

Prüfbericht-Nr.: Test report no.:	ULR- TC568821300000035F	Auftrags-Nr.: Order no.:	166554137 0010	Seite 1 von 64 Page 1 of 64
Kunden-Referenz-Nr.: Client reference no.:	NA		Auftragsdatum: Order date:	2021-05-18
Auftraggeber: Client:	1.HONEYWELL INTERNATIONAL INC,Honeywell Safety and Productivity Solutions 9680 OLD BAILES RD, FORT MILL, SC 29707, USA 2.M/S Venture Corporation Limited 4, Jalan Kempas 5/2 (Block D) Tampoi, 81200 Johor Bahru DID +60 7231 2391 Main +60 7237 7201 Fax +60 7236 4146			
Prüfgegenstand: Test item:	HWB11AC-PRTM	Product Type	Wi-Fi BT Module	
Bezeichnung: Identification:	HWB11AC-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 RSS 247 Issue 2 and RSS GEN Issue 5			
Wareneingangsdatum: Date of sample receipt:	2021-05-20			
Prüfmuster-Nr & Serien-Nr.: Test sample no & serial no.:	A003068621-001 2021061001			
Prüfzeitraum: Testing period:	2021-05-21 - 2021-06-08			
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: 2021-06-11	Ausstellatum: Issue date: 2021-07-12
Stellung / Position: Likhithesh M D Engineer	Stellung / Position: Mahammadgouse Kaladagi Assistant Manager
Sonstiges / Other: FCC ID: HD5-HWB11 IC: 1693B-HWB11	
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 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable 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) 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 SPECIAL CONNECTOR (RP-TNC) 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
ULR-TC568821300000035F	01	Initial issue of report	2021-07-01
ULR-TC568821300000035F	02	Reviewer comments updated	2021-07-09
ULR-TC568821300000035F	03	Reviewer comments updated	2021-07-12

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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

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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	27.01.2022	Yearly	Radiated Spurious Emission
Active loop antenna	Frankonia	FMZB 1519 B	1519B-00111	-	28.02.2022	Yearly	
Balloon and Biconical Antenna	Schwarzbeck mess-elektronik	VHBB-9124 / BBA-9106	01028	-	02.09.2021	Yearly	
Log - Periodical Antenna	Schwarzbeck mess-elektronik	VUSLP-9111B	9111B-111	-	31.08.2021	Yearly	
Horn Antenna	Frankonia	HAX-18	802	-	01.03.2022	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	
Spectrum Analyser	Agilent Technologies	E4407B	US41192 772	A.14.06	10.08.2021	Yearly	Antenna-Port Conducted test
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100811	-	04.08.2021	Yearly	AC Power line conducted emission
LISN	Rohde & Schwarz	ENV216	100022	-	04.09.2021	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

HWB11AC-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 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 QCA6174A, **HWB11AC-PRTM** achieve the best possible connectivity and performance in RF Environment.

3.1 Ratings and System Details of Equipment under Test

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

Radio Protocol	Bluetooth
Operating Frequency Range	2400MHz-2483.5MHz
No. of Channels	79
Channel Spacing	1MHz
Transmitting Power Level	Refer Clause 11
Maximum Measured peak conducted power	8.49 dBm (1Mbps 2480MHz)
Modulation	GFSK, pi/4-DQPSK,8-DPSK
Data Rates	1Mbps,2Mbps,3Mbps
Number of antennas	1
Antenna Gain	2.35dBi
Antenna Type	Omni-directional Dipole Antenna
Supply Voltage to Product	5.0V DC, 0.5A
Environmental conditions	Storage temp: -20°C to +70°C Relative Humidity <95%
	Operating Temp: -20°C to +60°C Relative Humidity <95%
EUT Dimension(L x W)	80 x 37 x 18mm (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

Note: Product HWB11AC-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

3.2 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	±5 %
RF output power, conducted	±1.5 dB
Power Spectral Density, conducted	±3 dB
Unwanted Emissions, conducted	±3 dB
All emissions, radiated	±6 dB
Temperature	±3 °C
Supply Voltages	±3 %
Time	±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 channel.

4.2 Test Operation and Test Software

Hardware Version Identification number (HVIN) : 50180228-001
Software version : 10.17.98.0257

4.3 Special Accessories and Auxiliary Equipment

Test laptop (QRCT tool with Software Version : 3.0.296.0),
LAN cable

4.4 Simultaneous Transmission

This product does not supports Simultaneous transmission

4.5 Countermeasures to achieve EMC Compliance

- No

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 : A003068621-001– Radiated test Sample
A003068621-001– Conducted test Sample

4.7 Report references

Note: Product HWB11AC-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)	ULR-TC568821300000033F
RF test report for Wi-Fi (5GHz)	ULR-TC568821300000034F
RF test report for Bluetooth (2.4GHz) – (This report)	ULR-TC568821300000035F

5 Operational Description

This HWB11AC-PRTM is a WiFi/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 and the Bluetooth modem.

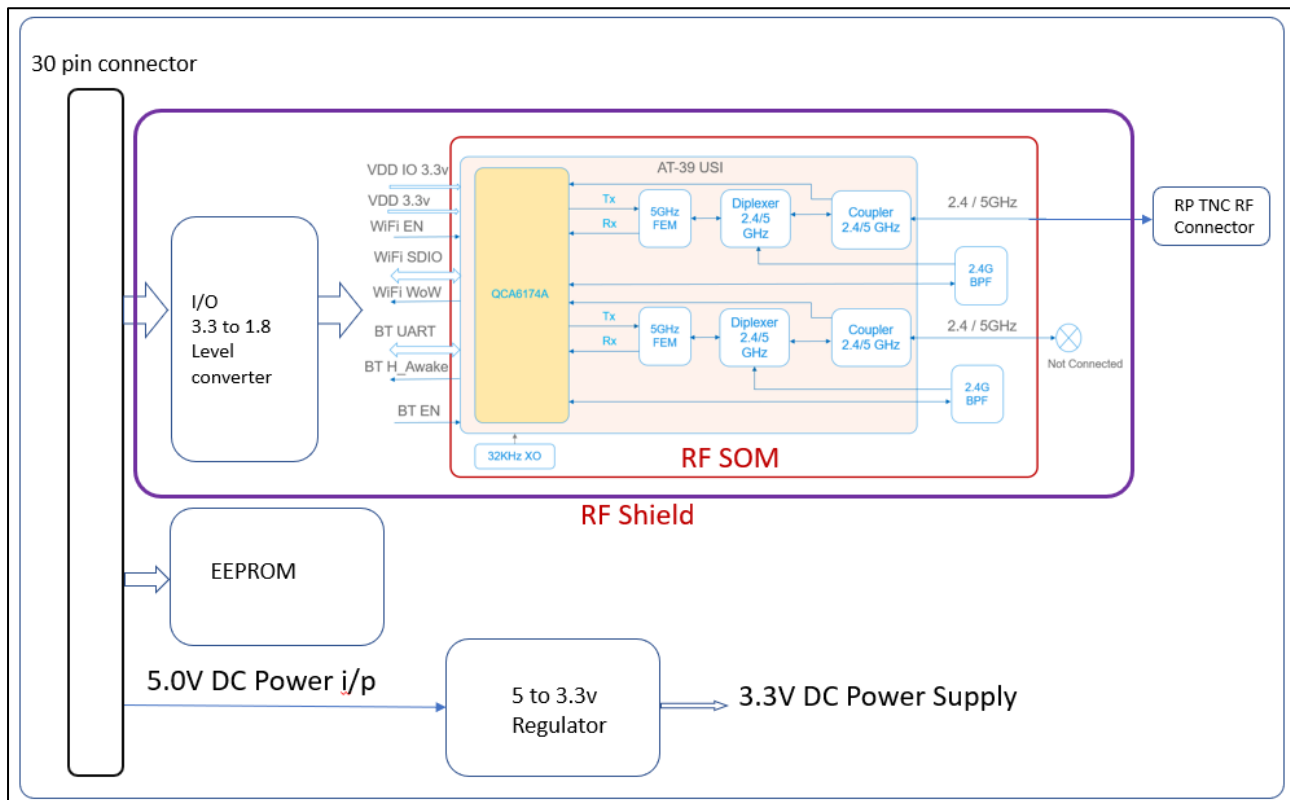
This module operates on 5.0V DC Power supply with internal on board regulation to generate 3.3v for powering ON all the circuits. The entire RF circuits is enclosed in RF shield of dimension 25mm X 25mm.

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 1X1 output.

The module supports range of data rates from 1Mbps in 802.11b mode to MCS9 in 802.11ac mode. This chipset also supports concurrent operation of Bluetooth (Version 5.0) 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 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

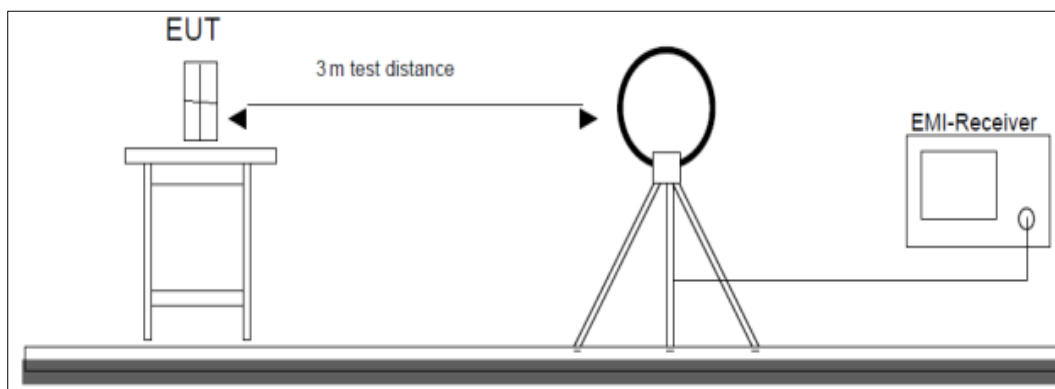


Figure 1: Frequency Range 9 kHz- 30 MHz

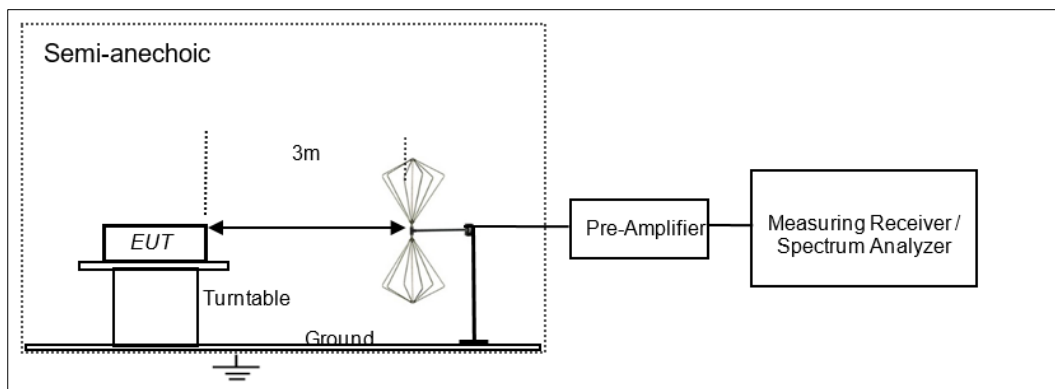


Figure 2: Frequency Range 30 MHz – 200 MHz

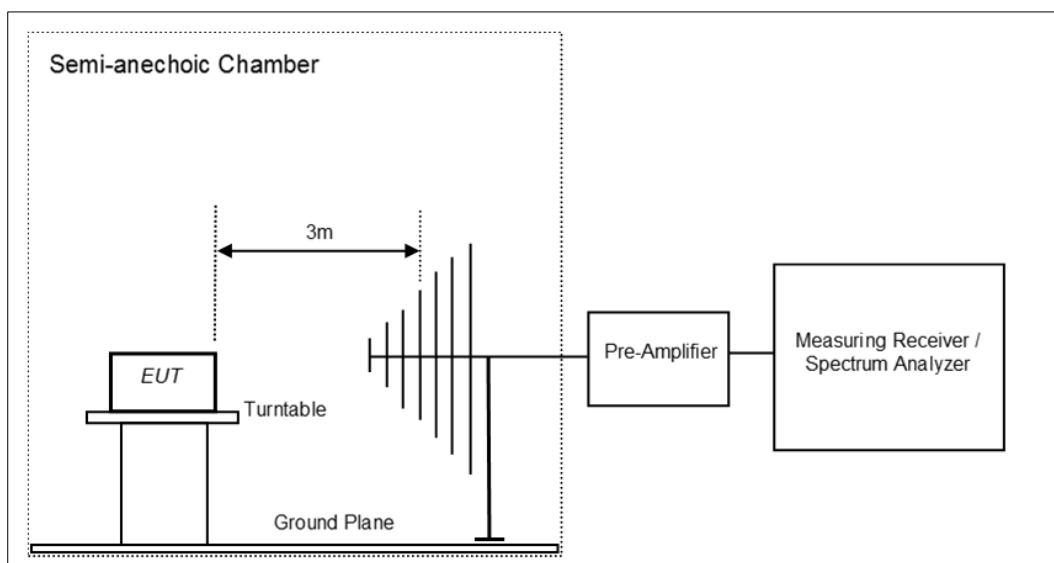


Figure 3: Frequency Range 200 MHz - 1GHz

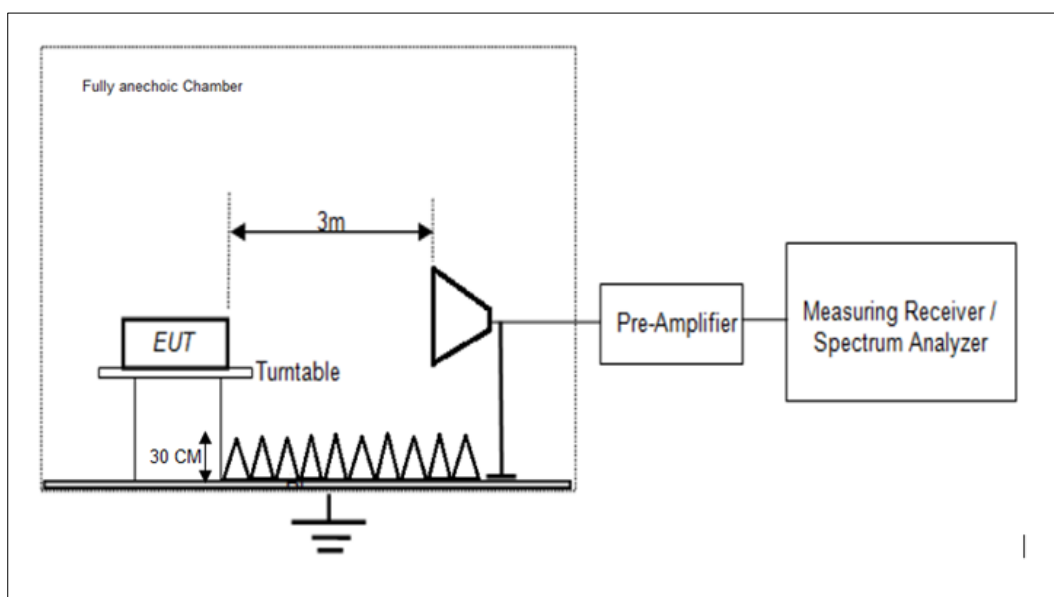


Figure 4: Frequency Range above 1 GHz

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8 TEST RESULTS

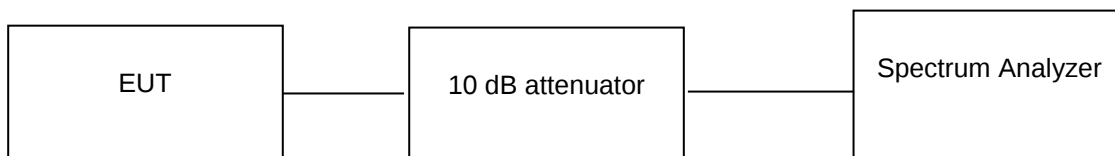
8.1 Maximum conducted (Peak) output power

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	1 MHz
Detector	Peak
Port of testing	Antenna port
Requirement	Power ≤ 1 W (30 dBm) & e.i.r.p ≤ 4 W (36 dBm)

Test Setup



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 10 b (6) (i) in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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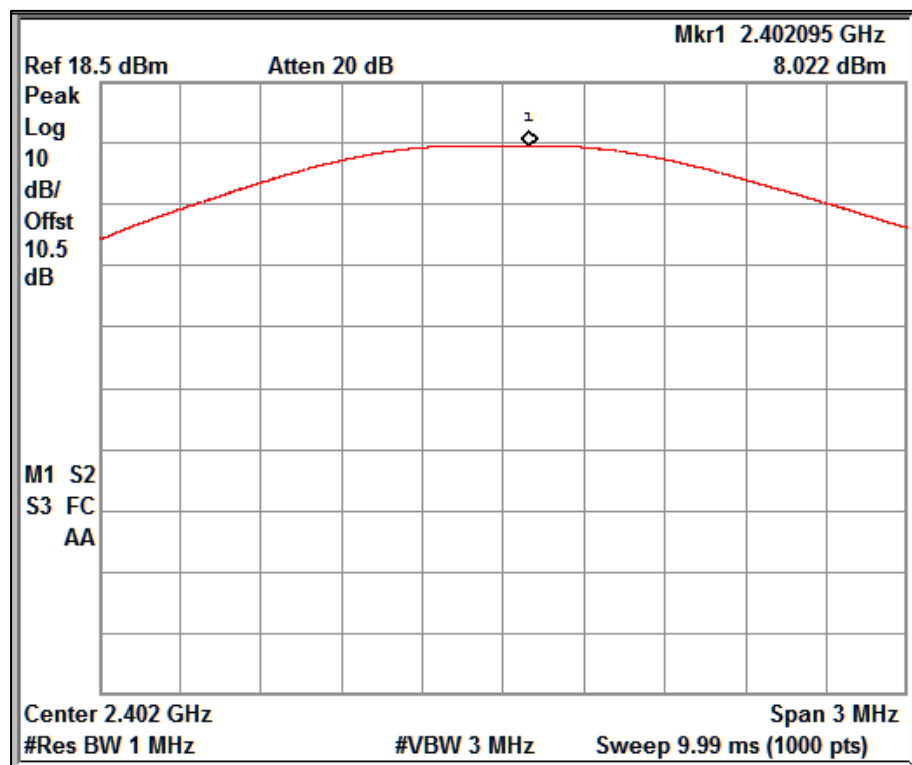
Test results:

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 (0.5dB) +
4. 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 dBi
5. Maximum (e.i.r.p) = Maximum Peak output power (dBm) + antenna gain (2.35 dBi)

Data Rate: 1Mbps

Data rate (Mbps)	Channel Frequency (MHz)	Measured Peak Power (dBm)	Maximum e.i.r.p (dBm)	e.i.r.p Limit (dBm)	Margin (dB)
1	2402	8.02	10.35	36	-25.98
	2440	8.49	10.84	36	-25.84
	2480	8.43	10.78	36	-25.22



