

Prüfbericht-Nr.: <i>Test report no.:</i>	IN22VUH5 ULR-TC568822300000106F	Auftrags-Nr.: <i>Order no.:</i>	146738981 010 Seite 1 von 51 Page 1 of 51
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	2458640	Auftragsdatum: <i>Order date:</i>	2022-11-23
Auftraggeber: <i>Client:</i>	Dotcom IoT LLP 1ST, C-25, OFFICE NO 1 LAXMI TOWERS, BANDRA KURLA COMPLEX Mumbai - 400051		
Prüfgegenstand: <i>Test item:</i>	S-node		
Bezeichnung <i>Identification</i>	SN0001A	Serien-Nr.: <i>Serial no.:</i>	Engineering Sample
Auftrags-Inhalt: <i>Order content:</i>	Testing and issue of Test Report and Grant Certificate		
Prüfgrundlage: <i>Test specification:</i>	FCC Part 15 Subpart C 15.247,15.205, 15.207 & 15.209		
Wareneingangsdatum: <i>Date of sample receipt:</i>	23-11-2022		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003377890-002		
Prüfzeitraum: <i>Testing period:</i>	2022-11-24 - 2022-11-26		
Ort der Prüfung: <i>Place of testing:</i>	Wireless laboratory, Bangalore		
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (India) Pvt. Ltd. 27/B,2nd cross road, Electronic city Phase1, Bangalore-560100, India		
Prüfergebnis*: <i>Test result*:</i>	Pass		
geprüft von: <i>tested by:</i>	genehmigt von: <i>authorized by:</i>		
Datum: <i>Date:</i> 2022-11-27	Ausstellatum: <i>Issue date:</i> 23-12-2022		
Stellung / Position:	Likhithesh M D Senior Engineer	Stellung / Position:	Madhu K N Senior Engineer
Sonstiges / Other:	FCC ID: 2A9OQ-SN0001A		
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* 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. <i>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.</i>			

V05

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TEST SUMMARY

Test Item	FCC	Result
Maximum conducted (average) output power	FCC 15.247(b)(3)	Pass
Maximum Power Spectral Density	FCC 15.247(e)	Pass
Occupied bandwidth and 6dB Bandwidth	15.247 (a) (2)	Pass
Emissions in non-restricted frequency bands	15.247 (d)	Pass
Spurious Radiated Emissions and Restricted Bands of Operation	FCC 15.209 / FCC 15.205	Pass
Conducted Spurious Emission on AC Power lines	FCC 15.207	Pass

Product Category: Electronics Testing
Test Discipline: EMC Test Facility

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REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
ULR-TC568822300000106F	01	Initial issue of report	16-12-2022
ULR-TC568822300000106F	02	Reviewer comments updated	23-12-2022

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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

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
Active loop antenna	Frankonia	LAX-10	LAX-10-800	-	31-01-2023	Yearly	Radiated Spurious Emission
Baloon and Biconical Antenna	Schwarzbeck Mess-Elektronik	VHBB-9124 / BBA-9106	1028	-	03-02-2023	Yearly	
Log - Periodical Antenna	Schwarzbeck Mess-Elektronik	VUSLP 9111B	9111B-111	-	04-02-2023	Yearly	
Horn Antenna	Schwarzbeck	HAX-18	HAX18-802	-	20-05-2023	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-1944	-	18-10-2023	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	
EMI Receiver	Rohde & Schwarz	ESW 44	101732	4.73.SP5	04-08-2023	Yearly	
EMI Receiver	Rohde & Schwarz	ESW44	101773	1.72SP1	12-02-2023	Yearly	
Spectrum Analyser	Agilent Technologies	E4407B	US41192 772	A.14.06	15-12-2022	Yearly	Antenna-Port Conducted test
EMI Receiver	Rohde & Schwarz	ESR7	101133	3.48 SP3	22-07-2023	Yearly	Conducted AC Power line Test
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100811	-	12-07-2023	Yearly	
LISN	Rohde & Schwarz	ENV216	100022	-	11-10-2023	Yearly	

Table 2: Instrument application Software versions

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

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

- S-node is a tiny, truly plug-and-play sensor node designed to enable predictive maintenance at a fingertip. A tiny, ultra-low power sensor nodes communicate with each other in a secure mesh network to send the sensor's raw data to the cloud via a gateway.
- S-node is used for measure 3D vibration, acoustic emissions, gas emissions, RPM, and IR thermal.

3.2 Ratings and System Details of Equipment under Test

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

Radio Protocol	ZigBee
Operating Frequency Range	2405MHz to 2480MHz
Channel Spacing	5 MHz
Tx Transmitting Power	-20 to to +6 dBm
Maximum Measured Power	6.96 dBm @ 2405MHz
Modulation	O-QPSK
Data Rate	250 kbps
Number of antennas	1
Antenna Gain & Antenna Type	1.5 dBi & PCB antenna
Antenna Model	B
Supply Voltage to Product	Li-Po Battery: 500mAh/3.7V or DC 5V from USB,
	System Supply Voltage 2.5V
Environmental conditions	-40°C to 85°C
EUT Dimension	Height: 70 mm , S-Node Ring Diameter: 60 mm

***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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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.

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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 Test Operation and Test Software

Software Version: V01

Hardware Version: V01

Test Firmware used for tests where Continuous Transmission

4.3 Special Accessories and Auxiliary Equipment

- None

4.4 Countermeasures to achieve EMC Compliance

- None

4.5 List of frequencies

Frequency Band (GHz)	Channel No.	Frequency (MHz)
ZigBee (2405 MHz – 2480 MHz)	Low	2405
	:	:
	Mid	2440
	:	:
	High	2480

Table 5: List of ZigBee Center frequencies

Channel used for Zigbee 2.4GHz testing

Channel Low : 2405MHz

Channel Mid : 2440MHz

Channel High : 2480MHz

Note:

1. TUV Sample Identification number : A003377890-002– Radiated & Conducted test Sample

5 OPERATIONAL DESCRIPTION

- **S-node Theory of Operations**

S-node is the Dotcom IoT LLP's flagship product, which is designed for Industry 4.0 to make predictive maintenance easy without prior expertise in IoT and machine learning.

It's a tiny, battery-operated wireless device, which sends the sensor's raw data to the gateway by forming the secure wireless mesh network on top of the OpenThread.

The hardware section is divided into the two parts:

1. Motherboard
2. Sensor board

The S-Node supports the plug-and-play architecture which allows plugging sensors board as per the application and industrial needs.

The B2B connector is used to attach the sensor board to the motherboard.

- **SoC/MCU Section**

As per the block diagram, **nRF82540** is the heart of the motherboard which is the High-end multiprotocol Bluetooth Low Energy (LE) SoC. it supports Bluetooth 5.3/Bluetooth mesh/Thread/ Zigbee/802.15.4/ANT.

nRF52840 is the soc with 64 MHz Arm® Cortex-M4 with FPU capability from the **Nordic Semiconductor**.

The sensor communicates with the Motherboard with either I2C, SPI, or UART-based communication depending on the sensors type and supported communication protocol.

- **Power section**

The power section is embedded with the **PMIC**, power switch, and Li-Po Battery. PMIC is responsible for battery charging, battery voltage, load current measurements, and battery health status monitoring. PMIC is digital and communicating with the soc via I2C.

S-node is powered by a **Li-Po Battery** having a capacity of 500 to 2000 mAh/3.7V.

The battery can be charged via **micro USB** with any generic 5V/2A android charger.

- **Storage Section**

S-node supports solid-state storage in form of the **4MB QSPI flash**. QSPI flash is used to store the node configuration, and to store the binary file during the OTA update.

The node also has the SD card socket to insert the **SD card** up to 8GB of storage.

The SD card is used to store the offline sampling data in case of the wireless connectivity failures.

- **Debug section**

Along with the charging, a **micro USB** is also used for the debugging purpose.

The USB supporting the CDC communication to emulate the virtual comm port with the serial terminal.

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- **User button & LED**

The **RGB LED** is used for the communication status indication of the Node.
The switch is attached to the GPIO, which is the user-programmable output pin.

- **Load switches**

Load switches are the solid-state switches that are controlled over the GPIO of the soc.
The main functionality of the load switches is to put off the devices when not to use or in low-power modes.

- **Matching Network, RF section, and antenna**

Matching to 50 ohms: The output impedance of the chip is not 50 ohms. Therefore a matching network needs to be inserted between the chip and the reference point.
There are basically two types of antenna matching networks; a pi-network and a matching network consisting of one shunt component only. The type of antenna decides which matching network to use.
If using a PCB antenna, the matching network should consist of one shunt component, and if using a chip antenna, the matching network should be a pi-network.

S-node is embedded with the PCB antenna having 1.5dBi gain

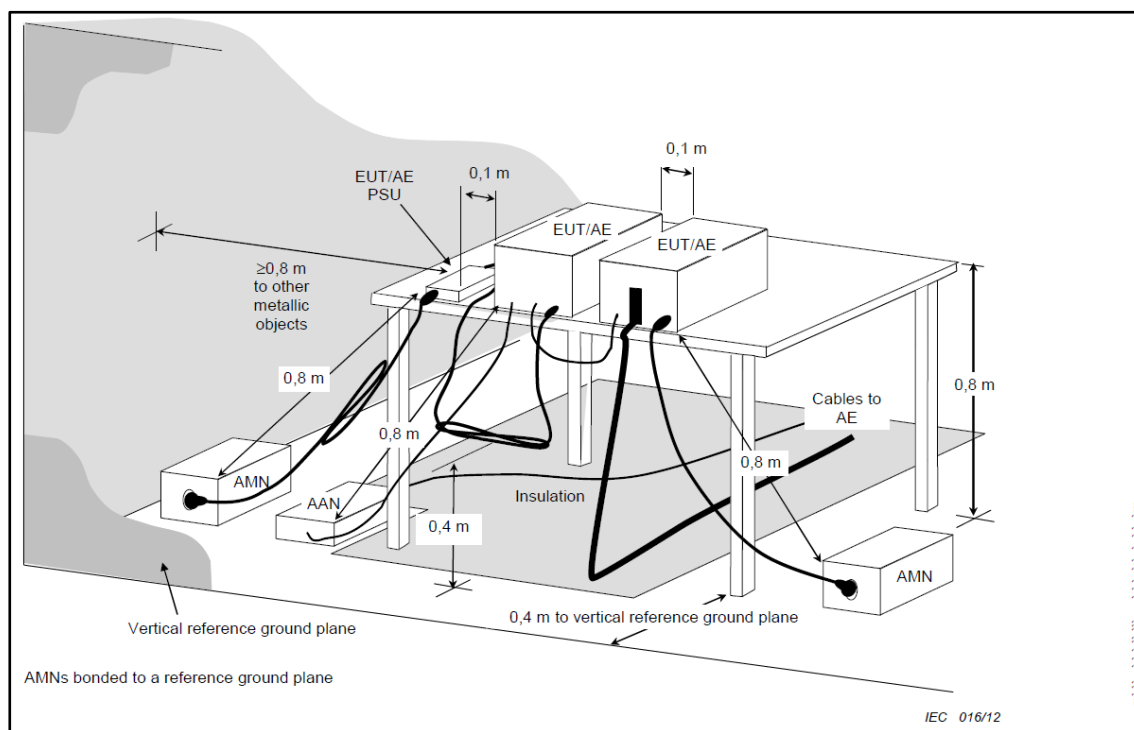
6 TEST METHODOLOGY

6.1 Conducted Spurious Emission Test on AC Power lines

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 by 2 methods and both method are tested individually, one with an AC adaptor with 110V AC 60Hz supply and second with Wireless charger with supply 110V AC 60Hz.

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

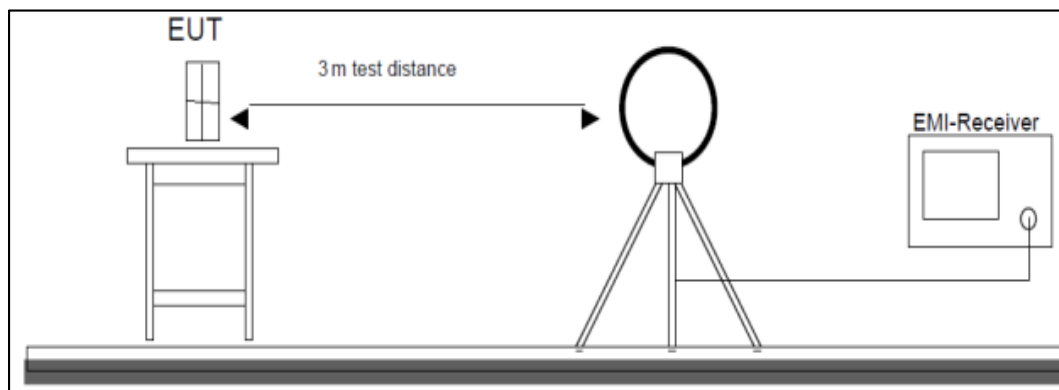


Figure 1: Frequency Range 9 kHz- 30 MHz

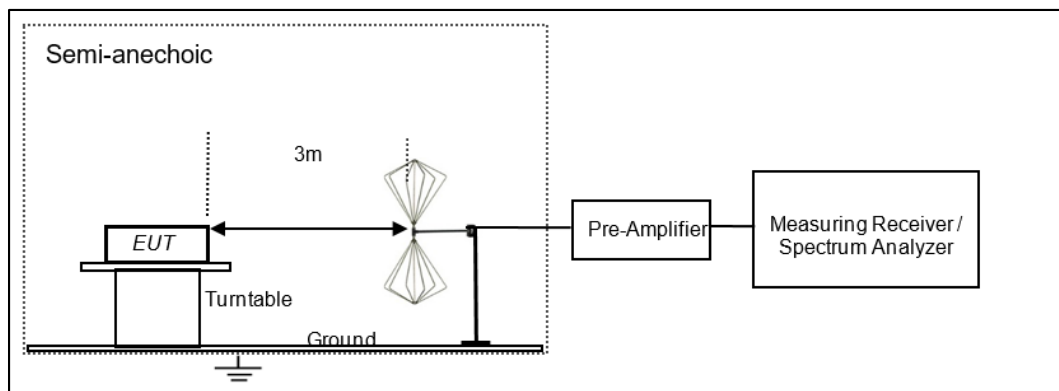


Figure 2: Frequency Range 30 MHz – 200 MHz

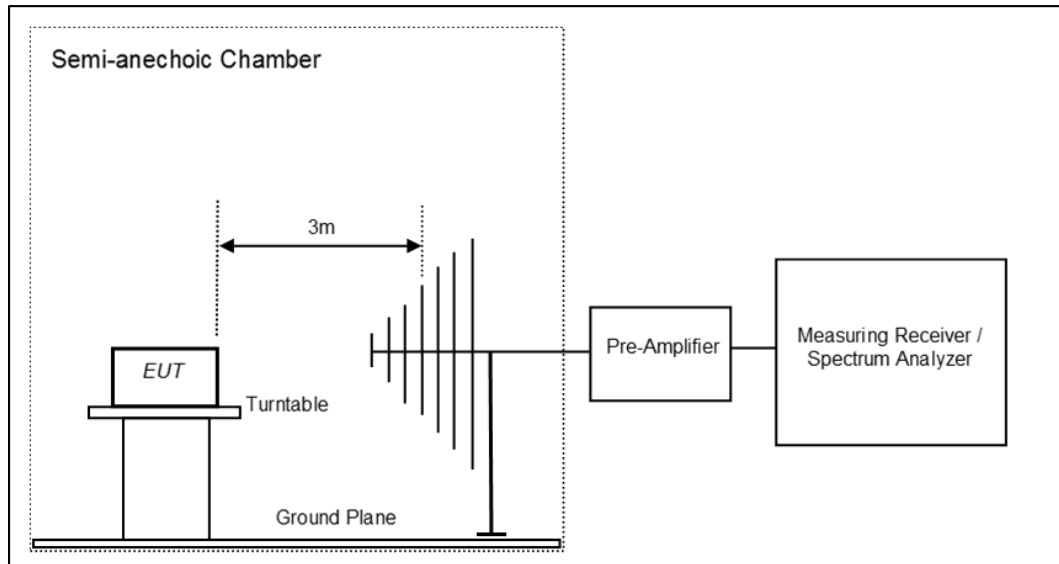


Figure 3: Frequency Range 200 MHz - 1GHz

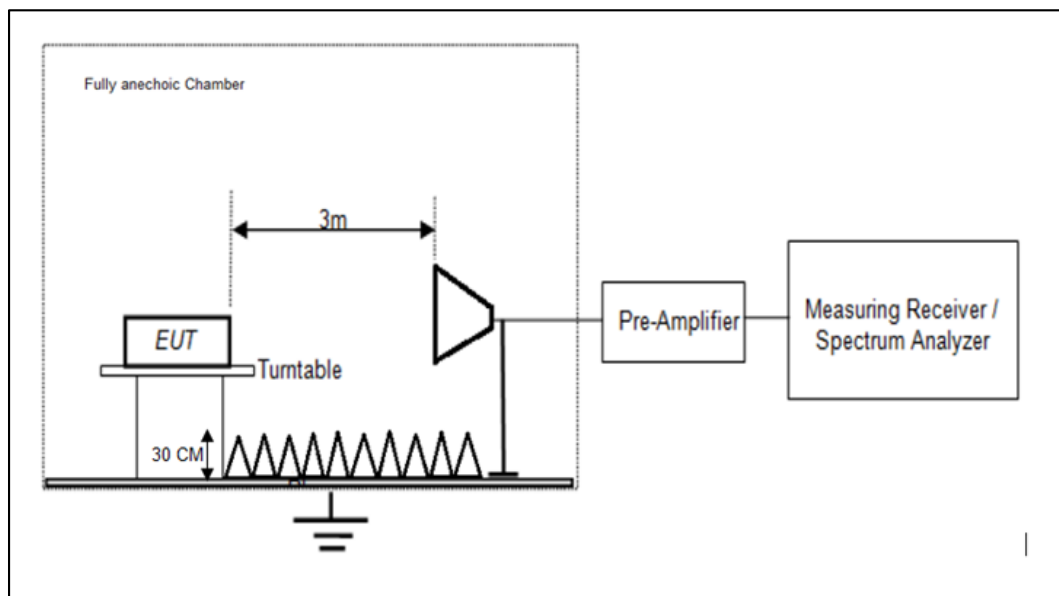


Figure 4: Frequency Range above 1 GHz

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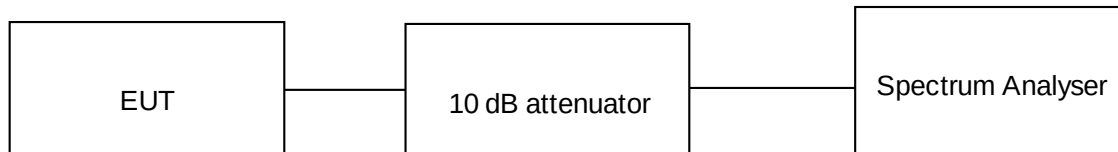
7 TEST RESULTS

