Prüfbericht-Nr.: *Test report no.:*	**ULR-TC568822300000017F**	**Auftrags-Nr.:** *Order no.:*	146621230 020	Seite 1 von 83 *Page 1 of 83*
Kunden-Referenz-Nr.: *Client reference no.:*	**2024735**	**Auftragsdatum:** *Order date:*	2021-10-11	
Auftraggeber: *Client:*	1. HONEYWELL INTERNATIONAL INC 1860W, ROSE GARDEN LANE, AZ75,M-16-7988, PHOENIX, ARIZON, UNITED STATES 2. Honeywell LTD 500 Brooksbank Avenue, North Vancouver, BC, V7J 3S4; Canada			
Prüfgegenstand: *Test item:*	Industrial RTLS			
Bezeichnung *Identification*	OW-RTLTG2	**Serien -Nr.:** *Serial no.:*	14W23C12345678912	
Auftrags-Inhalt: *Order content*:	Testing and issue of Test Report and Grant Certificate			
Prüfgrundlage: *Test specification:*	FCC Part 15 Subpart C 15.247,15.205 & 15.209 RSS 247 Issue 2,RSS Gen Issue 5			
Wareneingangsdatum: *Date of sample receipt:*	2021-12-16			
Prüfmuster-Nr.: *Test sample no:*	A003238199-001			
Prüfzeitraum: *Testing period:*	2021-12-16 - 2021-12-30			
Ort der Prüfung: *Place of testing:*	Wireless laboratory, Bangalore			
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (India) Pvt. Ltd. 27/B,2nd cross road, Electronic city Phase1, Banglore-560100, India FCC Test Site Registration No: 496599 IC Test Site Registration No: 3665-1			
Prüfergebnis*: *Test result*:*	Pass			

geprüft von:
tested by:

Datum:
Date: 2021-12-16

Stellung / *Position:* **Yogesh V**
Engineer

genehmigt von:
authorized by:

Ausstellatum:
Issue date: 2022-04-08

Stellung / *Position:* **Lokesh Ramu**
Manager

Sonstiges / *Other:* FCC ID: S5751460078
IC: 573W-51460078

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*

TEST SUMMARY

Test Item	FCC	IC	Result
Maximum conducted (Peak) output power	15.247 (b)(2)	RSS 247 Issue 2, Section 5.4 (b)	Pass
Occupied bandwidth and 20dB Bandwidth	15.247 (a) (i)	RSS 247 Issue 2, Section 5.1 (b)	Pass
Number of Hopping channels	15.247 (a) (i)	RSS 247 Issue 2, Section 5.1 (d)	Pass
Carrier Frequency Separation	15.247 (a) (1)	RSS 247 Issue 2, Section 5.1 (b)	Pass
Time of Occupancy (Dwell Time)	15.247 (a) (i)	RSS 247 Issue 2, Section 5.1 (d)	Pass
Emissions in non-restricted frequency bands	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
Antenna requirement	15.203		Pass
Conducted Emission test on AC Power Line	FCC 15.207	RSS-Gen Issue 5, Section 8.8	Pass

Product Category: Electronics Testing
Test Discipline: EMC Test Facility

REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
ULR-TC5688223000000017F	01	Initial issue of report	2022-04-08

Table of Contents

1 GENERAL REMARKS

1.1 Attachments

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

1. Test Setup photos
2. EUT External Photos
3. EUT Internal Photos
4. FCC Label and Label Location
5. Block Diagram
6. Specification of EUT
7. Schematic Diagrams
8. Bill of Material
9. User Manual
10. Maximum Permissible Exposure Information

2 TEST SITES

2.1 Testing Facilities

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	Schwarzbeck	FMZB 1519 B	1519B-00111	-	27.04.2022	Yearly	Radiated Spurious Emission
Balun & Biconical Antenna	Schwarzbeck Mess-Elektronik	BBA 9106+V HBB 9124	9124-1117	-	25.02.2022	Yearly	
Log - Periodical Antenna	Schwarzbeck Mess-Elektronik	VUSLP 9111B	9111B-324	-	24.02.2022	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-1944	-	11.05.2022	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	
EMI Receiver	Rohde & Schwarz	ESW 44	101732	4.73.SP5	19.05.2022	Yearly	
EMI Receiver	Rohde & Schwarz	ESW44	101773	1.72SP1	27.01.2022	Yearly	
Spectrum Analyzer	Agilent	E4407B	US41192772	A.14.06	15.12.2022	Yearly	

Table 2: Instrument application Software versions

SL. No.	Test Type	Application software	Version
1	Radiated spurious emission measurement in FAC	EMC 32	10.60.00
1	Radiated spurious emission measurement in FAC	BAT EMC	3.20.0.17

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

RTLS Tag is a personnel wearable Industrial wireless Tag operating at 2.4 GHz ISM band. It is a compact, light, and simple battery-operated device that will be wearable handily using a clip accessory. The RTLS Tag communicates with FDAP32 Anchors to enable Real-time location tracking. It is an intrinsically safe class1/div1 certified device with a battery life lasting up to 3 years. The RTLS Tag has an IP65 rating and the ability to operate in harsh environments. The RTLS Tag can also be mounted and used for asset tracking.

3.2 Ratings and System Details of Equipment under Test

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

Protocol	Proprietary
Operating Frequency Range	2405MHz to 2477.5MHz
No. of Channels	120
Channel Spacing	500KHz
Tx Transmitting Power	8 dBm
Maximum Measured Power	8.63dBm at 2405MHz Frequency
Modulation	CW-FHSS
Number of antennas	3
Antenna Gain & Antenna Type	1. Chip Antenna 2.4GHz - Chip RF Antenna 2.4GHz ~ 2.5GHz 0.5dBi Solder Surface Mount 2450AT18A100E 0.5dbi (Peak Gain) 2. Chip Antenna 2.4GHz - Chip RF Antenna 2.4GHz ~ 2.5GHz 0.5dBi Solder Surface Mount 2450AT18A100E 0.5dbi (Peak Gain) 3. Chip Antenna 2.4GHz - Bluetooth Chip RF Antenna 2.4GHz ~ 2.483GHz 1.7dBi Solder Surface Mount W3008 1.1dBi(Peak Gain)
Supply Voltage to Product	3.6VDC Battery Supply
Environmental conditions	Operating temperature is -20 deg to +60 deg
EUT Dimension	88 mm height x 62.5 mm length x 20.6 mm width

*__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.