Channel Frequency: 2402MHz

Data rate: 1Mbps

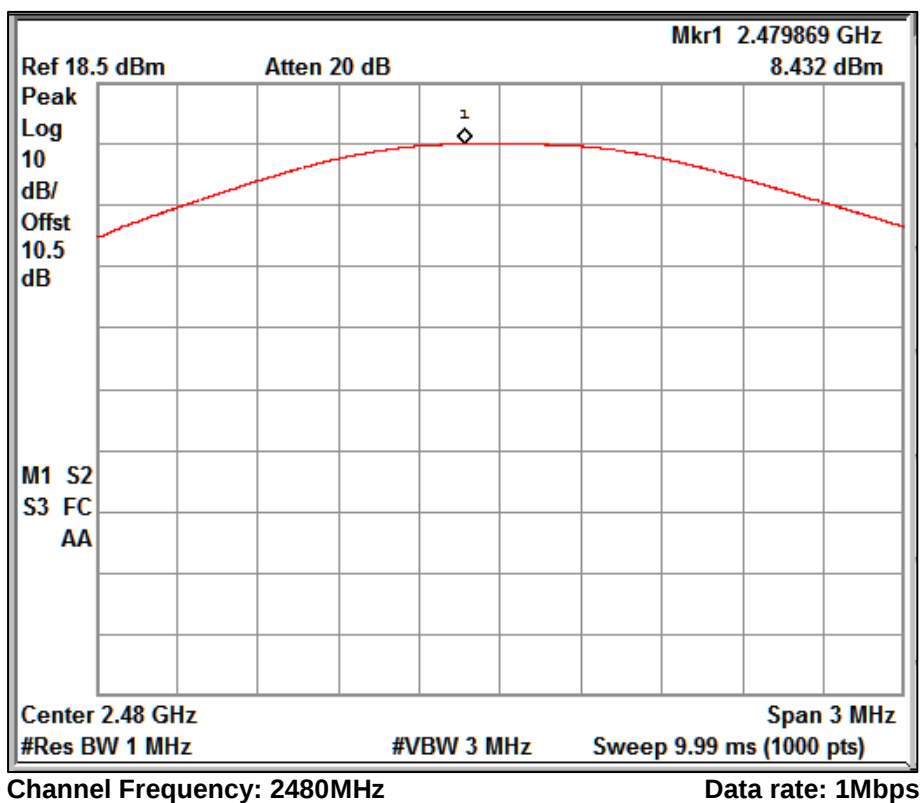
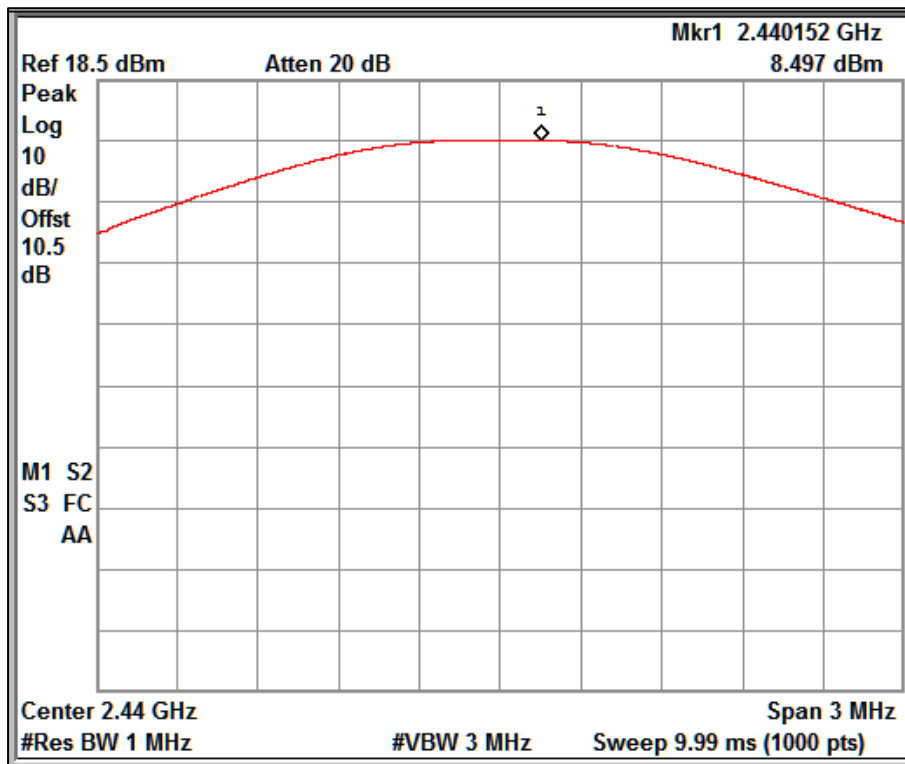
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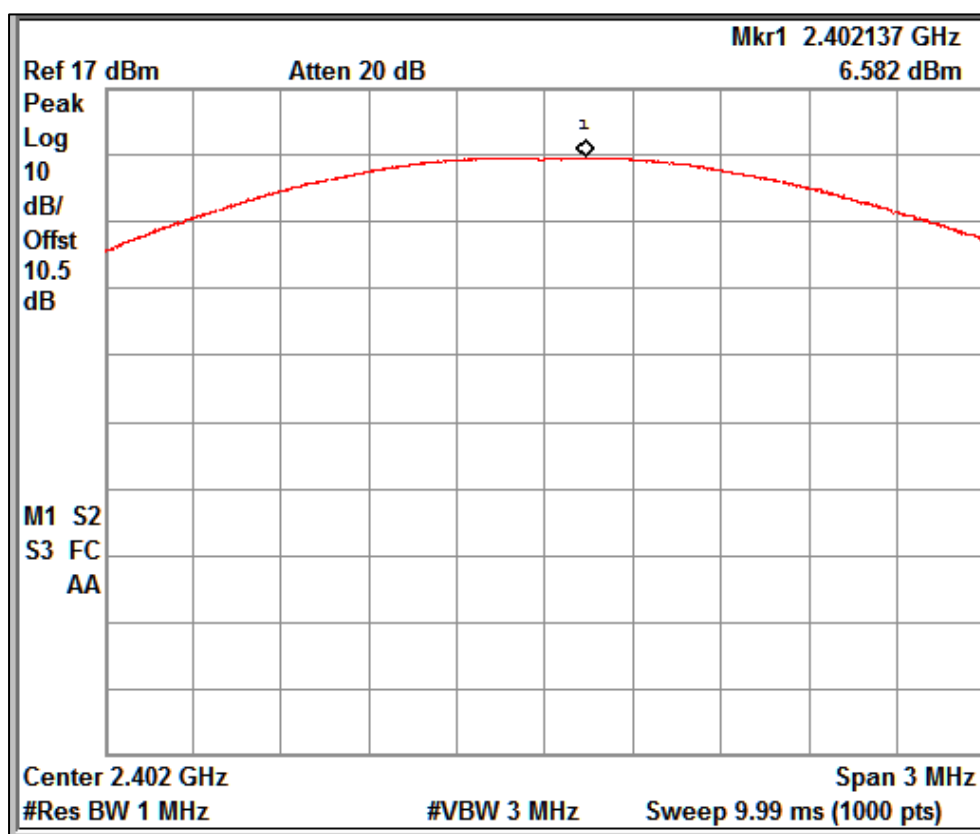
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Data Rate: 2Mbps

Data rate (Mbps)	Channel Frequency (MHz)	Measured Peak Power (dBm)	Maximum e.i.r.p (dBm)	e.i.r.p Limit (dBm)	Margin (dB)
2	2402	6.58	8.93	36	-27.07
	2440	7.06	9.41	36	-26.59
	2480	6.82	9.17	36	-26.83



Channel Frequency 2402MHz

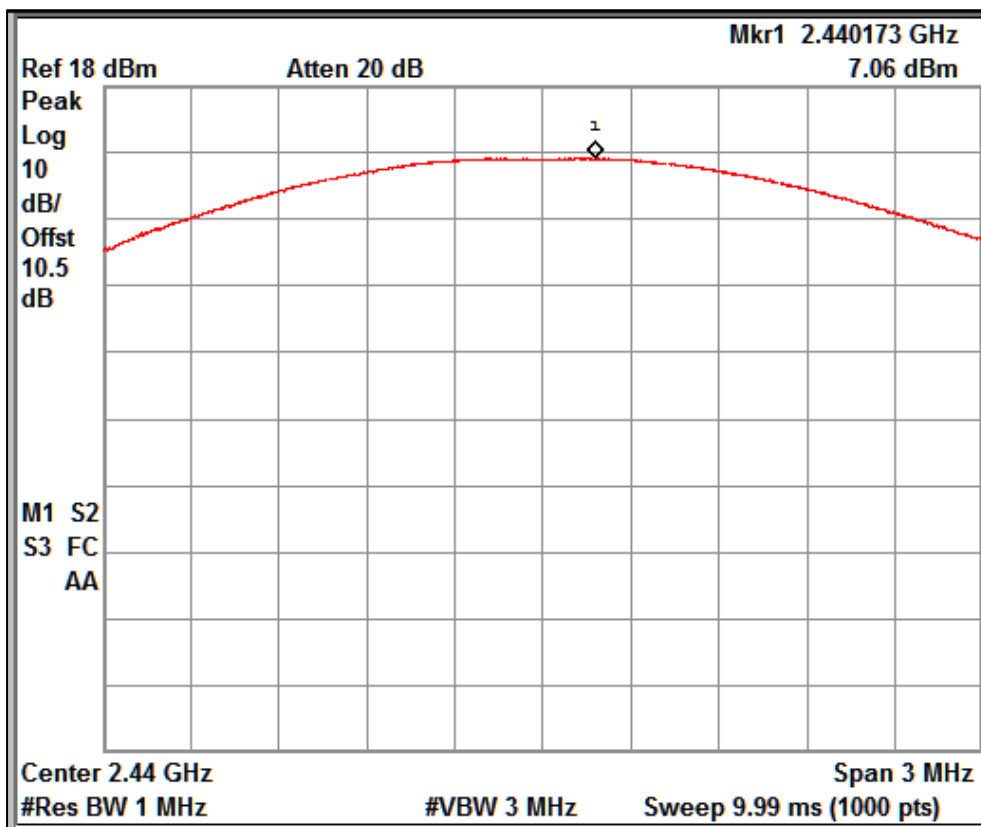
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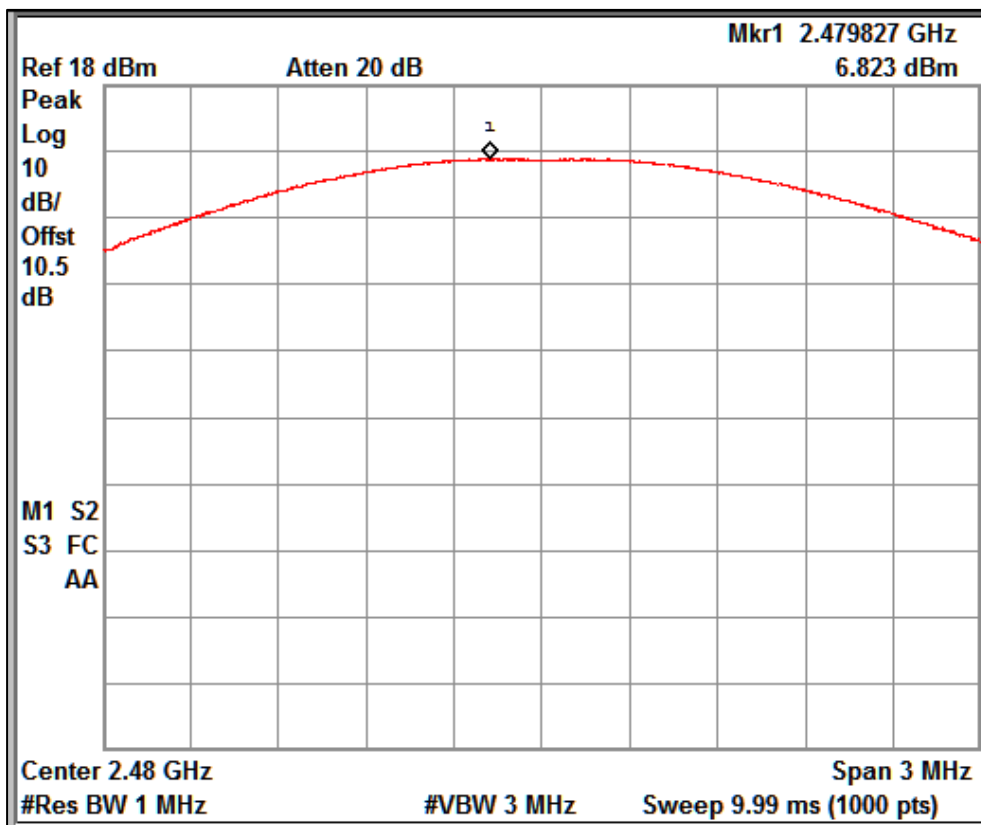
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Channel Frequency 2440MHz



Channel Frequency 2480MHz

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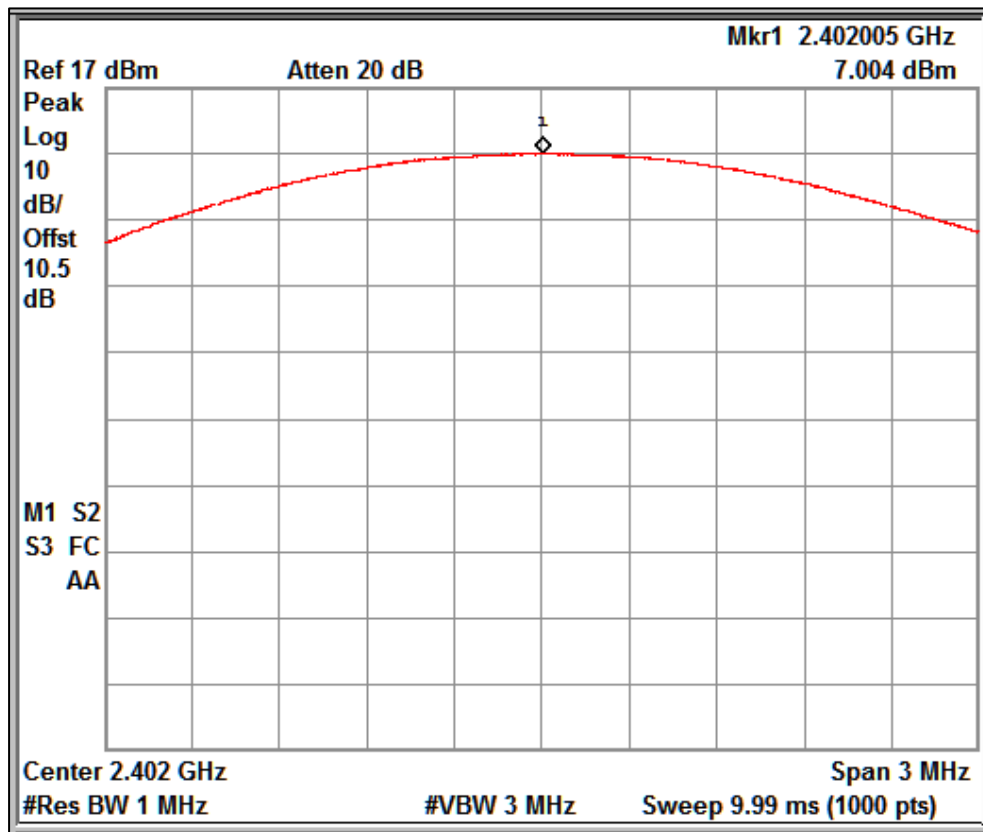
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Data Rate: 3Mbps

Data rate (Mbps)	Channel Frequency (MHz)	Measured Peak Power (dBm)	Maximum e.i.r.p (dBm)	e.i.r.p Limit (dBm)	Margin (dB)
3	2402	7.00	9.35	36	-26.65
	2440	7.48	9.83	36	-26.17
	2480	7.26	9.61	36	-26.39



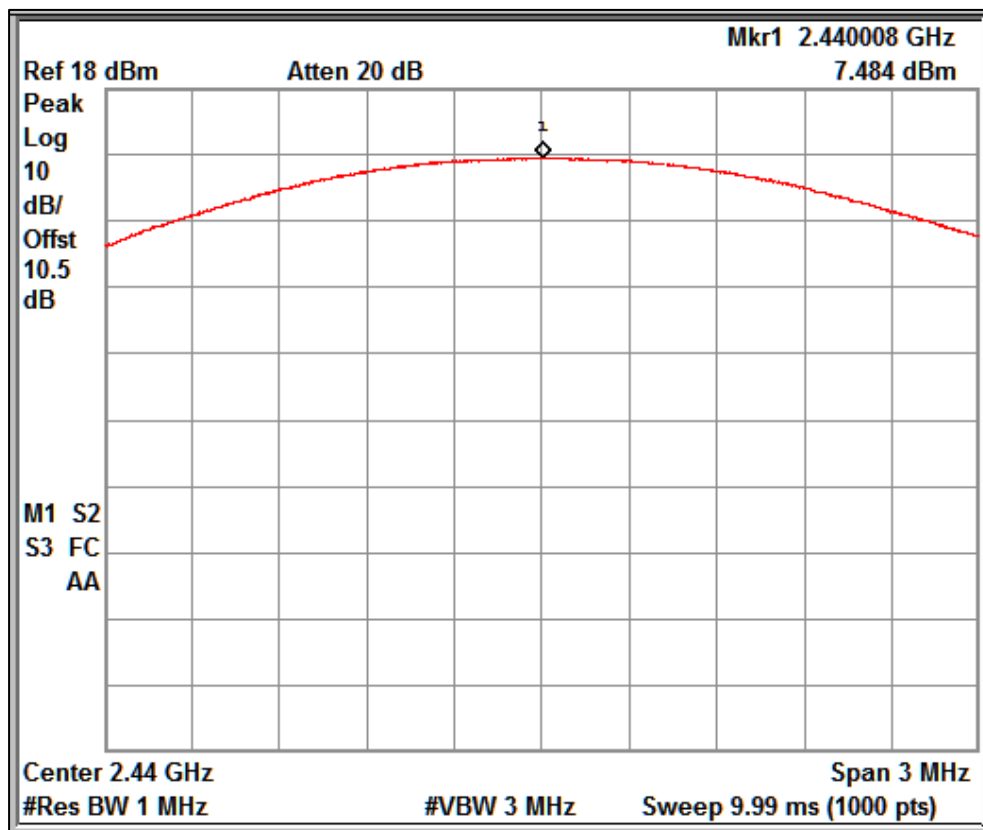
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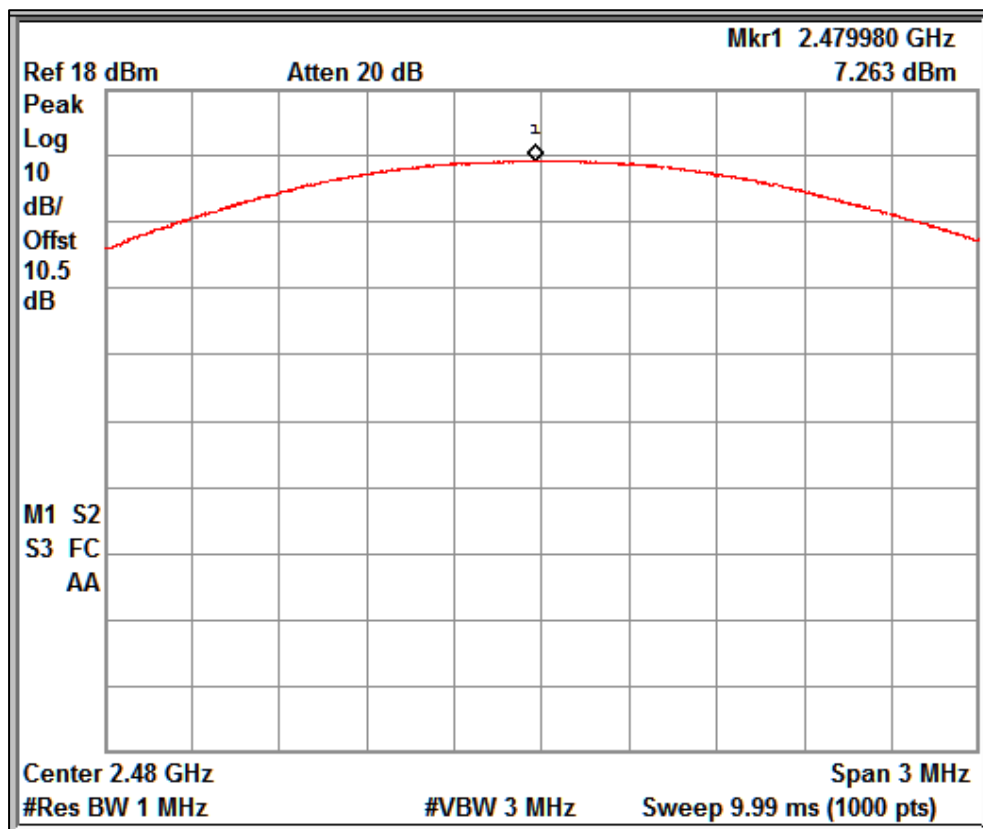
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Channel Frequency 2440MHz



Channel Frequency 2480MHz

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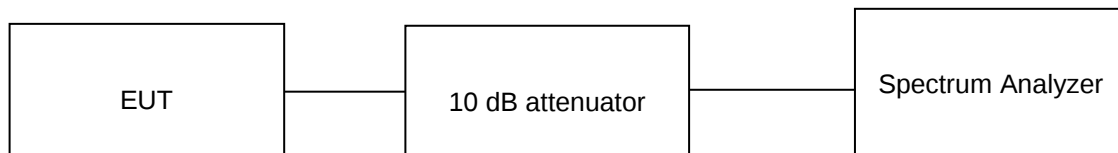
8.2 20dB Bandwidth

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) = + 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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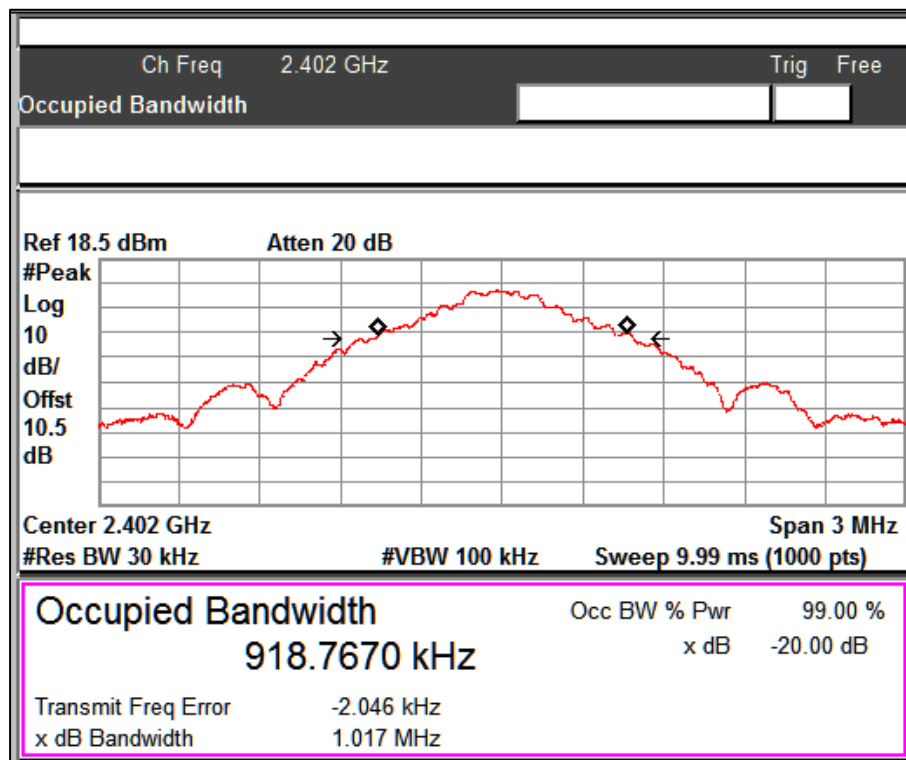
Test results:

Note:

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

Data Rate: 1Mbps

Data Rate (Mbps)	Channel Frequency (MHz)	20 dB Bandwidth (MHz)	99% OBW (kHz)
1	2402	1.01	918.76
	2440	1.02	914.47
	2480	1.02	917.20

