

Prüfbericht-Nr.: <i>Test report no.:</i>	IN23CPI5 001 ULR-TC5688233000000094F	Auftrags-Nr.: <i>Order no.:</i>	0146716970 020	Seite 1 von 28 Page 1 of 28	
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	2269507	Auftragsdatum: <i>Order date:</i>	2022.09.08		
Auftraggeber: <i>Client:</i>	Trimble Inc. 5475 Kellenburger Road , Building 2, Dayton, Ohio 45424 United States				
Prüfgegenstand: <i>Test item:</i>	GS920	Serien-Nr.: Serial No.:	Engineering Sample		
Bezeichnung: <i>Identification .:</i>	GS920				
Auftrags-Inhalt: <i>Order content:</i>	Testing and issue of Test report with Grant Certificate				
Prüfgrundlage: <i>Test specification:</i>	FCC Part 15 Subpart C 15.247,15.205, 15.207 & 15.209 RSS 247 Issue 3, RSS Gen Issue 5				
Wareneingangsdatum: <i>Date of sample receipt:</i>	2022-11-11				
Prüfmuster-Nr <i>Test sample no</i>	A003370833-001 A003370833-002 A003370833-003				
Prüfzeitraum: <i>Testing period:</i>	2022.11.12 - 2022.11.20				
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 FCC Test Site Registration No: 496599 IC Test Site Registration No: 27711 HVIN: MB119-00SD-A				
Prüfergebnis*: <i>Test result*:</i>	Pass				
geprüft von: <i>tested by:</i>	Yogesh V Senior Engineer	genehmigt von: <i>authorized by:</i>	Madhu K N Asst. Manager		
Datum: <i>Date:</i> 2022.11.22		Ausstellatum: <i>Issue date:</i> 2023.09.12			
Sonstiges / Other:	FCC ID: S9E-131488 IC: 5817A-131488				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	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 N/A = nicht anwendbar	4 = ausreichend N/T = nicht	5 = mangelhaft N/T = nicht
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory N/A = not applicable	4 = sufficient N/T = not tested	5 = poor N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <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>					

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1	<p>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p>
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3	<p>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</p> <p><i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p>
4	<p>Die Entscheidungsregel für Konformitätserklärungen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird.</p> <p><i>The decision rule for statements of conformity in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report.</i></p>

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TEST SUMMARY

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

Note:

*N/T: Not tested – These test cases are not tested,

The product uses certified RF module **BLUENRG-M2SP Module** from **STMicroelectronics**, with **FCC ID: S9NBNRGM2SP & IC ID: 8976C-BNRGM2SP**. Issued by the **IMQ**, Report no. **AR19-0034275-01** issued on **2019-04-03**.

Product Category: Electronics Testing
Test Discipline: EMC Test Facility

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REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
IN23CPI5 001 ULR-TC5688233000000094F	01	Initial issue of report	2023.09.12

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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 DIAGRAM
- 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	04.08.2023	Yearly	Radiated Spurious Emission
EMI Receiver	Rohde & Schwarz	ESW 44	101733	1.72SP1	15.02.2024	Yearly	
Active loop antenna	Frankonia	LAX-10	LAX-10-800	-	02.03.2024	Yearly	
Balun & Biconical Antenna	Schwarzbeck Mess-Elektronik	BBA 9106+V HBB 9124	9124-1117	-	05.05.2024	Yearly	
Log-Periodic Antenna	Schwarzbeck mess-elektronik	VUSLP 9111B	9111B-111	-	17.02.2024	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-1944	-	11.10.2023	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-0904	-	13.10.2023	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	

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 3mtr-FAC	EMC 32	10.60.00

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3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

The GS920 system includes the cabin mounted GS920, compatible crane mounted sensors and an android/ ios tablet with Lifting works application. GS920 is designed to show the state of sensors that monitors the system where the equipment is installed on and provide the real time data to an android/ ios tablet to assist the operator.

3.2 Ratings and System Details of Equipment under Test

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

Radio Protocol		BLE
Operating Frequency Range		2402MHz to 2480MHz
No. of Channels		40 (Refer Table 6)
Channel Spacing		2MHz
Modulation		GFSK
Number of antennas		1
Antenna Gain		0dBi (max peak gain)
Antenna Type		Integral (Strip line on PCB)
Supply Voltage to Product		10V to 30V (Typical 12 V or 24 V)
Environmental conditions	Storage	-40 °C to 85 °C
	Operating	-40 °C to 85 °C
EUT Dimension(L x W x H) in mm		52mm x 182mm x 251mm

***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 **GS920** 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	±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 %

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: MB119-00SD-A

Software version : B0082_V2008B, B0082_V2008D

Software Name: B0082

Hardware Name: GS920

4.3 Special Accessories and Auxiliary Equipment

- None

4.4 Simultaneous Transmission

This product supports Simultaneous operation.

Combinations of Simultaneous Operations performed	BLE
	LoRa

Note: Simultaneous Operation was performed with the above mentioned combination and worst case test results are mentionrd in this report.

4.5 Countermeasures to achieve EMC Compliance

- None

4.6 List of frequencies

Frequency Band (GHz)	Channel No.	Frequency (MHz)
BLE (2.402-2.4835)	0	2402
	1	2404
	2	2406
	3	2408
	:	:
	:	:
	18	2438
	19	2440
	20	2437
	:	:
	:	:
	36	2474
	37	2476
	38	2478
	39	2480

Table 5: List of BLE center Frequencies

Channel used for BLE testing

Channel low : 2402MHz

Channel mid : 2440MHz

Channel High : 2480MHz

Note:

1. TUV Sample Identification number : A003370833-002 & A003370833-001– Radiated & Conducted test Sample

4.7 Report references

Note: Product **GS920** 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 BLE (2.4GHz) – This report	ULR-TC5688233000000094F
RF test report for LoRa (902MHz – 928MHz)	ULR-TC5688233000000095F

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5 OPERATIONAL DESCRIPTION

The GS920 creates a two-way radio network with the sensors to bring required lift data to the operator.

The GS920 Sub-GHz module is a communication module that works on frequency channel 902MHz to 928 MHz and uses 2FSK modulation to communicate.

BLE in GS920 product is used to communicate with android/ ios tablet devices using 2.4GHz frequency band. This interface gives the real time information to the android/ ios tablet screen which we can use for monitoring and controlling.