7.1 Maximum Average Conducted Output Power

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (b)(3)
Test Method	Subclause 11.9.2.2.4 of ANSI C63.10
Measurement Bandwidth	100kHz
Detector	Average
Port of testing	Antenna port
Requirement	Power $\leq$ 1 W (30 dBm)



Test Condition

Normal Test Condition:

Temperature (Norm) = + 22.1 °C **Voltage** = Li-Po Battery 500mAh/3.7V or DC 5V from USB **Relative humidity** = 65%

KDB Guidelines applied:

Measurements were made as per section 8.3.2.2 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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Test results:

Note:

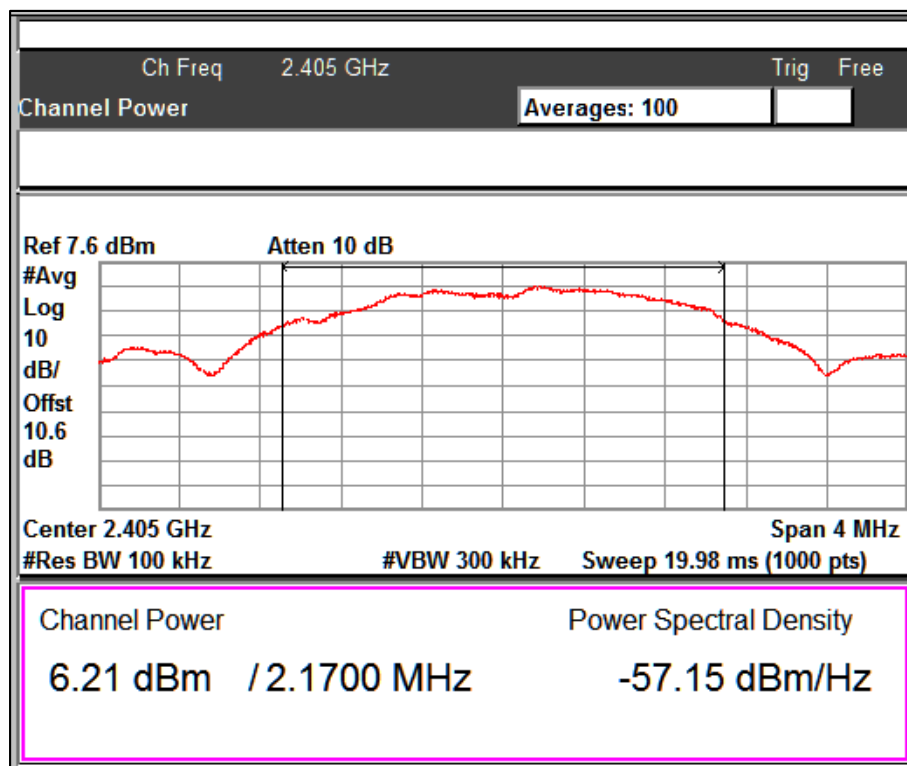
1. All the losses are included during measurement and final values are mentioned in the test report
2. Total Average Output power (dBm) = Measured Average power (dBm) + Attenuator factor (10dB) + Cable loss (0.6dB)
3. This product do not support additional beamforming gain / directional gain, it uses single antenna and hence Directional gain of the single antenna is 1.5 dBi

*Note: Duty Cycle Correction Factor Calculation

$10 \cdot \log(1/X)$ Where X is Duty Cycle is considered in below results

Duty cycle correction Factor is considered in Final Average Power

Channel Frequency (MHz)	Measured Average Power (dBm)	Duty cycle%	Duty Cycle Correction Factor	Maximum Power (dBm)	Power Limit (dBm)
2405	6.21	84.00	0.75	6.96	30
2440	6.12	85.00	0.70	6.82	30
2480	5.49	85.00	0.70	6.19	30

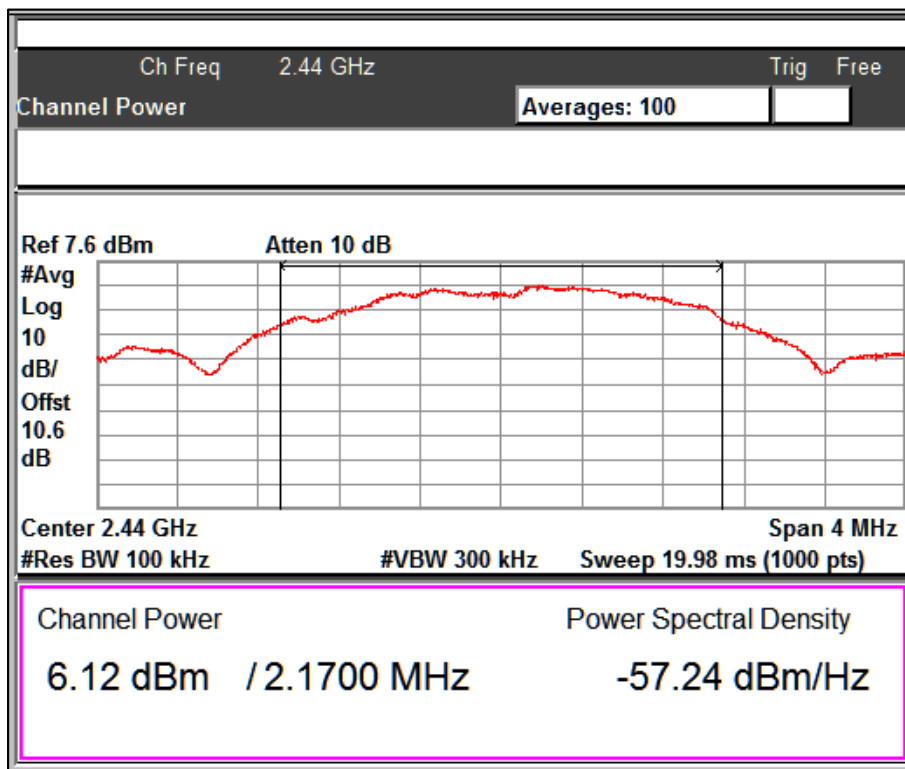


Channel Frequency: 2405MHz

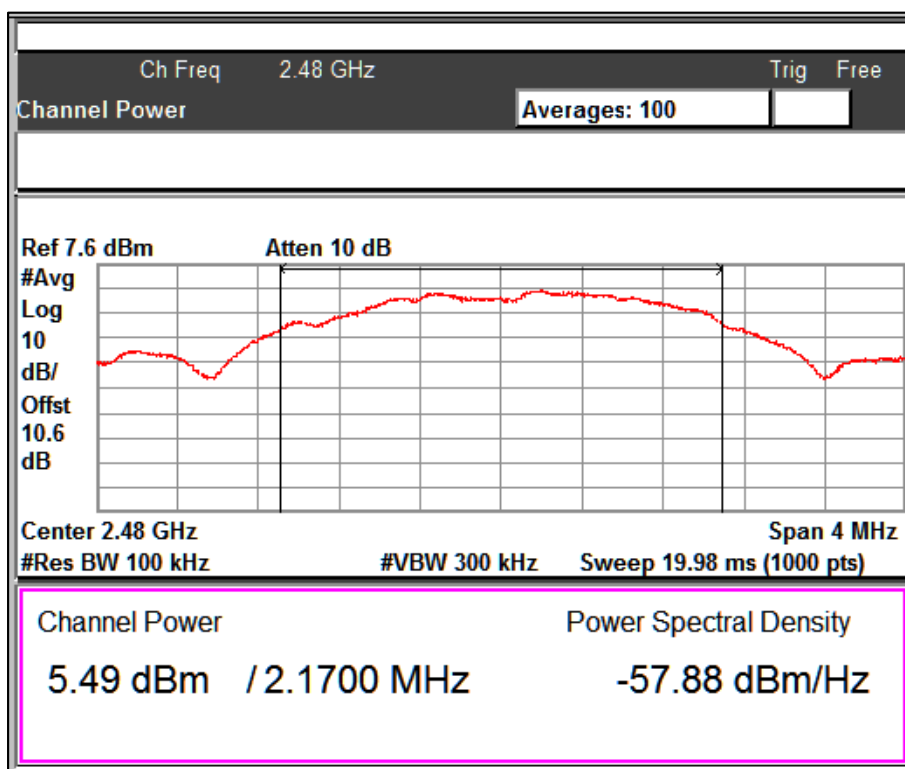
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Channel Frequency: 2440MHz



Channel Frequency: 2480MHz

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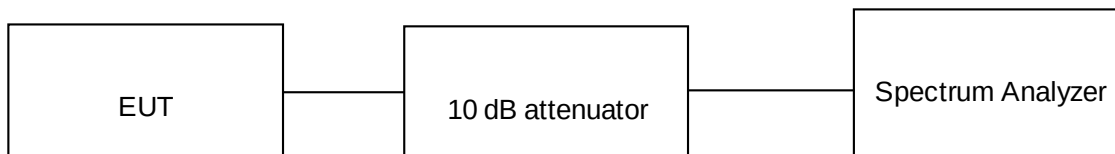
7.1 Maximum Power Spectral Density

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (e)
Test Method	Subclause 11.10.5 of ANSI C63.10
Measurement Bandwidth	100 kHz
Detector	Average sample detector mode
Port of testing	Antenna port
Requirement	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 22.1 °C **Voltage** = Li-Po Battery 500mAh/3.7V or DC 5V from USB **Relative humidity** = 65%

KDB Guidelines applied:

Measurements were made as per section 8.4 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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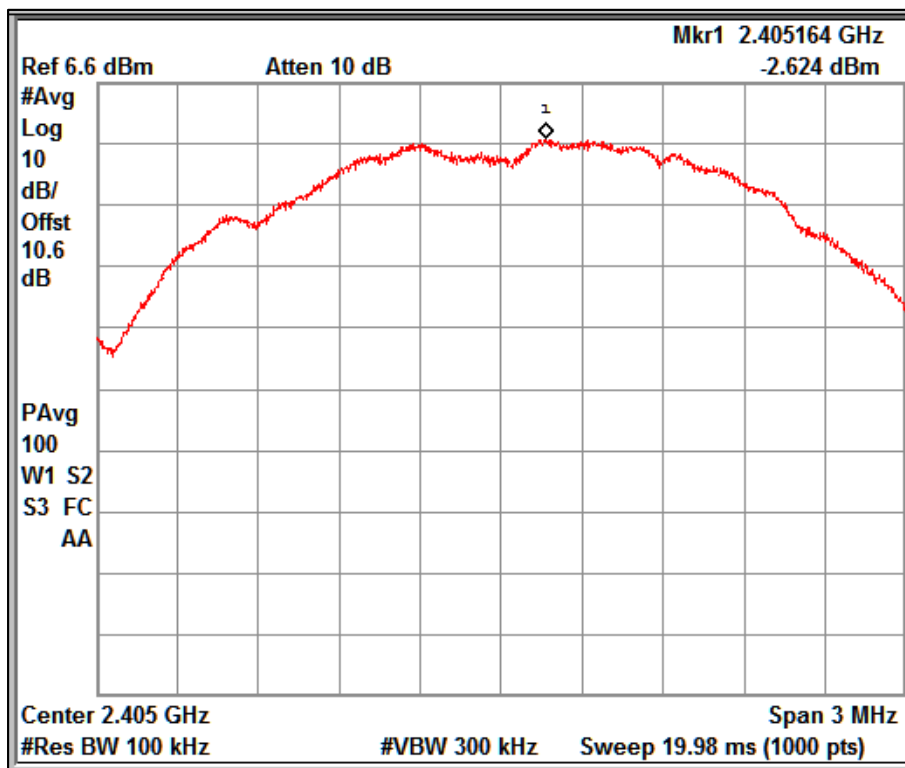
Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Average PSD (dBm) = Measured Average PSD (dBm) + Attenuator factor (10dB) + Cable loss (0.6dB)
3. This product do not support additional beamforming gain / directional gain, it uses signal antenna and hence directional gain of the single antenna is 1.5 dBi

Modulation: 802.11b

Channel Frequency (MHz)	Measured average PSD (dBm/100kHz)	PSD Limit (dBm/100kHz)
2405	-2.62	8.00
2440	-2.67	8.00
2480	-3.64	8.00

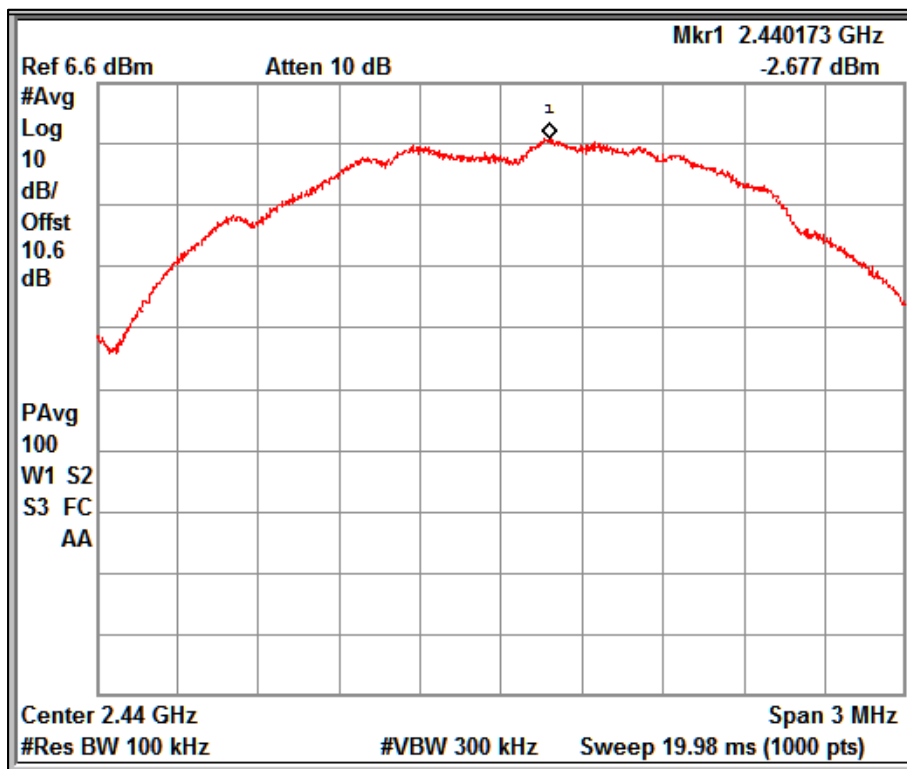


Channel Frequency: 2405MHz

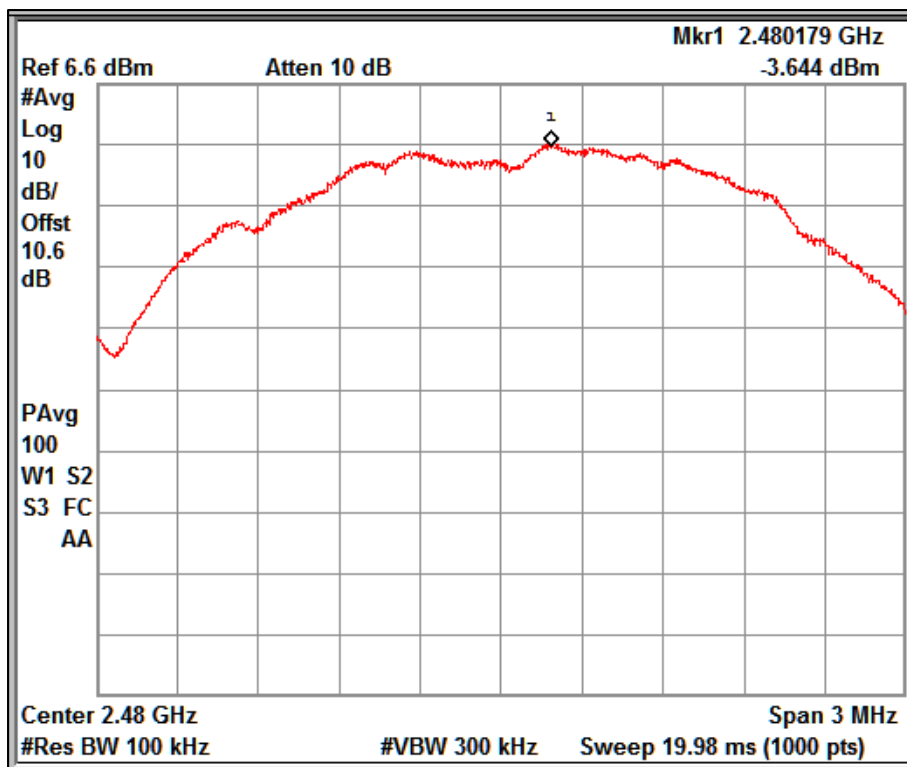
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Channel Frequency: 2440MHz



Channel Frequency: 2480MHz

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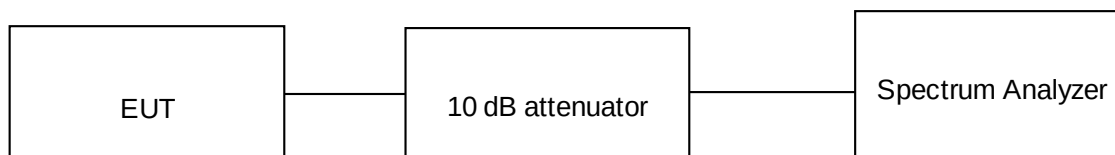
7.2 Occupied bandwidth