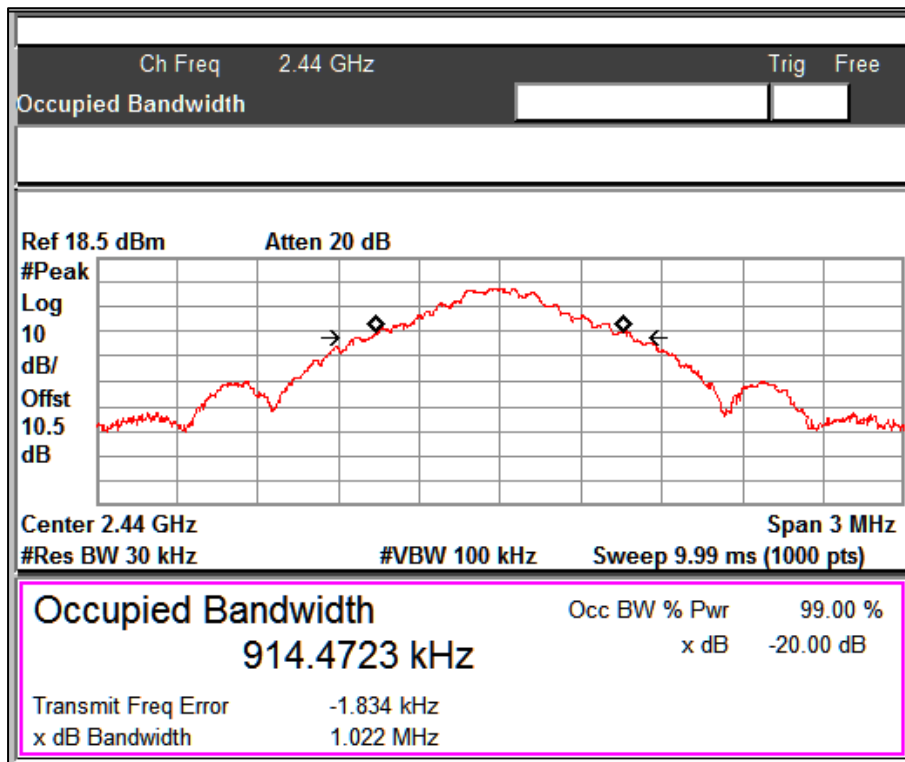


Channel Frequency: 2402MHz

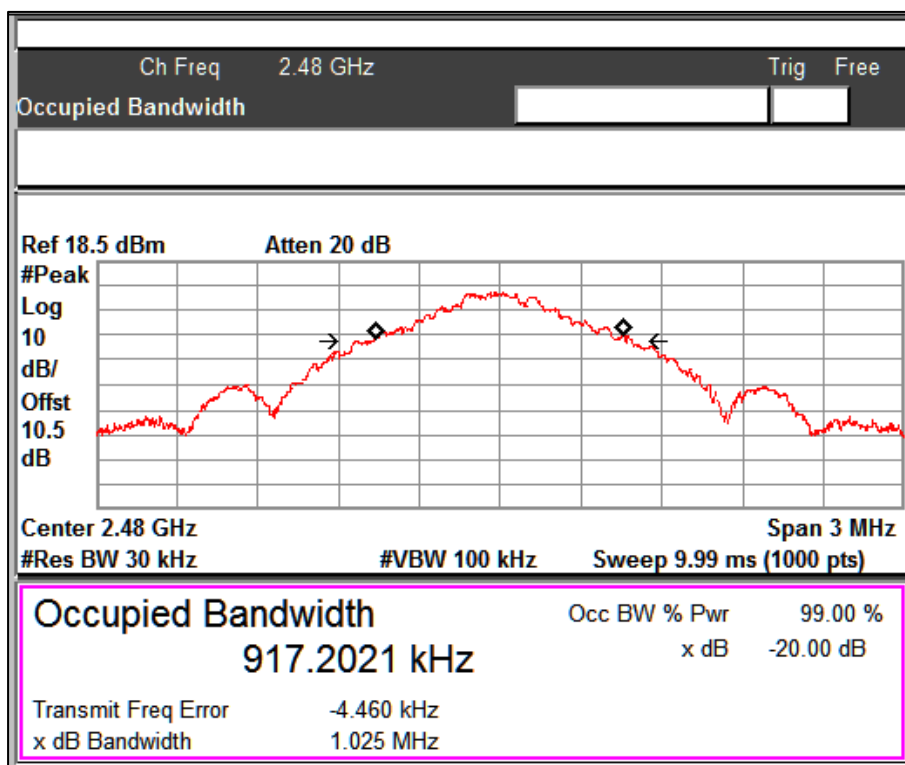
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Channel Frequency: 2440MHz



Channel Frequency: 2480MHz

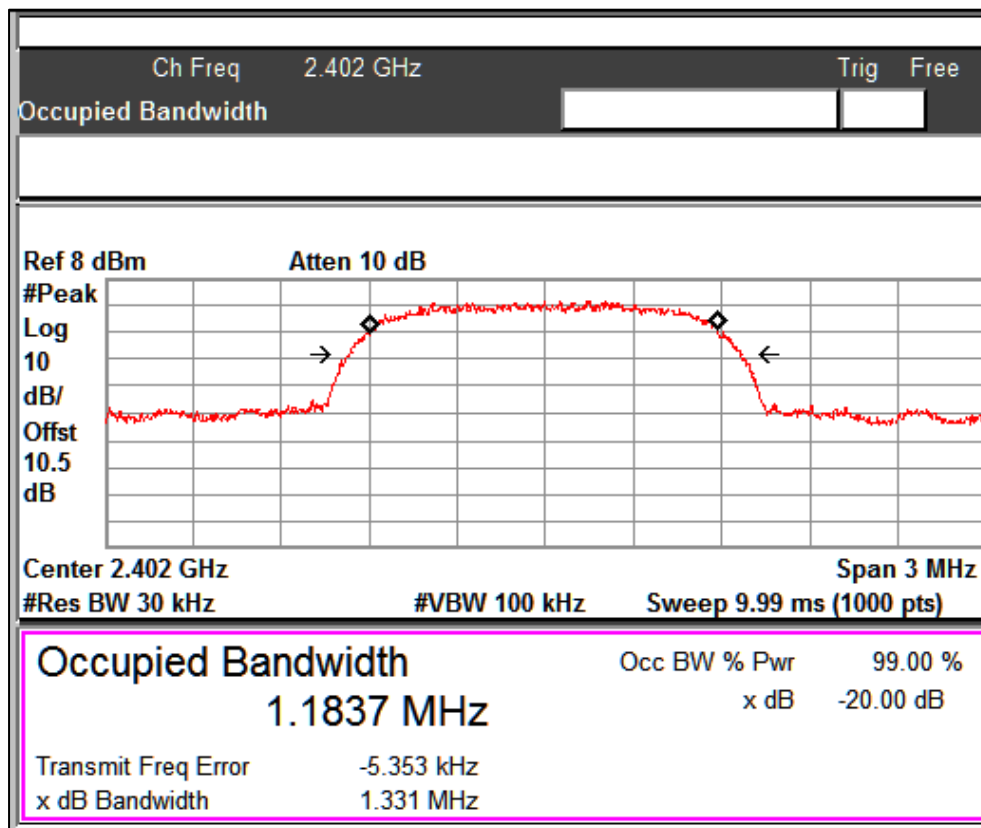
Prüfbericht - Nr.:
Test Report No.:

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Data Rate: 2Mbps

Data Rate (Mbps)	Channel Frequency (MHz)	20 dB Bandwidth (MHz)	99% OBW (MHz)
2	2402	1.18	1.331
	2440	1.19	1.328
	2480	1.18	1.329



Channel Frequency 2402MHz

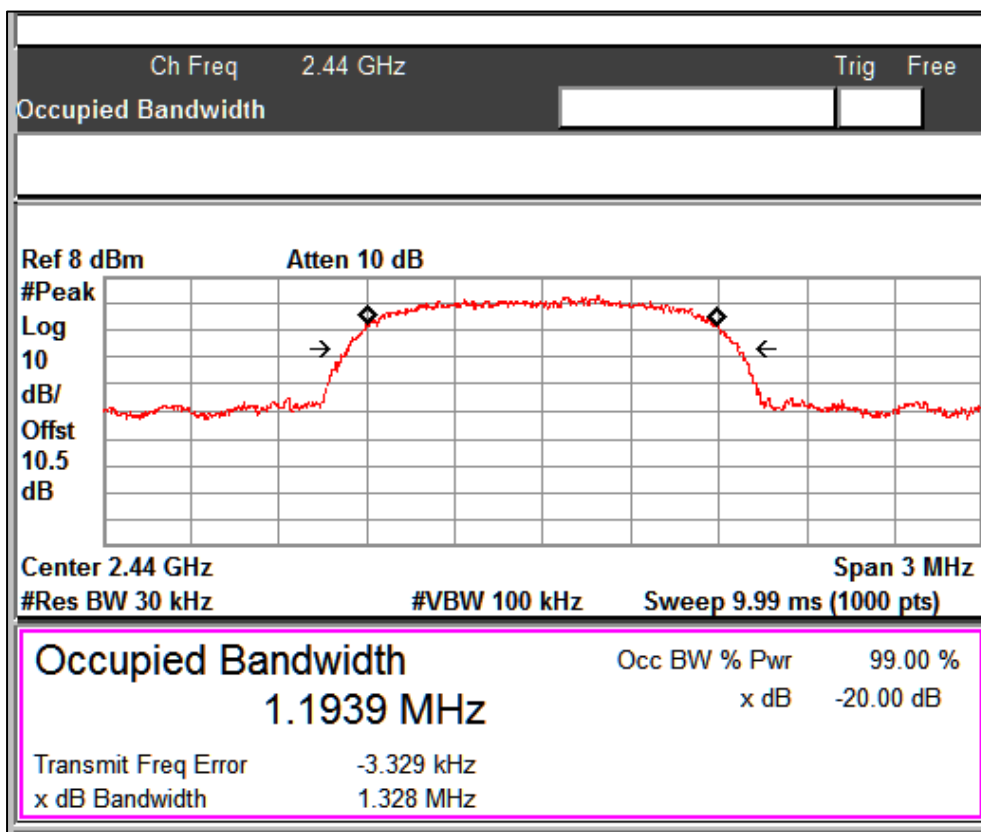
Prüfbericht - Nr.:

Test Report No.:

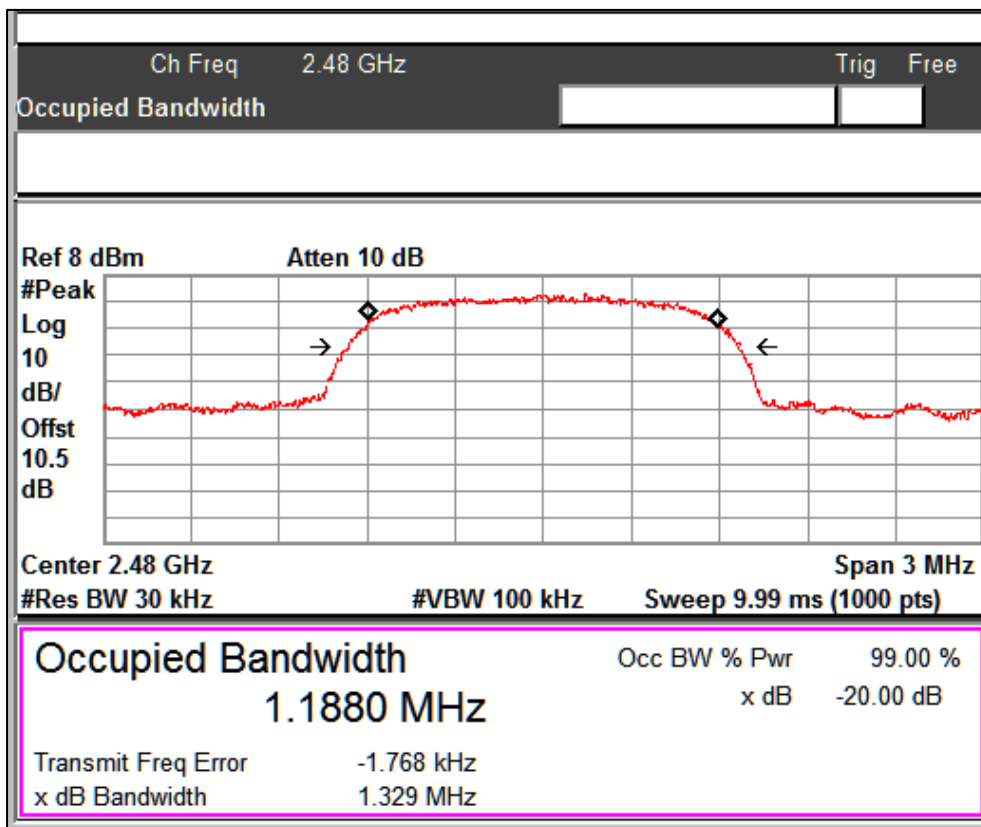
ULR-TC568821300000035F

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Channel Frequency 2440MHz



Channel Frequency 2480MHz

Prüfbericht - Nr.:

Test Report No.:

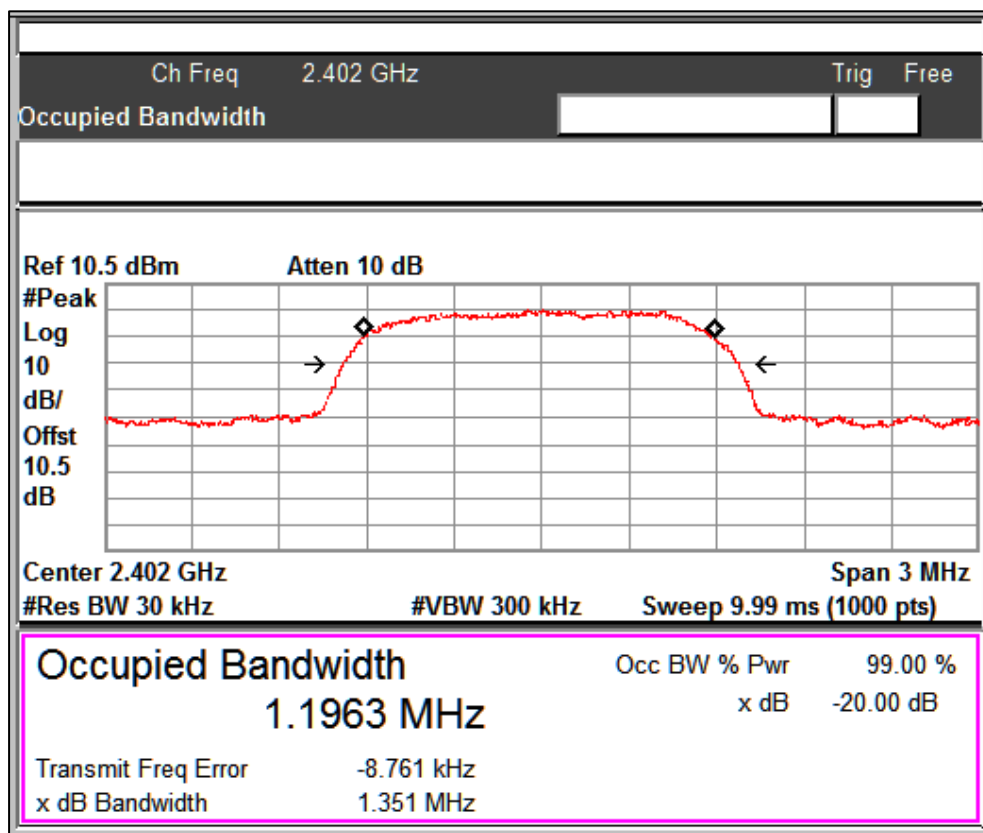
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Data Rate: 3Mbps

Data Rate (Mbps)	Channel Frequency (MHz)	20 dB Bandwidth (MHz)	99% OBW (MHz)
3	2402	1.19	1.351
	2440	1.19	1.342
	2480	1.19	1.340

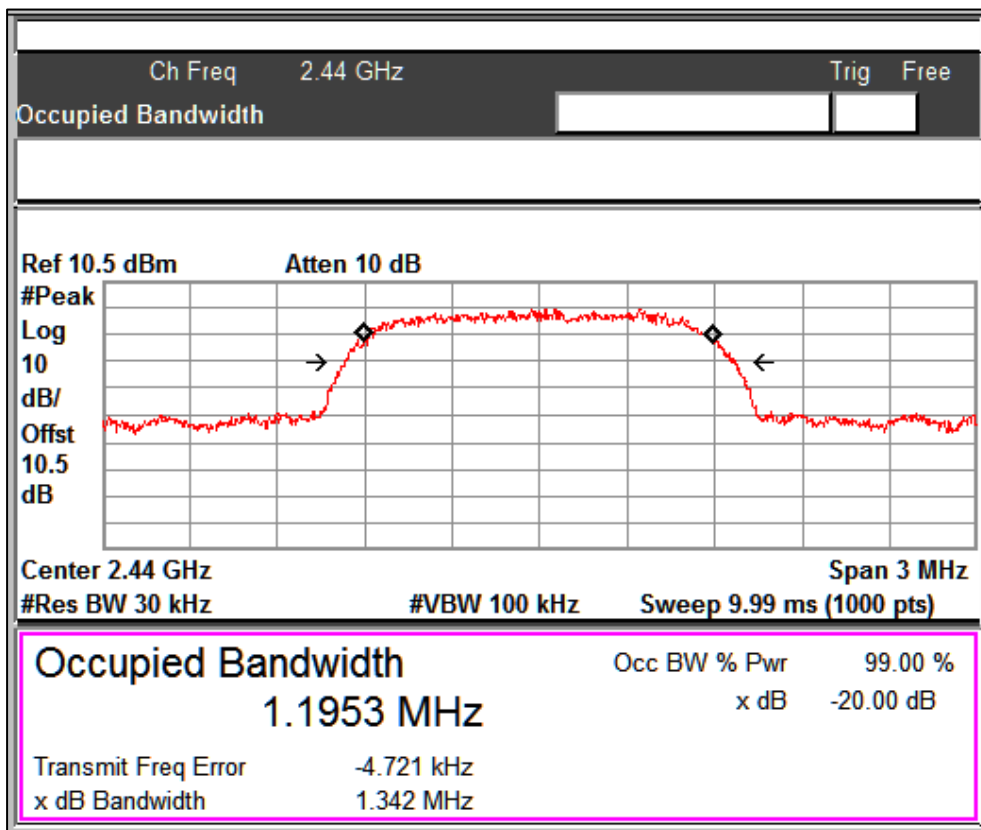


Channel frequency 2402MHz

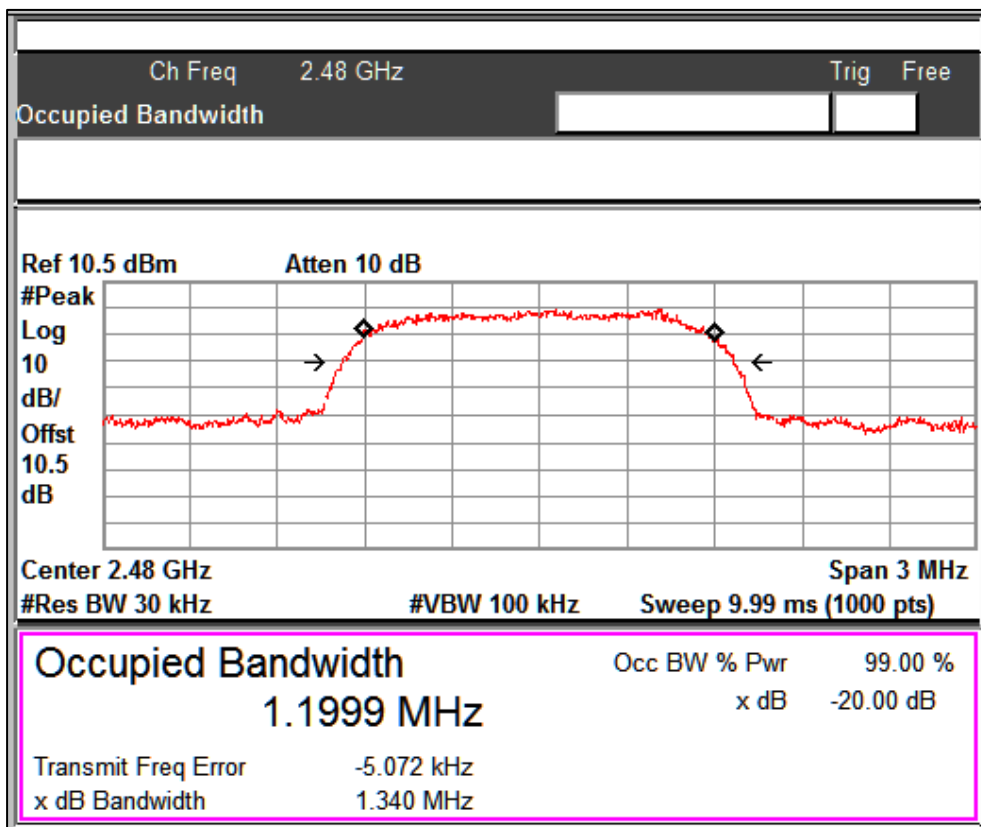
Prüfbericht - Nr.:
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Channel frequency 2440MHz



Channel frequency 2480MHz

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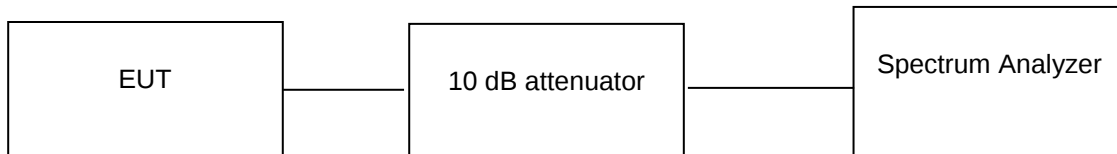
8.3 Number of Hopping Channels

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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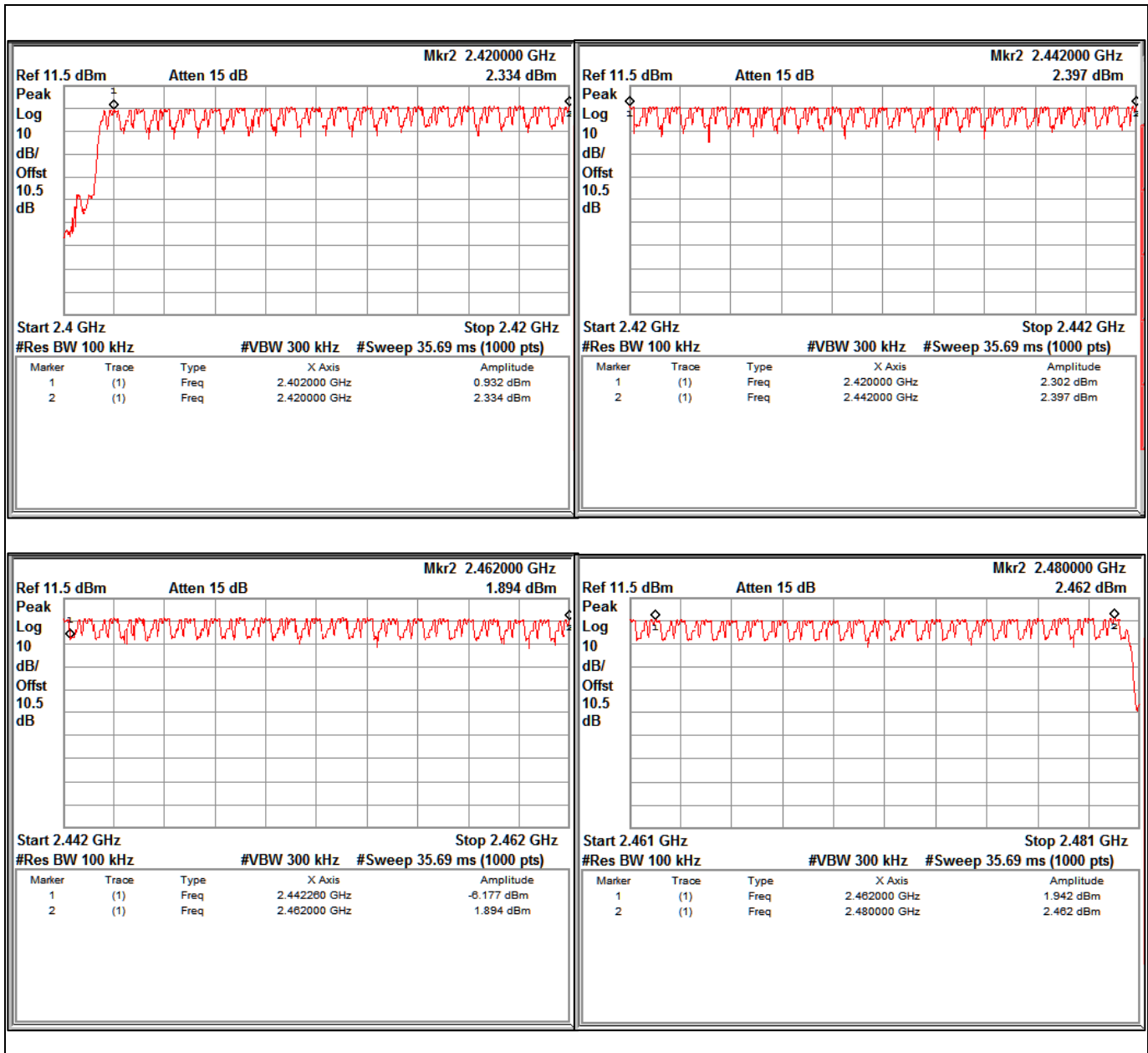
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Test results:

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 (0.5dB).