6 TEST METHODOLOGY

6.1 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

6.1.1 Test Setup Configuration

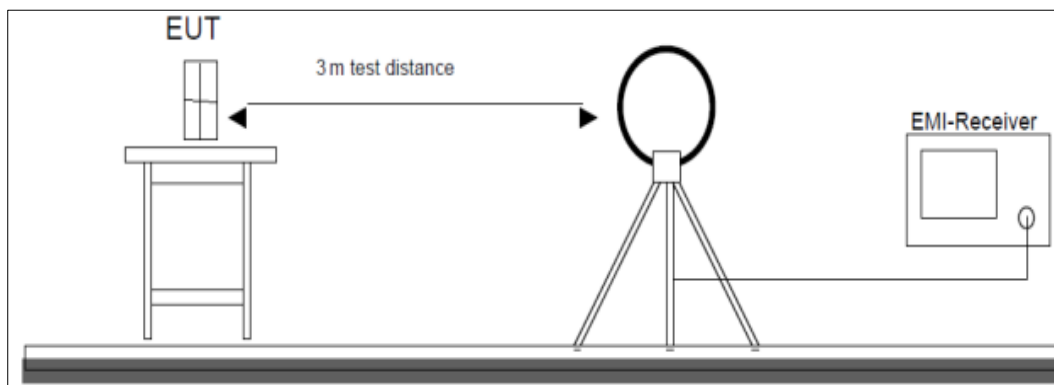


Figure 1: Frequency Range 9 kHz- 30 MHz

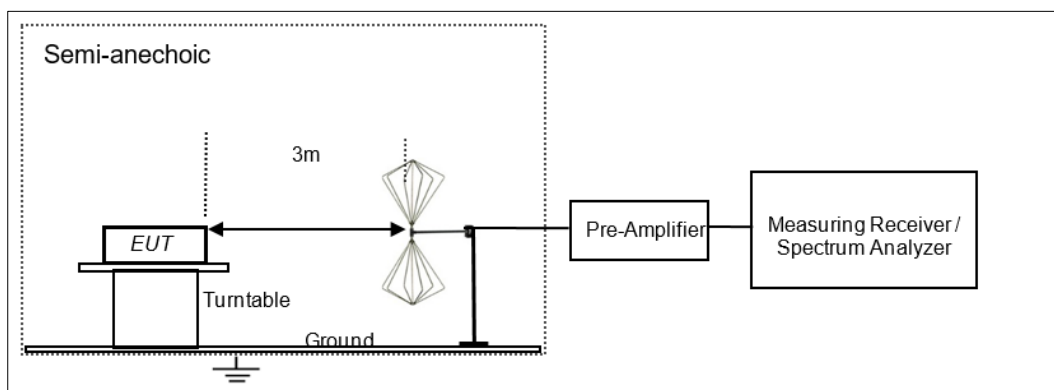


Figure 2: Frequency Range 30 MHz – 200 MHz

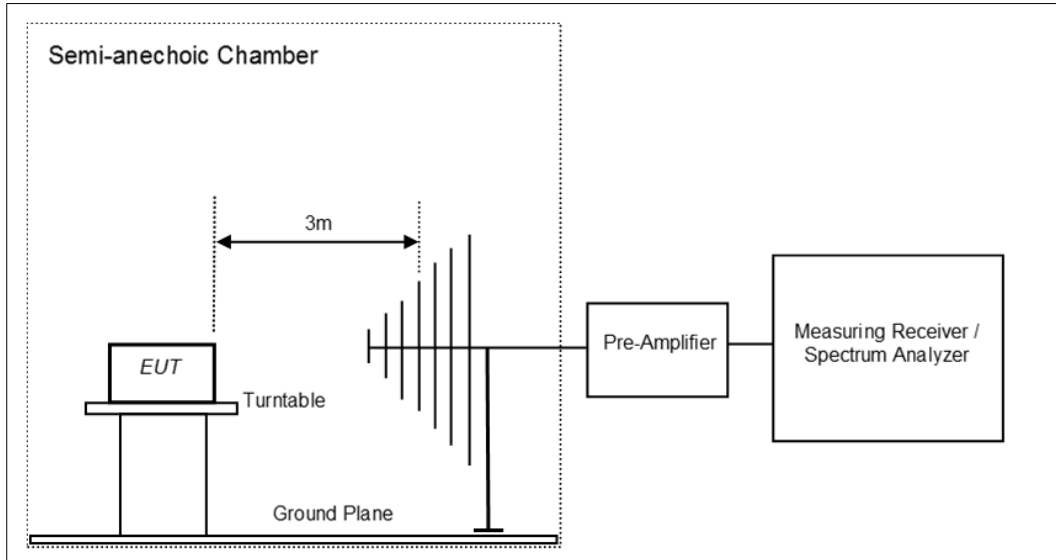


Figure 3: Frequency Range 200 MHz - 1GHz

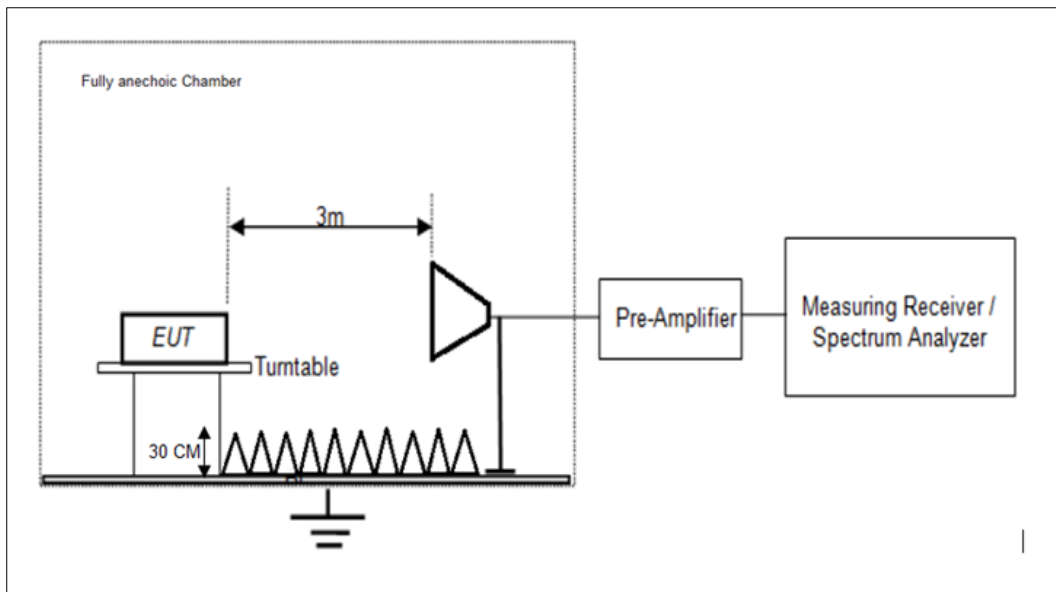


Figure 4: Frequency Range above 1 GHz

7 TEST RESULTS

7.1 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 C63.10.2013
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 Clause 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	54.00	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 69.54.00 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) = + 22.3 °C

Voltage = 12V through AC to DC supply

Relative humidity: 62%

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Test results:

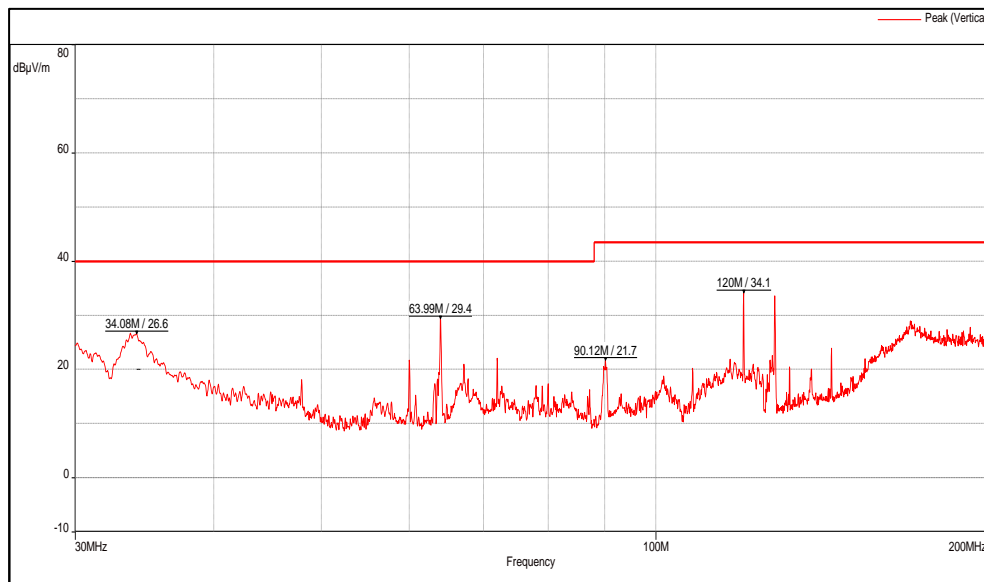
Note: All the losses are included during measurement and final values are mentioned in the test report. Refer Clause 7 TEST METHODOLOGY for more details

Test results for frequency range 9kHz – 30MHz

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

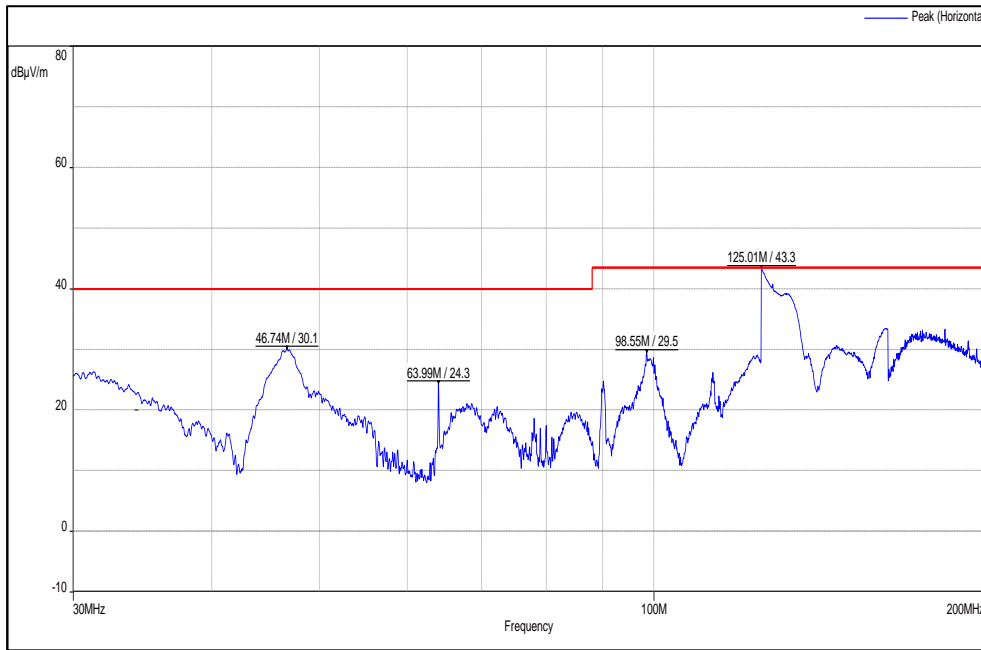
Test results for frequency range 30MHz – 200MHz

Antenna Polarization	Measured Frequency (MHz)	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Vertical	34.08(PK)	26.60	40	-13.40
	63.99(PK)	29.40	40	-10.60
	90.12(PK)	21.70	43.5	-21.80
	120.00(PK)	34.10	43.5	-9.40
Horizontal	46.74(PK)	30.10	40	-9.90
	63.99(PK)	24.30	40	-15.70
	98.55(PK)	29.50	43.5	-14.00
	125.01(PK)	39.30	43.5	-4.20