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (a) (2)
Test Method	Subclause 11.8.1 & 6.9.3 of ANSI C63.10
Measurement Bandwidth	100 kHz for x dB bandwidth 1 to 5% of OCB for 99% bandwidth
Detector	Peak
Port of testing	Antenna port
Requirement	The minimum 6 dB bandwidth shall be at least 500 kHz

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 22.1 °C **Voltage** = Li-Po Battery 500mAh/3.7V or DC 5V from USB **Relative humidity** = 65%

KDB Guidelines applied:

Measurements were made as per section 8.2 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

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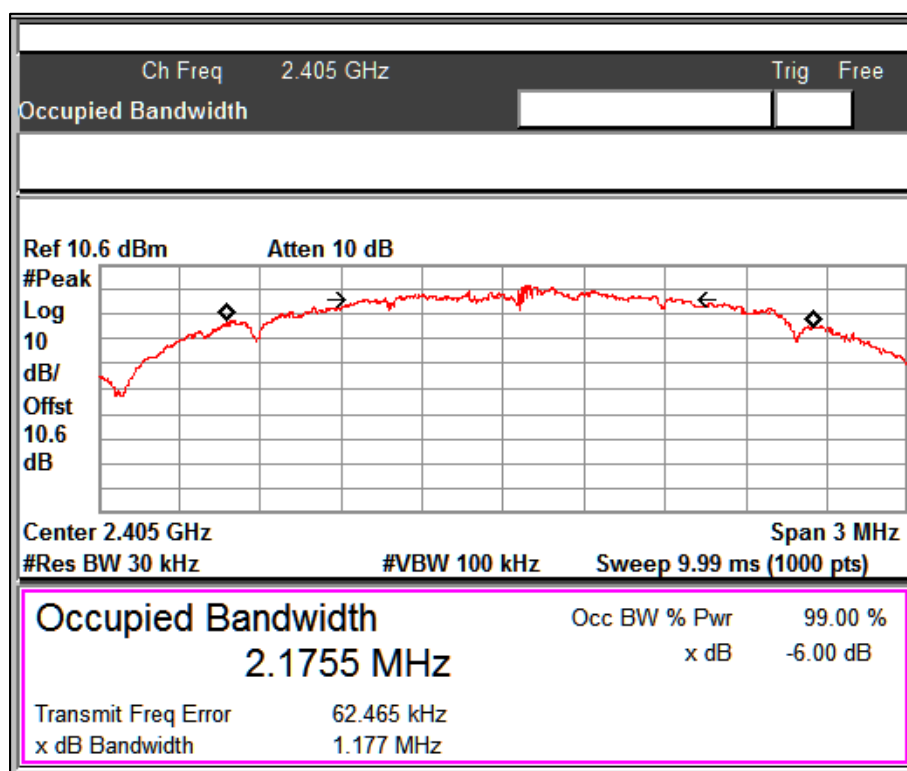
Test results:

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 (0.6dB)
3. This product do not support additional beamforming gain / directional gain, it uses single antenna and hence Directional gain of the single antenna is 1.5 dBi.

Channel Frequency (MHz)	6 dB Bandwidth (MHz)	99% OBW (MHz)	Minimum Limit (MHz)
2405	1.88	2.17	0.5
2440	1.20	2.19	0.5
2480	1.18	2.18	0.5

99% Band width



Channel Frequency: 2405MHz

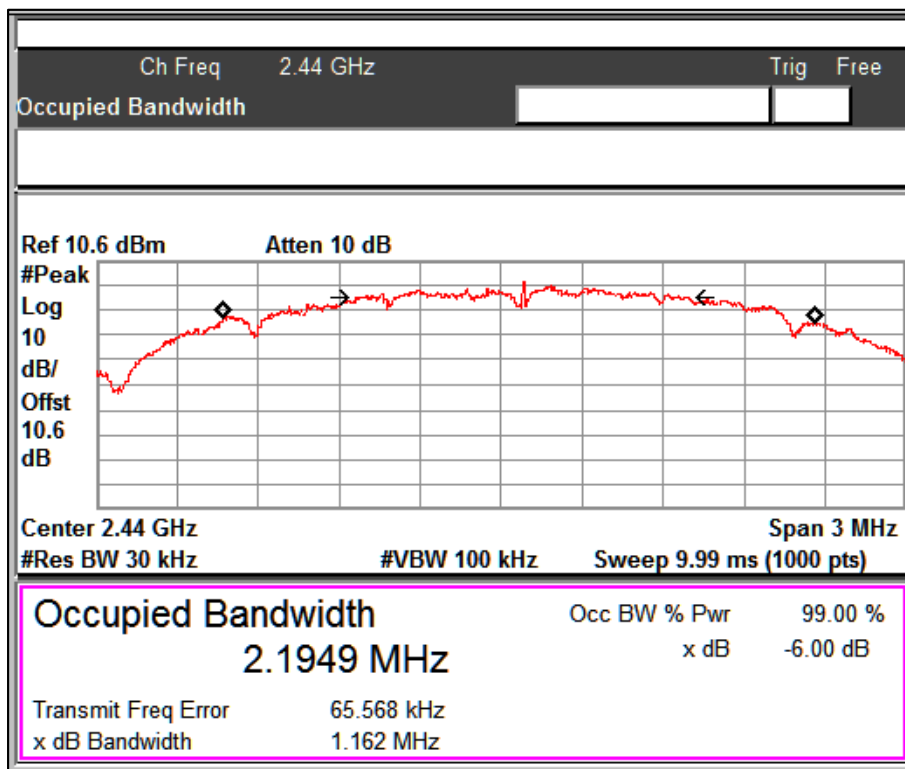
Prüfbericht - Nr.:

Test Report No.:

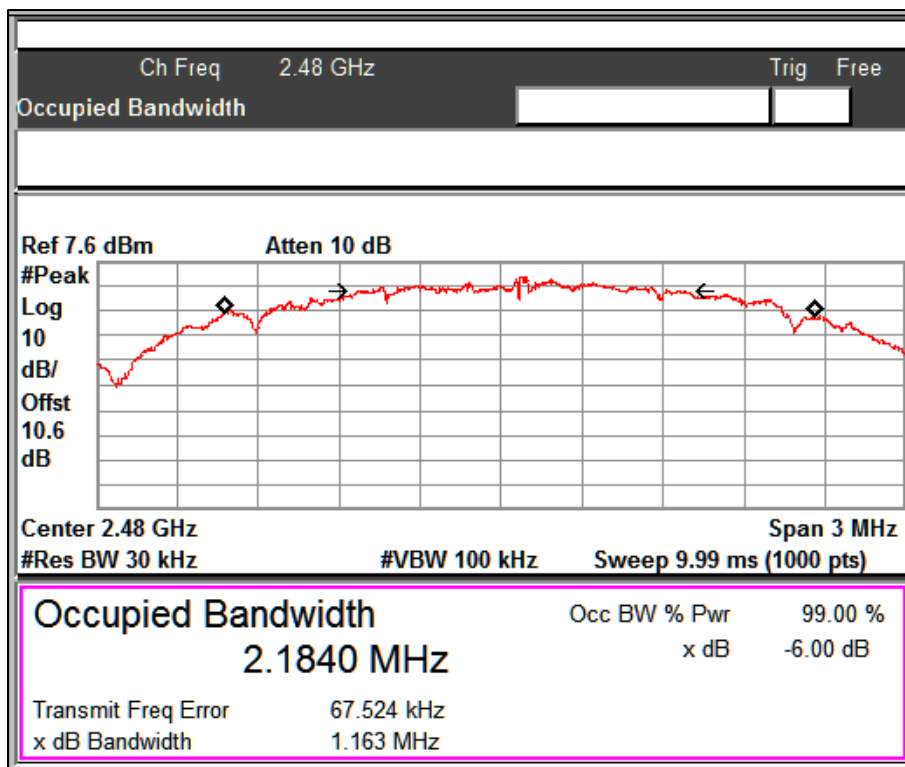
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Channel Frequency: 2440MHz



Channel Frequency: 2480MHz

Prüfbericht - Nr.:

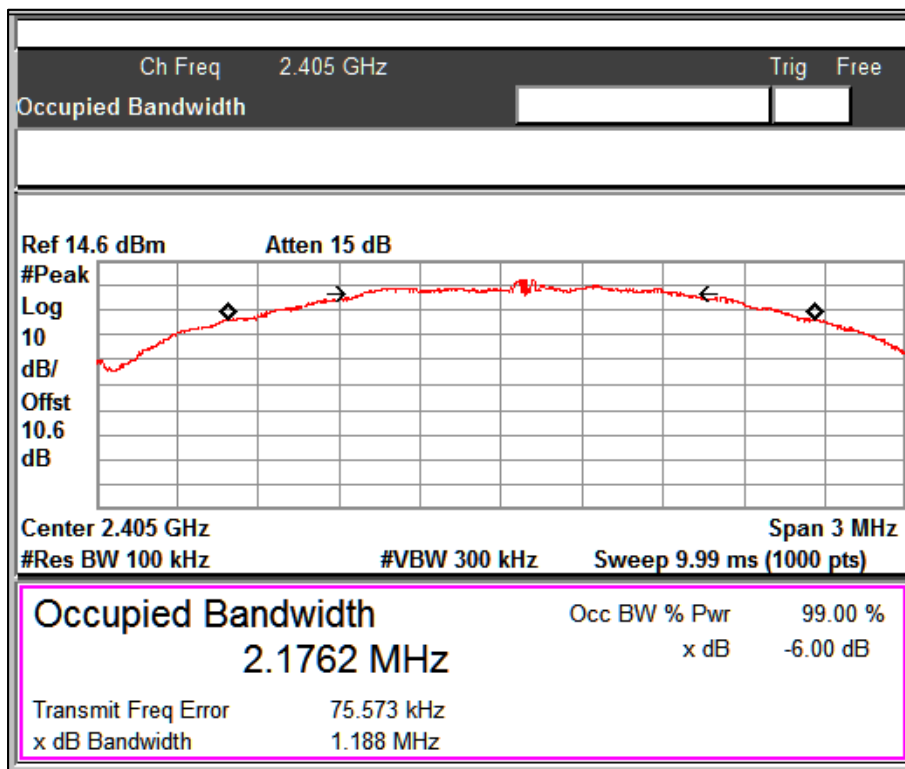
Test Report No.:

ULR-TC568822300000106F

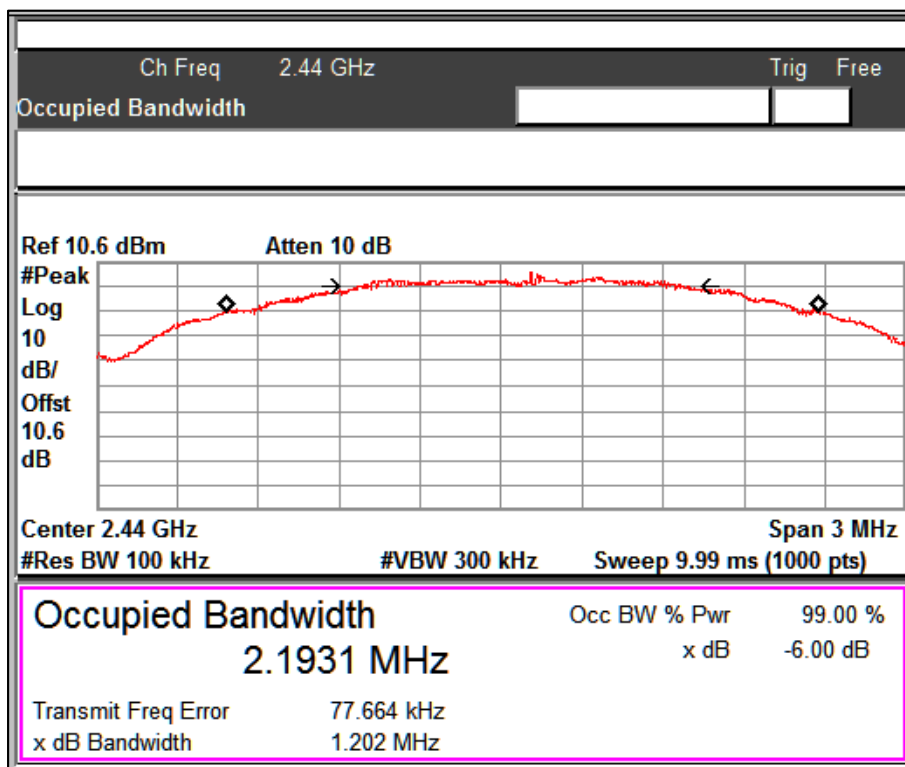
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DTS Band width



Channel Frequency: 2405MHz

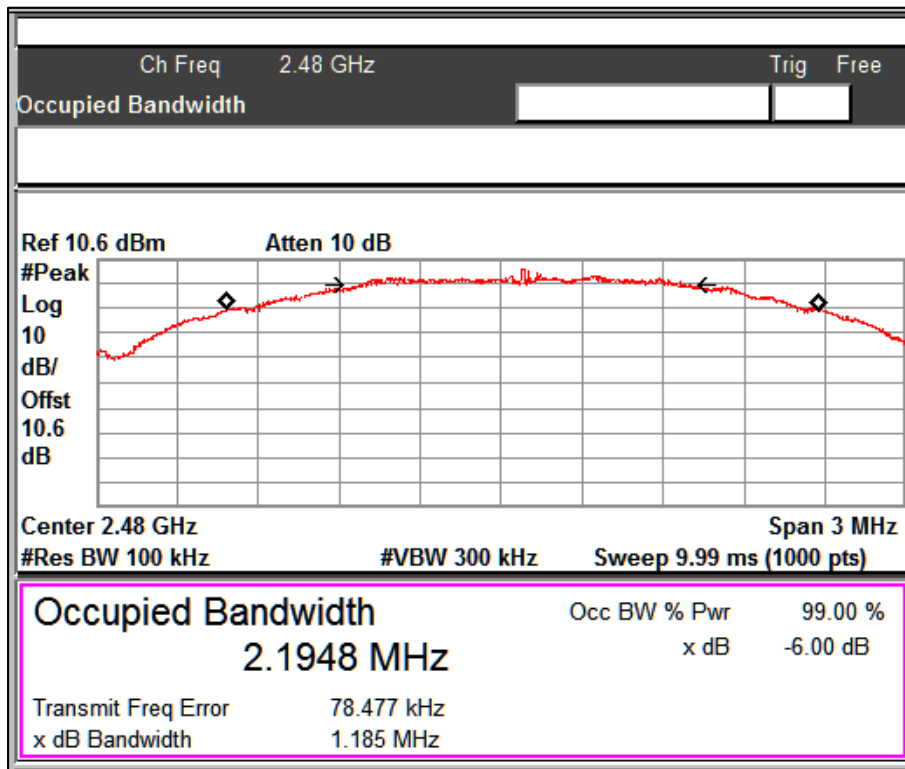


Channel Frequency: 2440MHz

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Channel Frequency: 2480MHz

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

Result

Pass

Test Specification FCC part 15 Subpart C 15.247 (d)

Test Method Subclause 11.11.3 of ANSI C63.10

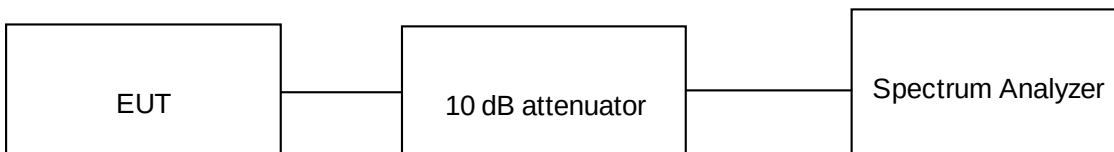
Measurement Bandwidth 100 kHz

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

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 22.1 °C Voltage = Li-Po Battery 500mAh/3.7V or DC 5V from USB Relative humidity = 65%

KDB Guidelines applied:

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

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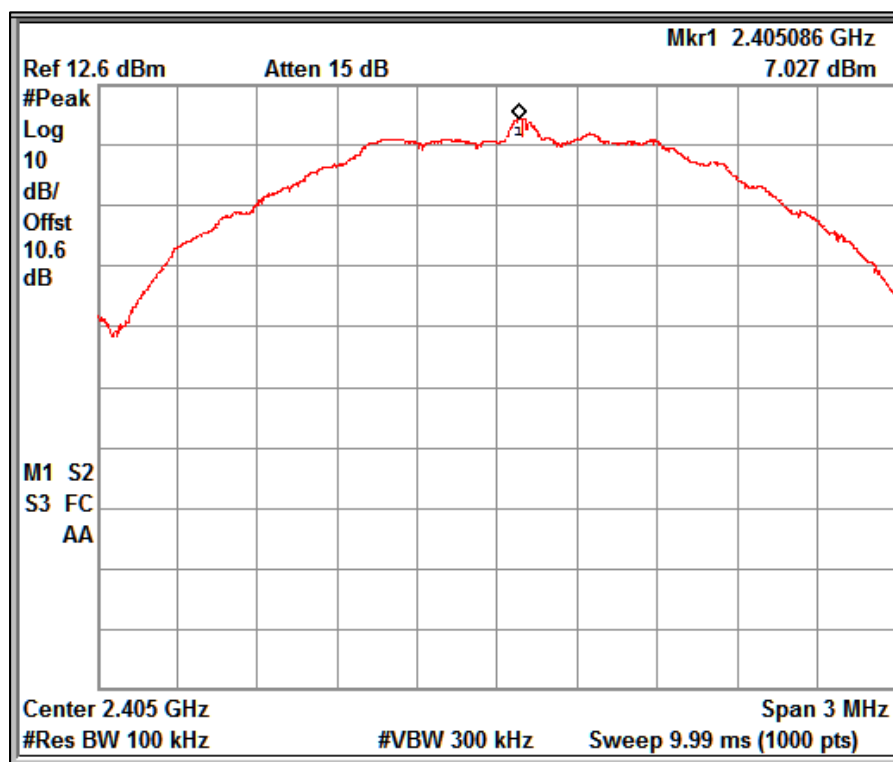
Test results:

Note:

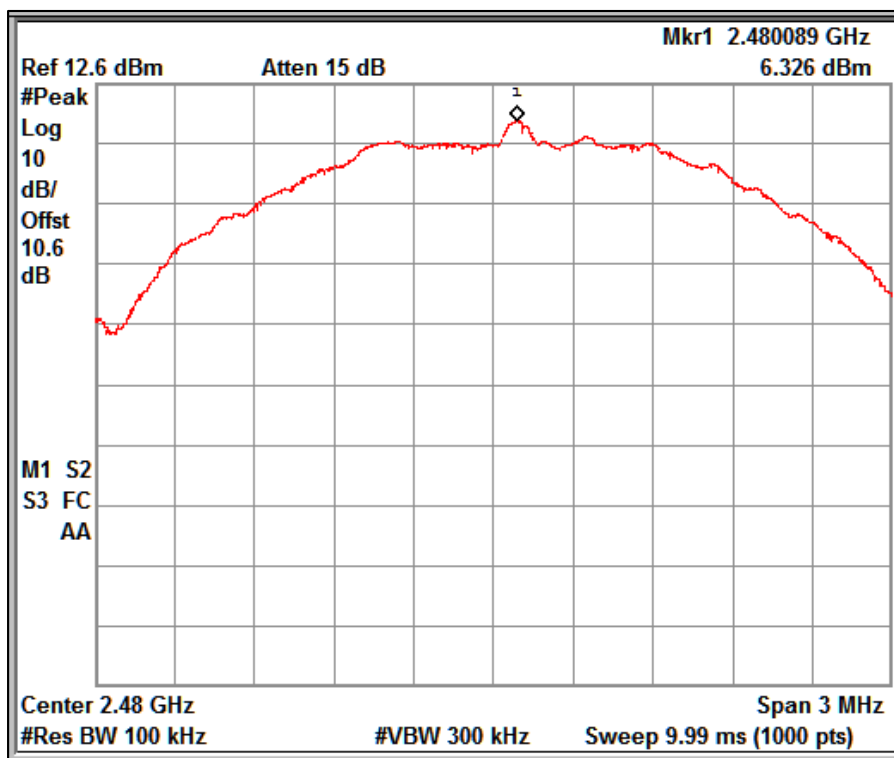
1. All the losses are included during measurement and final values are mentioned in the test report
2. Final Value (dBm) = Measured Value (dBm) + Attenuator factor (10dB) + Cable loss (0.6dB)
3. This product do not support additional beamforming gain / directional gain, it uses single antenna and hence Directional gain of the single antenna is 1.5 dBi

7.3.1 Band edge and reference plots

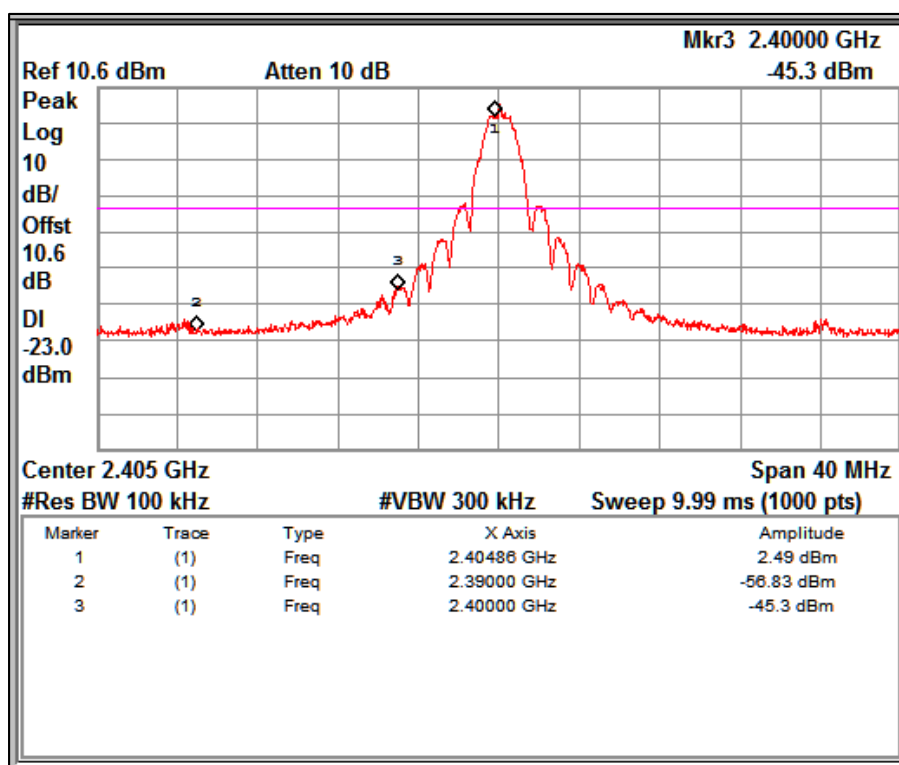
Channel Frequency (MHz)	Band edge Frequency (MHz)	Value at Band edge (A) (dBm)	Reference Value (B) (dBm)	A-B (dBc)	Minimum Limit (dBc)
2405	2390.00	-56.83	7.02	-63.85	-30
2480	2483.50	-41.44	6.32	-47.76	-30



Reference plot for 2405MHz



Reference plot for 2480MHz

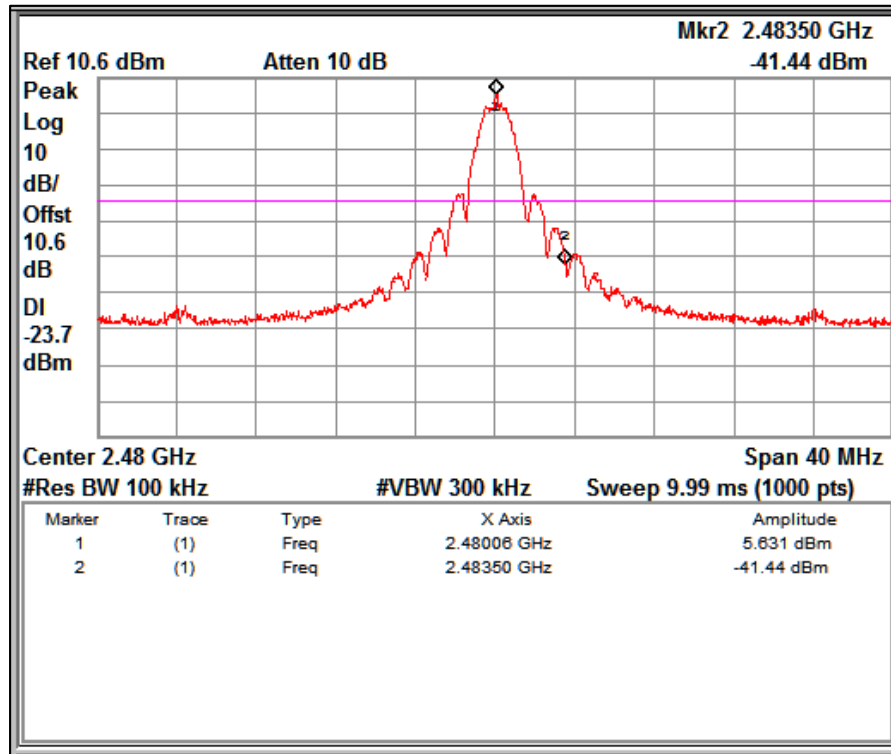


Band edge Channel Frequency 2405MHz

Prüfbericht- Nr.:
Test Report No.:

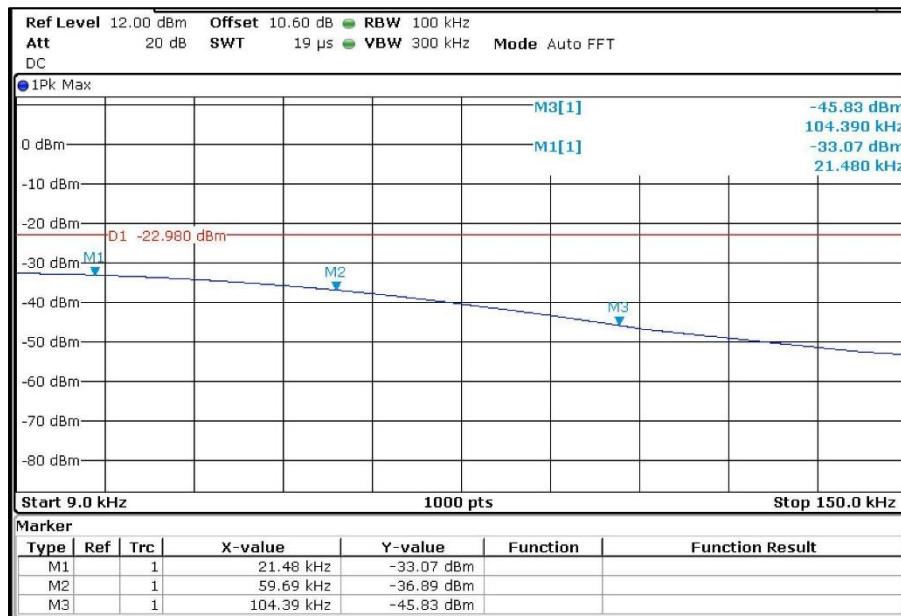
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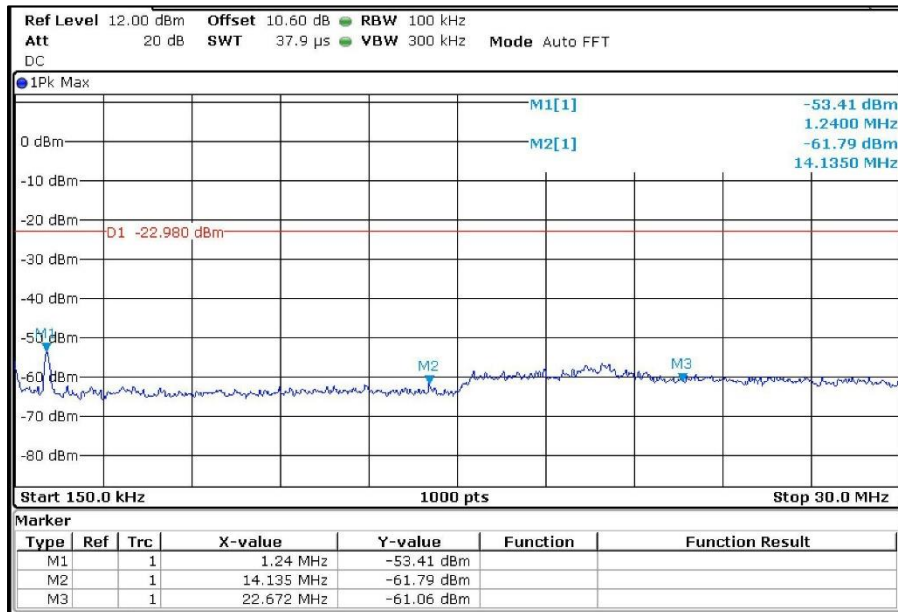


Band edge Channel Frequency 2480MHz

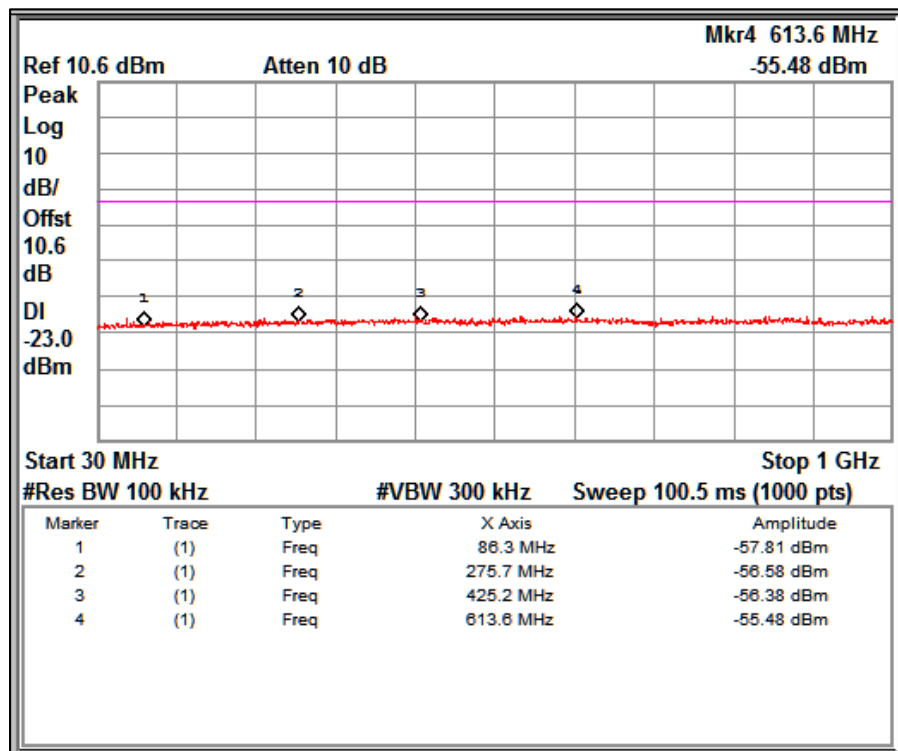
7.3.2 Out-Of-Band Emissions



Channel Frequency 2405MHz Frequency Range 9KHz – 150KHz



Channel Frequency 2405MHz Frequency Range 150KHz – 30MHz

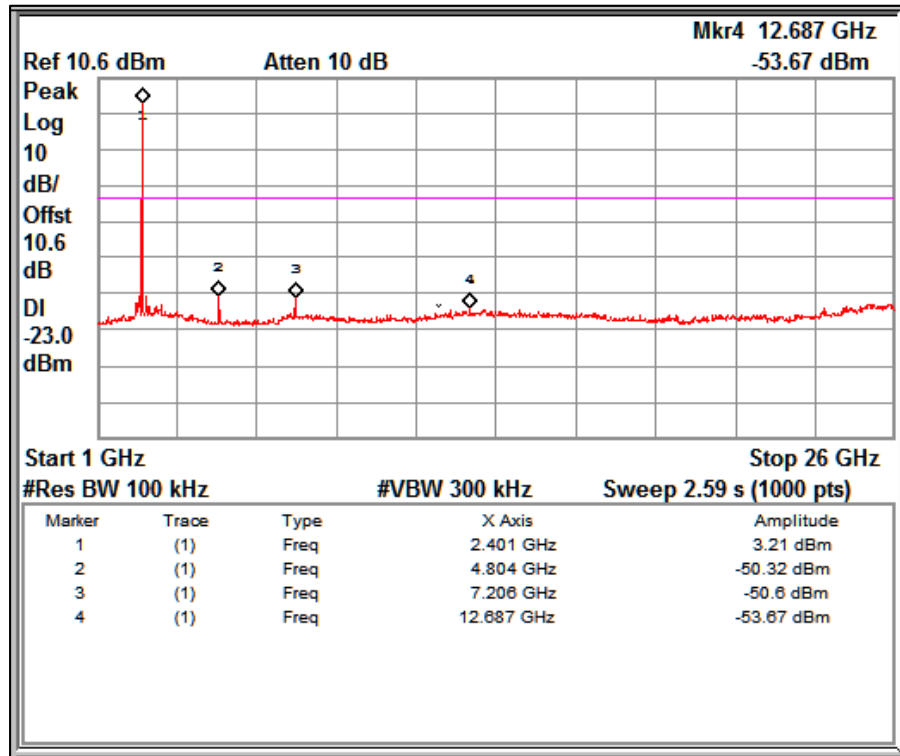


Channel Frequency 2405MHz Frequency Range 30MHz – 1GHz

Prüfbericht - Nr.:
Test Report No.:

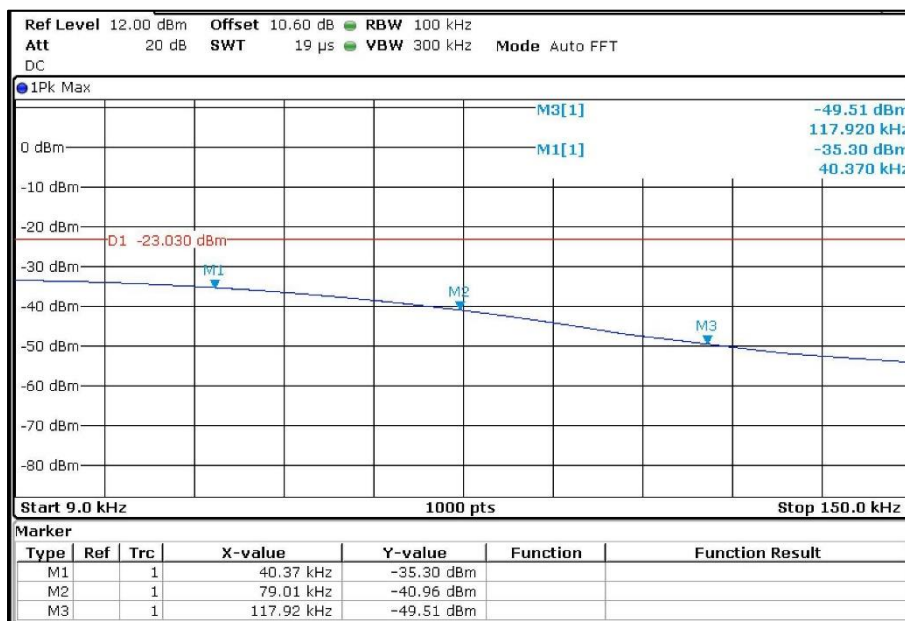
ULR-TC568822300000106F

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Channel Frequency 2405MHz

Frequency Range 1GHz – 26GHz



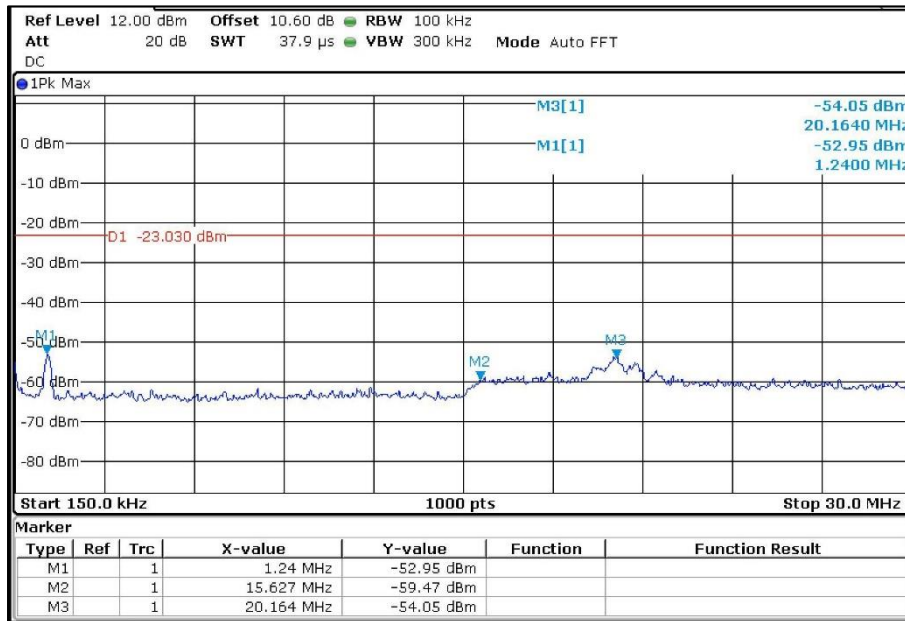
Channel Frequency 2440MHz

Frequency Range 9KHz – 150KHz

Prüfbericht - Nr.:
Test Report No.:

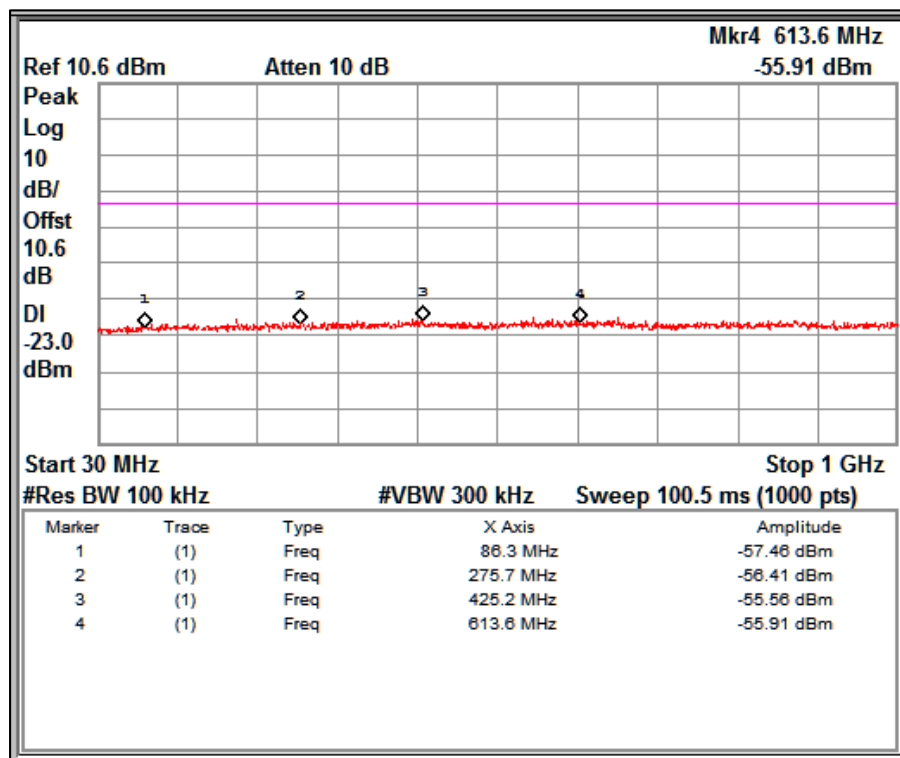
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Channel Frequency 2440MHz

Frequency Range 150KHz – 30MHz



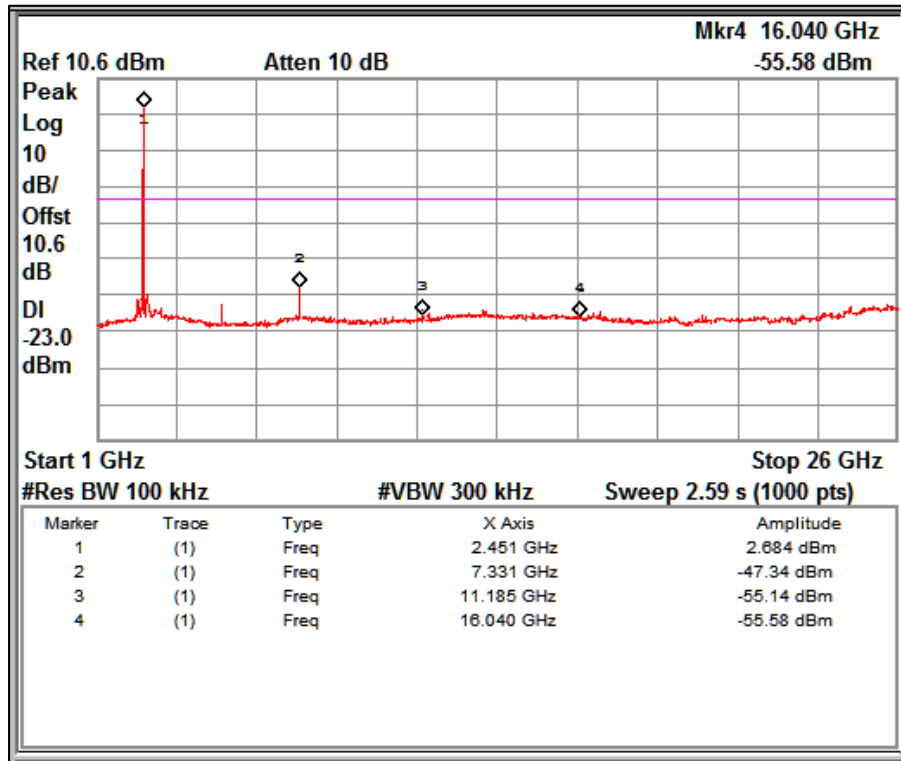
Channel Frequency 2440MHz

Frequency Range 30MHz – 1GHz

Prüfbericht - Nr.:
Test Report No.:

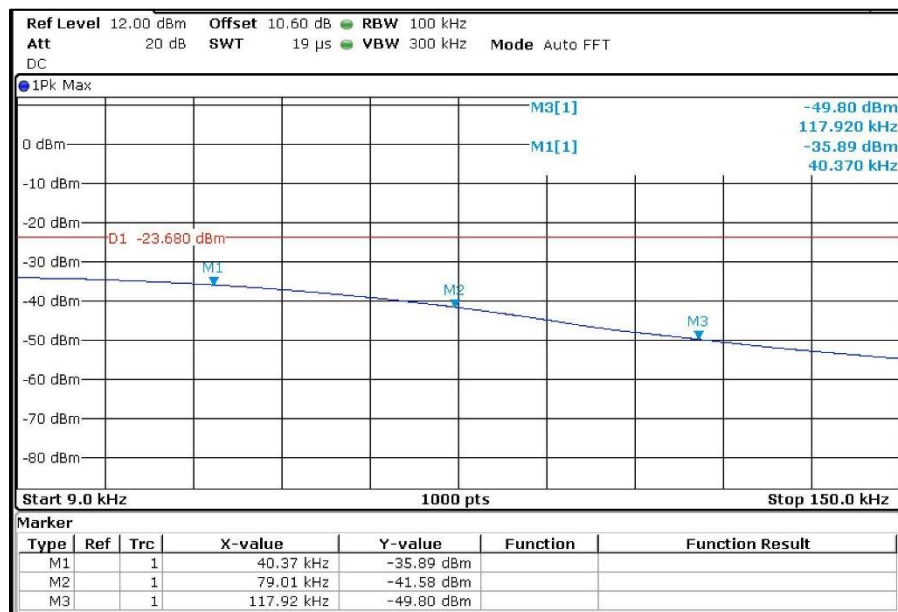
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Channel Frequency 2440MHz

Frequency Range 1GHz – 26GHz



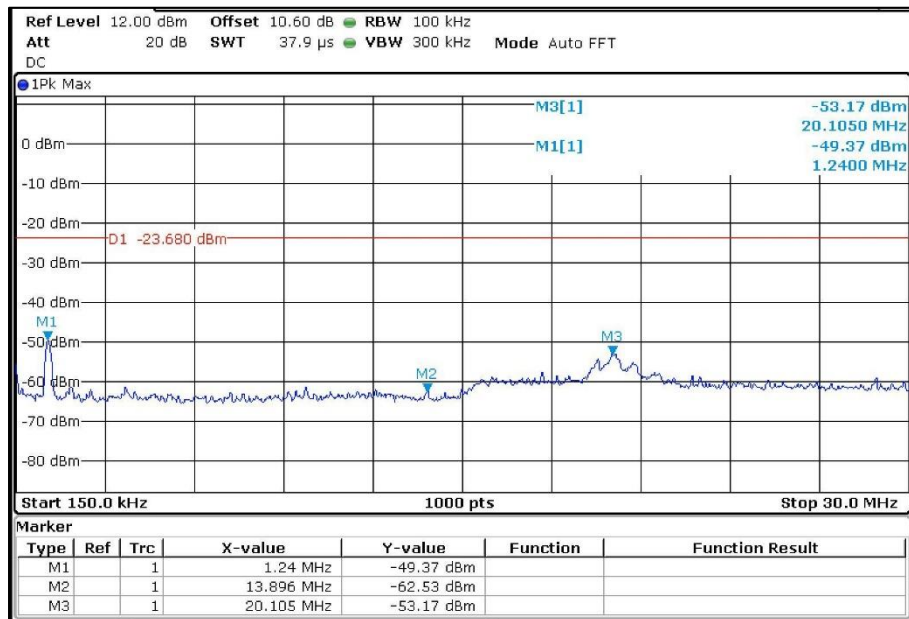
Channel Frequency 2480MHz

Frequency Range 9KHz – 150KHz

Prüfbericht - Nr.:
Test Report No.:

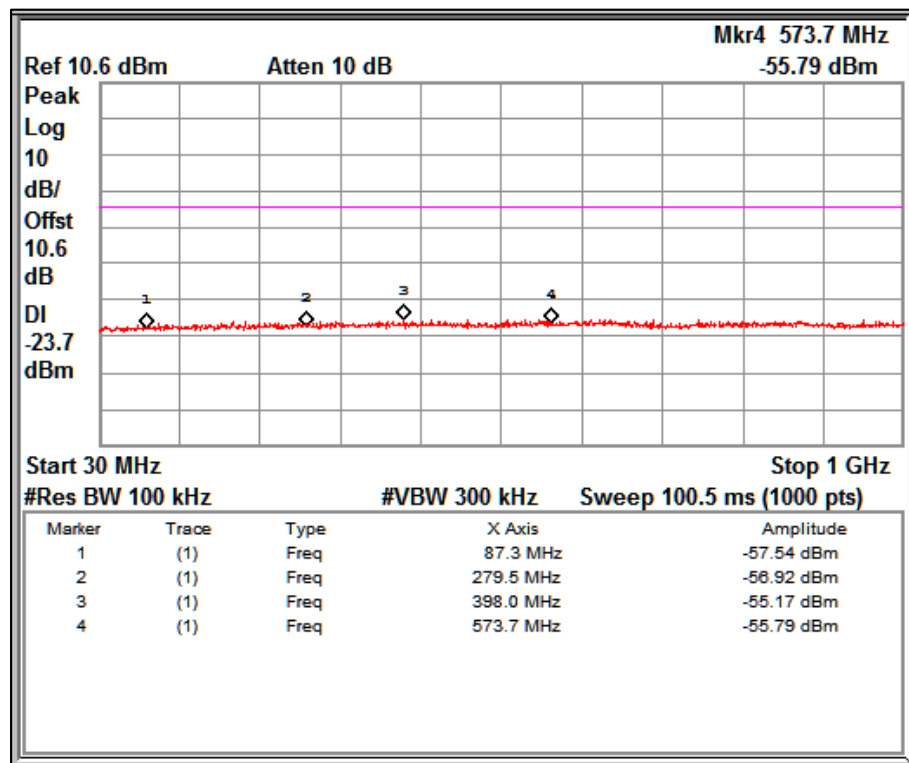
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Channel Frequency 2480MHz

Frequency Range 150KHz – 30MHz



Channel Frequency 2480MHz

Frequency Range 30MHz – 1GHz

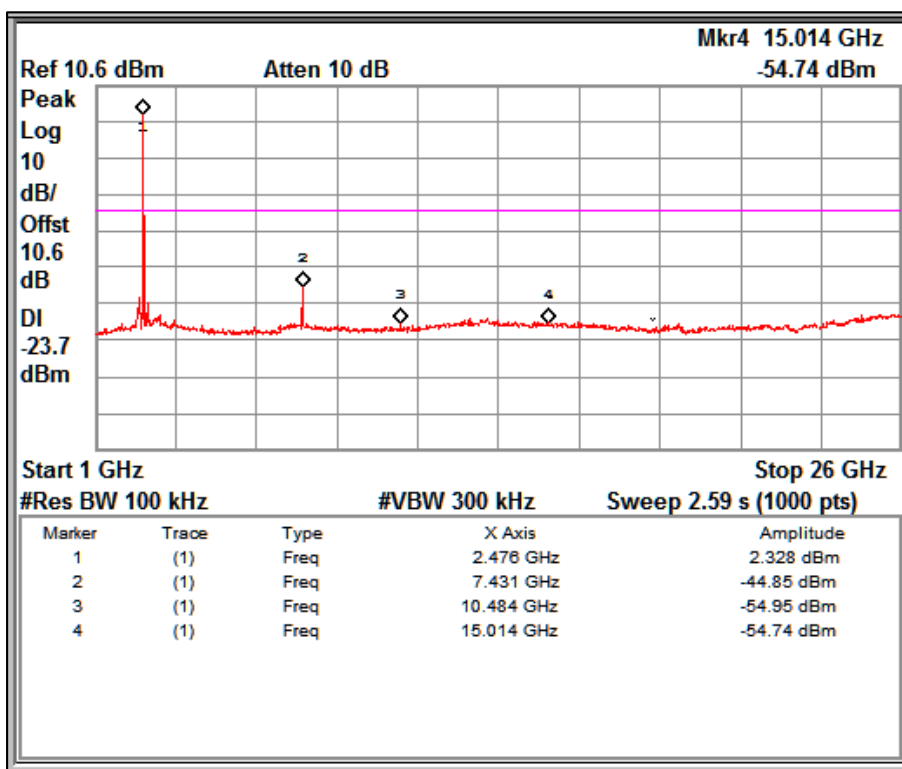
Prüfbericht - Nr.:

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Channel Frequency 2480MHz

Frequency Range 1GHz – 26GHz

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7.4 Spurious Radiated Emissions & Restricted Bands of Operation

Result	Pass
Test Specification	FCC part 15 Subpart C 15.247 (d) / (15.209 & 15.205)
Test Method	ANSI C63.10
Measurement Location	Semi Anechoic Chamber 9kHz - 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 Condition

Normal Test Condition:

Temperature (Norm) = + 22.1 °C **Voltage** = Li-Po Battery 500mAh/3.7V or DC 5V from USB **Relative humidity** = 65%

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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

Table 7: Test results for frequency range 30MHz – 200MHz

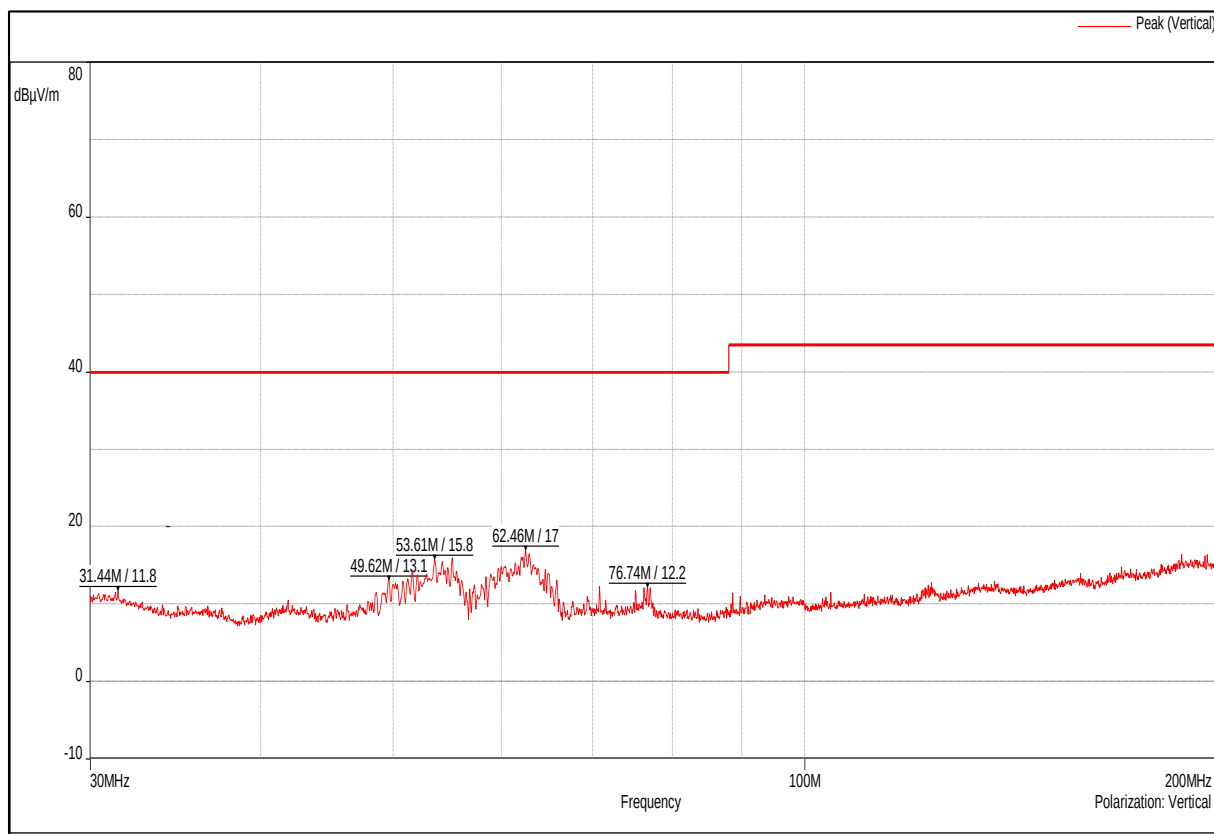
Battery Mode:-

Antenna Polarization	Measured Frequency (MHz)	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	53.16(Pk)	15.80	40.00	-24.20
	62.46(Pk)	17.00	40.00	-23.00
	76.74(Pk)	12.20	40.00	-27.80
Horizontal	84.24(Pk)	14.50	40.00	-25.50
	144.39(Pk)	22.90	43.50	-20.60
	161.82(Pk)	18.70	43.50	-24.80