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 ℃
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 transmission on low, mid and high channel.

4.2 Test Operation and Test Software

Hardware Version: OW-RTLTG2

Software Version: R100.1-15.0

Hardware version of identification Number (HVIN): OW-RTLTG2

Firmware version of identification Number (FVIN): R100.1-15.0

4.3 Special Accessories and Auxiliary Equipment

None

4.4 Simultaneous Transmission

IEEE 802.15.4 (DTS) and Proprietary (FHSS) will not be able to transmit simultaneously and also Antenna 1 and Antenna 2 will not be able to transmit simultaneously.

4.5 Countermeasures to achieve EMC Compliance

None

4.6 List of frequencies

Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
2400 – 2483.5	**01**	**2405**
	02	2405.5
	-	-
	-	-
	-	-
	-	-
	59	2442
	60	**2442.5**
	61	2443
	-	-
	-	-
	-	-
	-	-
	119	2477
	120	**2477.5**

Table 5: List of EUT Center frequencies

Channel used for EUT testing

Channel low : 2405MHz

Channel mid : 2442.5MHz

Channel High : 2477.5MHz

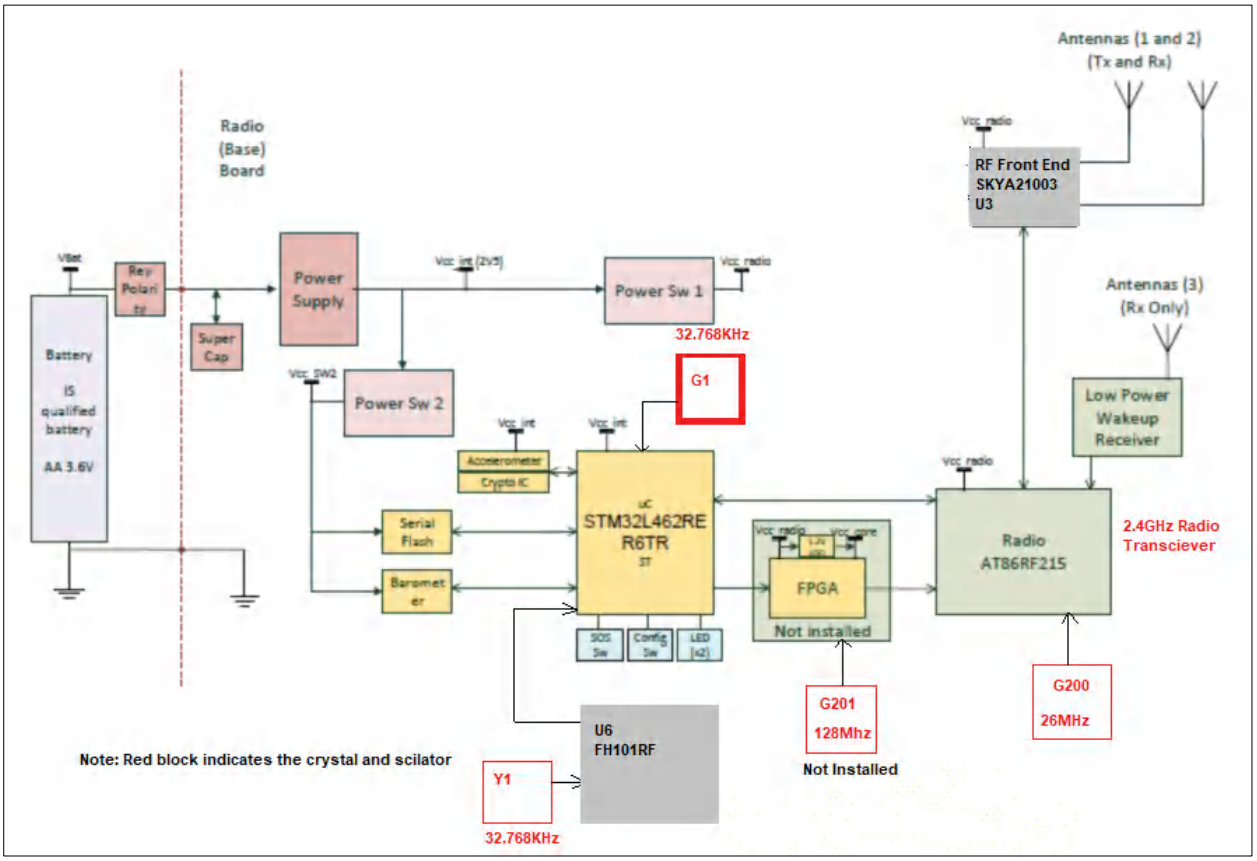
Note:

1. TUV Sample Identification number : A003238199-001 – Radiated & Conducted test Sample

5 Operational Description

The RTLS Tag (Real time location Sensing) is an RF radio module which detects and calculates the position of the asset/person carrying the module within an installation. The RTLS Tag works in tandem with the Anchor (module) to calculate the position information. The RTLS Tag is an intrinsically safe module expected to be worn as a badge on a person or fixed to an asset within an installation. The RTLS Tag is a battery-operated compact module. Block diagram of the Tag is shown below. All the frequency generating components are marked.