Test Plots:



Start hopping Frequency Observed 2400MHz
Stop hopping Frequency Observed 2481MHz

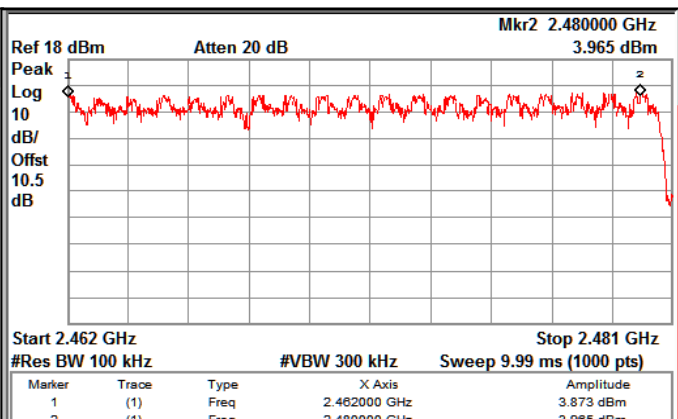
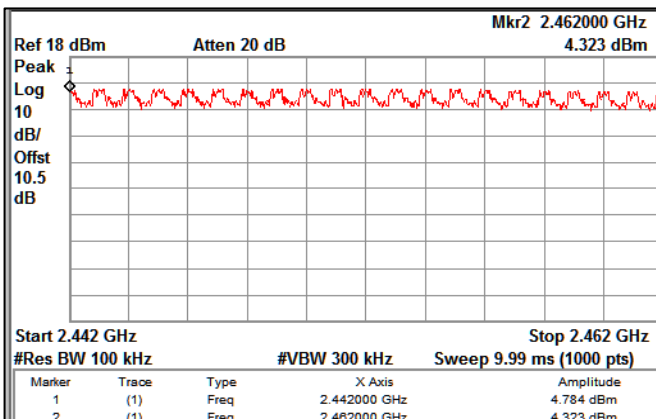
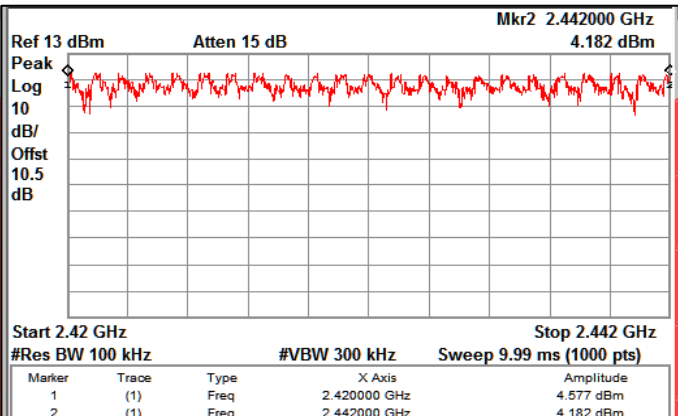
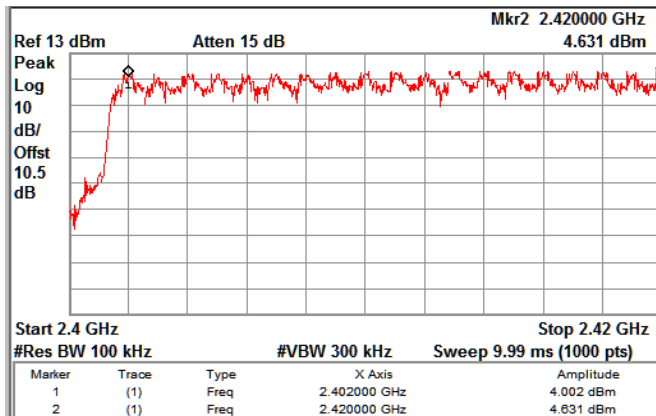
Total Number of Hopping Channels Observed = 79

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Data Rate: 2Mbps



Start hopping Frequency Observed 2400MHz
Stop hopping Frequency Observed 2481MHz

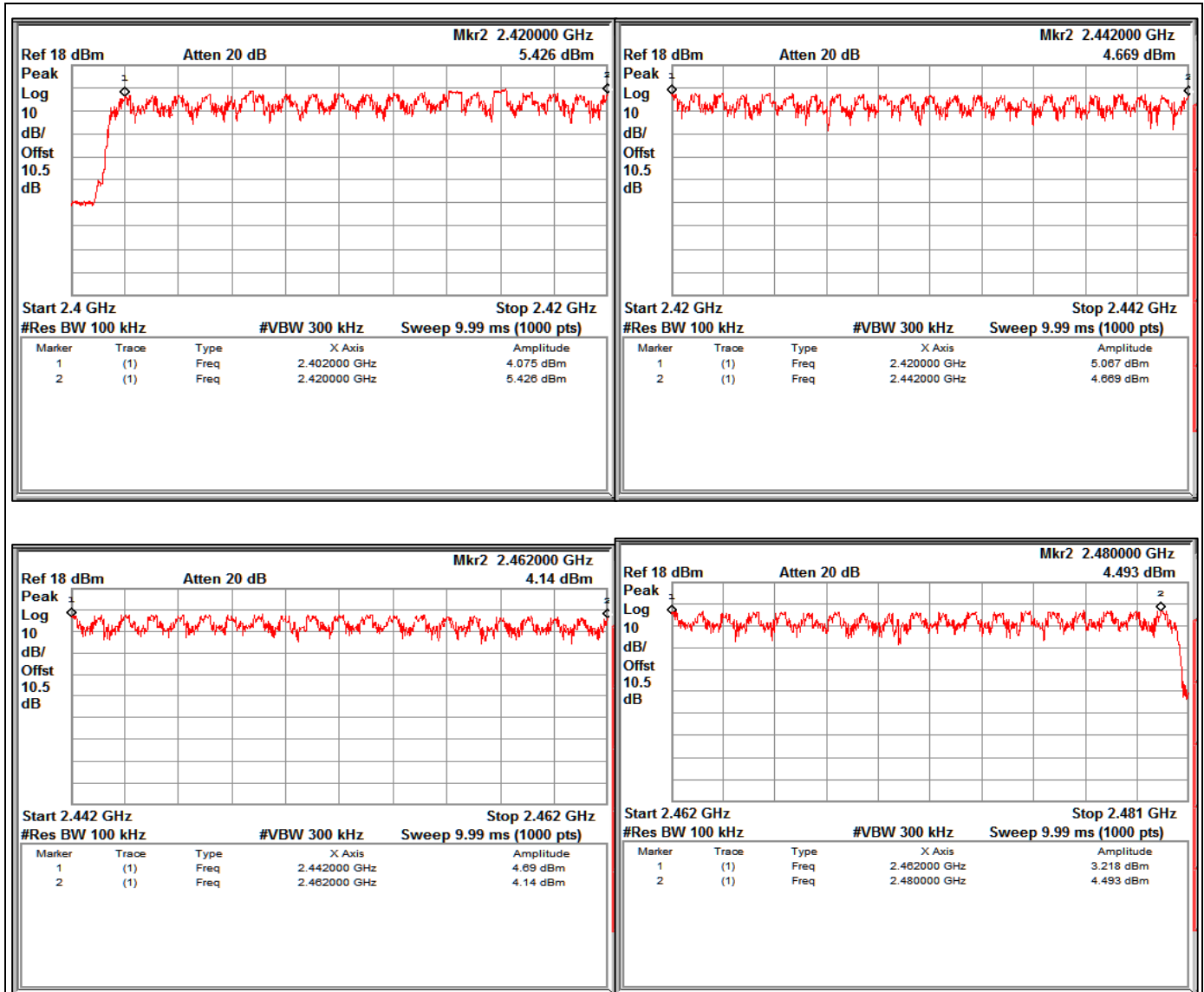
Total Number of Hopping Channels Observed = 79

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Data Rate: 3Mbps



Start hopping Frequency Observed 2400MHz

Stop hopping Frequency Observed 2481MHz

Total Number of Hopping Channels Observed = 79

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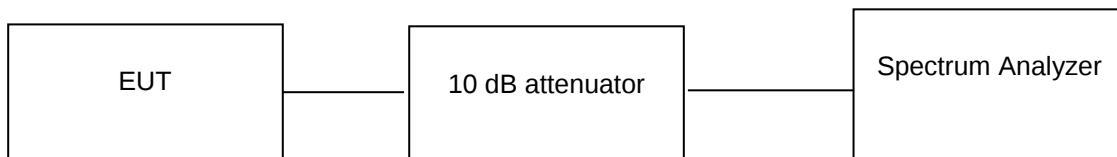
8.4 Carrier Frequency Separation

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.

Prüfbericht - Nr.:

Test Report No.:

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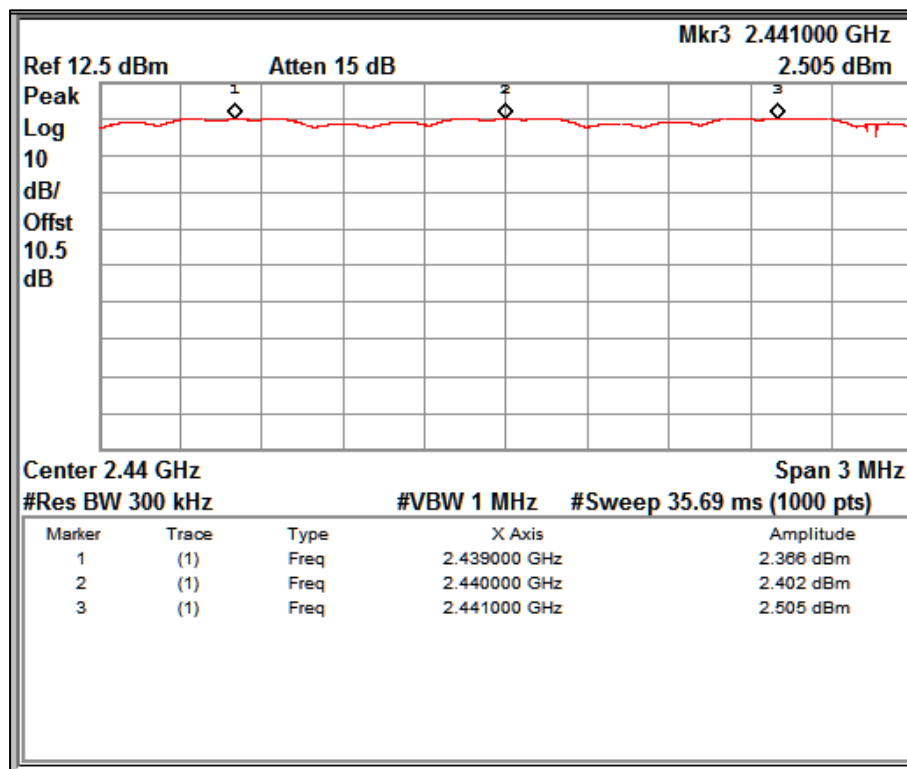
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Test results:

Note:

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



Frequency (MHz)	Channel spacing Observed (MHz)	20 dB Band width (MHz)
2439	1	1.01
2440	1	1.02
2441	1	1.02

Prüfbericht - Nr.:

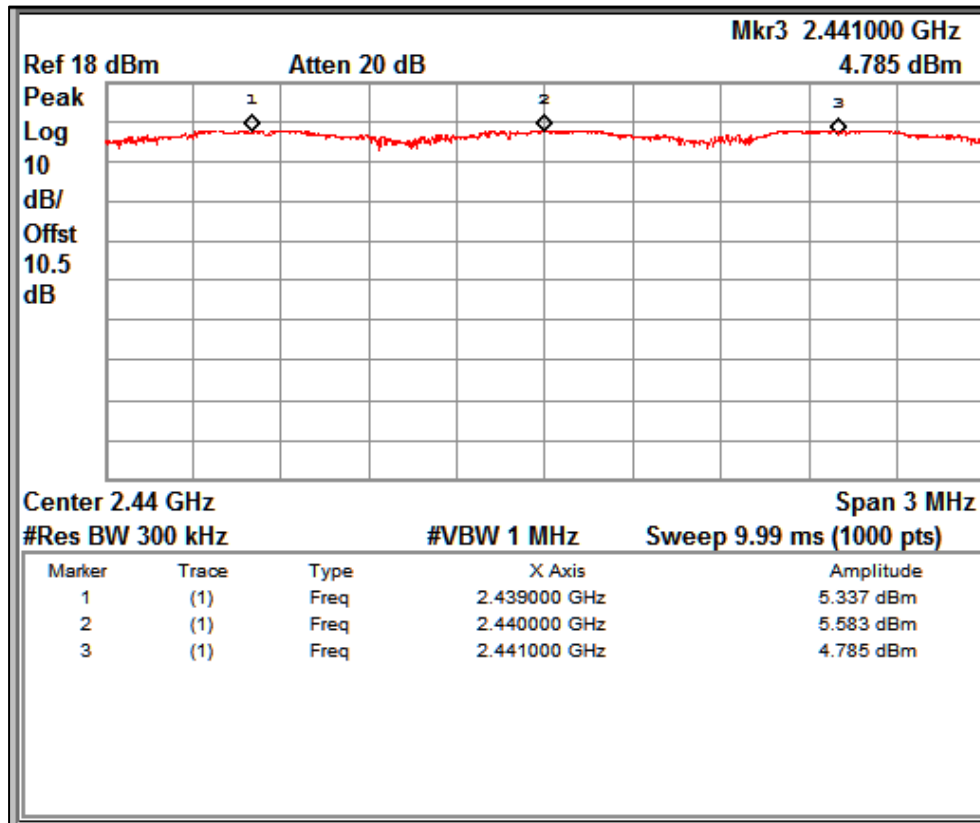
Test Report No.:

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Data Rate: 2Mbps



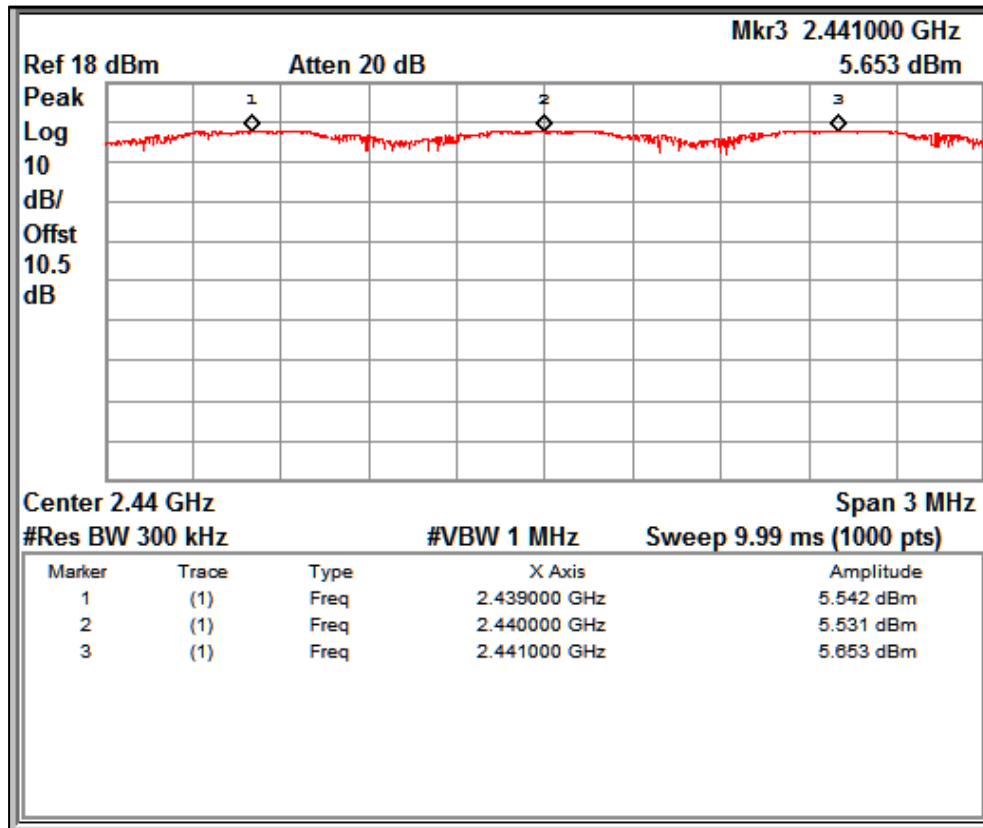
Frequency (MHz)	Channel spacing Observed (MHz)	20 dB Band width (MHz)
2439	1	1.18
2440	1	1.19
2441	1	1.18

Prüfbericht - Nr.:
Test Report No.:

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Data Rate: 3Mbps



Frequency (MHz)	Channel spacing Observed (MHz)	20 dB Band width (MHz)
2439	1	1.19
2440	1	1.19
2441	1	1.19

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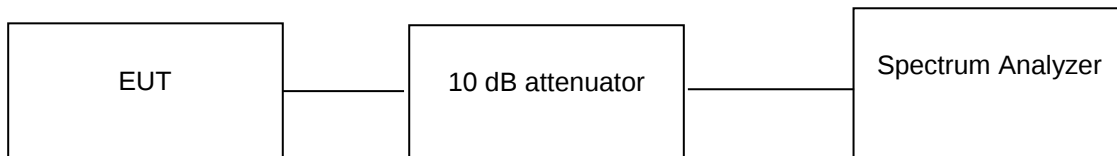
8.5 Time of Occupancy (Dwell Time)

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	300 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.

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000035F

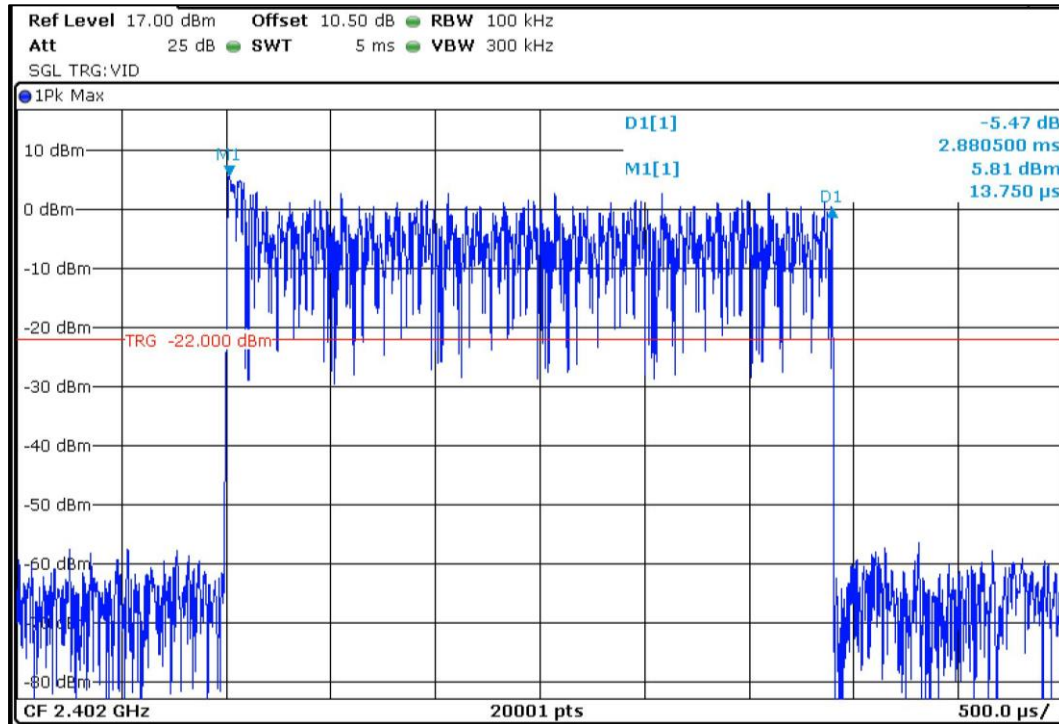
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Test results:

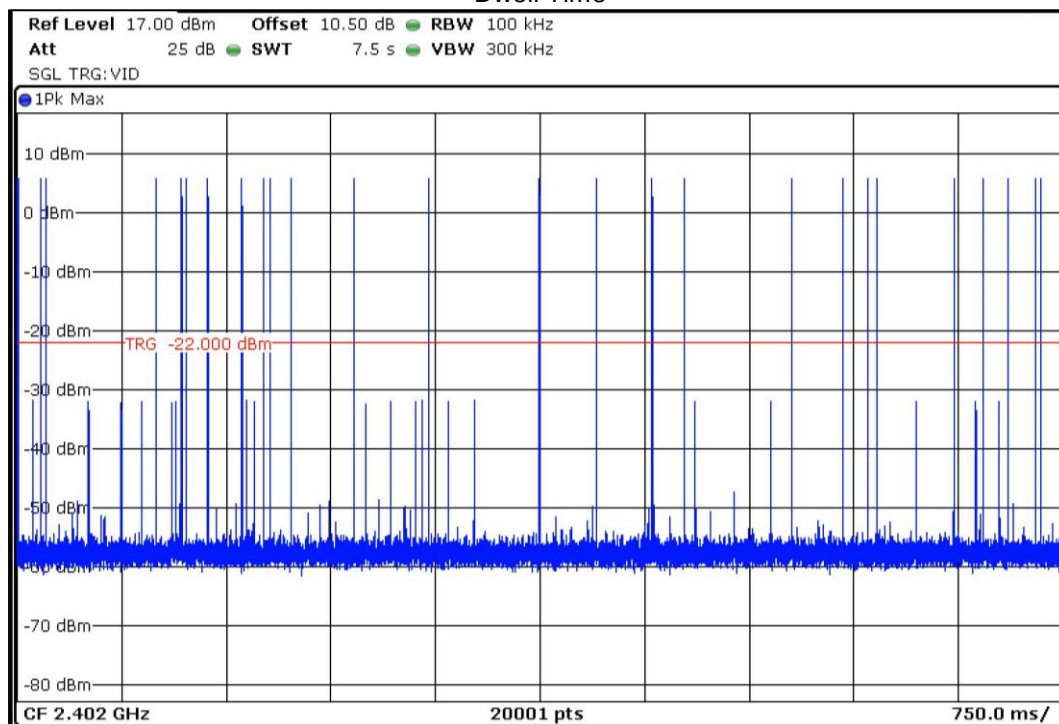
Note:

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 (0.5dB)
3. Testing is performed for all the applicable data rates only worst case graphs are reported (3DH5)

Data Rate: DH5



Dwell Time



Number of bins

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Single Burst	2.8805	ms
Measured Span (Seconds)	7.5	sec
No. Of Bins/Bursts in Measured Span	32	No.
Observation Period (79 hop ch x0.4s) - Seconds	31.6	sec
Total Burst in 31.6sec	388.36	ms
Limit	400.00	ms

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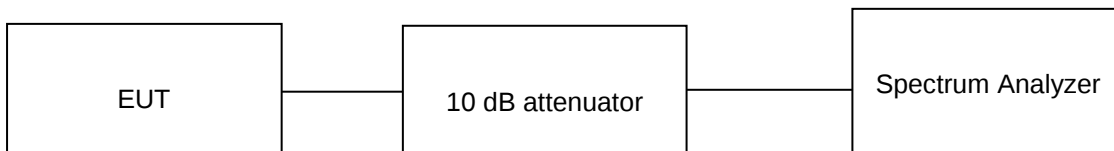
8.6 Emissions in non-restricted frequency bands and Conducted Spurious Emission

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (d) / RSS 247 Issue 2, Section 5.5
Test Method	Subclause 7.8.8 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 20dB 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

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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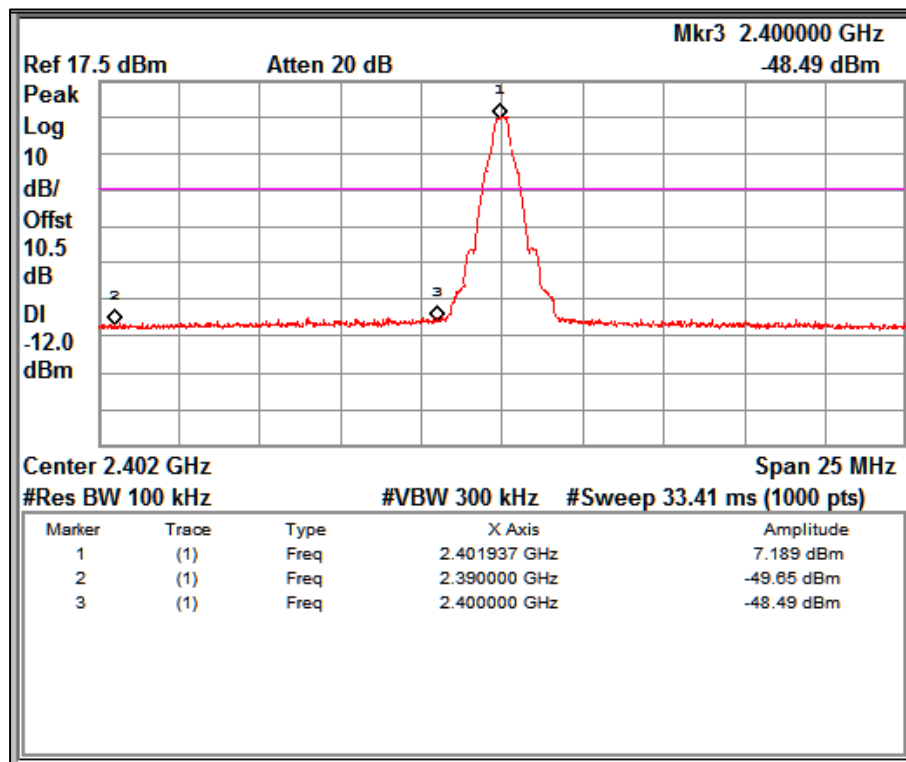
Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report
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 single antenna and hence Directional gain of the single antenna is 2.35 dBi

8.6.1 Band edge and reference plots

Data Rate (Mbps)	Channel Frequency (MHz)	Reference Value (B) (dBm)	Band edge Frequency (MHz)	Value at Band edge (A) (dBm)	A-B (dBc)	Minimum Limit (dBc)
1	2402	7.18	2390	-49.65	-56.83	-20.00
	2480	7.75	2483.5	-49.54	-57.29	-20.00

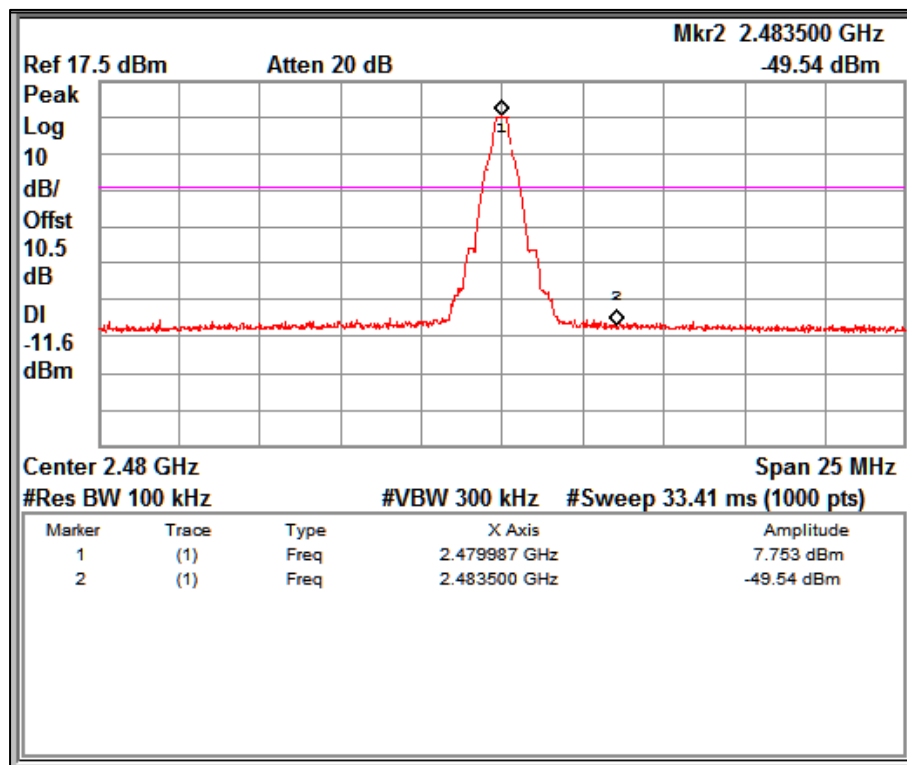


Channel Frequency 2402MHz

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Channel Frequency 2480MHz

Data Rate: 2Mbps

Data Rate (Mbps)	Channel Frequency (MHz)	Reference Value (B) (dBm)	Band edge Frequency (MHz)	Value at Band edge (A) (dBm)	A-B (dBc)	Minimum Limit (dBc)
2	2402	3.67	2390	-49.88	-53.55	-20.00
	2480	3.84	2483.5	-51.18	-55.02	-20.00

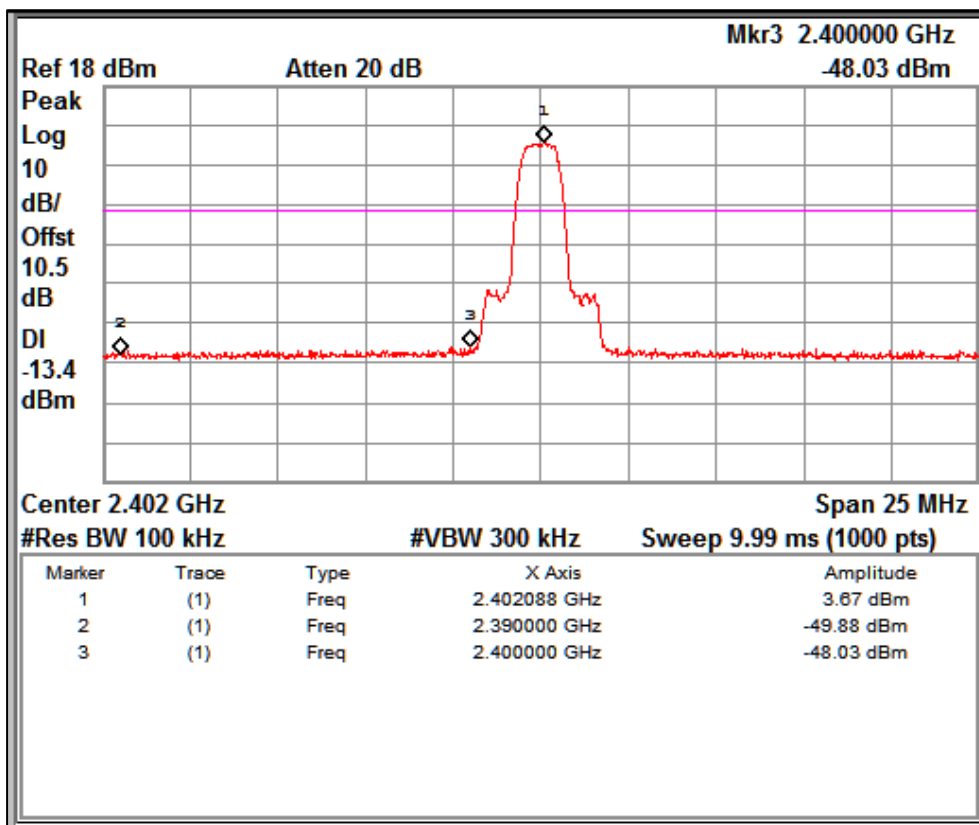
Prüfbericht - Nr.:

Test Report No.:

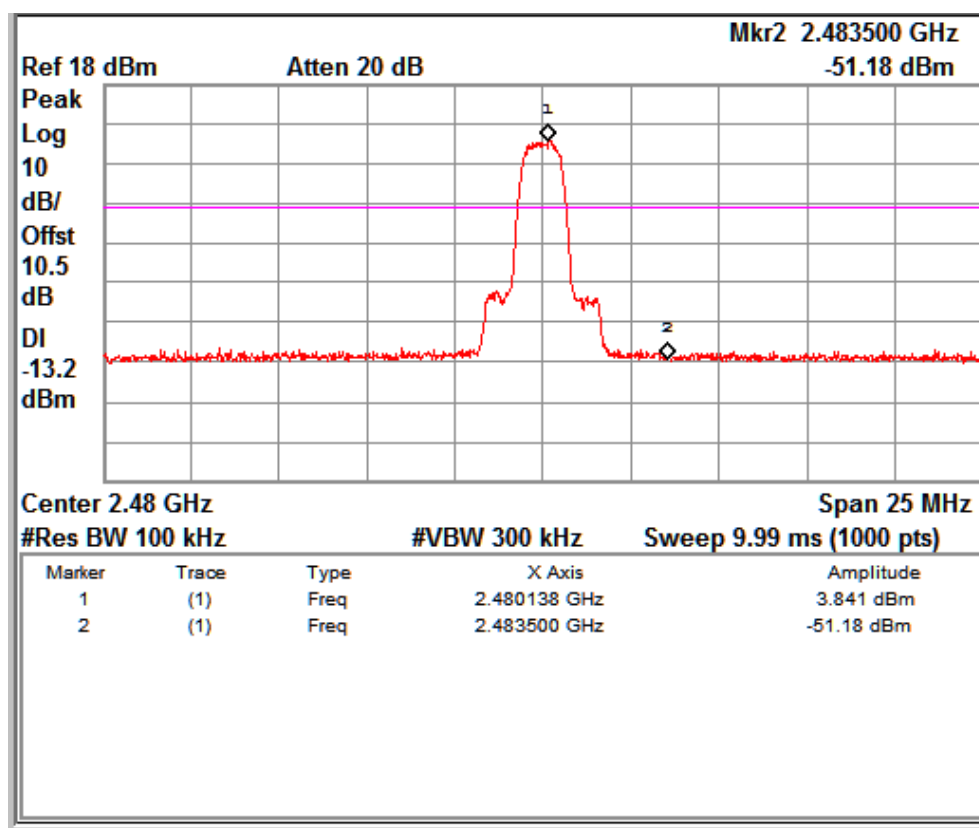
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Channel Frequency 2402MHz



Channel Frequency 2440MHz

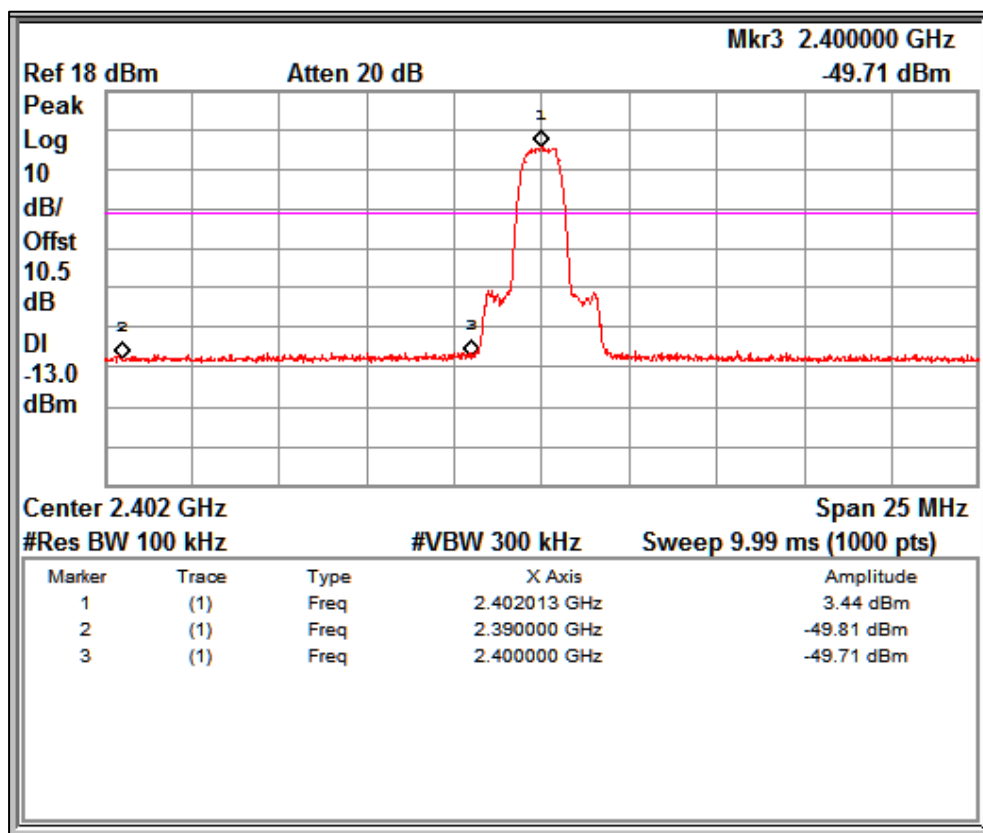
Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000035F

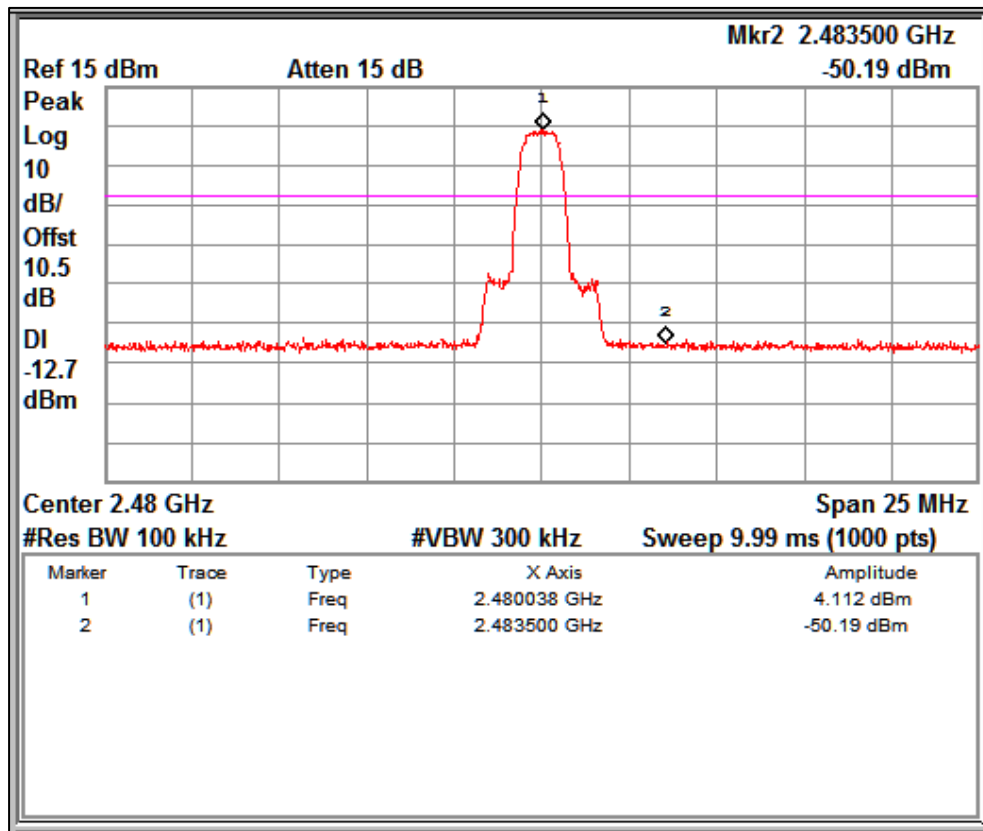
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Data Rate: 3Mbps

Data Rate (Mbps)	Channel Frequency (MHz)	Reference Value (B) (dBm)	Band edge Frequency (MHz)	Value at Band edge (A) (dBm)	A-B (dBc)	Minimum Limit (dBc)
3	2402	3.44	2390	-49.81	-52.62	-20.00
	2480	4.11	2483.5	-50.19	-54.30	-20.00

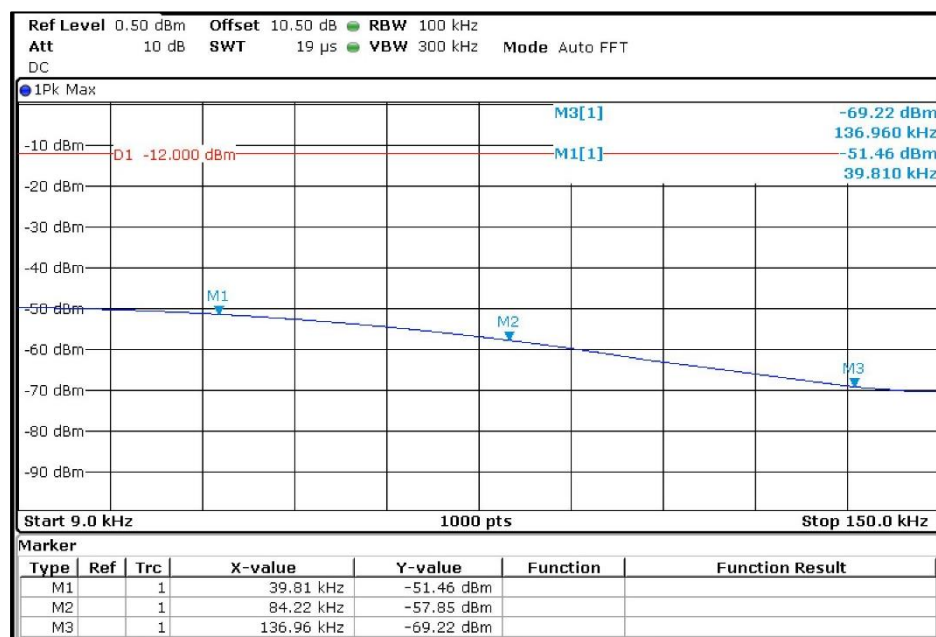


Channel Frequency 2402MHz



Channel Frequency 2480MHz

8.6.2 Out-Of-Band Emissions



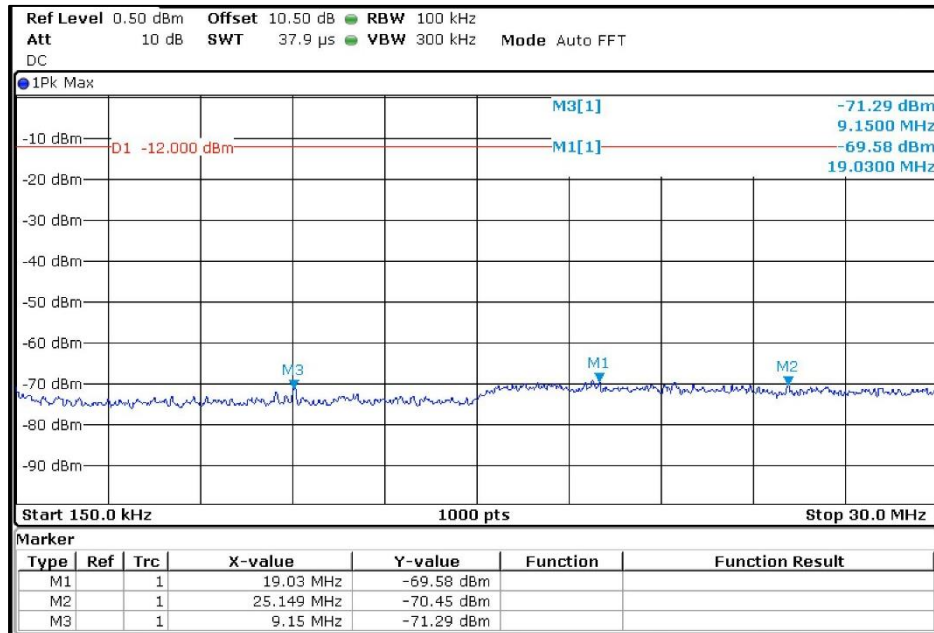
Channel Frequency 2402MHz

Frequency Range 9KHz – 150KHz

Prüfbericht - Nr.:
Test Report No.:

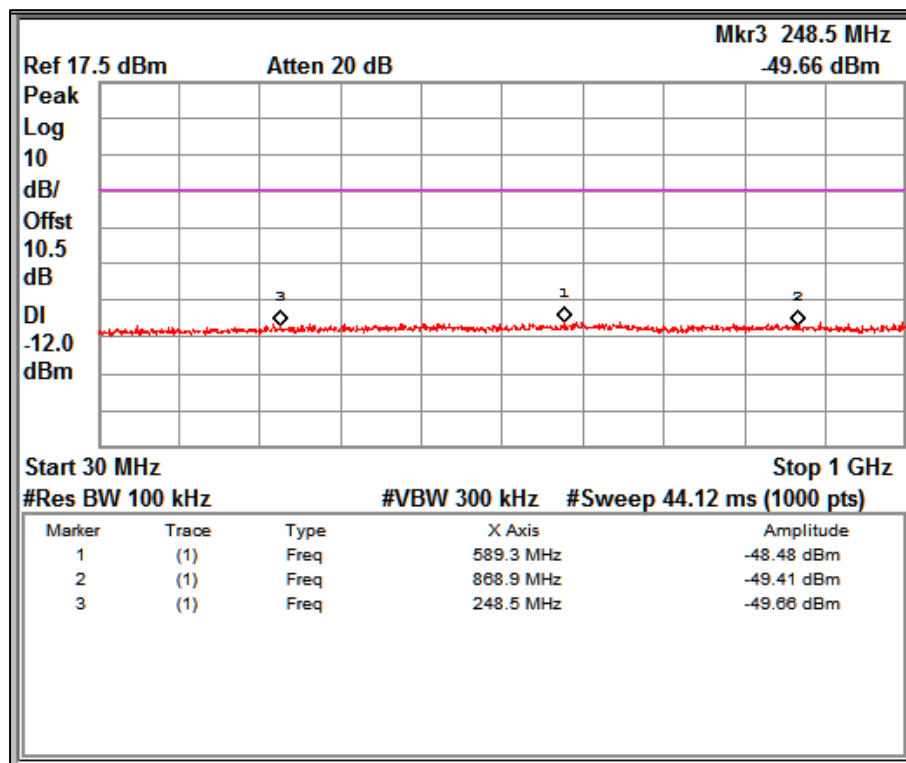
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Channel Frequency 2402MHz

Frequency Range 150KHz – 30MHz



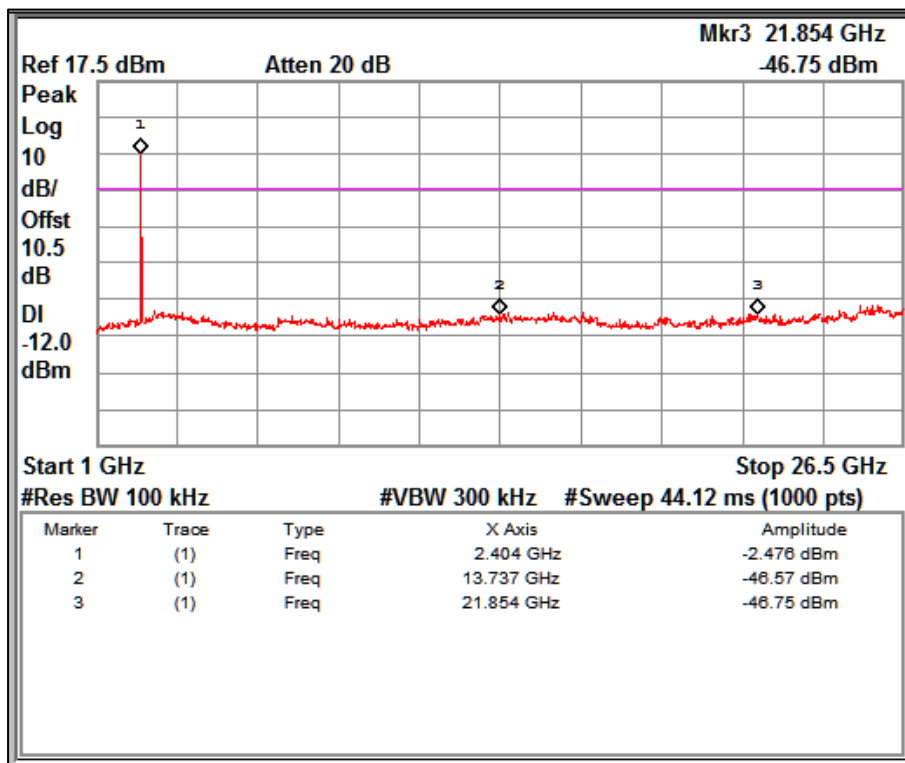
Channel Frequency 2402MHz

Frequency Range 30MHz – 1GHz

Prüfbericht - Nr.:
Test Report No.:

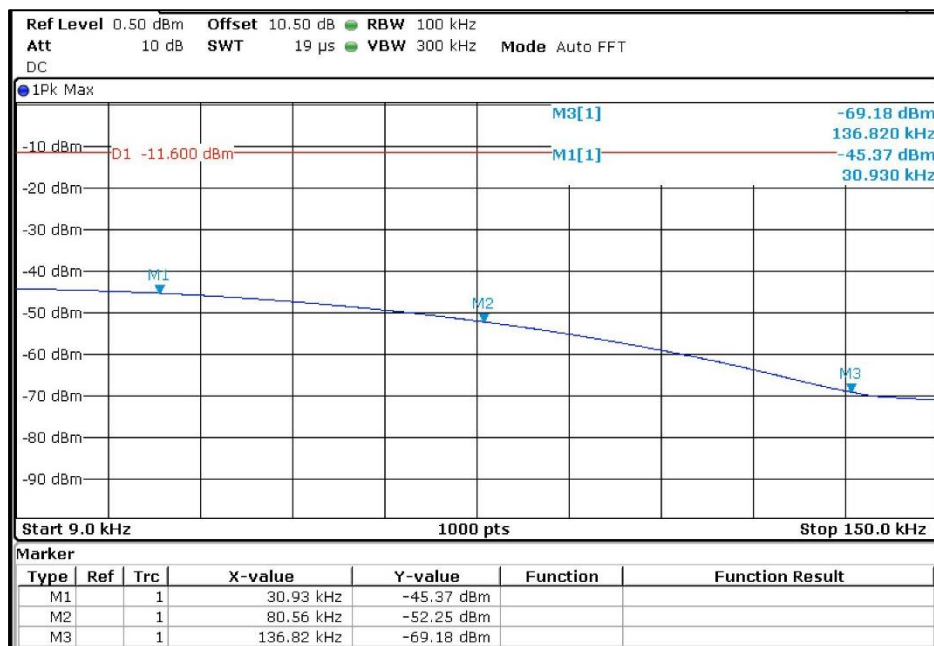
ULR-TC568821300000035F

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Channel Frequency 2402MHz

Frequency Range 1GHz – 26.5GHz



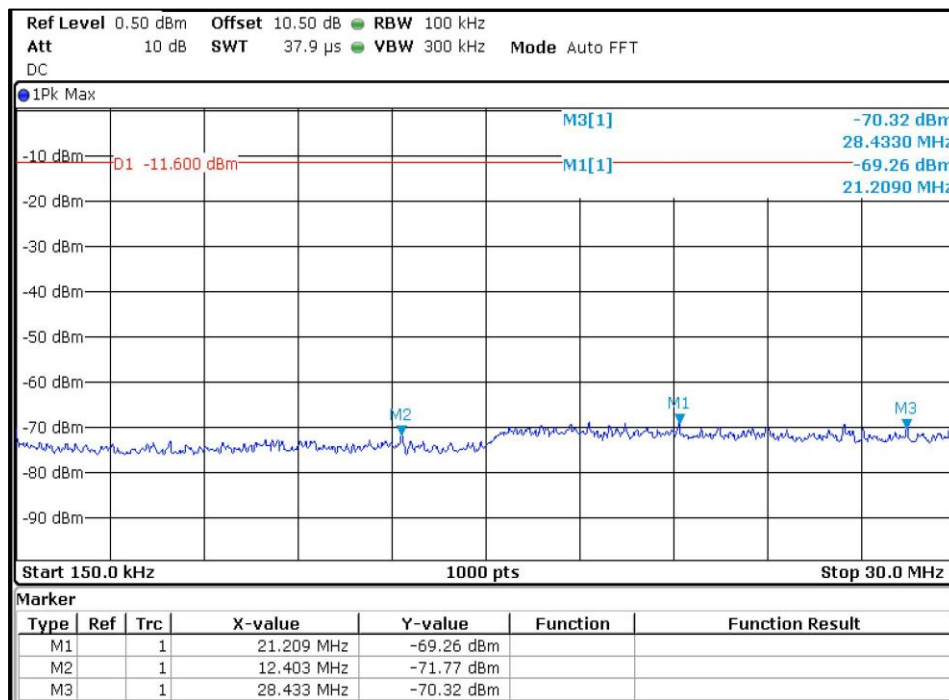
Channel Frequency 2440MHz

Frequency Range 9KHz – 150KHz

Prüfbericht - Nr.:
Test Report No.:

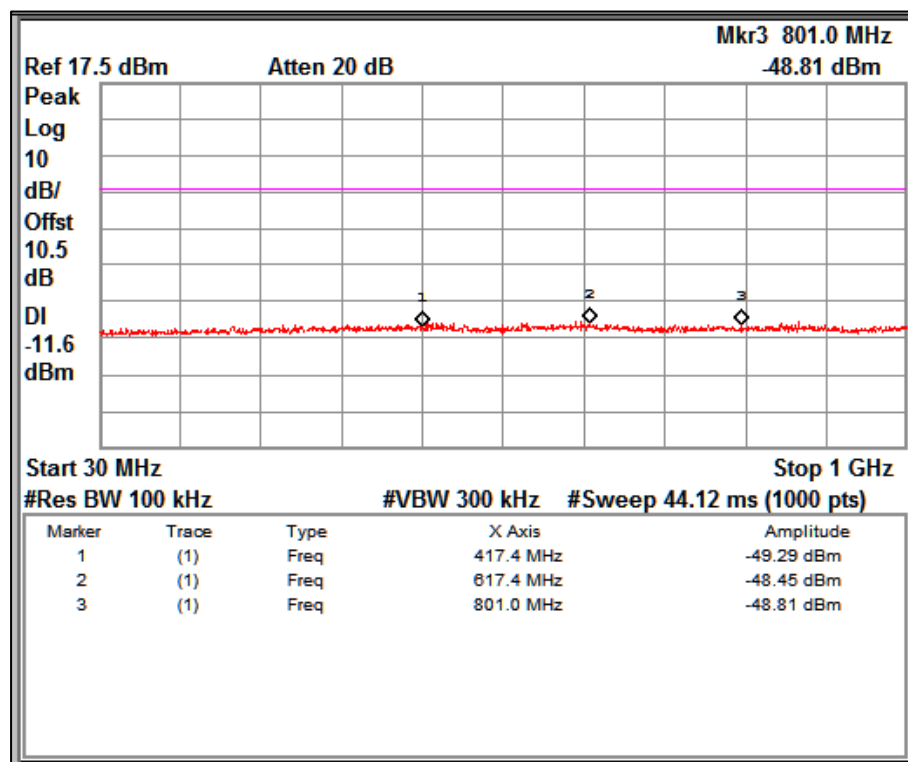
ULR-TC568821300000035F

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Channel Frequency 2440MHz

Frequency Range 150KHz – 30MHz



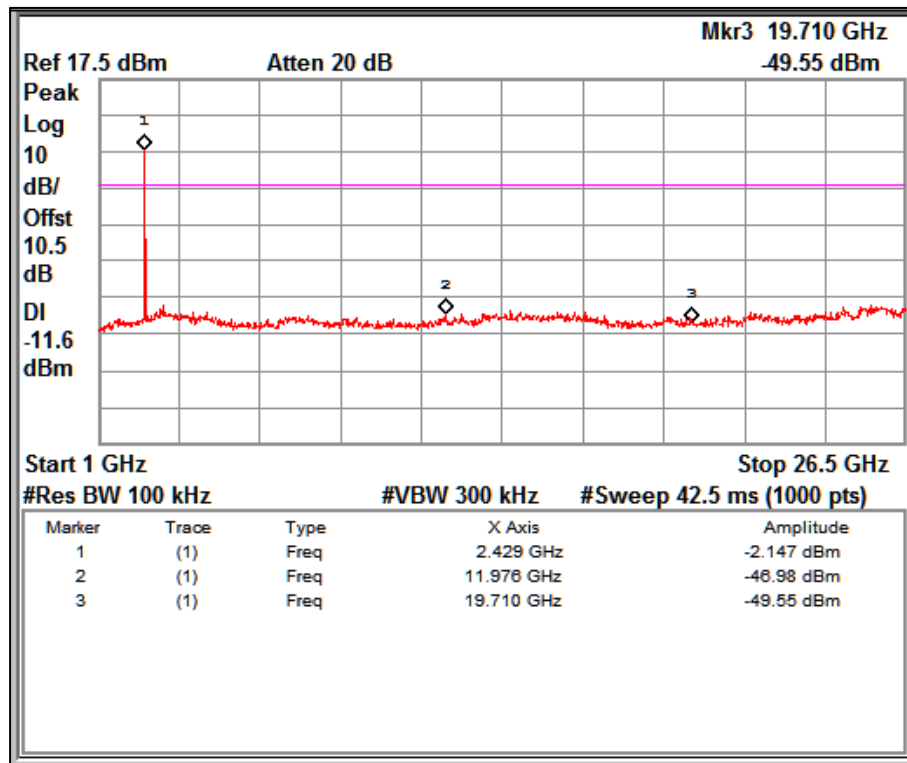
Channel Frequency 2440MHz

Frequency Range 30MHz – 1GHz

Prüfbericht - Nr.:
Test Report No.:

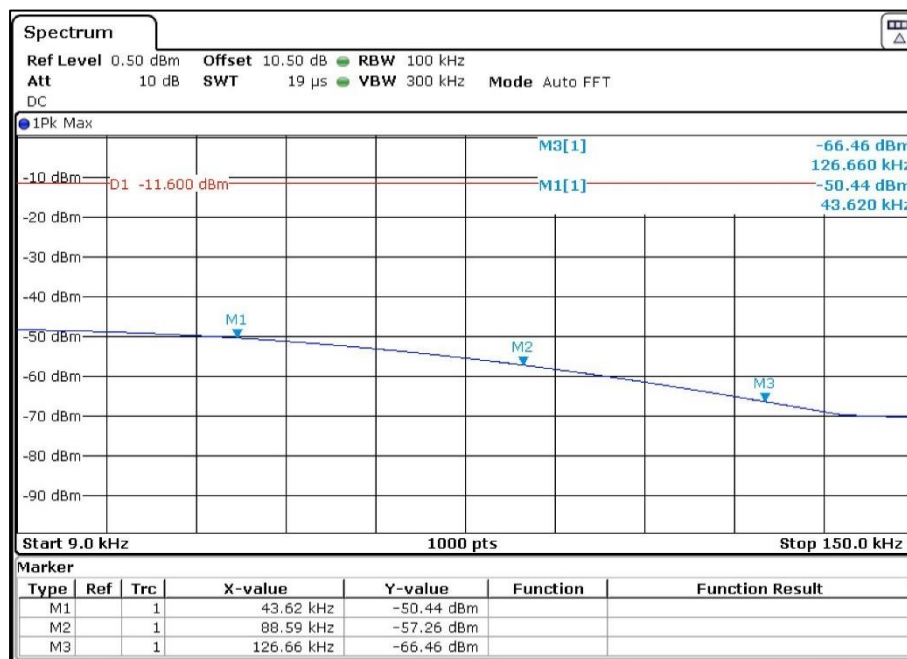
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Channel Frequency 2440MHz

Frequency Range 1GHz – 26.5GHz



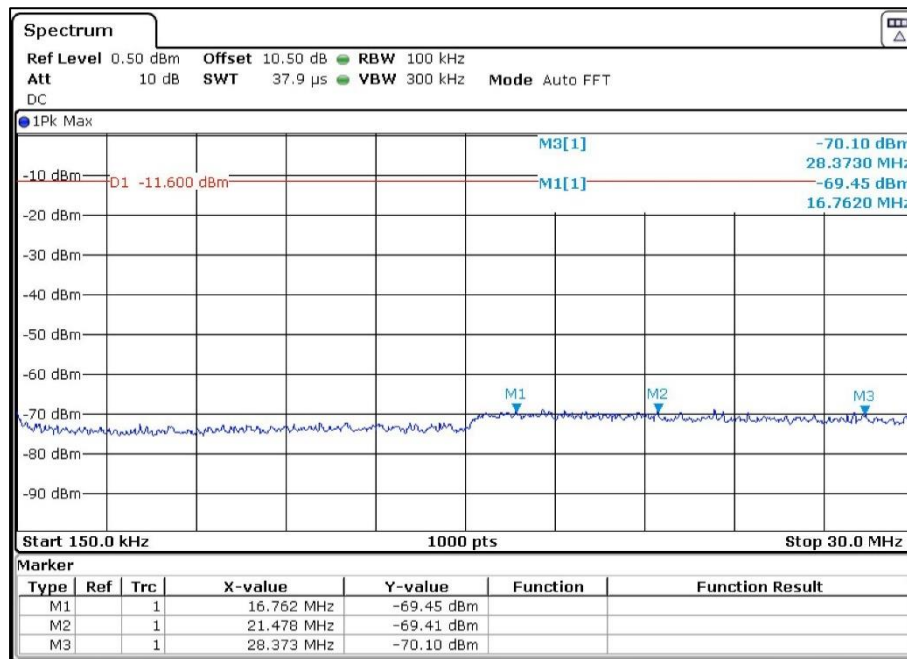
Channel Frequency 2480MHz

Frequency Range 9KHz – 150KHz

Prüfbericht - Nr.:
Test Report No.:

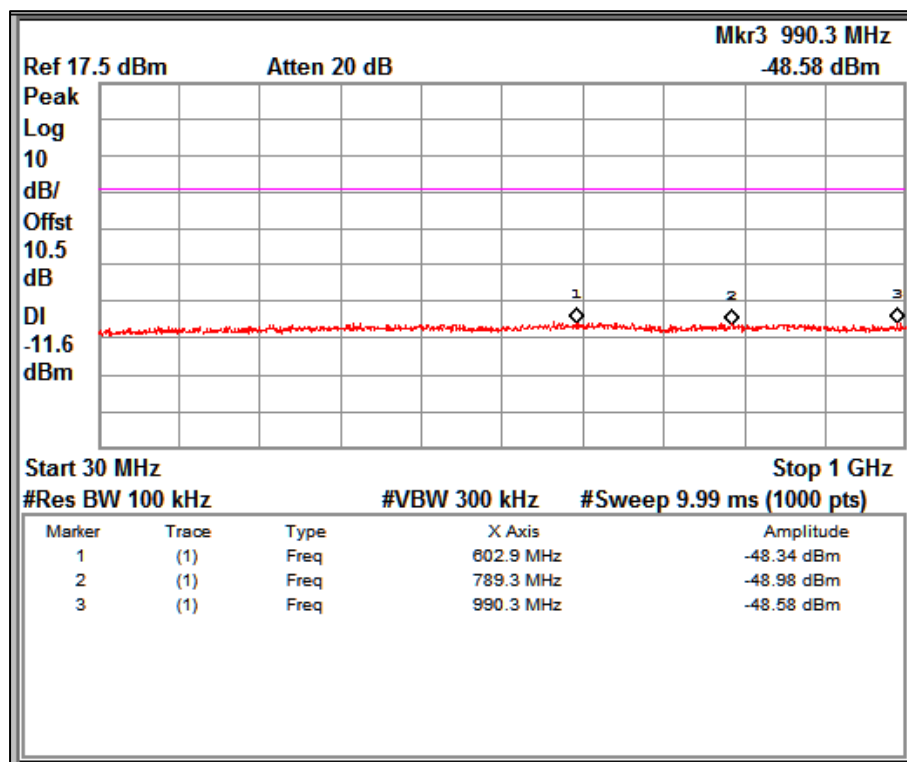
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Channel Frequency 2480MHz

Frequency Range 150KHz – 30MHz



Channel Frequency 2480MHz

Frequency Range 30MHz – 1GHz

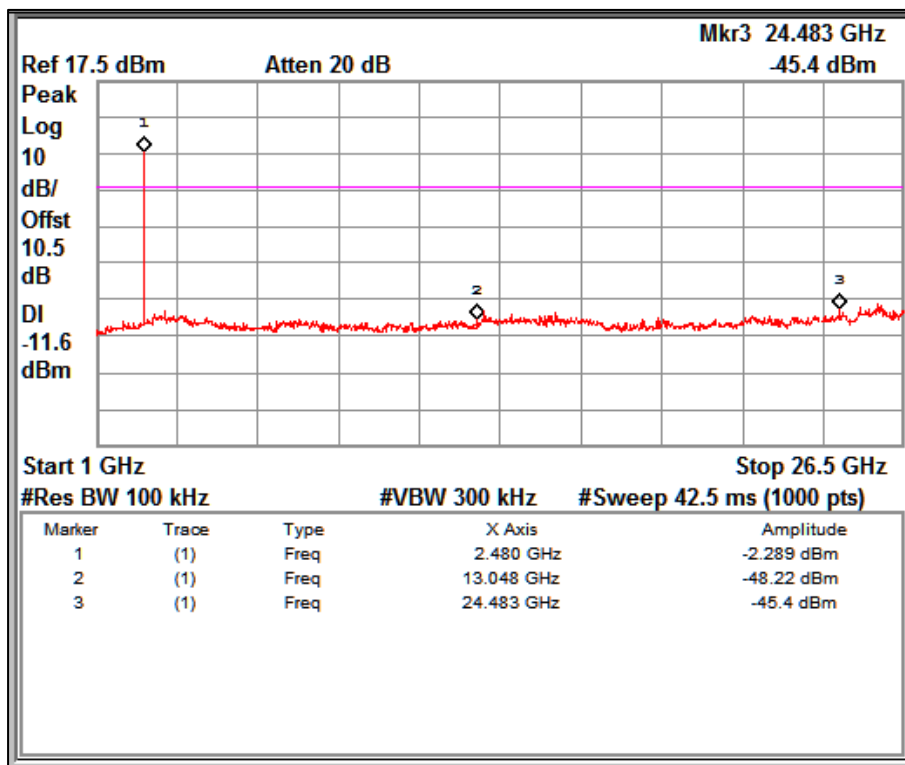
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Channel Frequency 2480MHz