Channel Frequency 30MHz – 200MHz

Polarization Vertical

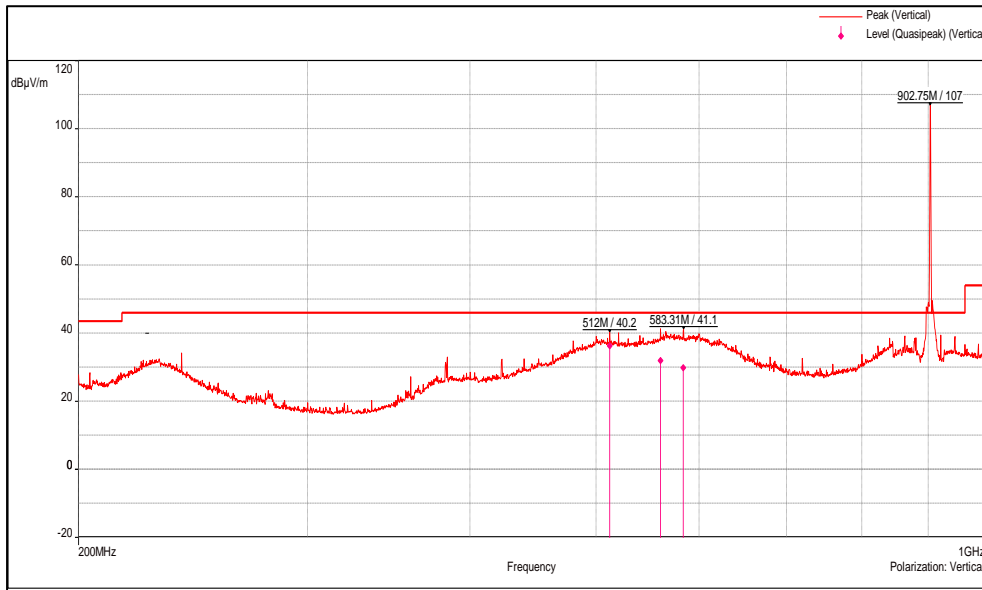


Channel Frequency 30MHz – 200MHz

Polarization Horizontal

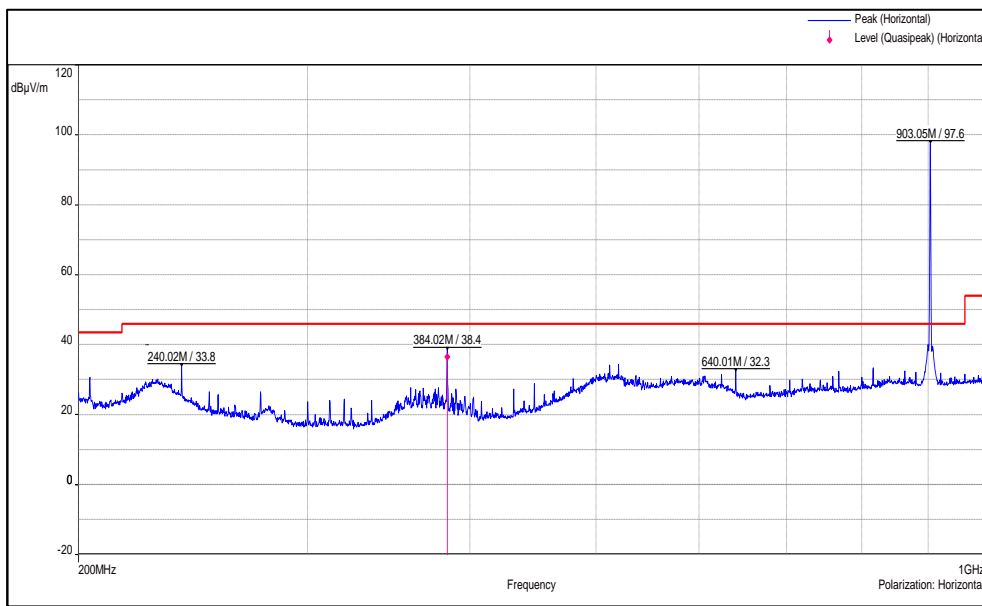
Test results for frequency range 200MHz – 1GHz

Antenna Polarization	Measured Frequency (MHz)	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	511.98(QP)	36.28	46	-9.72
	559.97(QP)	31.93	46	-14.07
	582.91(QP)	29.87	46	-16.13
	902.75(PK)	107.00	-	*
Horizontal	240.02(PK)	33.80	46	-12.20
	384.00(QP)	36.52	46	-9.48
	640.01(PK)	32.30	46	-13.70
	903.05(PK)	97.60	-	*



Channel Frequency 200MHz – 1GHz

Polarization Vertical



Channel Frequency 200MHz – 1GHz

Polarization Horizontal

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

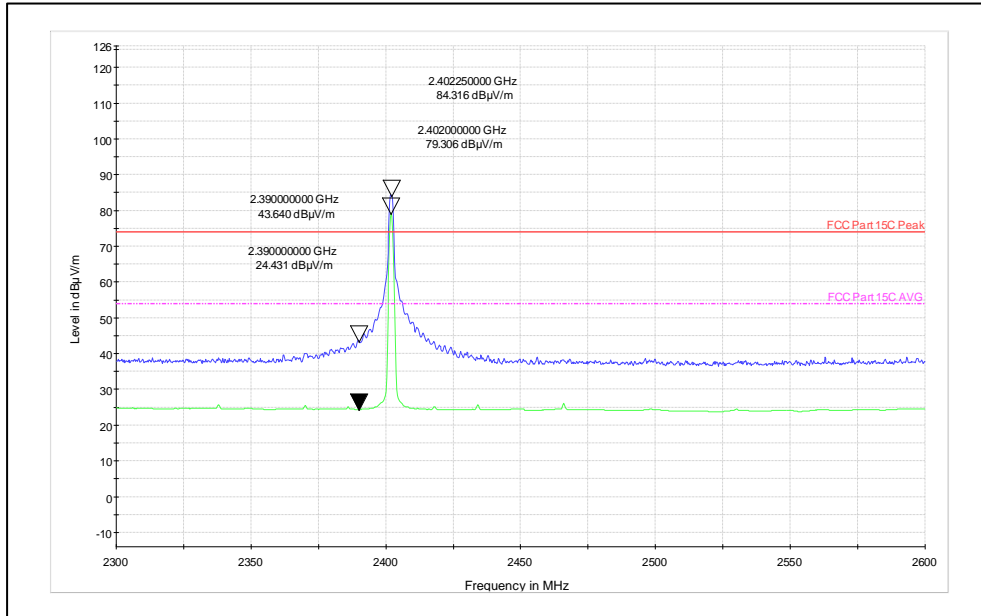
Data rate: 1Mbps

Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2402	2402(Pk)	Vertical	84.31	-	-
	2402(Av)		79.3	-	-
	2390(Pk)		43.64	74*	-30.36
	2390(Av)		24.43	54*	-29.57
	4804(Pk)		49.74	74	-24.26
	4804(Av)		40.38	54	-13.62
	7206(Pk)		48.38	74	-25.62
	7206(Av)		37.28	54	-16.72
	2402(Pk)	Horizontal	84.53	-	-
	2402(Av)		79.51	-	-
	2390(Pk)		43.97	74*	-30.03
	2390(Av)		24.48	54*	-29.52
	4804(Pk)		48.17	74	-25.83
	4804(Av)		38.36	54	-15.64
	7206(Pk)		50.64	74	-23.36
	7206(Av)		39.03	54	-14.97
2440	2440(Pk)	Vertical	84.13	-	-
	2440(Av)		79.11	-	-
	4880(Pk)		50.49	74	-23.51
	4880(Av)		41.10	54	-12.90
	7320(Pk)		48.74	74	-25.26
	7320(Av)		36.56	54	-17.44
	2440(Pk)	Horizontal	84.96	-	-
	2440(Av)		79.93	-	-
	4880(Pk)		48.62	74	-25.38
	4880(Av)		39.39	54	-14.61
	7320(Pk)		50.15	74	-23.85
	7320(Av)		37.93	54	-16.07
2480	2480(Pk)	Vertical	84.96	-	-
	2480(Av)		79.92	-	-
	2483.5(Pk)		55.30	74*	-18.70
	2483.5(Av)		26.46	54*	-27.54
	4960(Pk)		49.56	74	-24.44
	4960(Av)		40.34	54	-13.66
	7440(Pk)		48.53	74	-25.47
	7440(Av)		36.51	54	-17.49
	2480(Pk)	Horizontal	85.70	-	-
	2480(Av)		80.65	-	-
	2483.5(Pk)		56.05	74*	-17.95
	2483.5(Av)		26.73	54*	-27.27
	4960(Pk)		48.10	74	-25.90
	4960(Av)		38.58	54	-15.42
	7440(Pk)		49.55	74	-24.45
	7440(Av)		36.67	54	-17.33