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 mesurement 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

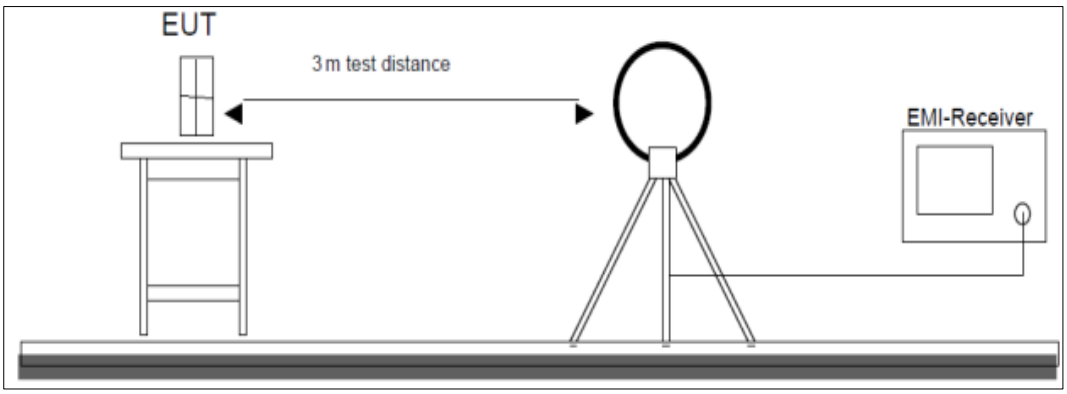


Figure 1: Frequency Range 9 kHz- 30 MHz

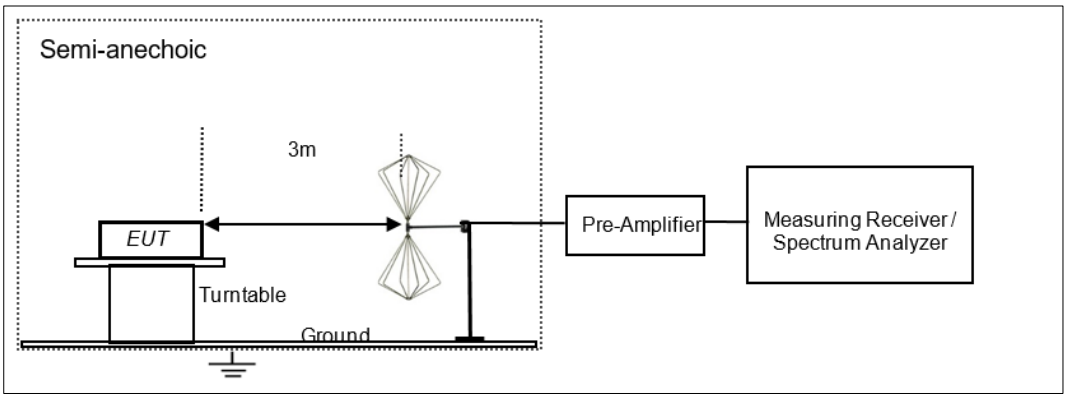


Figure 2: Frequency Range 30 MHz – 200 MHz

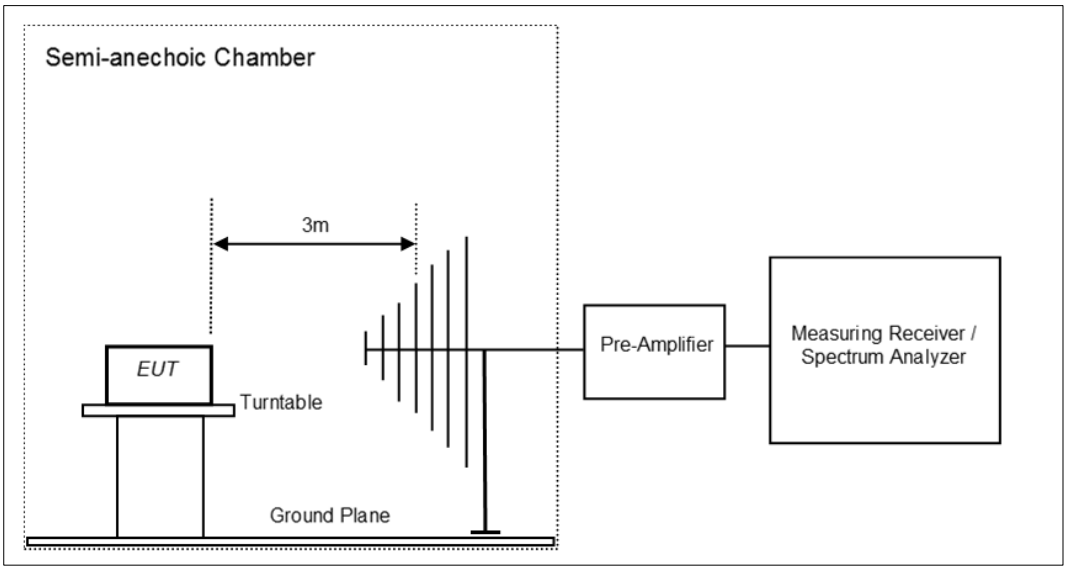


Figure 3: Frequency Range 200 MHz - 1GHz

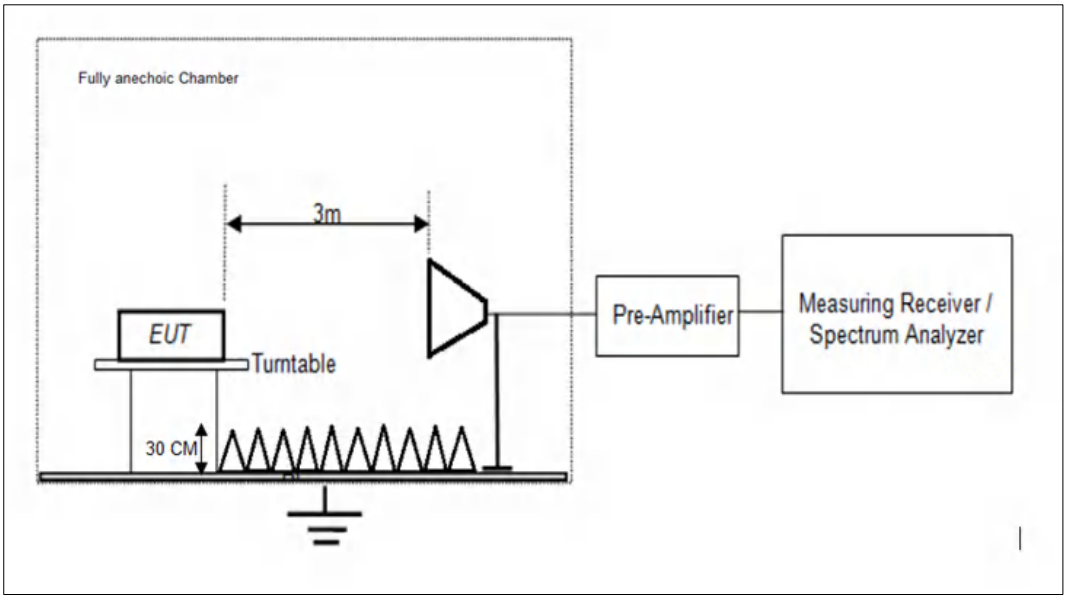


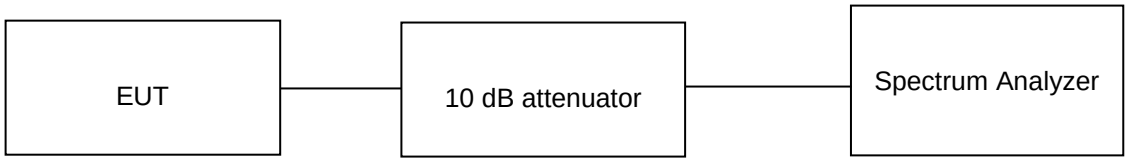
Figure 4: Frequency Range above 1 GHz

8 TEST RESULTS

8.1 Maximum Peak Conducted Output Power

Result ***Pass***

Test Specification	FCC part 15 Subpart C 15.247 (b) (1) / RSS 247 Issue 2 5.1(b)
Test Method	Subclause 7.8.5 of ANSI C63.10
Measurement Bandwidth	30kHz
Detector	Peak