Frequency Range 1GHz – 26.5GHz

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8.7 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	Fully anechoic chamber
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 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 Condition:

Temperature (Norm) = + 25 °C

Voltage = 5.0V AC to DC Adaptor

Relative humidity: 62%

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Test results:

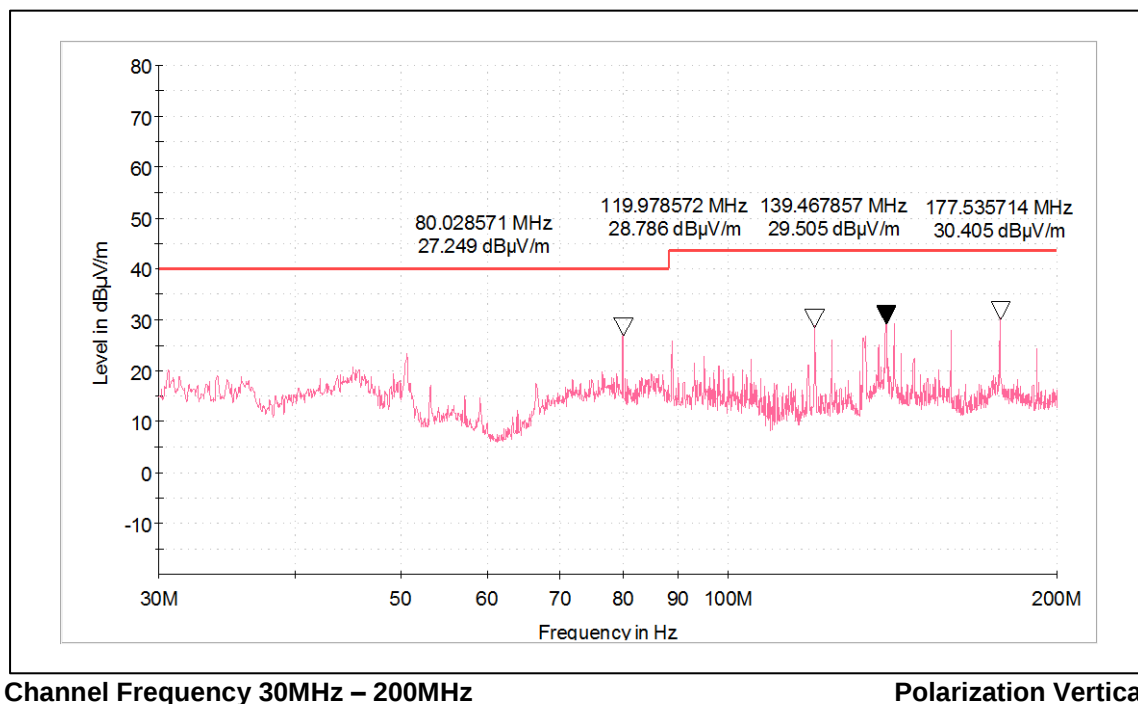
Note: All the losses are included during measurement and final values are mentioned in the test report. Refer TEST METHODOLOGY For more details

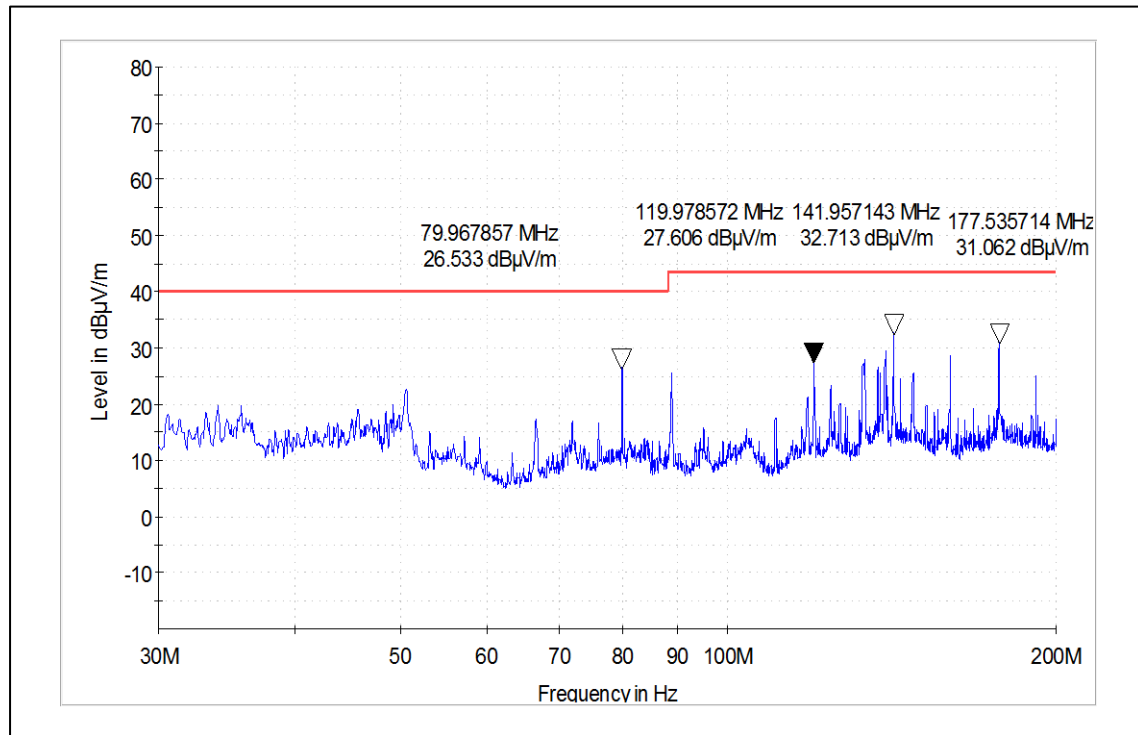
Test results for frequency range 9kHz – 30MHz

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

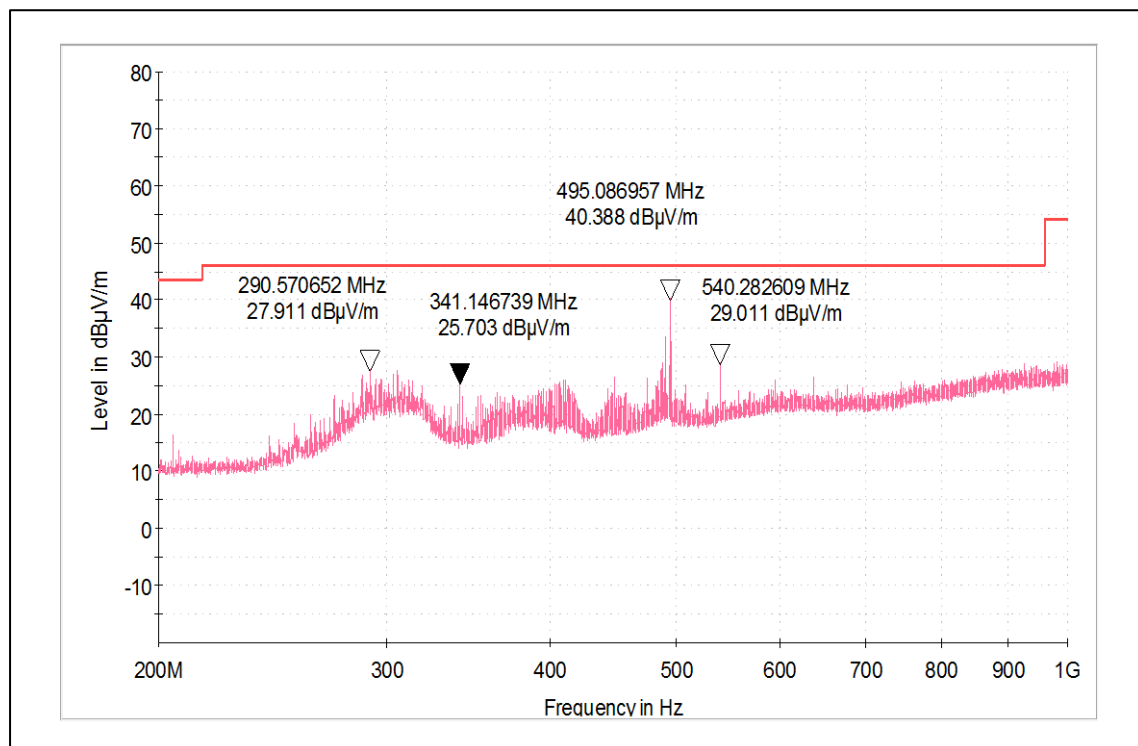
Antenna Polarization	Measured Frequency (MHz)	Measured value (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	80.02	27.24	40.00	-12.76
	119.97	28.78	43.50	-14.72
	139.46	29.50	43.50	-14.00
	177.53	30.40	43.50	-13.10
	290.57	27.91	46.00	-18.09
	341.14	25.70	46.00	-20.30
	495.08	40.38	46.00	-5.62
	540.28	29.01	46.00	-16.99
Horizontal	79.96	26.53	40.00	-13.47
	119.97	27.60	43.50	-15.90
	141.95	32.71	43.50	-10.79
	177.53	31.06	43.50	-12.44
	316.69	31.90	46.00	-14.10
	356.75	31.95	46.00	-14.05
	396.02	34.00	46.00	-12.00
	490.42	30.22	46.00	-15.78





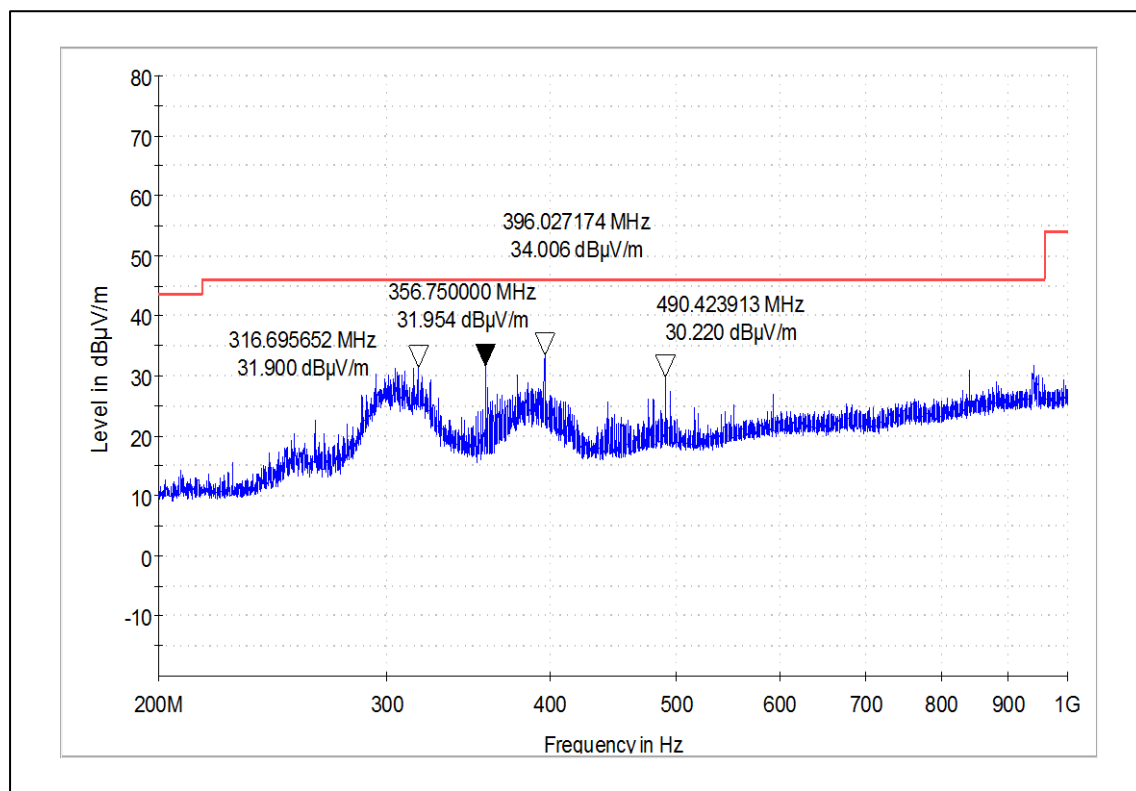
Channel Frequency 30MHz – 200MHz

Polarization Horizontal



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

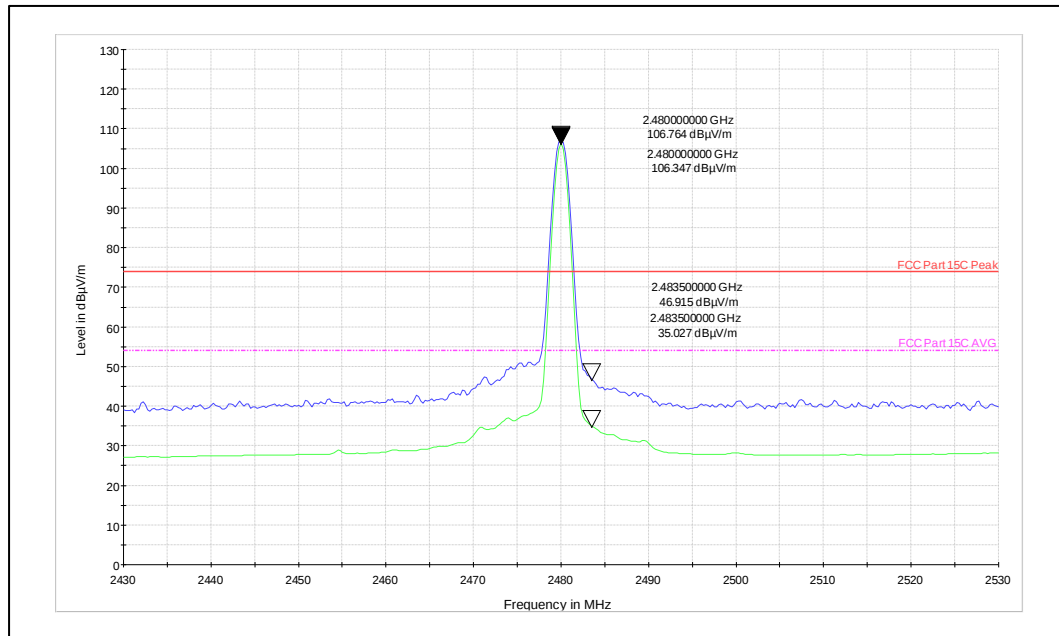
Data Rate: 1Mbps

Channel Frequency (MHz)	Antenna Polarization	Frequency (MHz)	Emission level (dBμV/m)	Limit (dBm)	Margin (dB)
2402	Vertical	2402(Pk)	105.06	-	-
		2402(Av)	104.68	-	-
		2390(Pk)	38.60	74*	-35.40
		2390(Av)	26.19	54*	-27.81
		4804(Pk)	41.43	74	-32.57
		4804(Av)	30.41	54	-23.59
		7206(Pk)	47.05	74	-26.95
		7206(Av)	34.80	54	-19.20
	Horizontal	2402(Pk)	95.04	-	-
		2402(Av)	95.43	-	-
		2390(Pk)	36.40	74*	-37.60
		2390(Av)	23.40	54*	-30.60
		4804(Pk)	41.30	74	-32.70
		4804(Av)	28.89	54	-25.11
		7206(Pk)	46.52	74	-27.48
		7206(Av)	34.69	54	-19.31
2440	Vertical	2440(Pk)	105.72	-	-
		2440(Av)	105.33	-	-
		4880(Pk)	41.05	74	-32.95
		4880(Av)	29.19	54	-24.81
		7320(Pk)	47.39	74	-26.61
		7320(Av)	35.00	54	-19.00
	Horizontal	2440(Pk)	98.65	-	-
		2440(Av)	98.25	-	-
		4880(Pk)	40.83	74	-33.17
		4880(Av)	28.90	54	-25.10
2480	Vertical	7320(Pk)	47.31	74	-26.69
		7320(Av)	34.87	54	-19.13
		2483.5(Pk)	46.91	74*	-27.09
		2483.5(Av)	35.02	54*	-18.98
		2480(Pk)	106.76	-	-
		2480(Av)	106.34	-	-
		4960(Pk)	42.26	74	-31.74
		4960(Av)	30.30	54	-23.70
	Horizontal	7440(Pk)	46.88	74	-27.12
		7440(Av)	34.92	54	-19.08
		2483.5(Pk)	40.98	74*	-33.02
		2483.5(Av)	29.23	54*	-24.77
		2480(Pk)	100.05	-	-
		2480(Av)	99.61	-	-
		4960(Pk)	40.98	74	-33.02
		4960(Av)	28.91	54	-25.09
		7440(Pk)	47.48	74	-26.52
		7440(Av)	34.77	54	-19.23