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

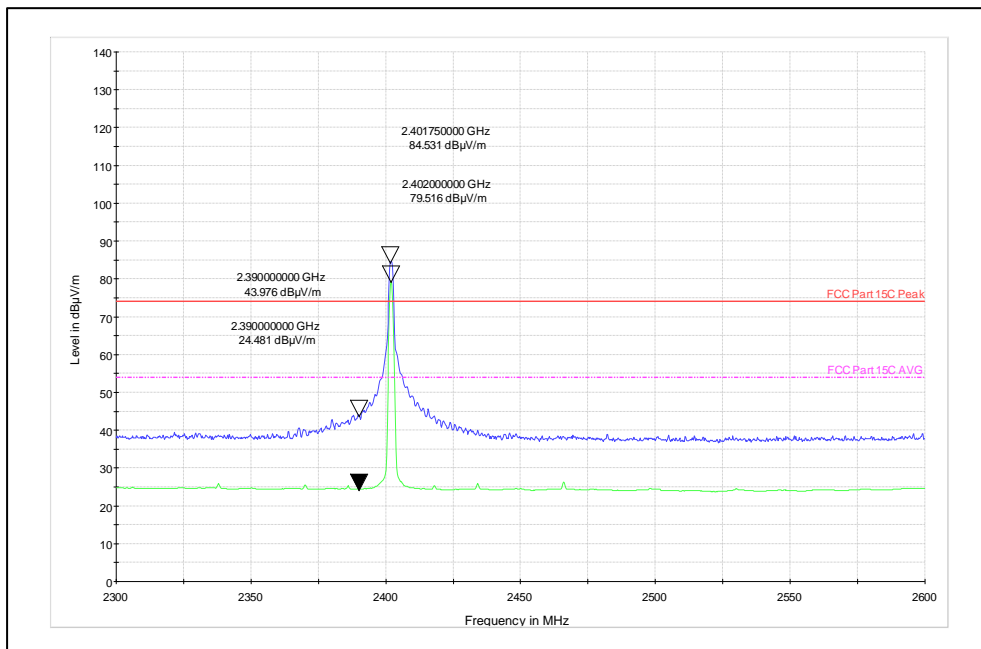
Test Plots

Data Rate: 1Mbps
Channel Frequency: 2402MHz



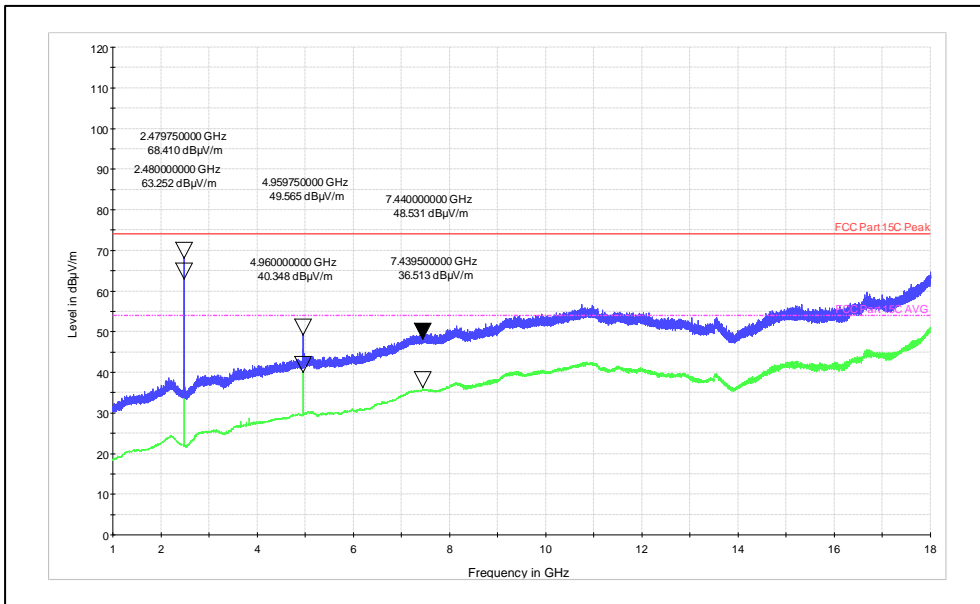
Channel Frequency: 2402MHz

Polarization: Vertical



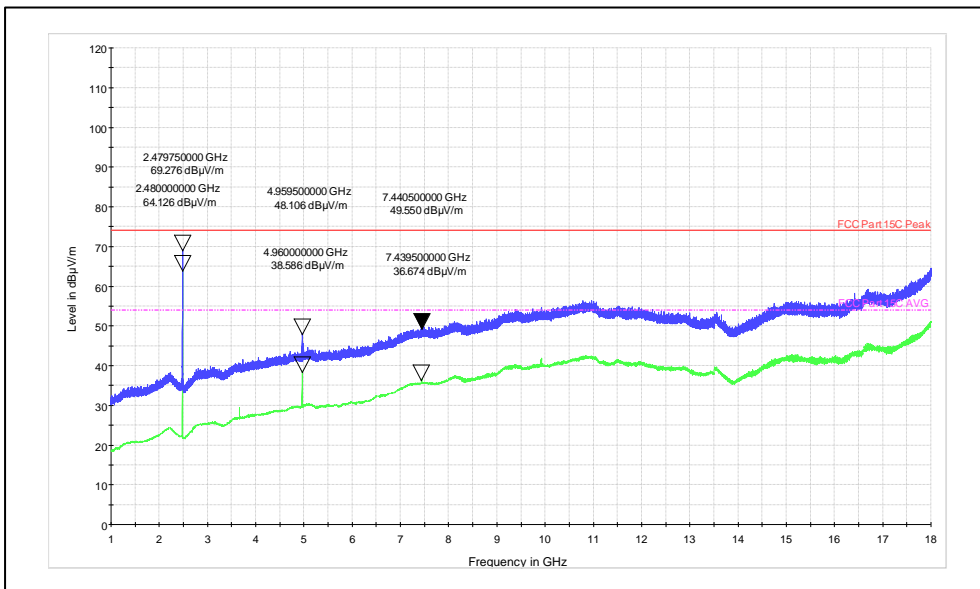
Channel Frequency: 2402MHz

Polarization: Horizontal



Channel Frequency: 1 – 18 GHz

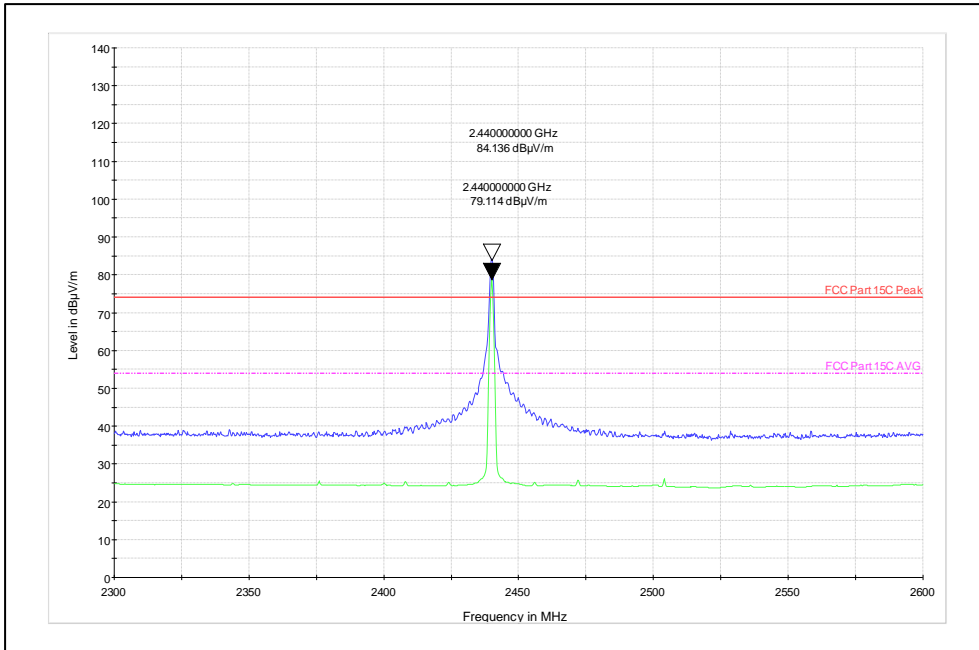
Polarization: Vertical



Channel Frequency: 1 – 18 GHz

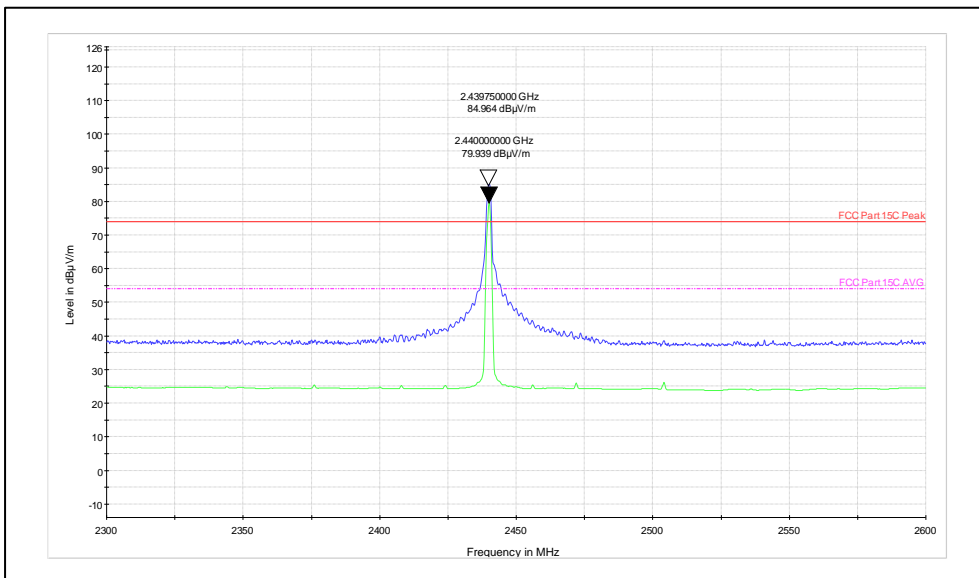
Polarization: Horizontal

Channel Frequency: 2440MHz



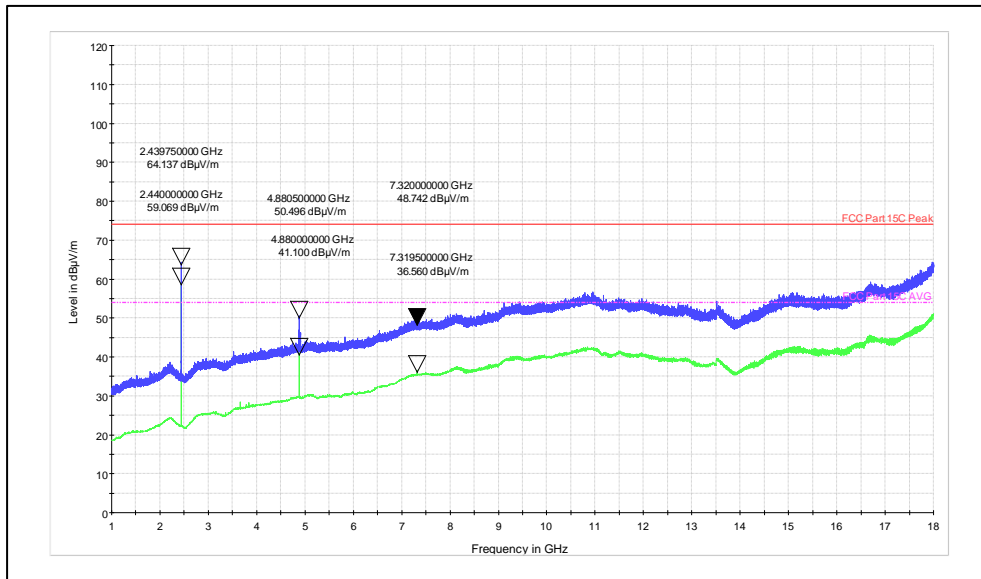
Channel Frequency: 2440MHz

Polarization: Vertical



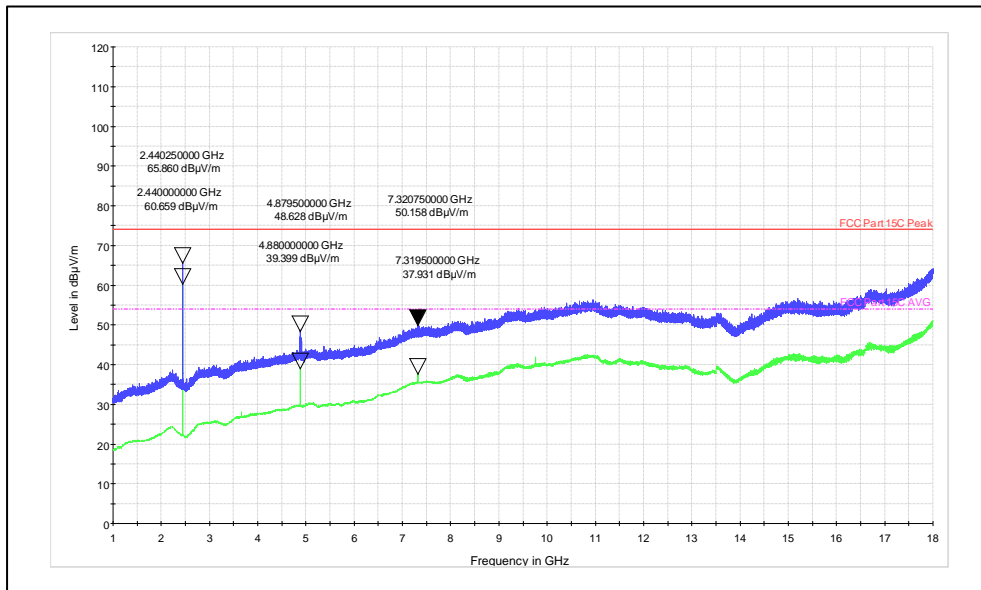