Port of testing	Antenna port
Requirement	Power ≤ 1 W (30 dBm)



Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.0 °C Voltage = 3.6V DC throgh DC Power supply Relative humidity: 64%

KDB Guidelines applied:

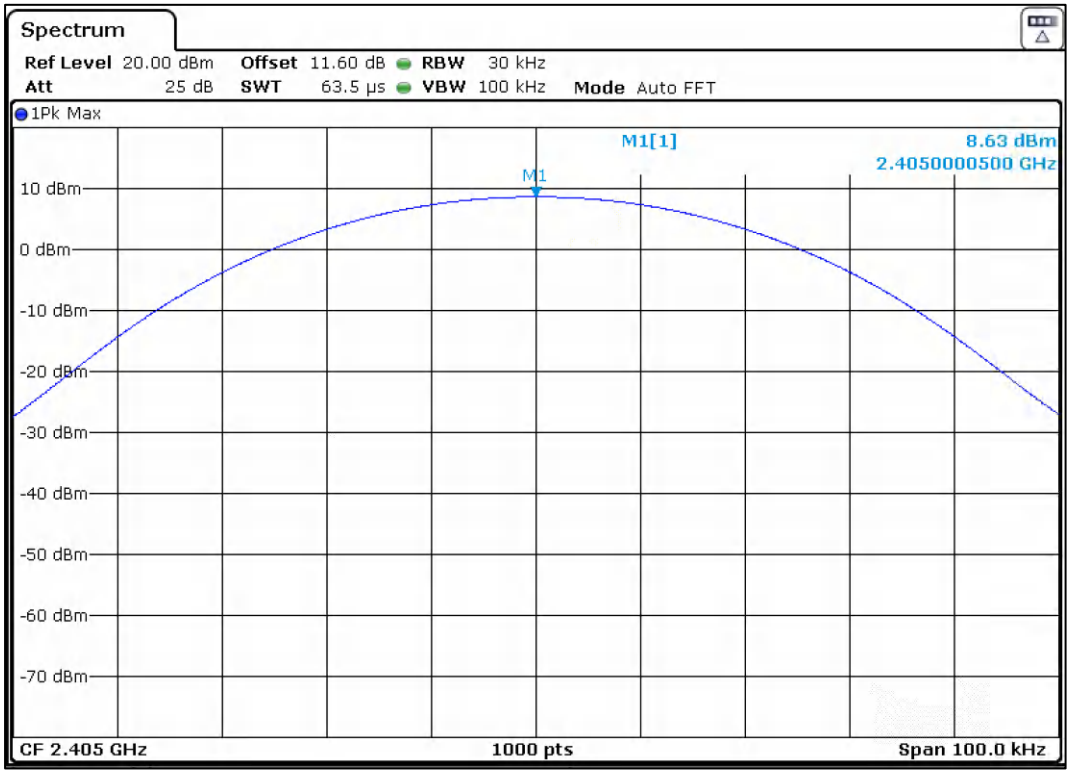
Measurements were made as per section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02.

Test results:

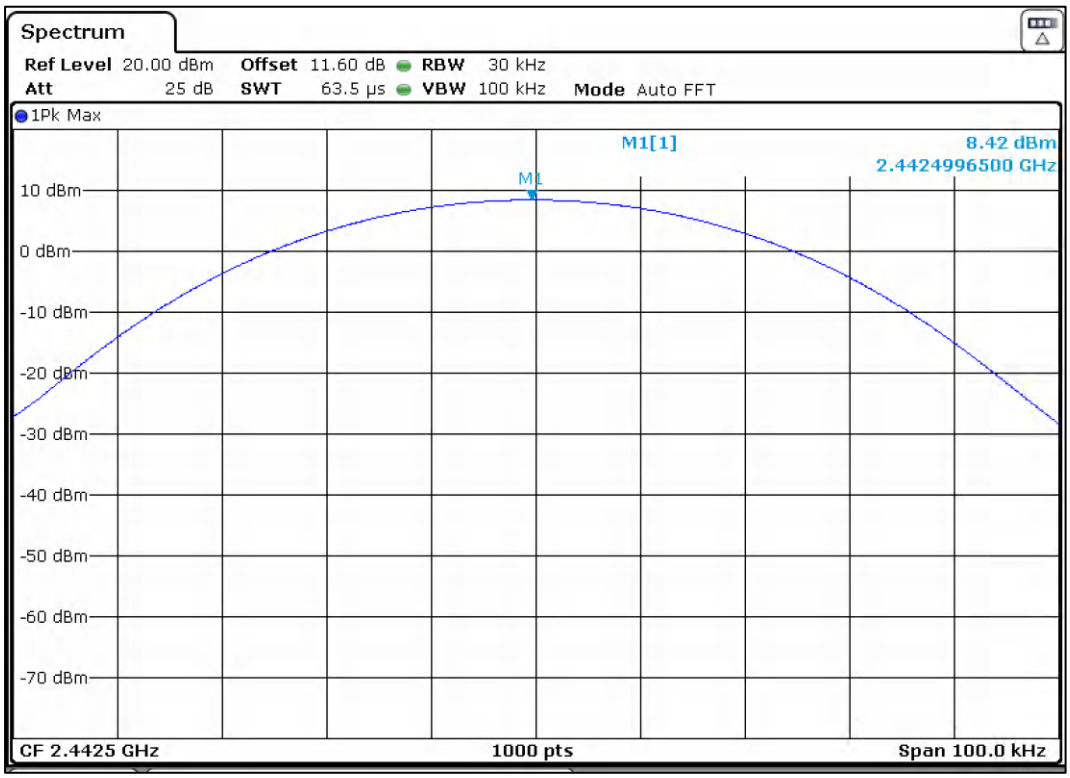
Note:
1. All the losses are included during measurement and final values are mentioned in the test report
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (10dB) + Cable loss (1.6dB)
3. This product do not support additional beamforming gain / directional gain, it uses single antenna and hence Directional gain of the single antenna is 0.5 dBi

