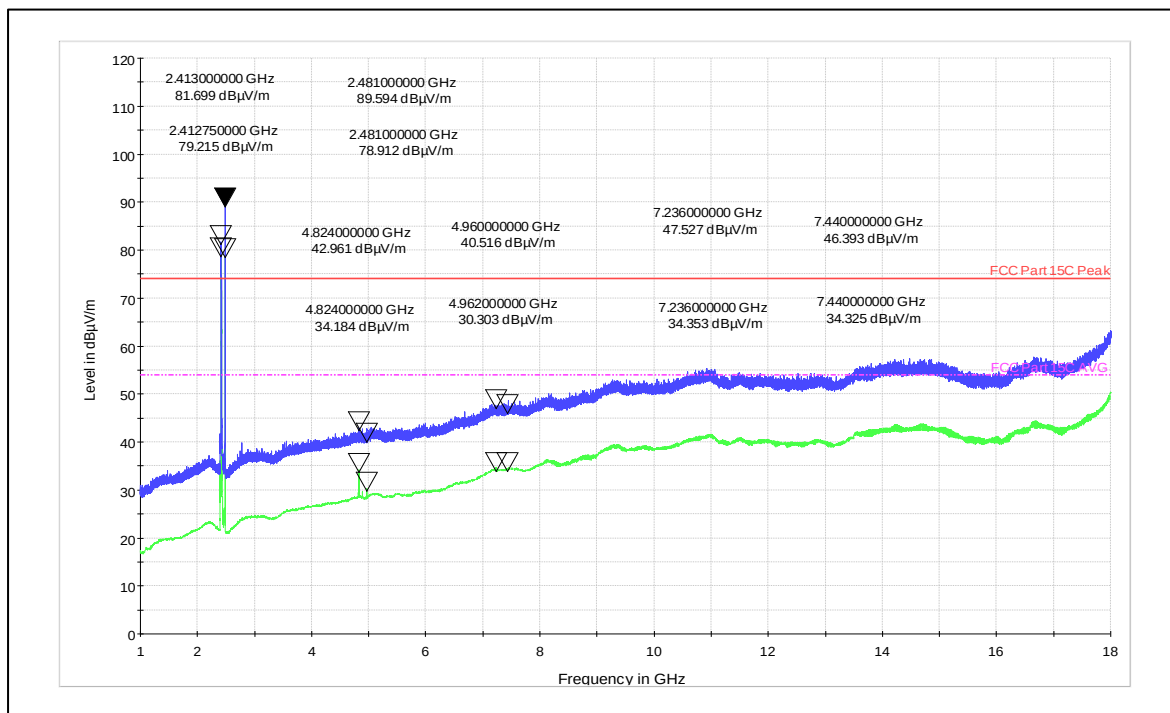


Simultaneous Operation:

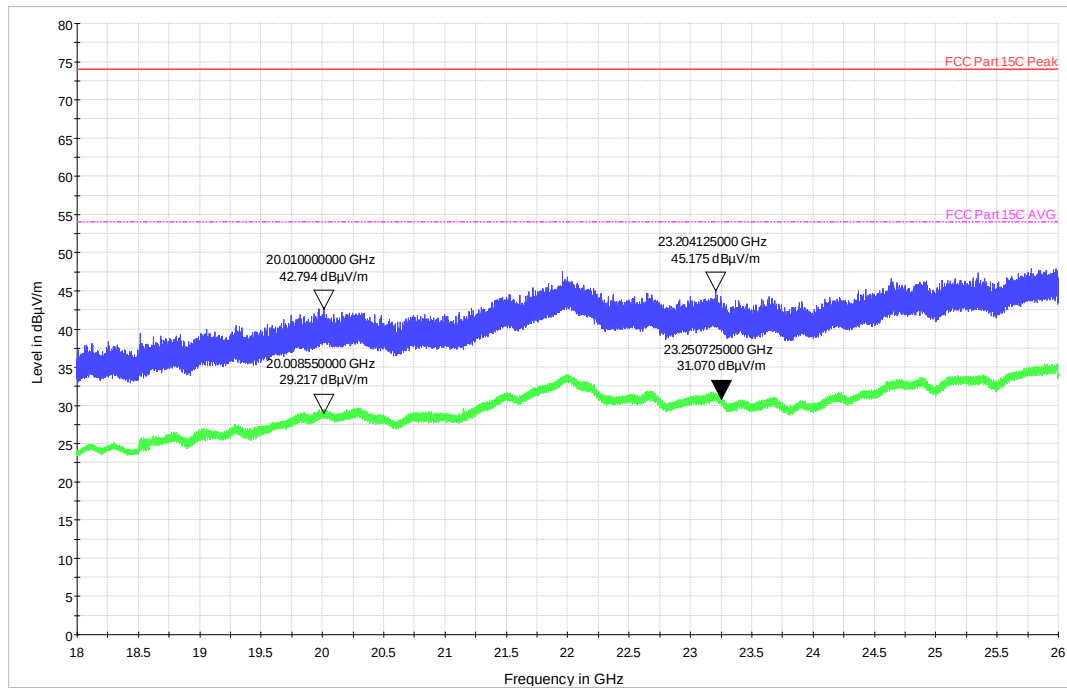
Combination of Wi-Fi 2.4GHz and Bluetooth 2.4GHz:



Channel Frequency -2412MHz and Channel Frequency 2480MHz _Vertical Polarization _1-18GHz

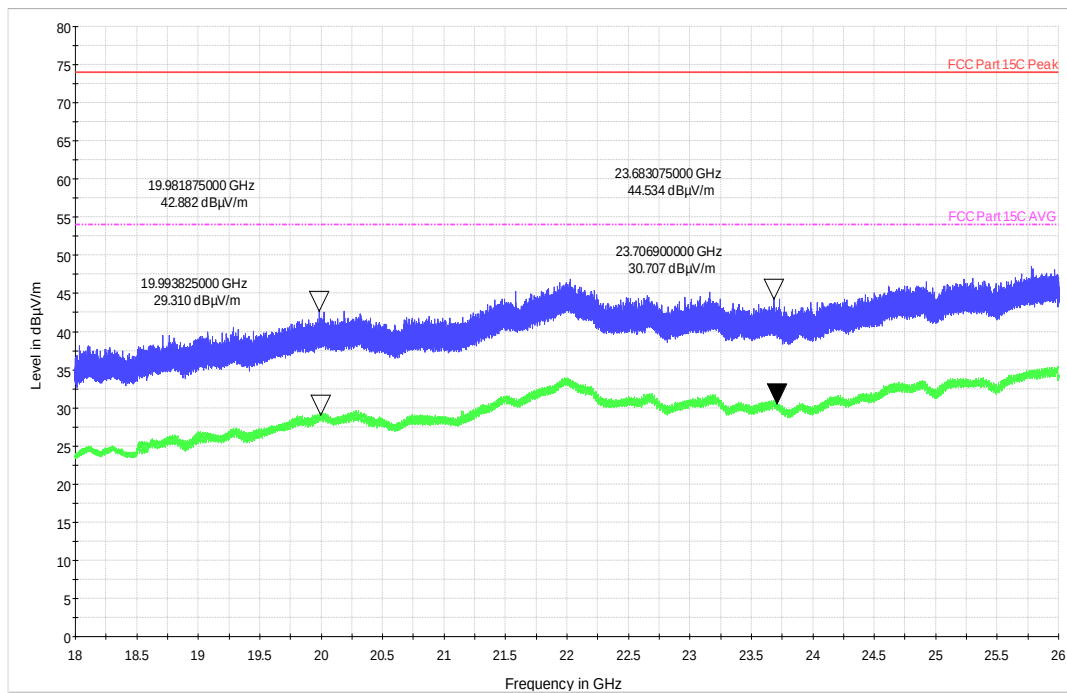


Channel Frequency -2412MHz and Channel Frequency 2480MHz _Horizontal Polarization _1-18GHz