Channel Frequency: 2440MHz

Polarization: Horizontal



Channel Frequency: 1 – 18 GHz

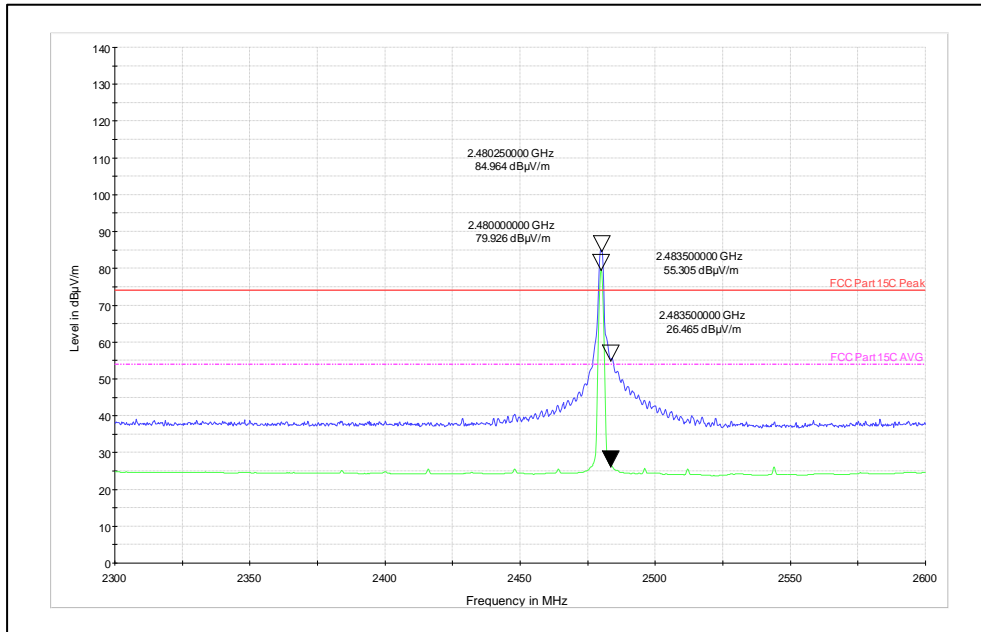
Polarization: Vertical



Channel Frequency: 1 – 18 GHz

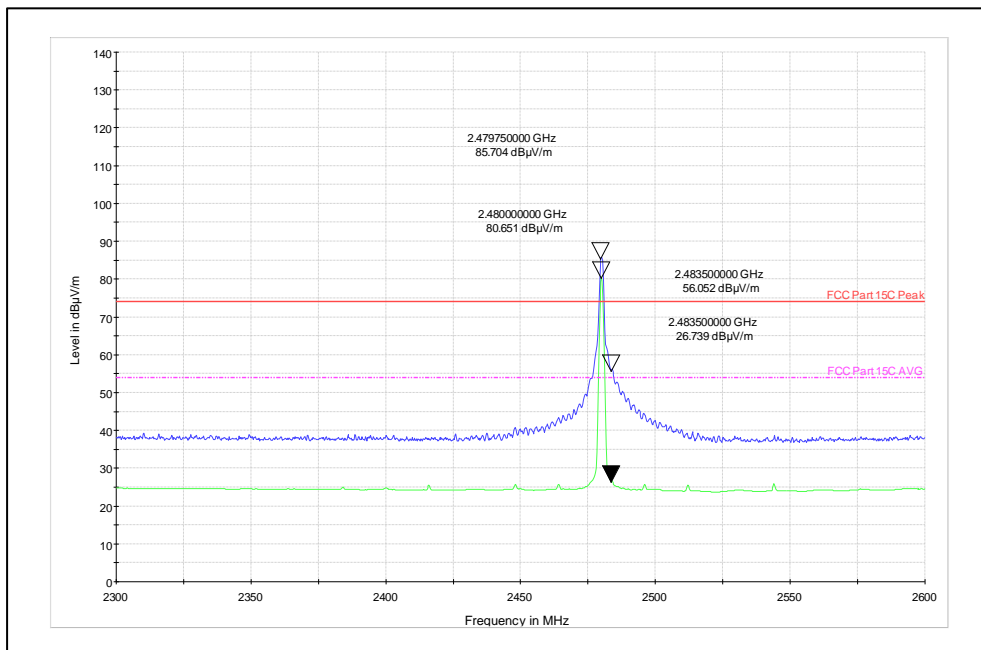
Polarization: Horizontal

Channel Frequency: 2480MHz



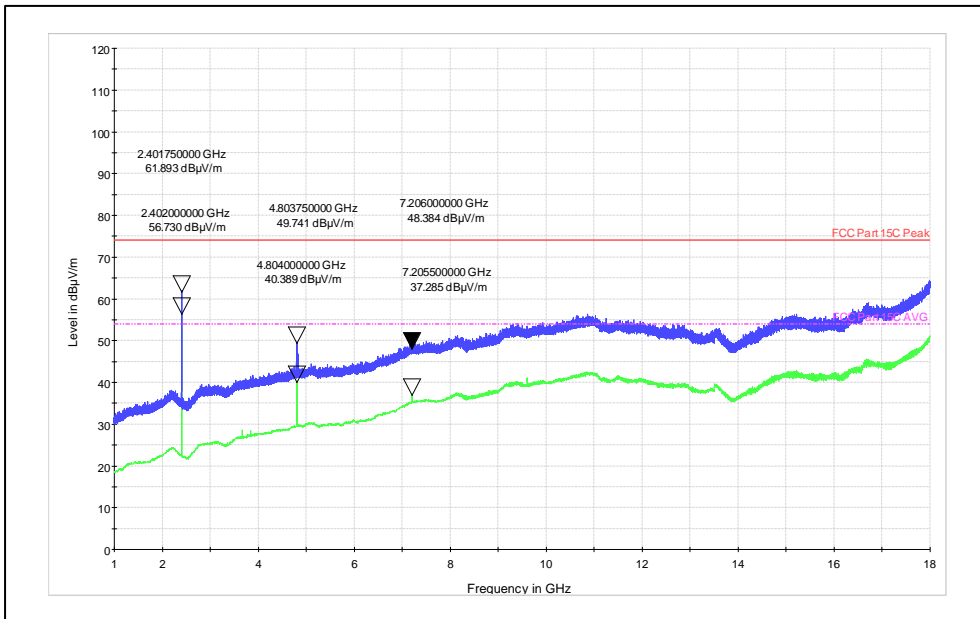
Channel Frequency: 2480MHz

Polarization: Vertical



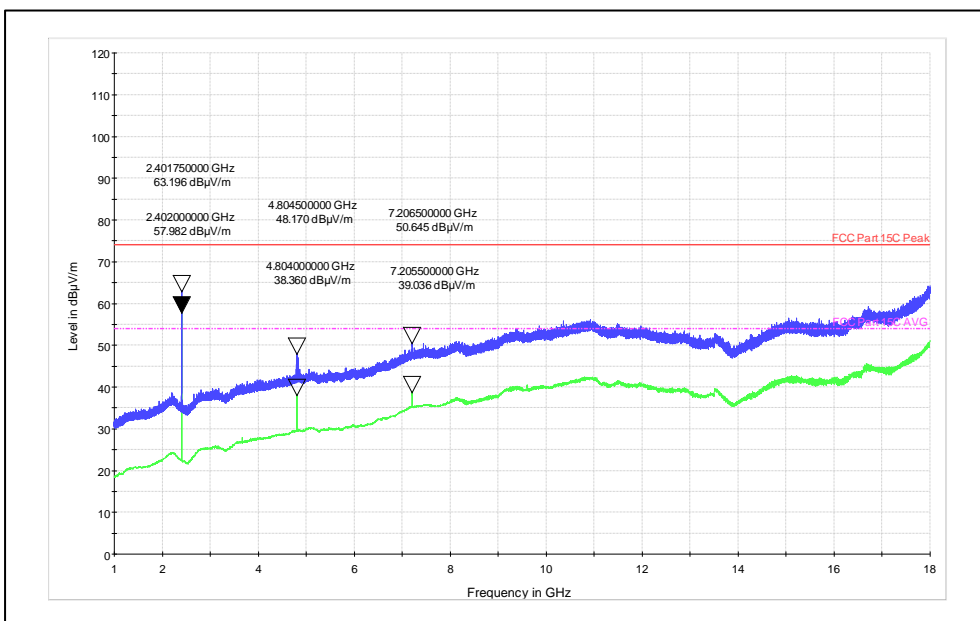
Channel Frequency: 2480MHz

Polarization: Horizontal



Channel Frequency: 1 – 18 GHz

Polarization: Vertical



Channel Frequency: 1 – 18 GHz

Polarization: Horizontal

No Emissions found above 18GHz

Prüfbericht - Nr.:
Test Report No.:

IN23CPI5 001
ULR-TC5688233000000094F