Antenna 1

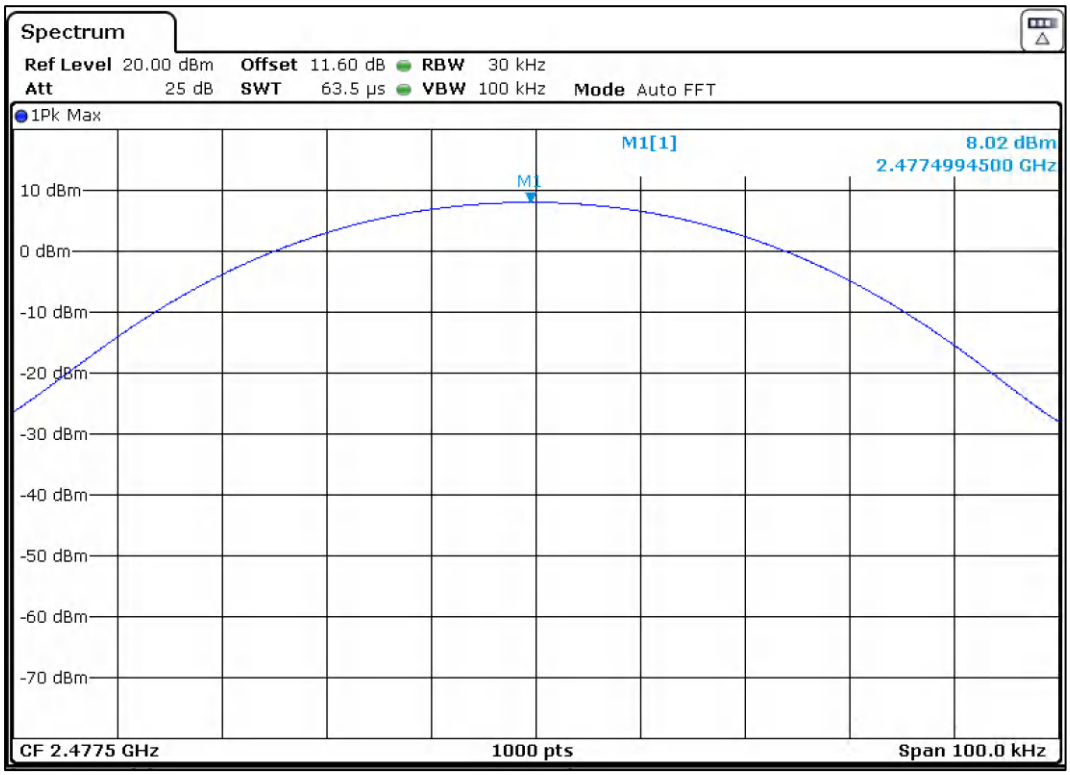
Channel Frequency (MHz)	Measured Peak Power (dBm)	Maximum e.i.r.p (dBm)	FCC Limit (dBm)	IC limit (dBm)
2405	8.63	9.13	30	20.97
2442.5	8.42	8.92	30	20.97
2477.5	8.02	8.52	30	20.97