Charging Mode:-

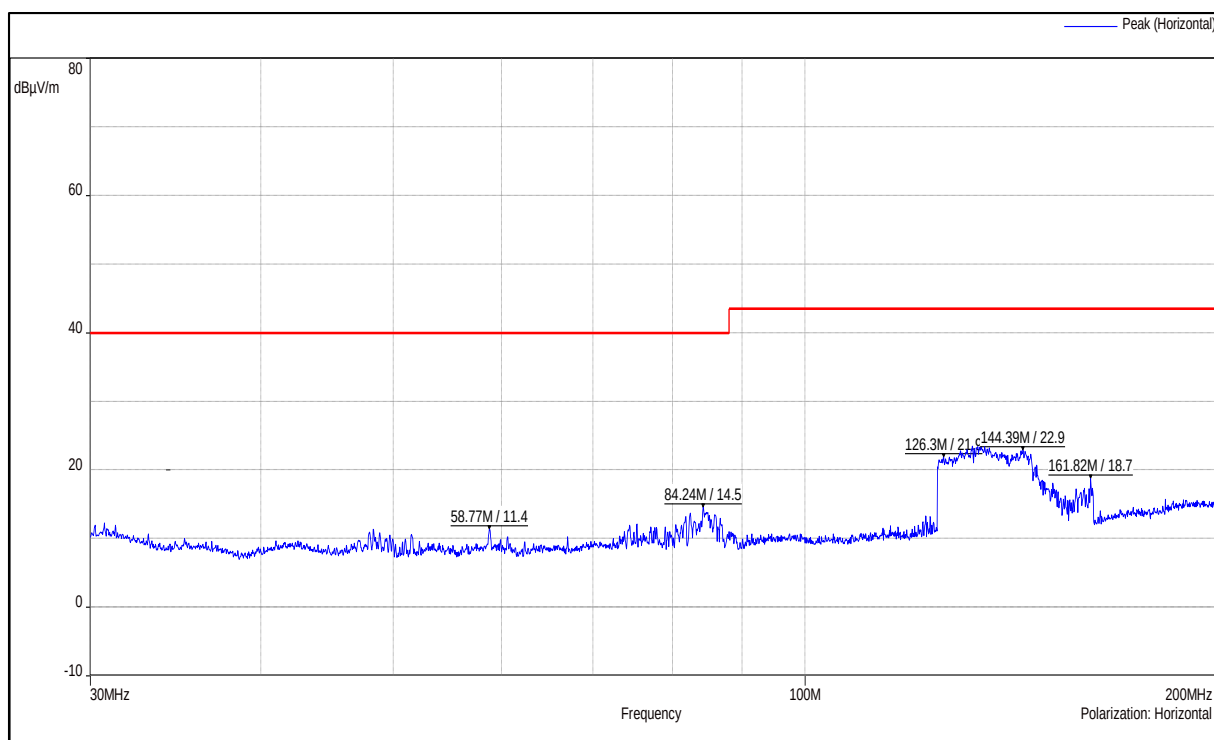
Antenna Polarization	Measured Frequency (MHz)	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	58.68(Pk)	25.00	40.00	-15.00
	79.65(Pk)	29.10	40.00	-10.90
	93.36(Pk)	24.90	43.50	-18.60
Horizontal	79.47(Pk)	22.40	40.00	-17.60
	103.86(Pk)	21.10	43.50	-22.40
	135.93(Pk)	26.10	43.50	-17.40

Battery Mode



Channel Frequency 30MHz – 200MHz

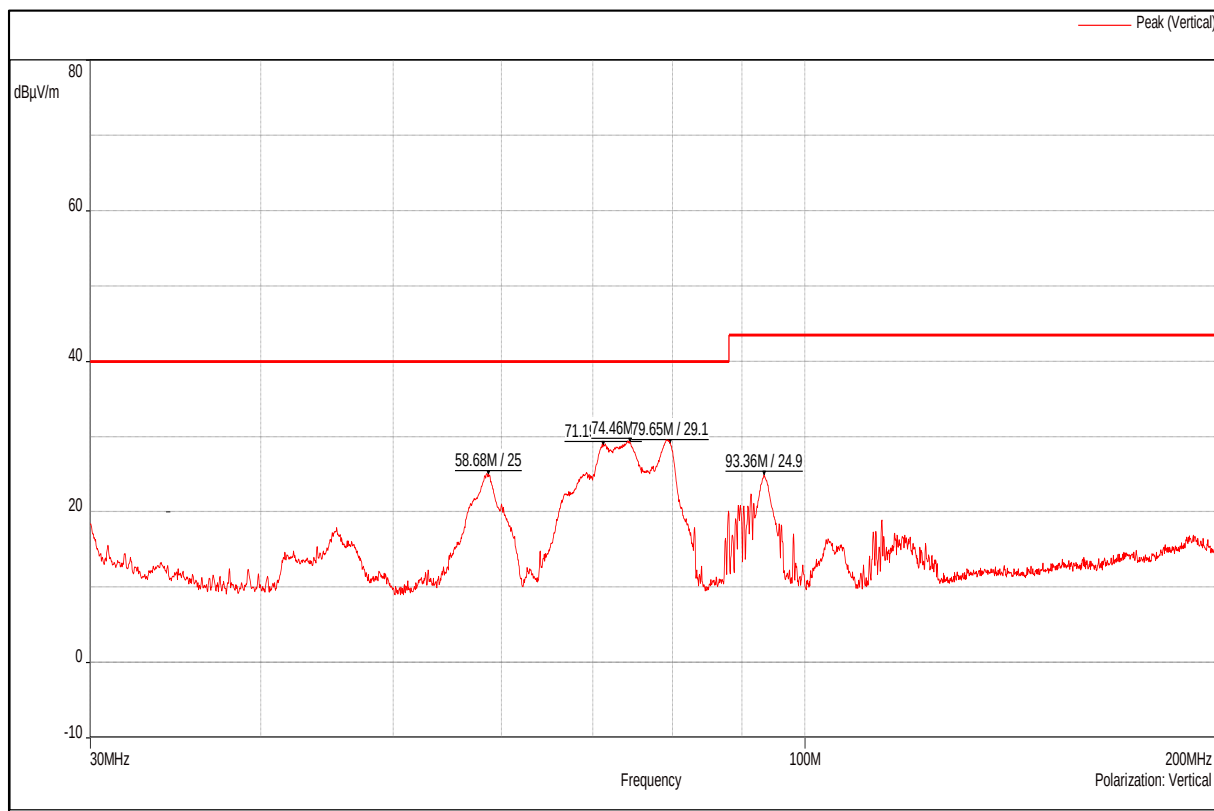
Polarization Vertical



Channel Frequency 30MHz – 200MHz

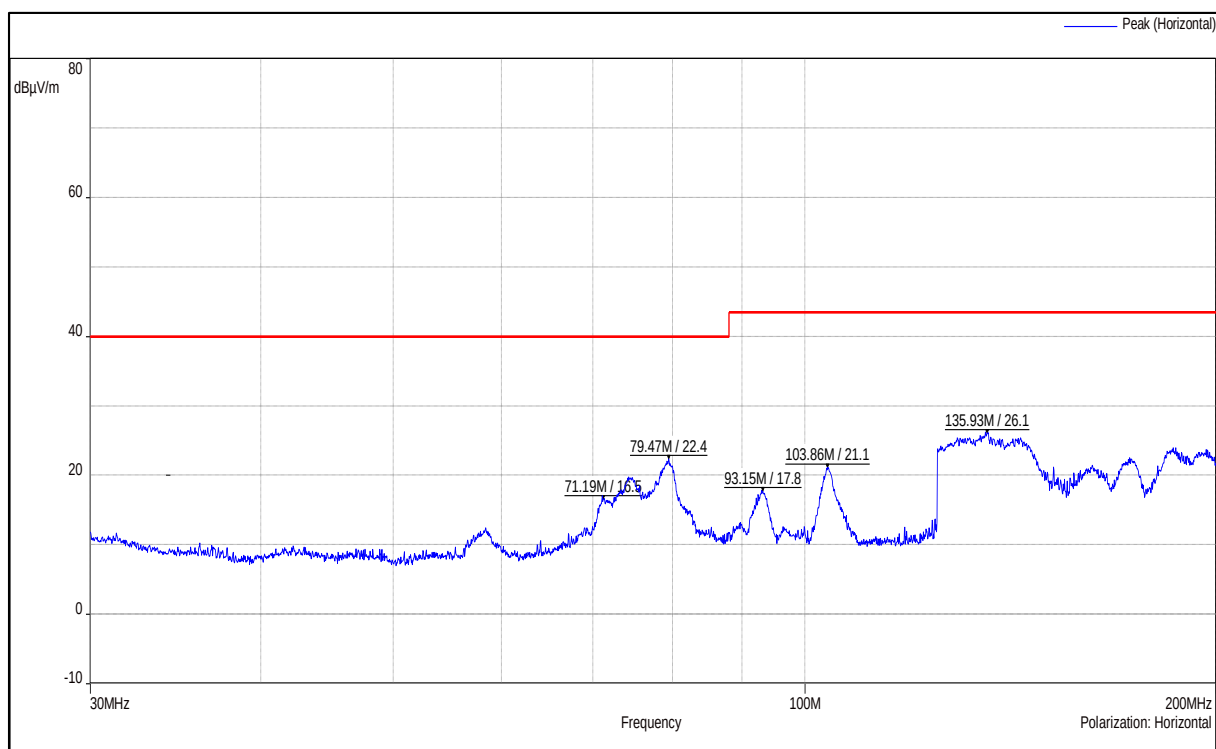
Polarization Horizontal

Charging Mode



Channel Frequency 30MHz – 200MHz

Polarization Vertical



Channel Frequency 30MHz – 200MHz

Polarization Horizontal

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Table 8: Test results for frequency range 200MHz – 1GHz

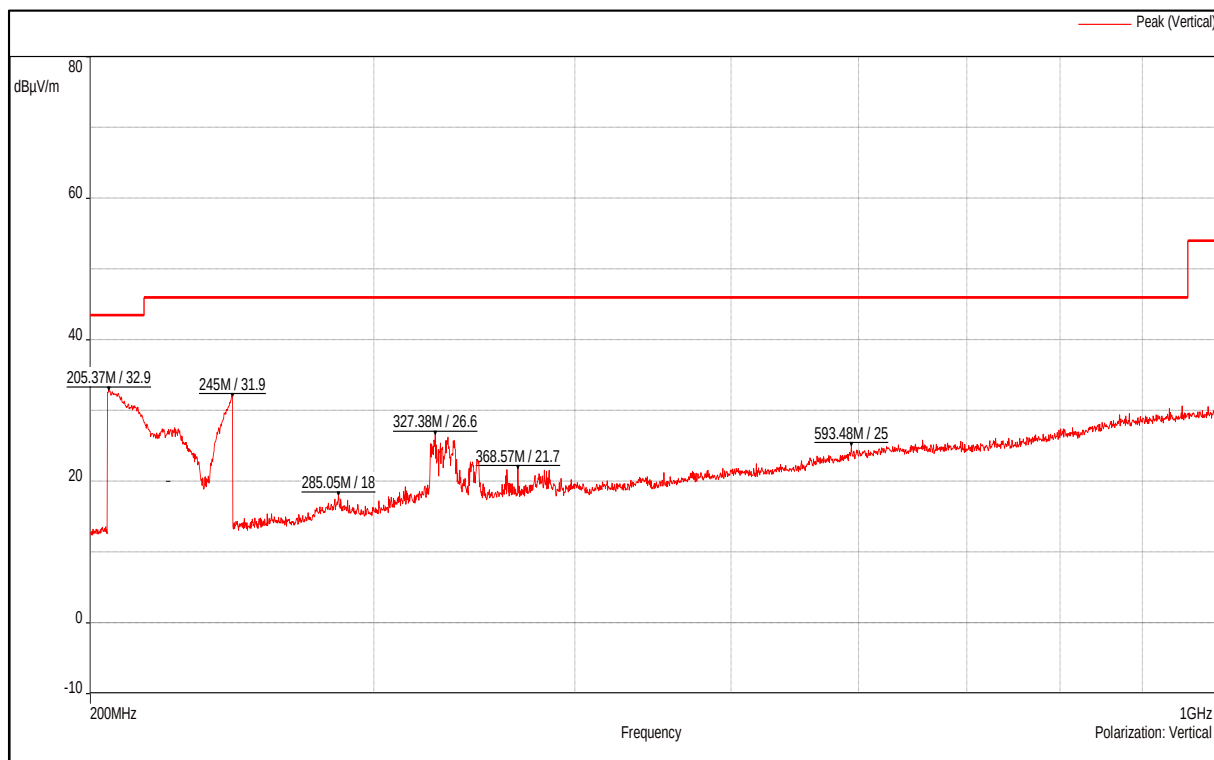
Battery Mode

Antenna Polarization	Measured Frequency (MHz)	Measured Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	205.37(Pk)	32.90	43.50	-10.60
	245.00(Pk)	31.90	46.00	-14.10
	327.38(Pk)	26.60	46.00	-19.40
	593.48(Pk)	25.00	46.00	-21.00
Horizontal	202.97(Pk)	23.50	43.50	-20.00
	400.22(Pk)	21.60	46.00	-24.40
	598.34(Pk)	27.20	46.00	-18.80
	816.8(Pk)	28.10	46.00	-17.90

Charging Mode

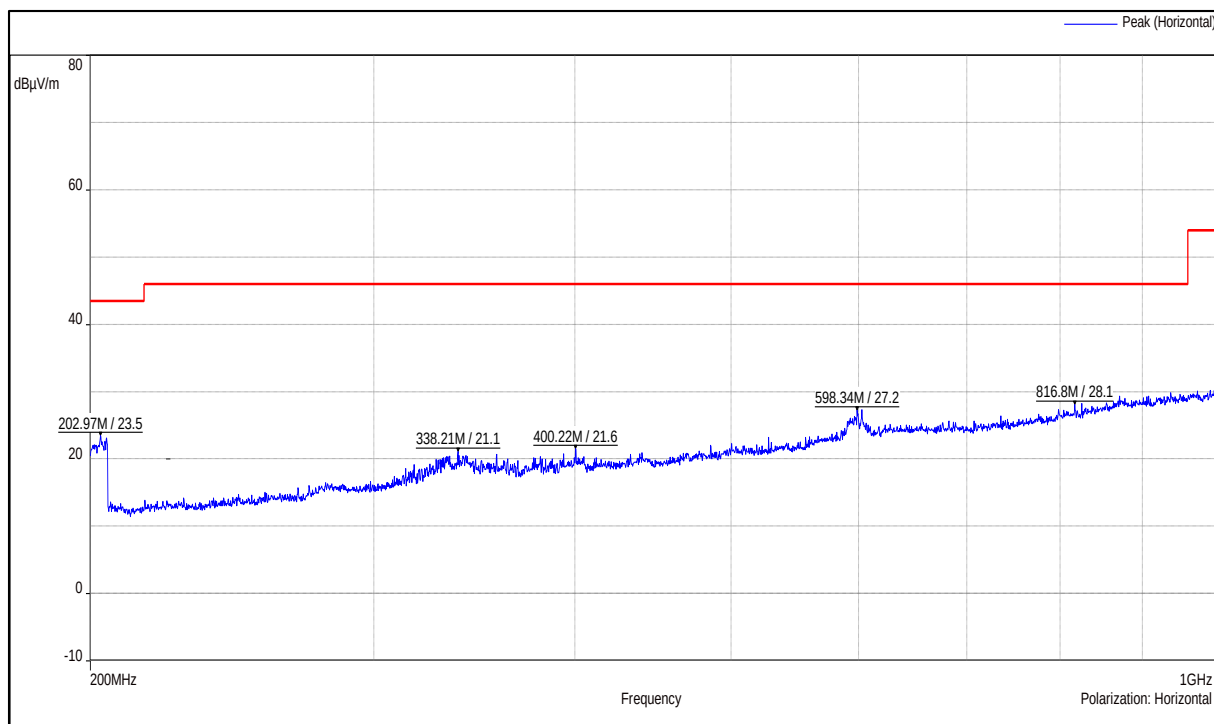
Antenna Polarization	Measured Frequency (MHz)	Measured Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	278.54(Pk)	23.80	46.00	-22.20
	326.24(Pk)	34.30	46.00	-11.70
	360.62(Pk)	37.70	46.00	-8.30
Horizontal	323.57(Pk)	30.80	46.00	-15.20
	339.32(Pk)	24.50	46.00	-21.50
	601.64(Pk)	26.80	46.00	-19.20