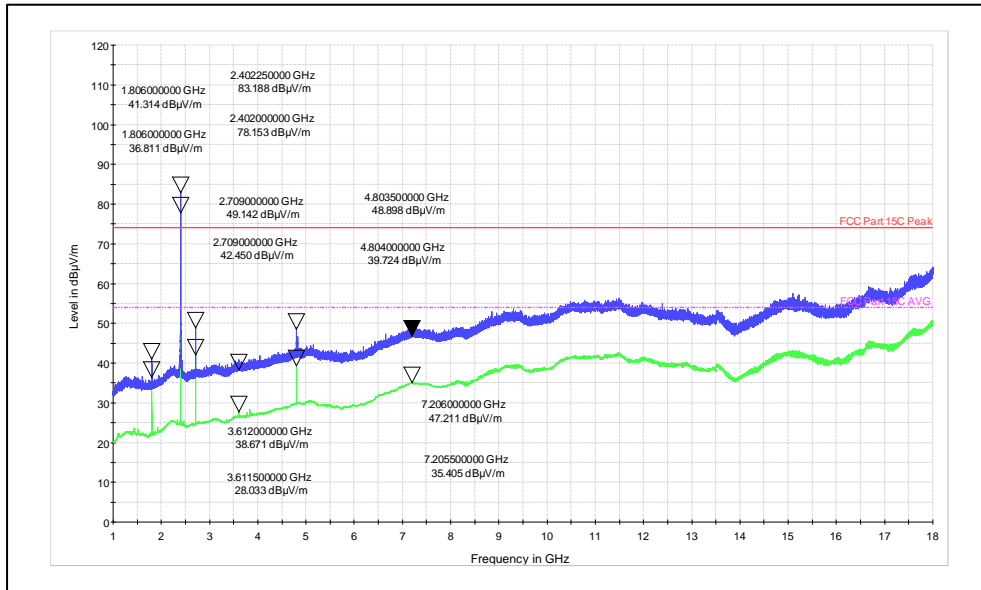
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7.1.1 RSE Test Results of Simultaneous Operation with BLE and LoRa:

Note: Simultaneous Operation was performed As specified under the section 4.4 Simultaneous Transmission and worst-case test results are mentioned below.

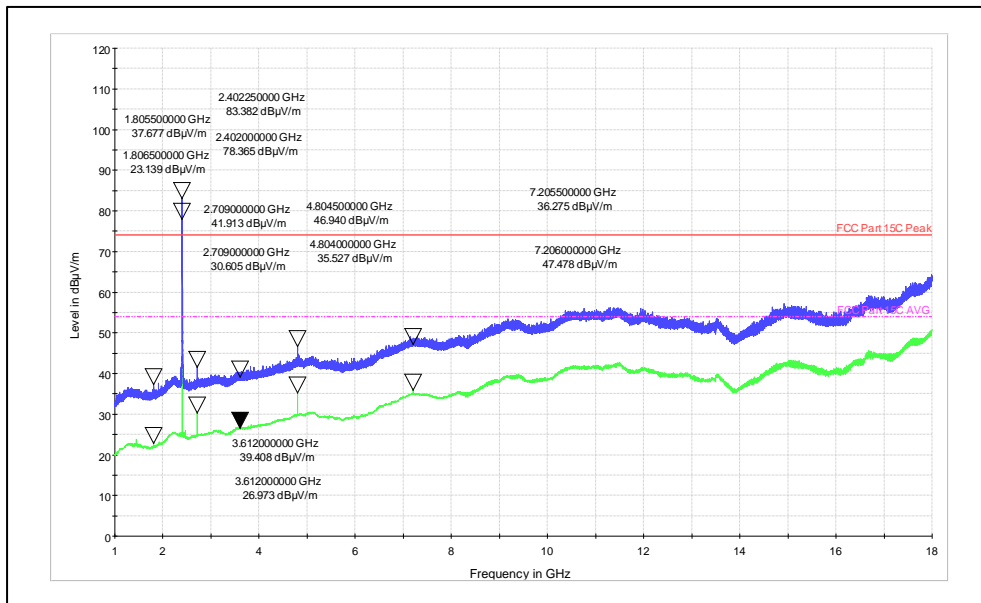
Channel Frequency (MHz)	Measured Frequency (MHz)	Antenna Polarization	Measured Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2402MHz & 903MHz	1806(Pk)	Vertical	37.67	74	-36.33
	1806(Av)		23.13	54	-30.87
	2709(Pk)		41.91	74	-32.09
	2709(Av)		30.60	54	-23.40
	3612(Pk)		39.40	74	-34.60
	3612(Av)		26.97	54	-27.03
	4804(Pk)		46.94	74	-27.06
	4804(Av)		35.52	54	-18.48
	7206(Pk)		36.27	74	-37.73
	7206(Av)		47.47	54	-6.53
	1806(Pk)	Horizontal	41.31	74	-32.69
	1806(Av)		36.81	54	-17.19
	2709(Pk)		49.14	74	-24.86
	2709(Av)		42.45	54	-11.55
	3612(Pk)		38.67	74	-35.33
	3612(Av)		28.03	54	-25.97
	4804(Pk)		48.98	74	-25.02
	4804(Av)		39.72	54	-14.28
	7206(Pk)		47.21	74	-26.79
	7206(Av)		35.40	54	-18.60

Test Plots



Channel Frequency: 1 – 18 GHz

Polarization: Vertical



Channel Frequency: 1 – 18 GHz

Polarization: Horizontal

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9 POWER LEVEL INDEX USED FOR TESTING

BLE 2.4GHz

1Mbps	
Channel Frequency (MHz)	Power level
2402	11.5
2440	11.5
2480	11.5

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