Channel Frequency: 2405MHz



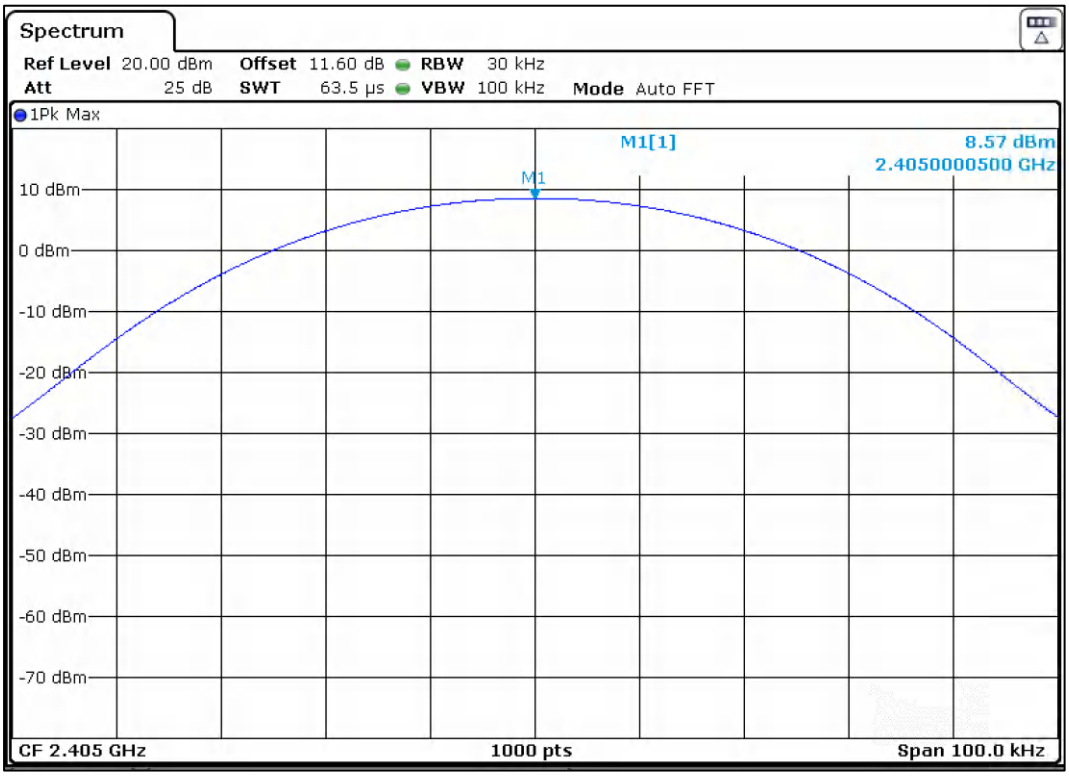
Channel Frequency: 2442.5MHz



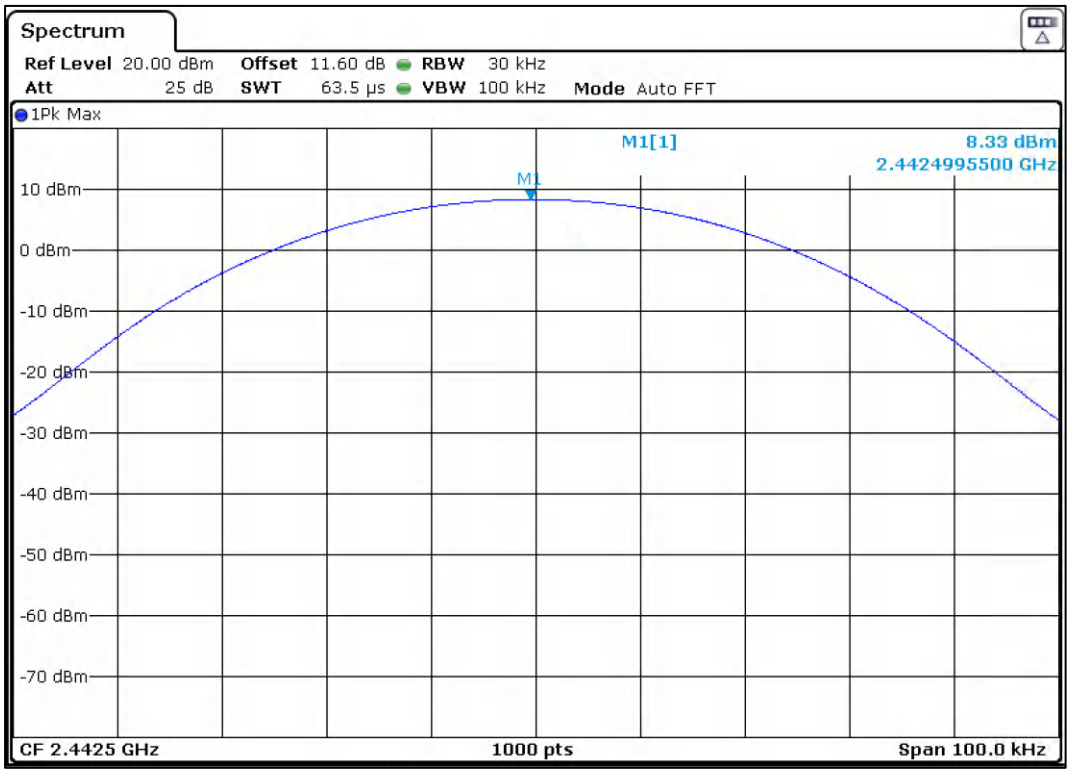
Channel Frequency: 2477.5MHz

Antenna 2

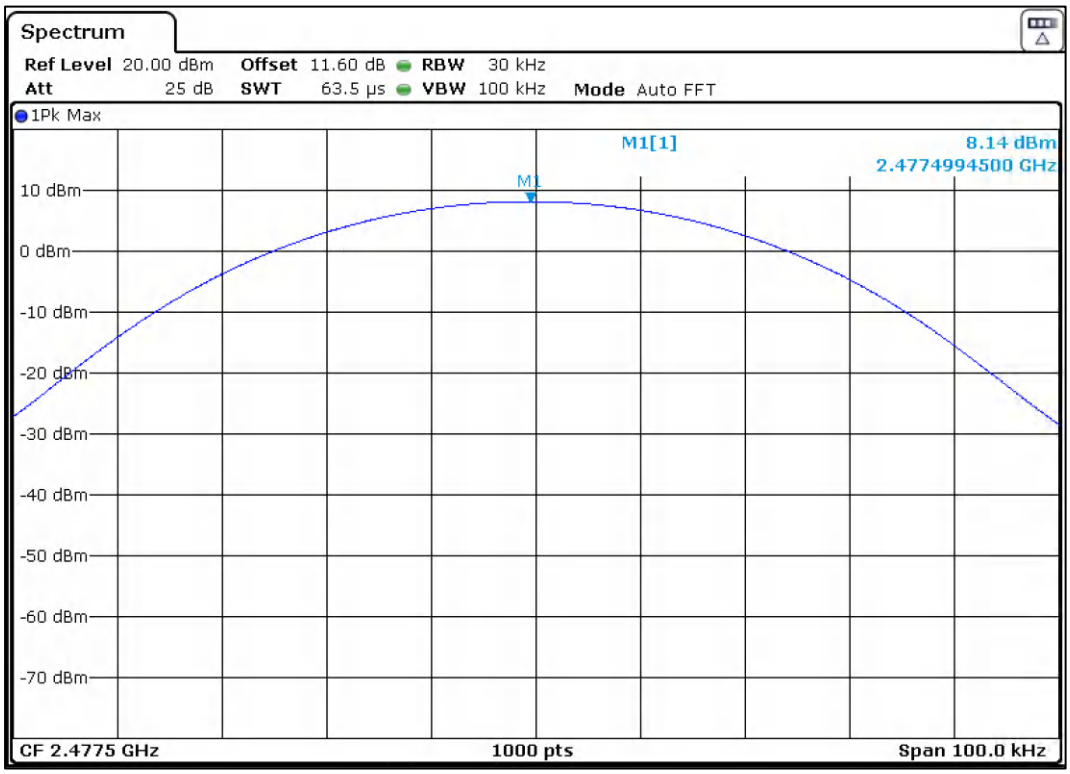
Channel Frequency (MHz)	Measured Peak Power (dBm)	Maximum e.i.r.p (dBm)	FCC Limit (dBm)	IC limit (dBm)
2405	8.57	9.07	30	20.97
2442.5	8.33	8.83	30	20.97
2477.5	8.14	8.64	30	20.97