Battery Mode



Channel Frequency 200MHz – 1GHz

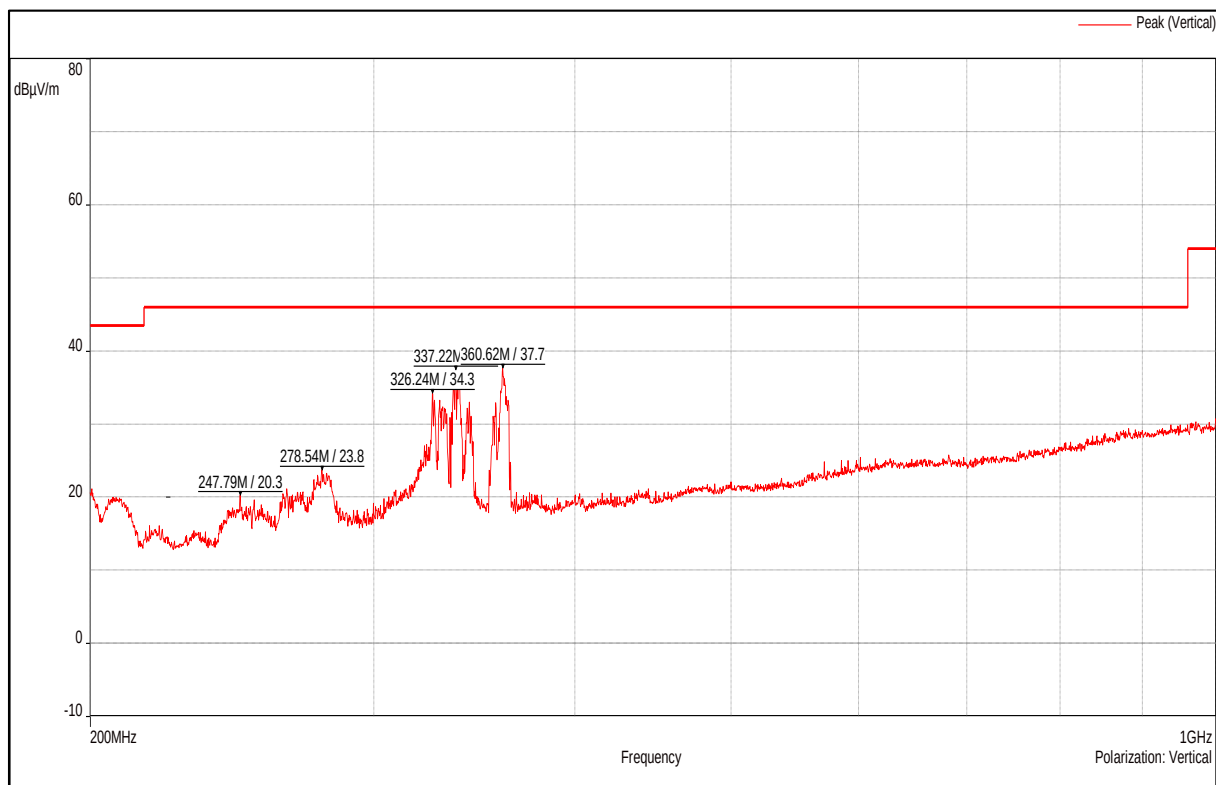
Polarization Vertical



Channel Frequency 200MHz – 1GHz

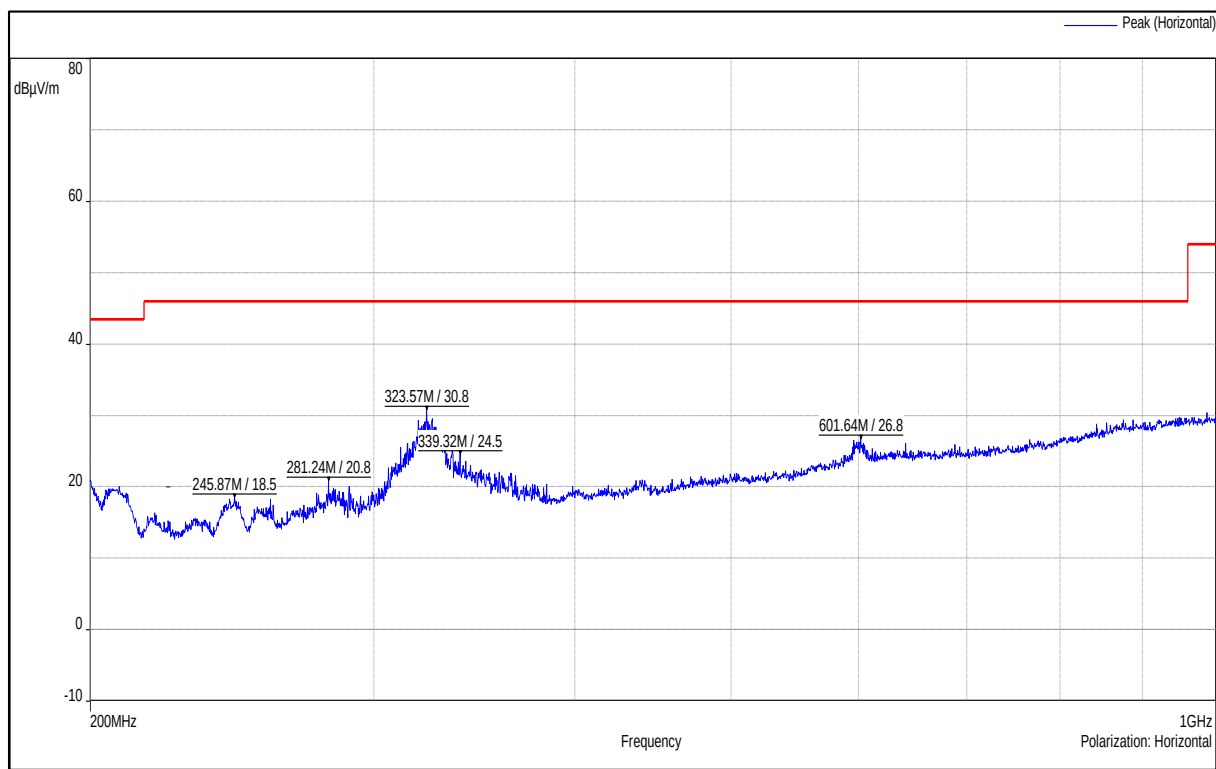
Polarization Horizontal

Charging Mode



Channel Frequency 200MHz – 1GHz

Polarization Vertical



Channel Frequency 200MHz – 1GHz

Polarization Horizontal

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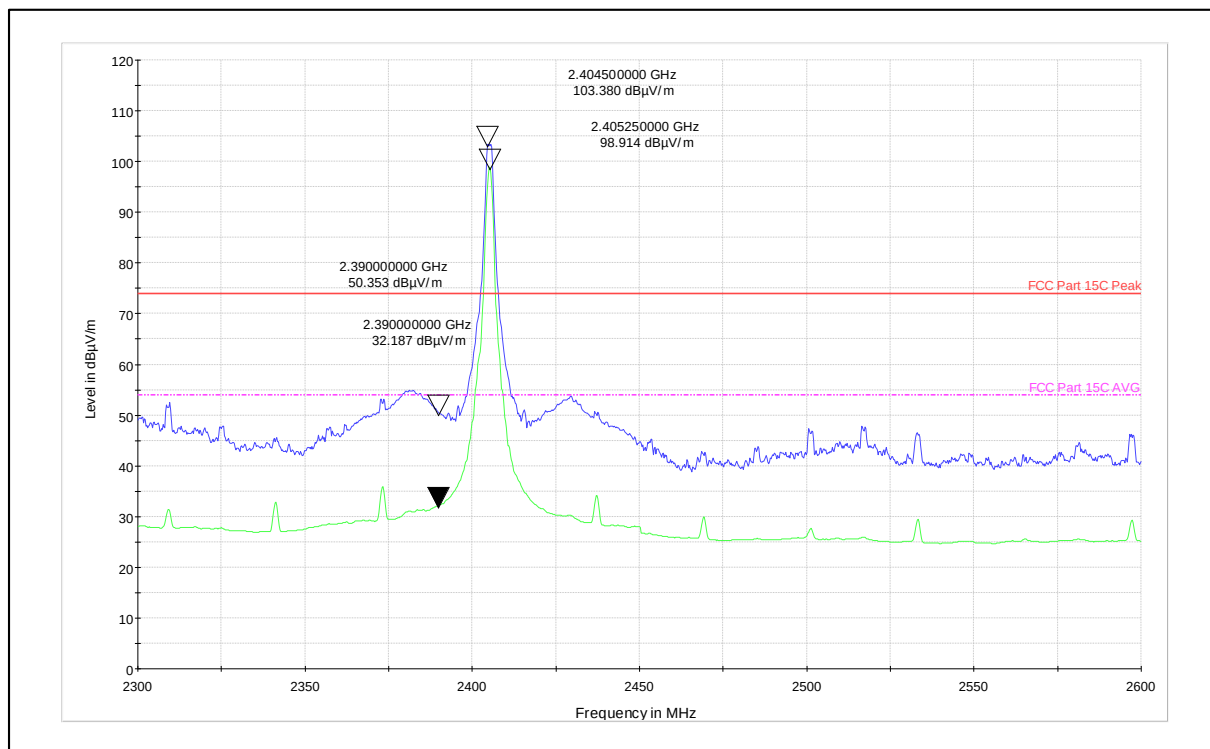
Table 9: Test results for the frequencies above 1GHz:

Channel Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Emission level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2405	Vertical	2390(Pk)	50.35	74*	-23.65
		2390(Av)	32.18	54*	-21.82
		2405(Pk)	103.38	-	-
		2405(Av)	98.91	-	-
		4810(Pk)	59.25	74	-14.75
		4810(Av)	51.38	54	-2.62
		7215(Pk)	55.92	74	-18.08
		7215(Av)	46.52	54	-7.48
	Horizontal	2390(Pk)	40.93	74*	-33.07
		2390(Av)	25.48	54*	-28.52
		2405(Pk)	91.66	-	-
		2405(Av)	87.17	-	-
		4810(Pk)	47.32	74	-26.68
		4810(Av)	37.46	54	-16.54
		7215(Pk)	53.06	74	-20.94
		7215(Av)	42.79	54	-11.21
2440	Vertical	2440(Pk)	102.25	-	-
		2440(Av)	97.75	-	-
		4880(Pk)	54.27	74	-19.73
		4880(Av)	45.80	54	-8.20
		7320(Pk)	56.15	74	-17.85
		7320(Av)	46.40	54	-7.60
	Horizontal	2440(Pk)	88.91	-	-
		2440(Av)	84.36	-	-
		4880(Pk)	45.74	74	-28.26
		4880(Av)	35.12	54	-18.88
2480	Vertical	2480(Pk)	98.62	-	-
		2480(Av)	94.15	-	-
		2483.5(Pk)	63.66	74*	-10.34
		2483.5(Av)	53.46	54*	-0.54
		4960(Pk)	53.13	74	-20.87
		4960(Av)	44.90	54	-9.10
		7440(Pk)	55.56	74	-18.44
		7440(Av)	46.32	54	-7.68
	Horizontal	2480(Pk)	88.45	-	-
		2480(Av)	84.02	-	-
		2483.5(Pk)	53.70	74*	-20.30
		2483.5(Av)	43.53	54*	-10.47
		4960(Pk)	47.33	74	-26.67
		4960(Av)	36.79	54	-17.21
		7440(Pk)	52.37	74	-21.63
		7440(Av)	41.37	54	-12.63