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

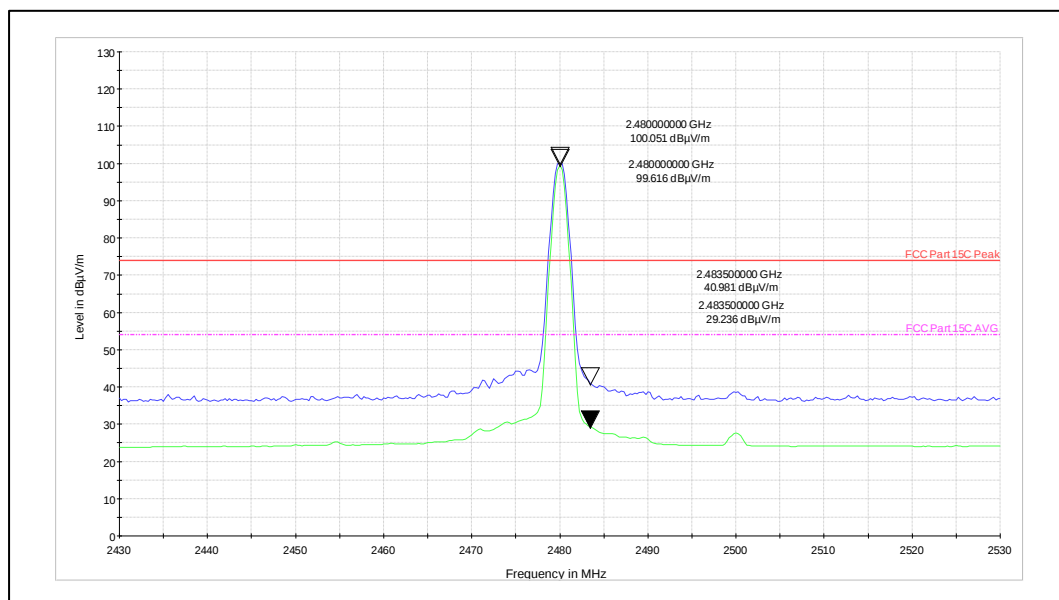
Worst case emissions plots

Data Rate: 1Mbps
Channel Frequency 2480MHz



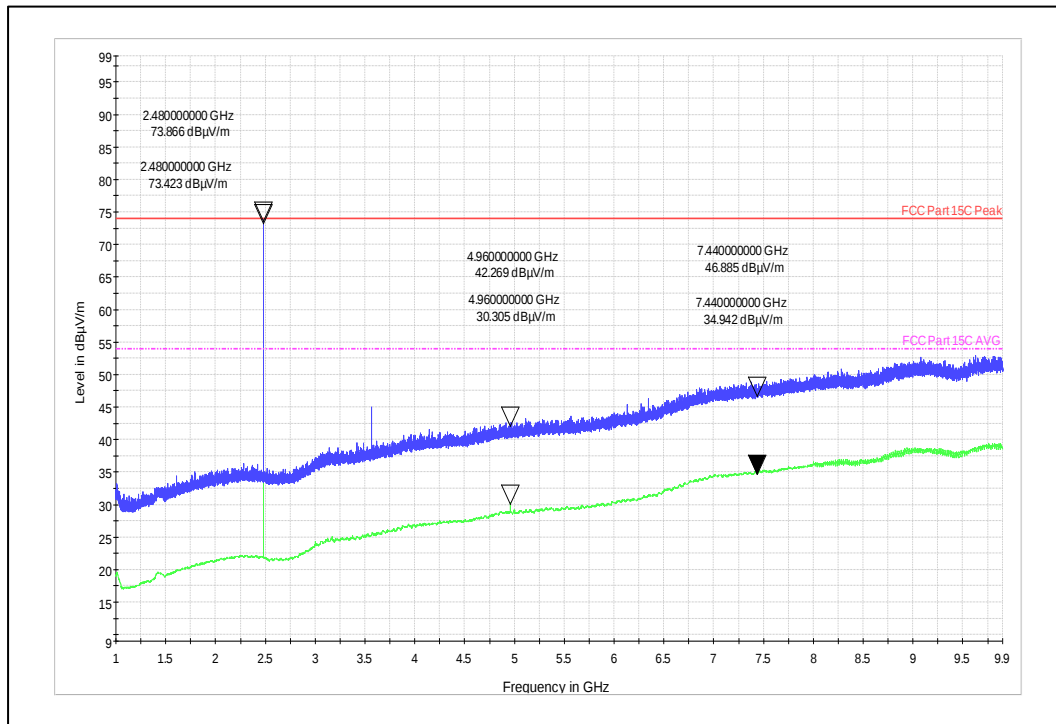
Channel Frequency: 2480MHz

Polarization: Vertical



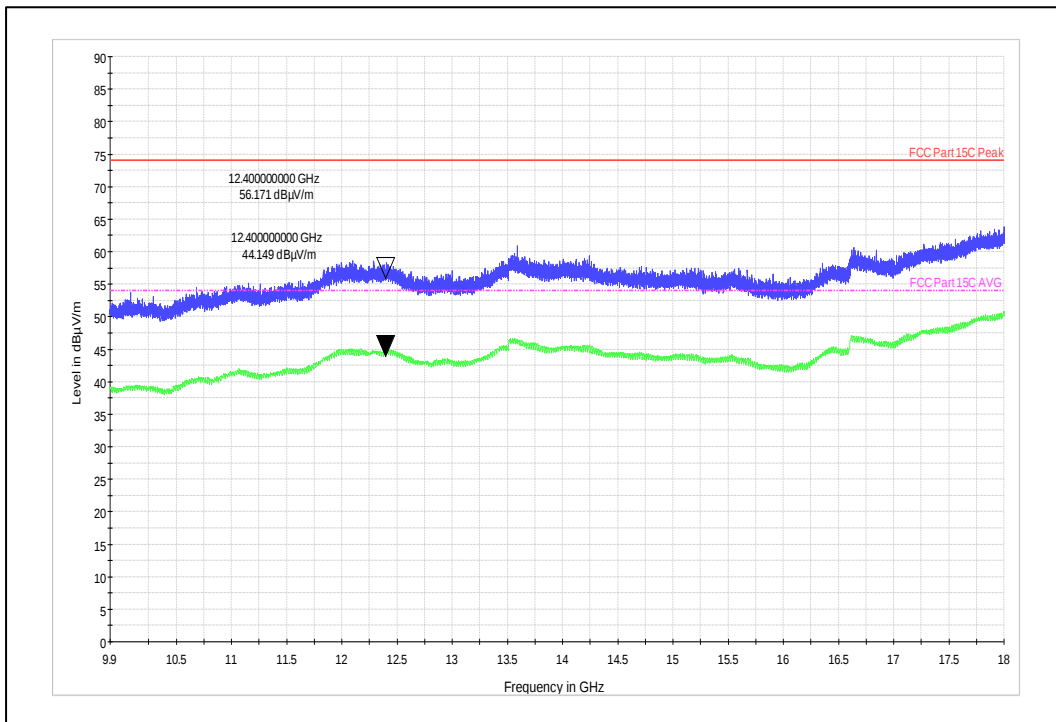
Channel Frequency: 2480MHz

Polarization: Horizontal



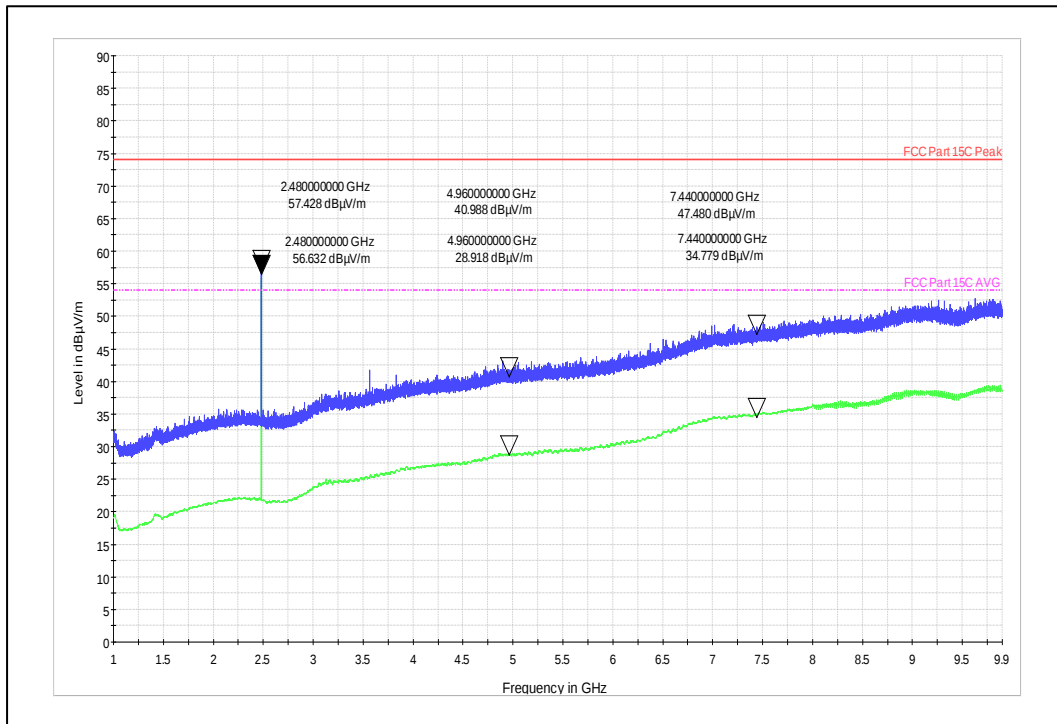
Channel Frequency: 1 – 9.9 GHz

Polarization: Vertical



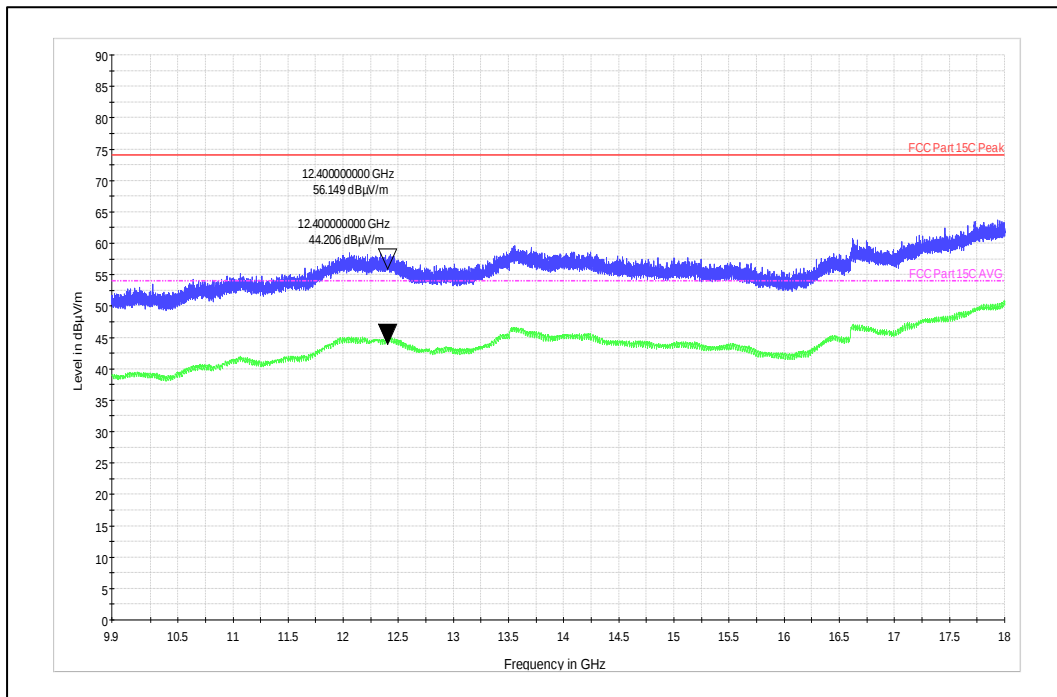
Channel Frequency: 9.9 – 18 GHz

Polarization: Vertical



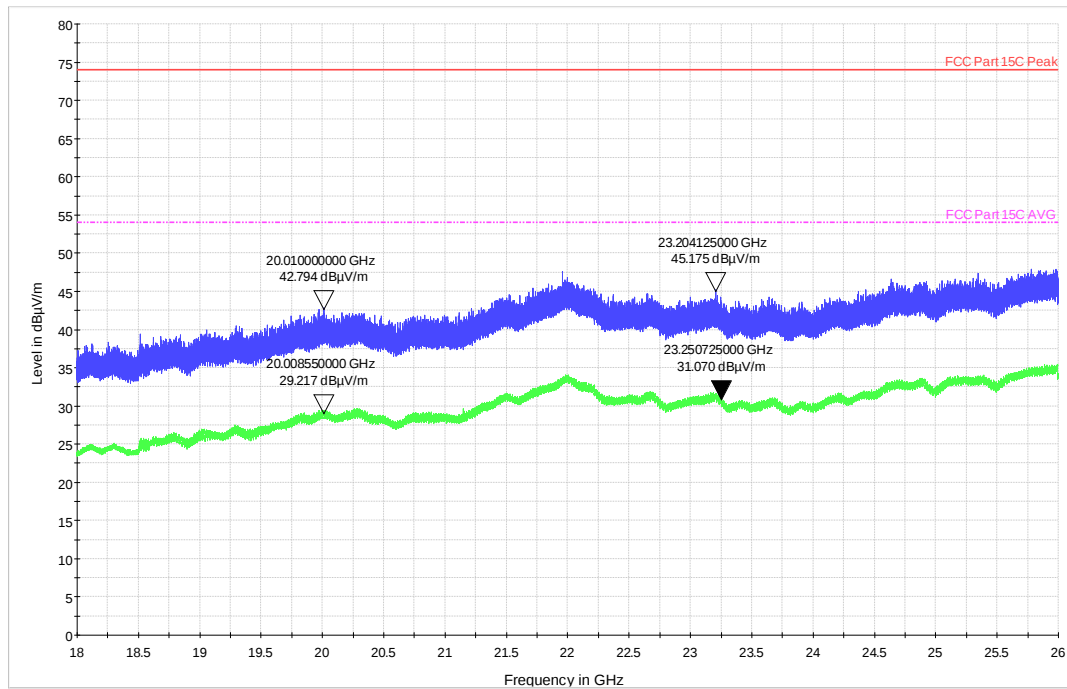
Channel Frequency: 1 – 9.9 GHz

Polarization: Horizontal



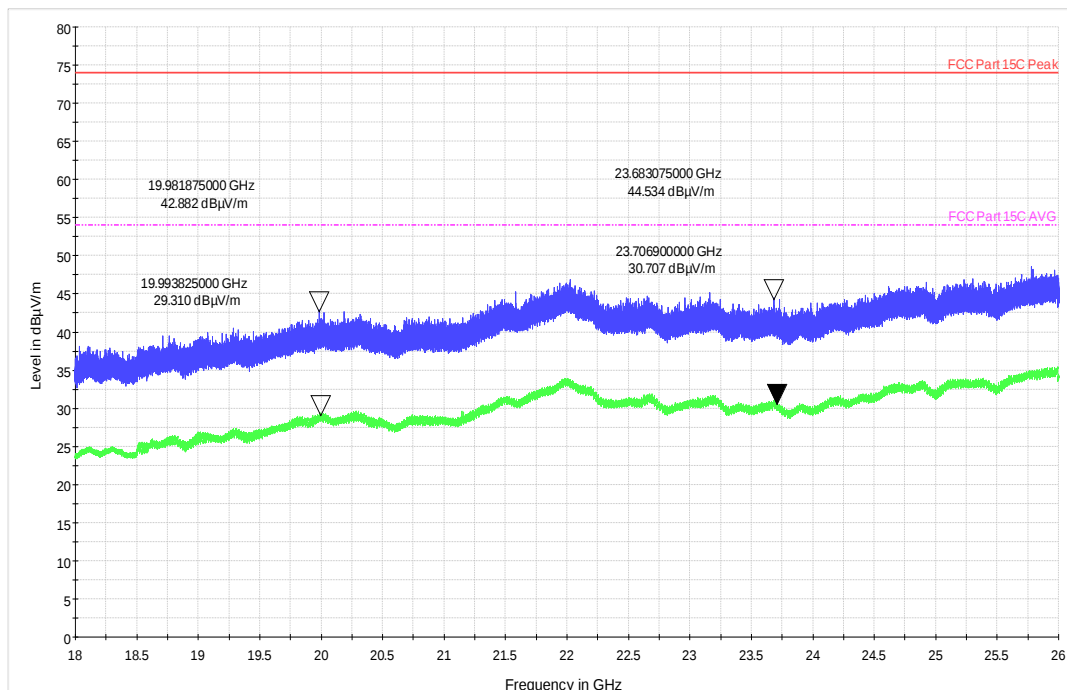
Channel Frequency: 9.9 – 18 GHz

Polarization: Horizontal



Channel Frequency: 18 - 40 GHz

Polarization: Vertical



Channel Frequency: 18 - 40 GHz

Polarization: Horizontal

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9 Conducted Emission on AC Power Lines

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

***Note: The product has tested with AC to DC adapter**

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 (Through AC to DC Adapter) Relative Humidity = 64%

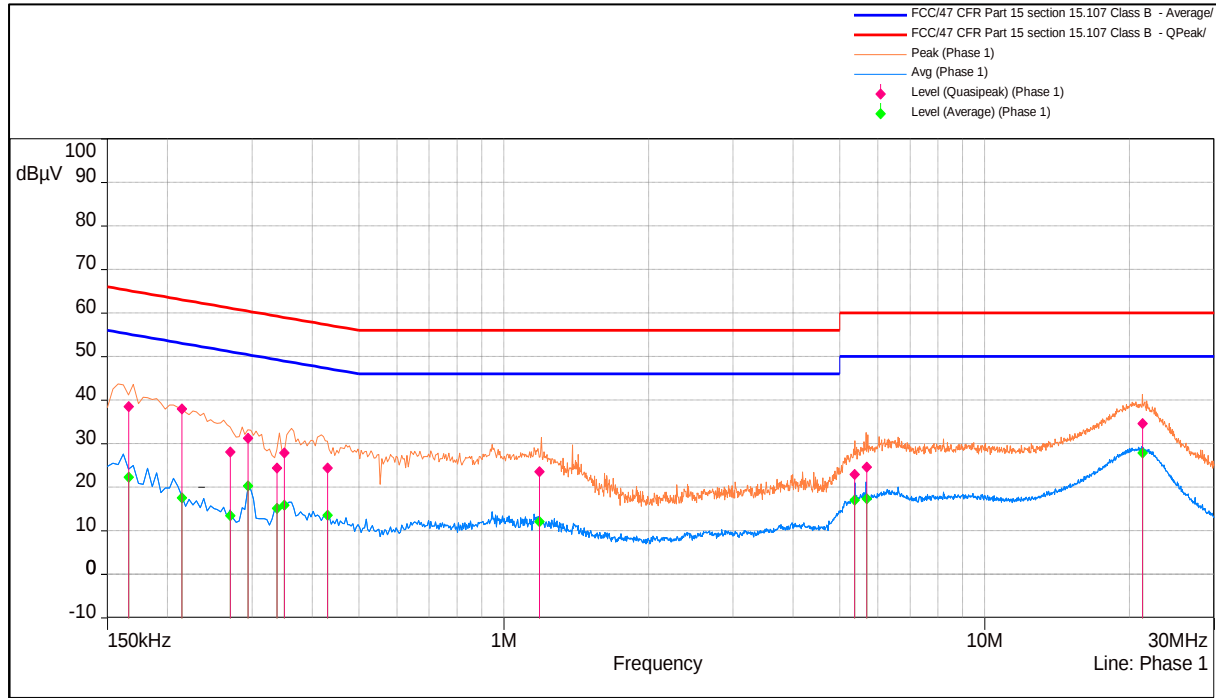
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Test result:

Power: 110V 60HZ_LINE



Line Graph

Quasipeak (23)										
Frequency (MHz)	SR	Level (dBμV)	Limit (dBμV)	Margin (dB)	Pos	Measuring time	RBW	Meas.Time	Comments	Correction (dB)
0.215	1	38.06	63.05	-24.99	Phase 1	1	9k	0.02	Pass	20.16
21.26465	1	34.62	60	-25.38	Phase 1	1	9k	0.02	Pass	20.14
0.1653	1	38.56	65.16	-26.6	Phase 1	1	9k	0.02	Pass	20.22
0.29535	1	31.3	60.41	-29.11	Phase 1	1	9k	0.02	Pass	20.06
0.3503	1	27.85	58.96	-31.11	Phase 1	1	9k	0.02	Pass	20.07
1.1863	1	23.61	56	-32.39	Phase 1	1	9k	0.02	Pass	20.43
0.4315	1	24.4	57.25	-32.85	Phase 1	1	9k	0.02	Pass	20.08
0.2715	1	28.12	61.12	-33	Phase 1	1	9k	0.02	Pass	20.09
0.33795	1	24.46	59.25	-34.79	Phase 1	1	9k	0.02	Pass	20.06
5.68075	1	24.6	60	-35.4	Phase 1	1	9k	0.02	Pass	20.54
5.3592	1	23	60	-37	Phase 1	1	9k	0.02	Pass	20.54

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Test Report No.:

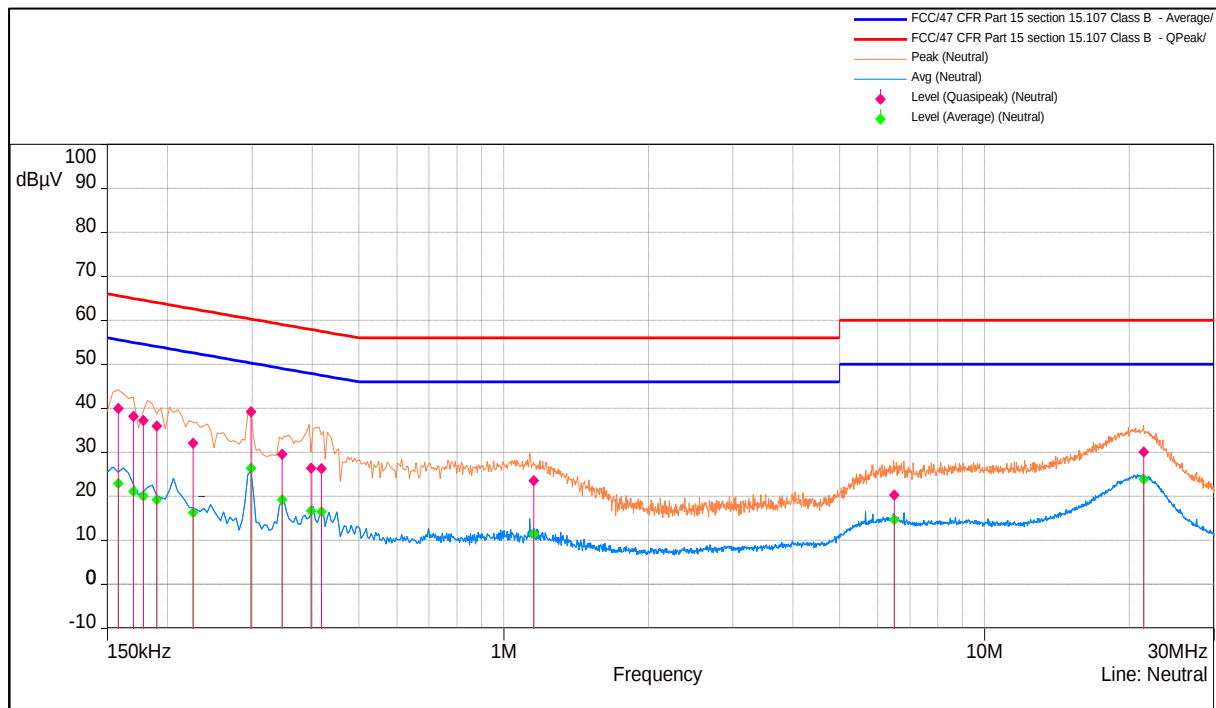
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Average (23)										
Frequency (MHz)	SR	Level (dBμV)	Limit (dBμV)	Margin (dB)	Pos	Measuring time	RBW	Meas.Time	Comments	Correction (dB)
0.1653	1	22.29	55.16	-32.87	Phase 1	1	9k	0.02	Pass	20.22
0.215	1	17.61	53.05	-35.44	Phase 1	1	9k	0.02	Pass	20.16
0.2715	1	13.51	51.12	-37.61	Phase 1	1	9k	0.02	Pass	20.09
0.29535	1	20.33	50.41	-30.08	Phase 1	1	9k	0.02	Pass	20.06
0.33795	1	15.19	49.25	-34.06	Phase 1	1	9k	0.02	Pass	20.06
0.3503	1	15.93	48.96	-33.03	Phase 1	1	9k	0.02	Pass	20.07
0.4315	1	13.57	47.25	-33.68	Phase 1	1	9k	0.02	Pass	20.08
1.1863	1	12.09	46	-33.91	Phase 1	1	9k	0.02	Pass	20.43
5.3592	1	17.01	50	-32.99	Phase 1	1	9k	0.02	Pass	20.54
5.68075	1	17.42	50	-32.58	Phase 1	1	9k	0.02	Pass	20.54
21.26465	1	27.9	50	-22.1	Phase 1	1	9k	0.02	Pass	20.14

Line Table

Power: 110V60HZ_NEUTRAL



Neutral Graph

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Quasipeak (23)										
Frequency (MHz)	SR	Level (dBμV)	Limit (dBμV)	Margin (dB)	Pos	Measuring time	RBW	Meas. Time	Comments	Correction (dB)
0.29665	2	39.24	60.3	-21.06	Neutral	1	9k	0.02	Pass	19.96
0.15675	2	39.99	65.57	-25.58	Neutral	1	9k	0.02	Pass	20.3
0.16805	2	38.24	64.96	-26.72	Neutral	1	9k	0.02	Pass	20.27
0.1795	2	37.25	64.58	-27.33	Neutral	1	9k	0.02	Pass	20.24
0.1916	2	36.02	64.04	-28.01	Neutral	1	9k	0.02	Pass	20.21
0.3442	2	29.58	59.06	-29.47	Neutral	1	9k	0.02	Pass	20.01
21.4065	2	30.08	60	-29.92	Neutral	1	9k	0.02	Pass	20.43
0.2262	2	32.15	62.6	-30.45	Neutral	1	9k	0.02	Pass	20.13
0.41605	2	26.37	57.49	-31.12	Neutral	1	9k	0.02	Pass	20.12
0.39895	2	26.43	57.9	-31.47	Neutral	1	9k	0.02	Pass	20.09
1.15335	2	23.55	56	-32.45	Neutral	1	9k	0.02	Pass	20.51
6.4893	2	20.28	60	-39.72	Neutral	1	9k	0.02	Pass	20.69

Average (23)										
Frequency (MHz)	SR	Level (dBμV)	Limit (dBμV)	Margin (dB)	Pos	Measuring time	RBW	Meas. Time	Comments	Correction (dB)
0.29665	2	26.41	50.3	-23.89	Neutral	1	9k	0.02	Pass	19.96
21.4065	2	23.85	50	-26.15	Neutral	1	9k	0.02	Pass	20.43
0.3442	2	19.24	49.06	-29.82	Neutral	1	9k	0.02	Pass	20.01
0.41605	2	16.58	47.49	-30.91	Neutral	1	9k	0.02	Pass	20.12
0.39895	2	16.71	47.9	-31.19	Neutral	1	9k	0.02	Pass	20.09
0.15675	2	22.95	55.57	-32.62	Neutral	1	9k	0.02	Pass	20.3
0.16805	2	21.18	54.96	-33.78	Neutral	1	9k	0.02	Pass	20.27
0.1795	2	20.11	54.58	-34.47	Neutral	1	9k	0.02	Pass	20.24
1.15335	2	11.44	46	-34.56	Neutral	1	9k	0.02	Pass	20.51
0.1916	2	19.27	54.04	-34.76	Neutral	1	9k	0.02	Pass	20.21
6.4893	2	14.7	50	-35.3	Neutral	1	9k	0.02	Pass	20.69
0.2262	2	16.31	52.6	-36.29	Neutral	1	9k	0.02	Pass	20.13

Neutral Table

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11 Power level used for 1, 2, 3 Mbps

Channel Frequency (MHz)	Power level
2402	9
2440	9
2480	9

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