Channel Frequency: 2405MHz



Channel Frequency: 2442.5MHz



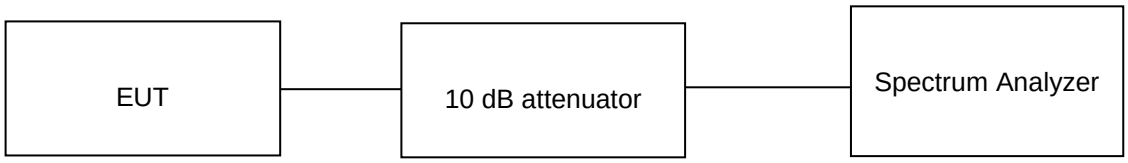
Channel Frequency: 2477.5MHz

8.2 Occupied 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	10 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) = + 23.0 °C Voltage = 3.6V DC through DC Supply Relative humidity: 64%

KDB Guidelines applied:

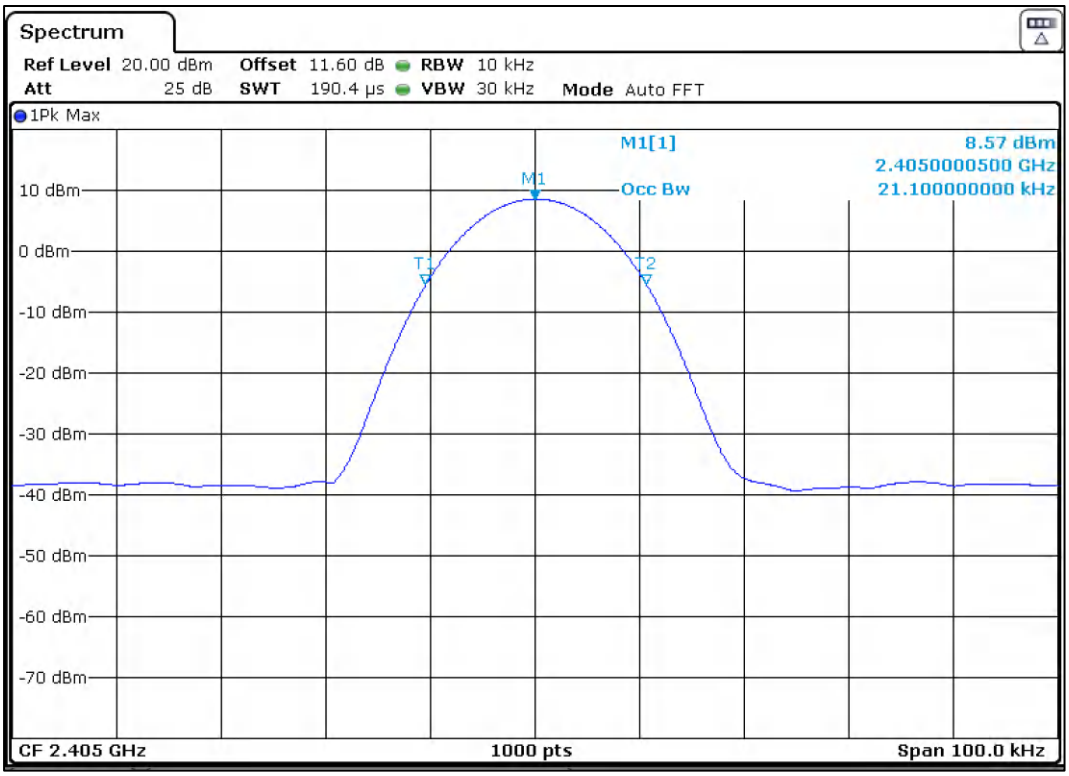
Measurements were made as per section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02.

Test results:

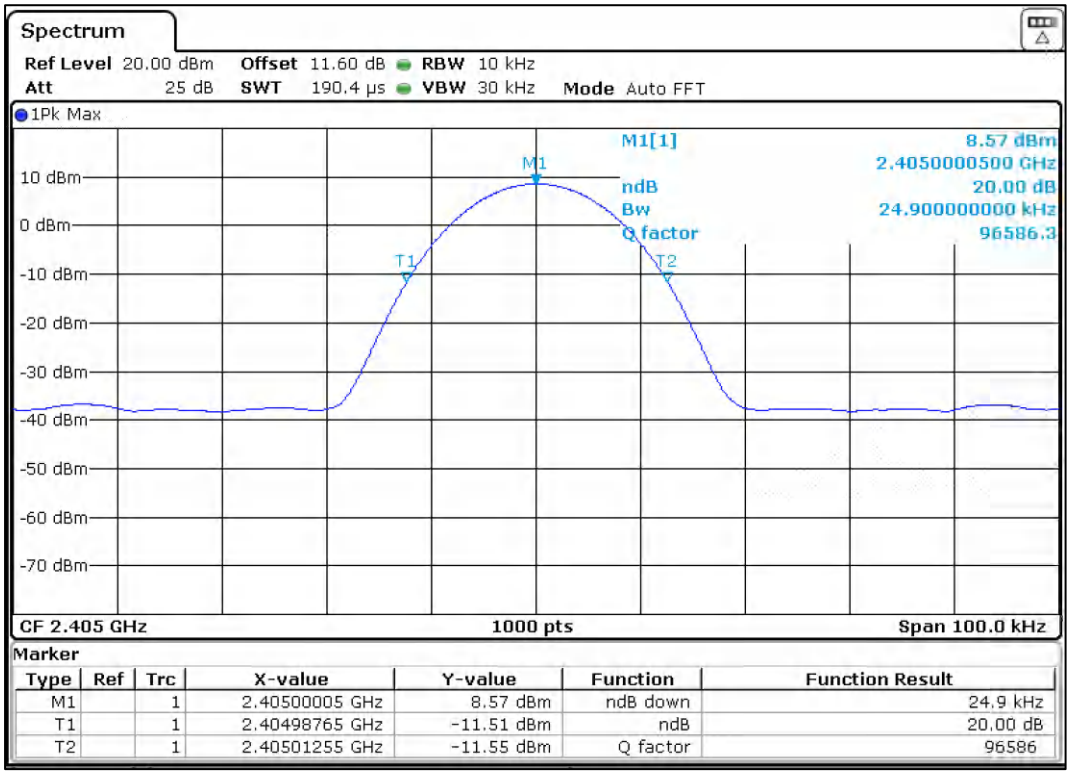
Note:
1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (10dB) + Cable loss (1.6dB)
3. This product do not support additional beamforming gain / directional gain, it uses single antenna and hence Directional gain of the single antenna is 0.5 dBi.