*- : Indicate restricted band of operation §15.205

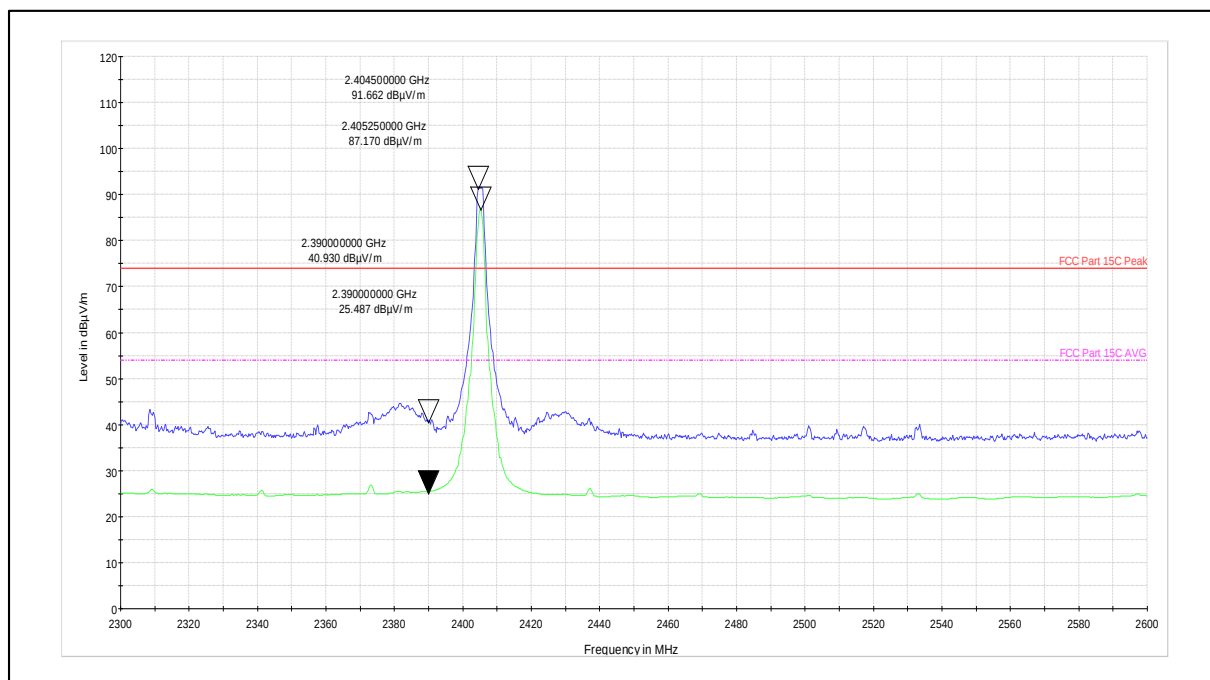
Pk: Peak Detector; Av: Average Detector

Channel Frequency 2405MHz



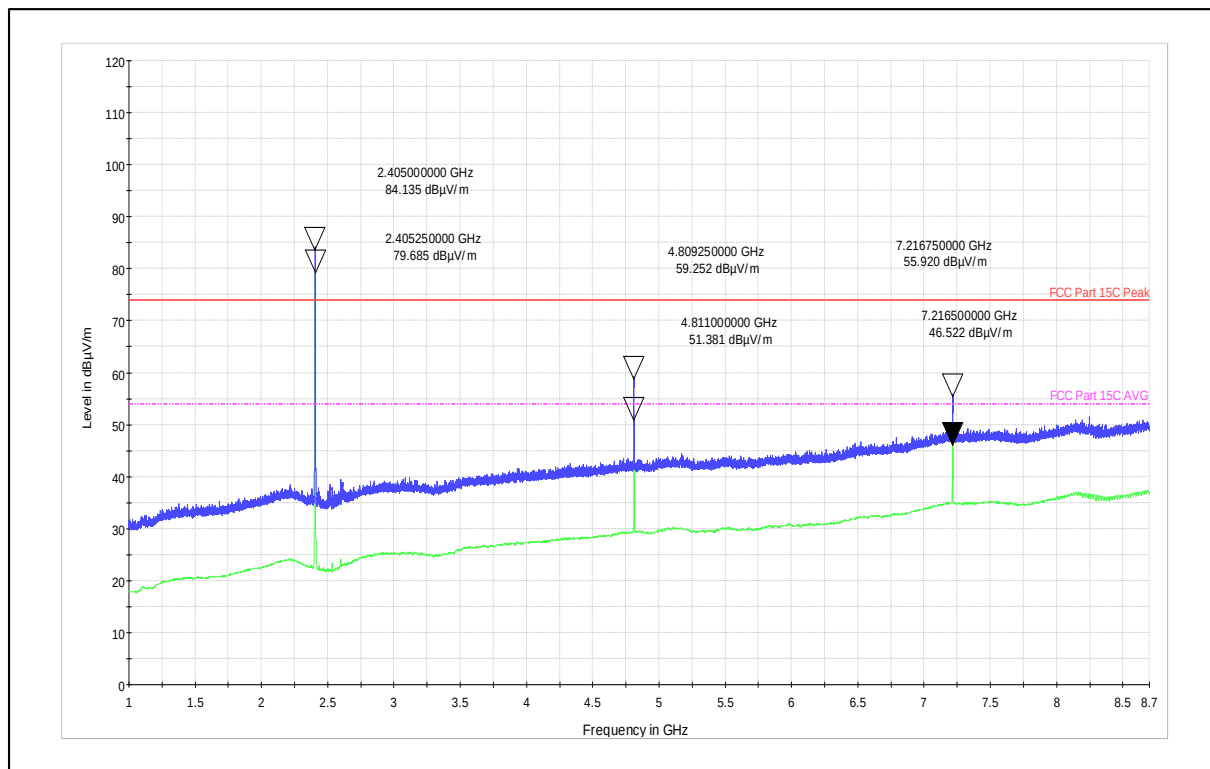
Channel Frequency 2405MHz

Polarization: Vertical



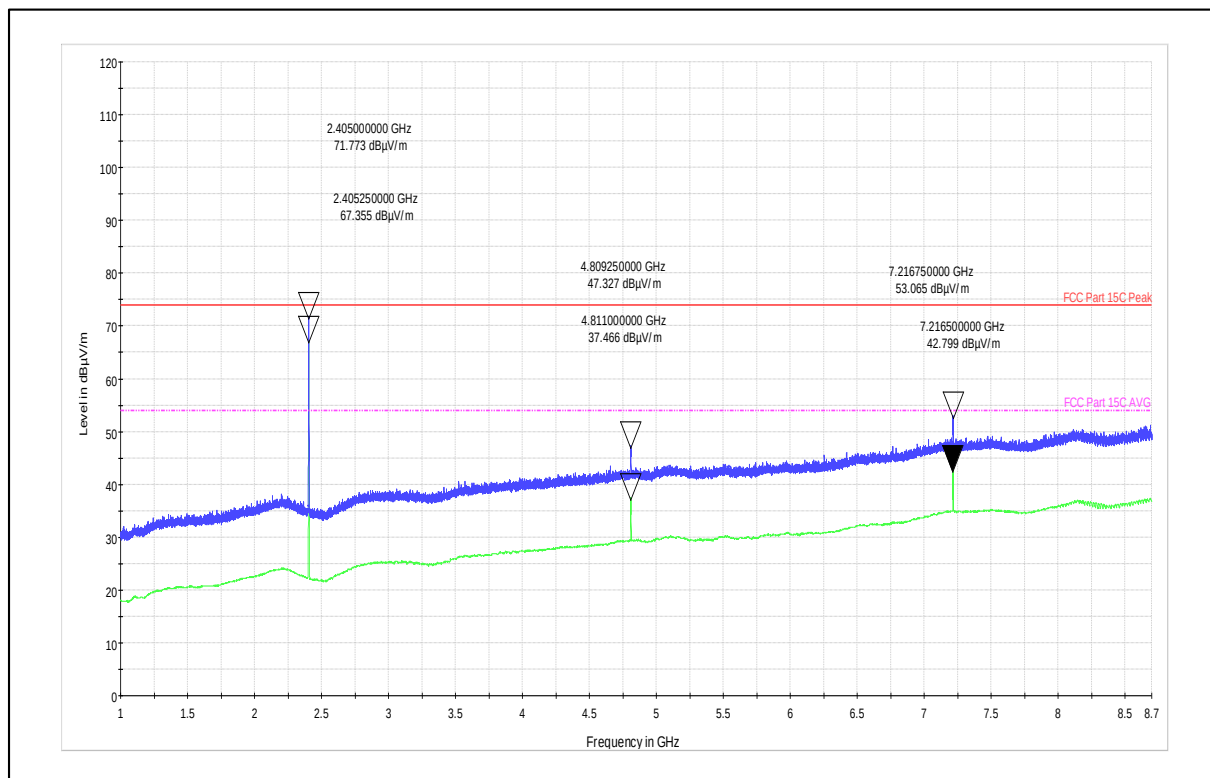
Channel Frequency 2405MHz

Polarization: Horizontal



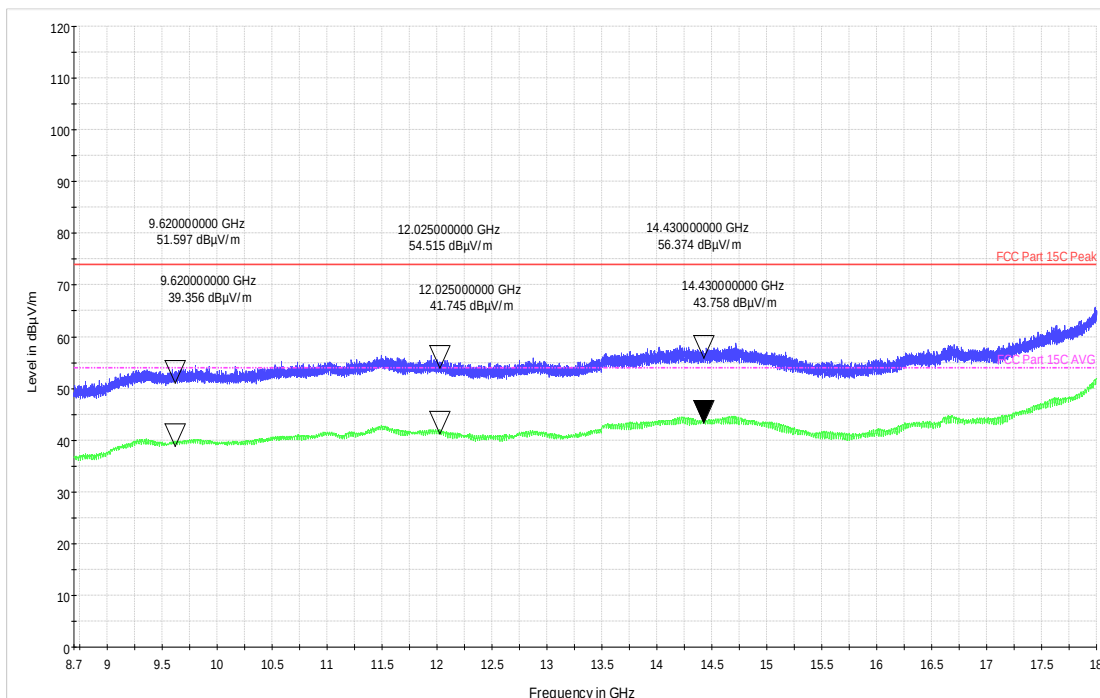
Channel Frequency: 1GHz – 8.7GHz

Polarization: Vertical



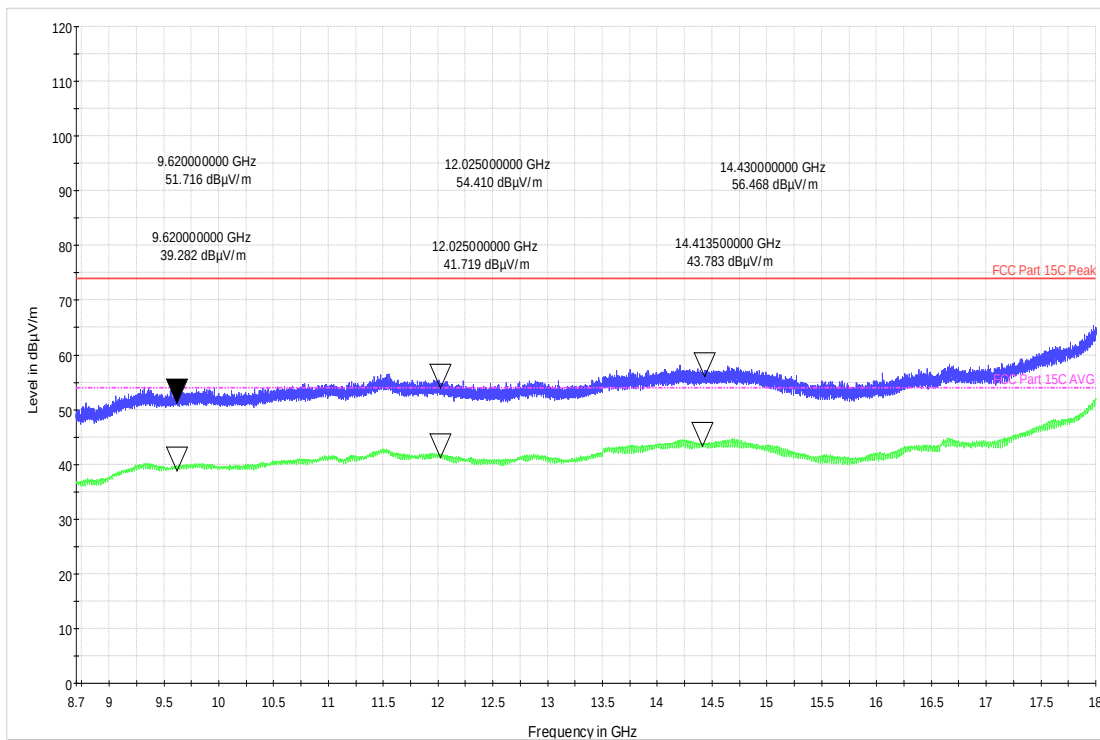
Channel Frequency: 1GHz – 8.7GHz

Polarization: Horizontal



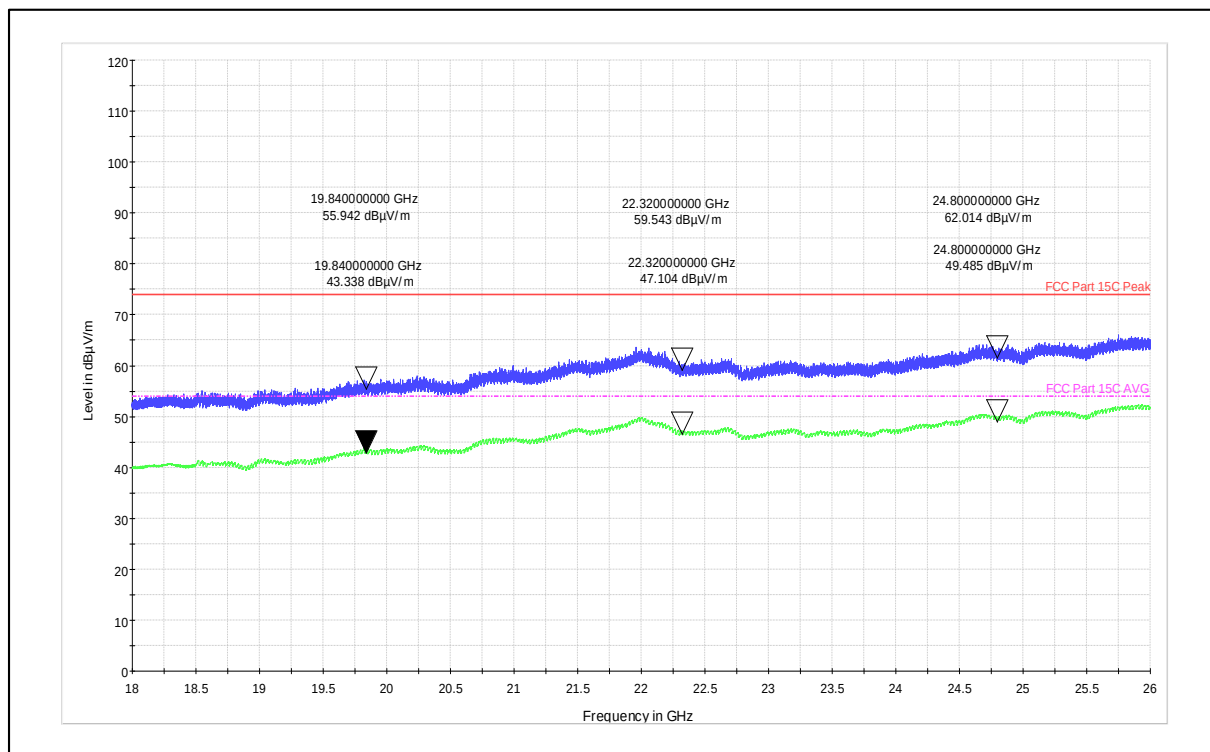
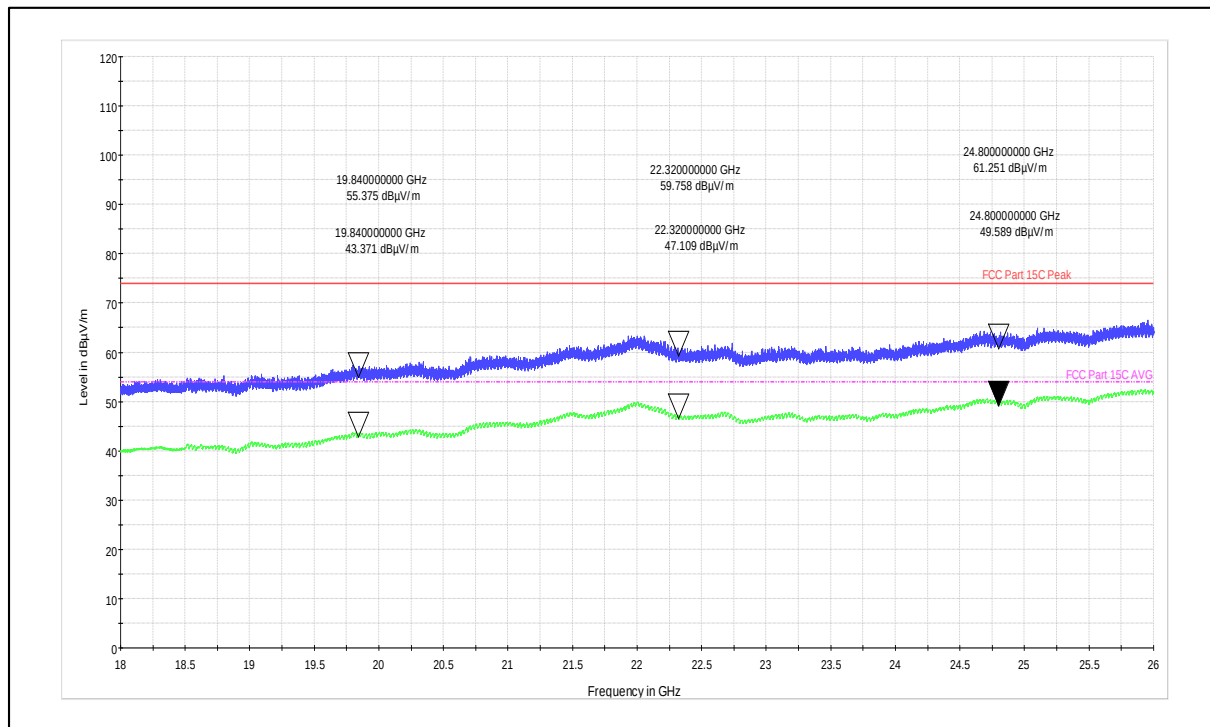
Channel Frequency: 8.7GHz – 18GHz

Polarization: Vertical



Channel Frequency: 8.7GHz – 18GHz

Polarization: Horizontal



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7.5 Conducted spurious emission Test on AC Power lines

Result

Pass

Test Specification : FCC Part 15 Section 15.207
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

Table 10: Limits for Conducted poweline emission

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak (dBµV)	Average (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 Condition

Normal Test Condition:

Temperature (Norm) = + 22.1 °C Voltage = 110V AC (Through AC to DC Adapter) Relative humidity = 65%

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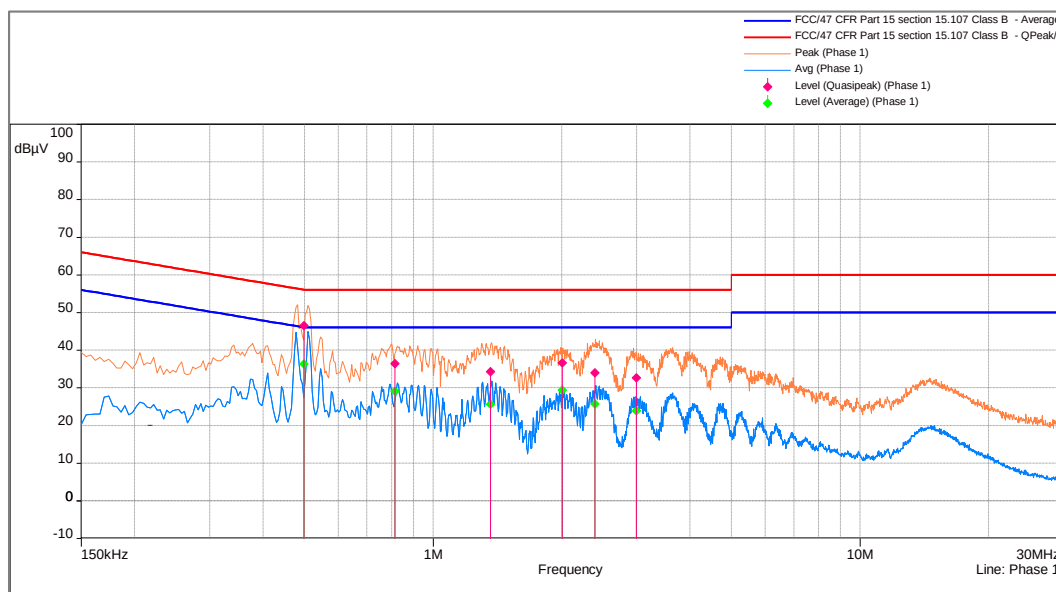
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Test results:

110VAC-60Hz-Line



Quasipeak

Frequency (MHz)	Level (dBμV)	Limit (dBμV)	Margin (dB)	Remarks
0.4982	46.57	56.03	-9.46	Pass
2.0062	36.69	56.00	-19.31	Pass
0.8147	36.47	56.00	-19.53	Pass
1.3605	34.28	56.00	-21.72	Pass
2.3920	34.03	56.00	-21.97	Pass
2.9895	32.68	56.00	-23.32	Pass

Average

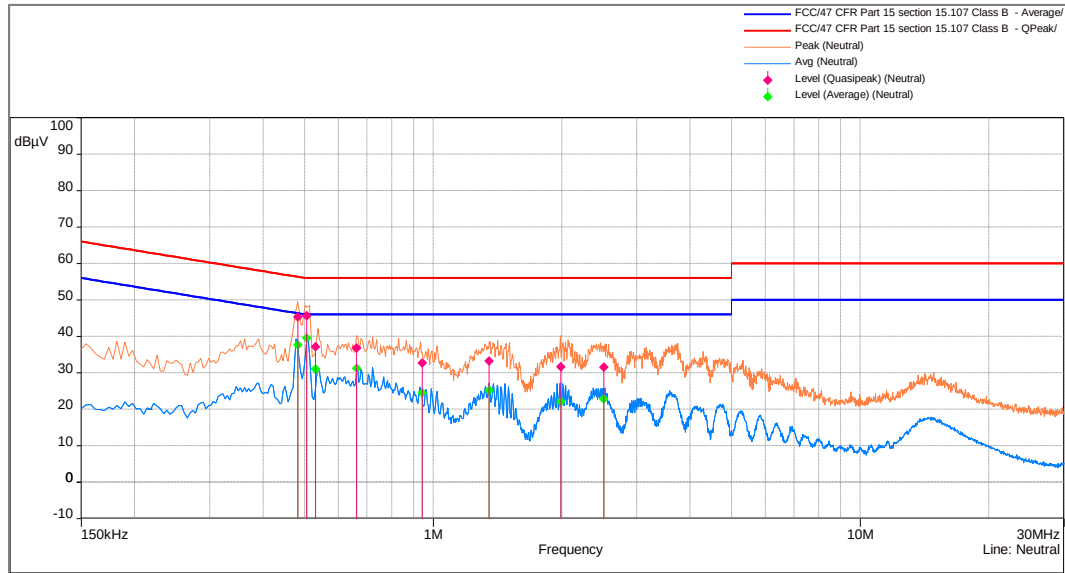
Frequency (MHz)	Level (dBμV)	Limit (dBμV)	Margin (dB)	Remarks
0.4982	36.36	46.03	-9.68	Pass
2.0062	29.46	46.00	-16.54	Pass
0.8147	29.14	46.00	-16.86	Pass
2.3920	25.73	46.00	-20.27	Pass
1.3605	25.65	46.00	-20.35	Pass
2.9895	23.97	46.00	-22.03	Pass

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110VAC-60Hz-Neutral



Quasipeak

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Remarks
0.5059	45.72	56.00	-10.28	Pass
0.4838	45.40	56.30	-10.90	Pass
0.5308	37.20	56.00	-18.80	Pass
0.6624	36.88	56.00	-19.12	Pass
1.3490	33.25	56.00	-22.75	Pass
0.9412	32.76	56.00	-23.24	Pass
1.9887	31.73	56.00	-24.27	Pass
2.5094	31.59	56.00	-24.41	Pass

Average

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Remarks
0.5059	39.63	46.00	-6.37	Pass
0.4838	37.69	46.30	-8.61	Pass
0.6624	31.23	46.00	-14.77	Pass
0.5308	31.10	46.00	-14.9	Pass
1.3490	25.24	46.00	-20.76	Pass
0.9412	24.57	46.00	-21.43	Pass
2.5094	22.86	46.00	-23.14	Pass
1.9887	22.08	46.00	-23.92	Pass

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*****End of test report*****