Frequency Range: 18 - 40 GHz

Polarization: Vertical



Frequency Range: 18 - 40 GHz

Polarization: Horizontal

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8 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	QP Limit	AV Limit
(MHz)	(dBμV)	(dBμV)
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 (Through AC to DC Adapter) Relative Humidity = 64%

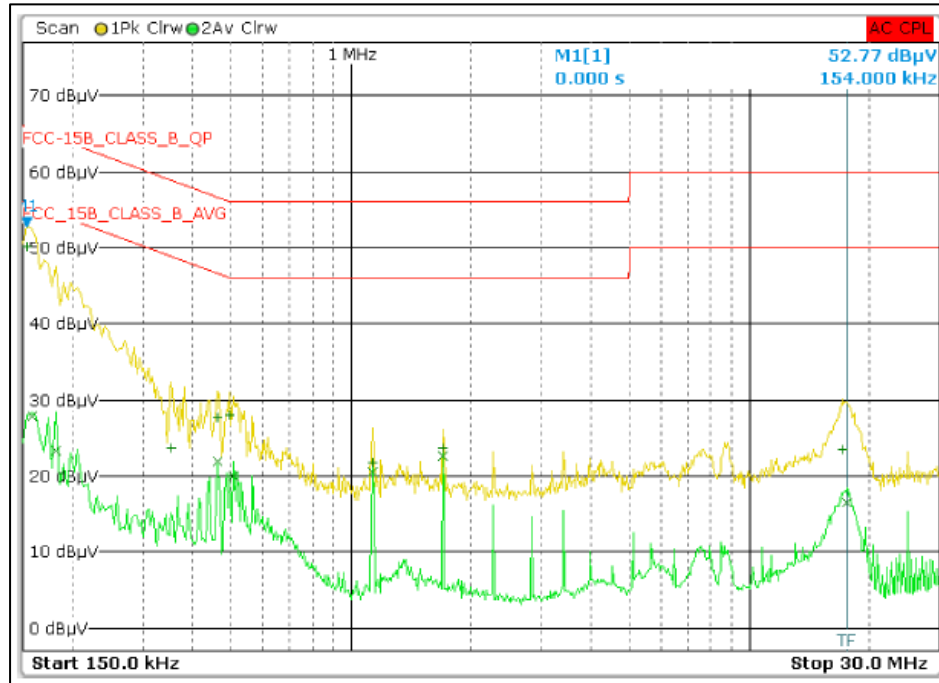
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Test result:

Power: 110V 60HZ_LINE



Line Graph

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	154.00000000 kHz	50.20		Quasi Peak	-15.58
2	1.70200000 MHz	22.70		Average	-23.30
2	462.00000000 kHz	21.96		Average	-24.70
2	1.13400000 MHz	20.59		Average	-25.41
2	506.00000000 kHz	19.96		Average	-26.04
2	158.00000000 kHz	27.82		Average	-27.75
1	494.00000000 kHz	27.97		Quasi Peak	-28.13
1	462.00000000 kHz	27.73		Quasi Peak	-28.93
2	182.00000000 kHz	23.32		Average	-31.07
1	1.70200000 MHz	23.69		Quasi Peak	-32.31
2	17.55800000 MHz	16.60		Average	-33.40
1	1.13400000 MHz	21.83		Quasi Peak	-34.17
1	354.00000000 kHz	23.74		Quasi Peak	-35.13
1	17.20600000 MHz	23.44		Quasi Peak	-36.56

Line Table

Prüfbericht - Nr.:

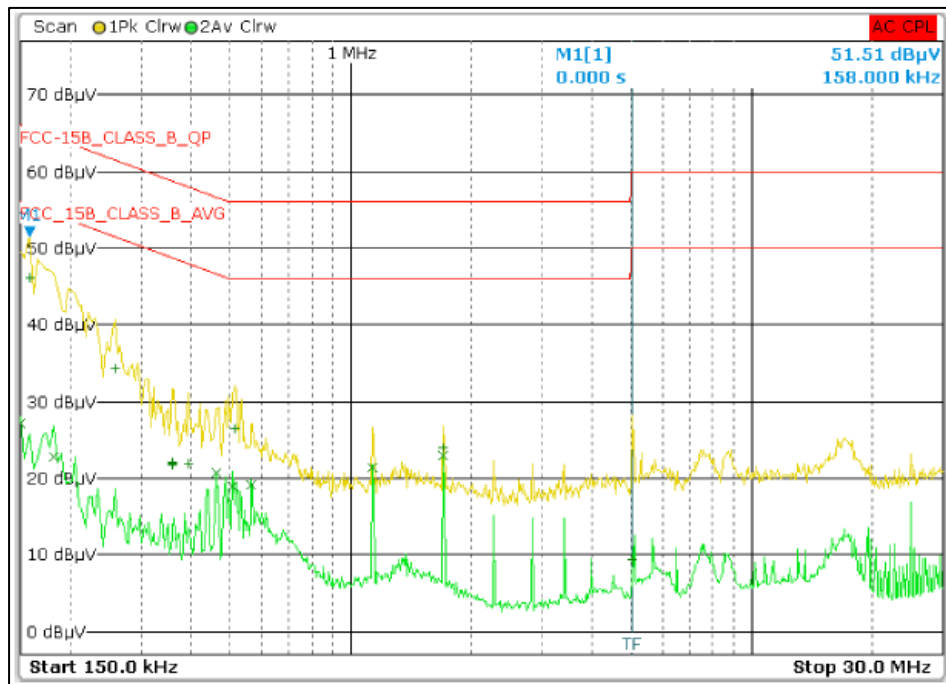
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Power: 110V60Hz_NEUTRAL



Neutral Graph

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	158.000000000 kHz	46.23		Quasi Peak	-19.34
2	1.702000000 MHz	23.02		Average	-22.98
2	1.134000000 MHz	21.40		Average	-24.60
2	462.000000000 kHz	20.64		Average	-26.02
2	566.000000000 kHz	19.17		Average	-26.83
2	506.000000000 kHz	18.92		Average	-27.08
1	258.000000000 kHz	34.31		Quasi Peak	-27.19
2	150.000000000 kHz	27.21		Average	-28.79
1	514.000000000 kHz	26.41		Quasi Peak	-29.59
2	182.000000000 kHz	22.79		Average	-31.60
1	1.702000000 MHz	24.01		Quasi Peak	-31.99
1	394.000000000 kHz	21.96		Quasi Peak	-36.02
1	394.000000000 kHz	21.90		Quasi Peak	-36.08
1	358.000000000 kHz	22.14		Quasi Peak	-36.63
1	358.000000000 kHz	21.94		Quasi Peak	-36.83
1	358.000000000 kHz	21.68		Quasi Peak	-37.09
1	5.034000000 MHz	9.29		Quasi Peak	-50.71

Neutral Table

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11 Power level used for testing

Bluetooth 2.4GHz

Channel BandWidth	Data rate (Mbps)	Channels	MAF94367 (Omni Directional Antenna)	1001932PT (Flex/PCB) Antenna	FPA3020-10A (Flex/PCB) Antenna
1MHz	1	Low	16.5	16.5	16.5
		Mid	16.5	16.5	16.5
		High	16.5	16.5	16.5
	2	Low	14.0	14.0	14.0
		Mid	14.0	14.0	14.0
		High	14.0	14.0	14.0
	3	Low	14.0	14.0	14.0
		Mid	14.0	14.0	14.0
		High	14.0	14.0	14.0

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