Antenna 1

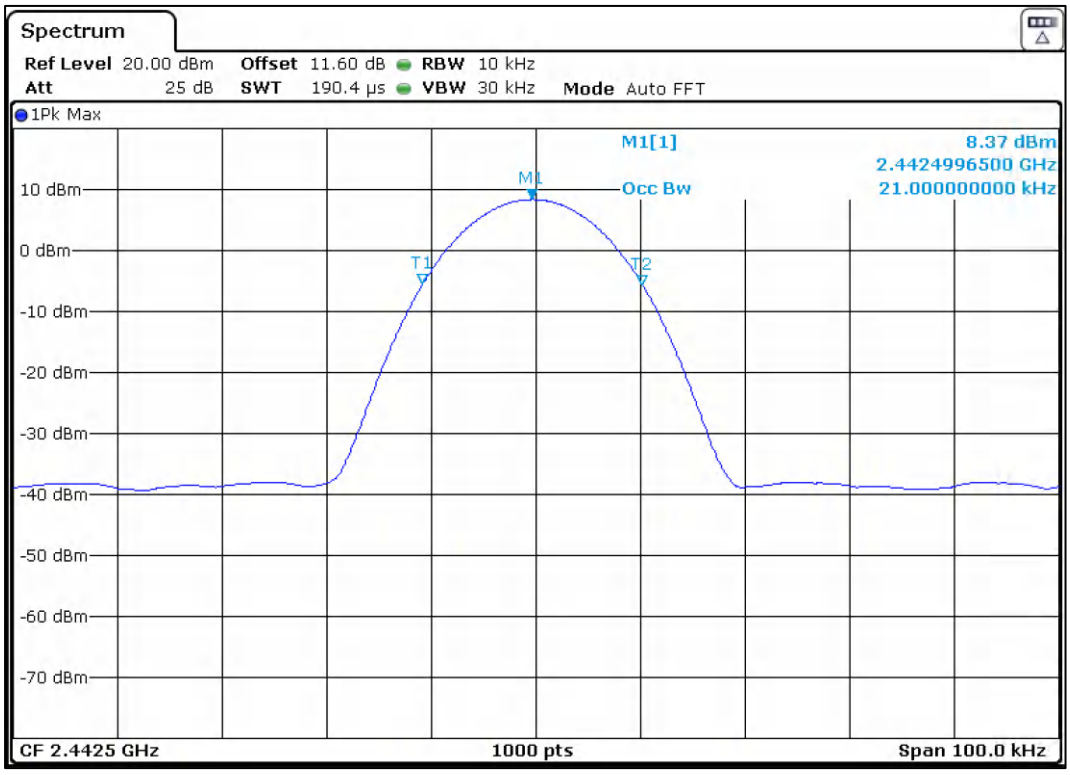
Channel Frequency (MHz)	20 dB Bandwidth (KHz)	99% OBW (KHz)
2405	24.90	21.10
2442.5	24.80	21.00
2477.5	24.90	21.10



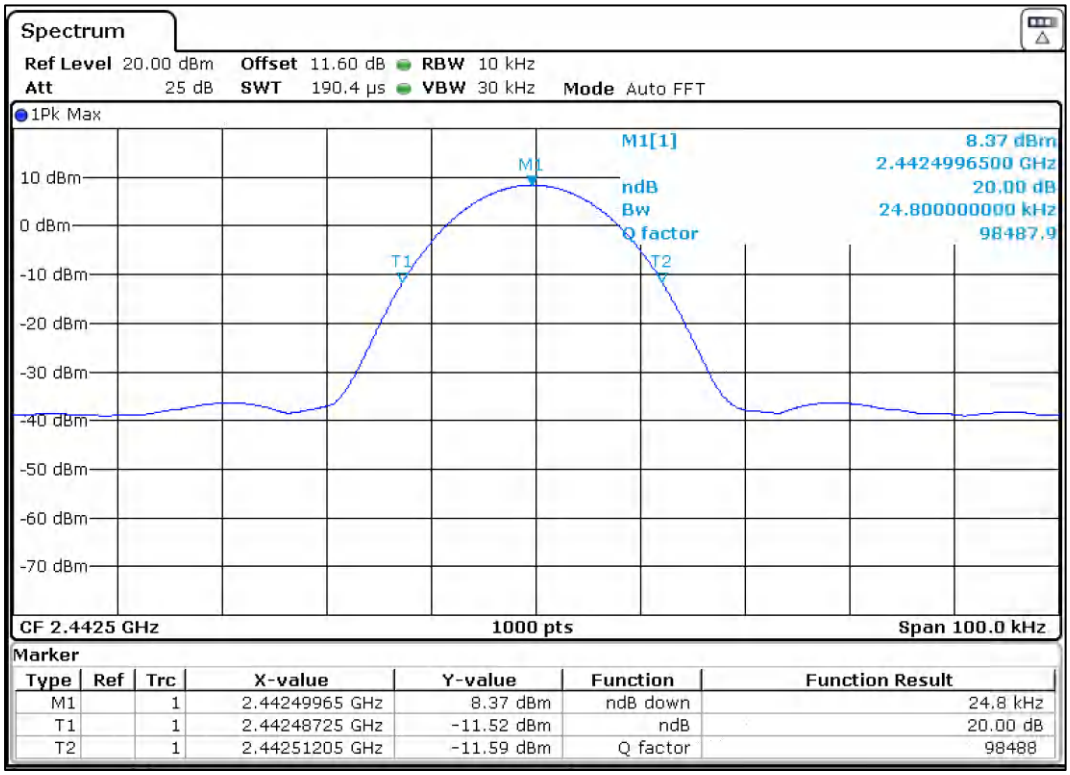
Channel Frequency: 2405MHz 99% Bandwidth



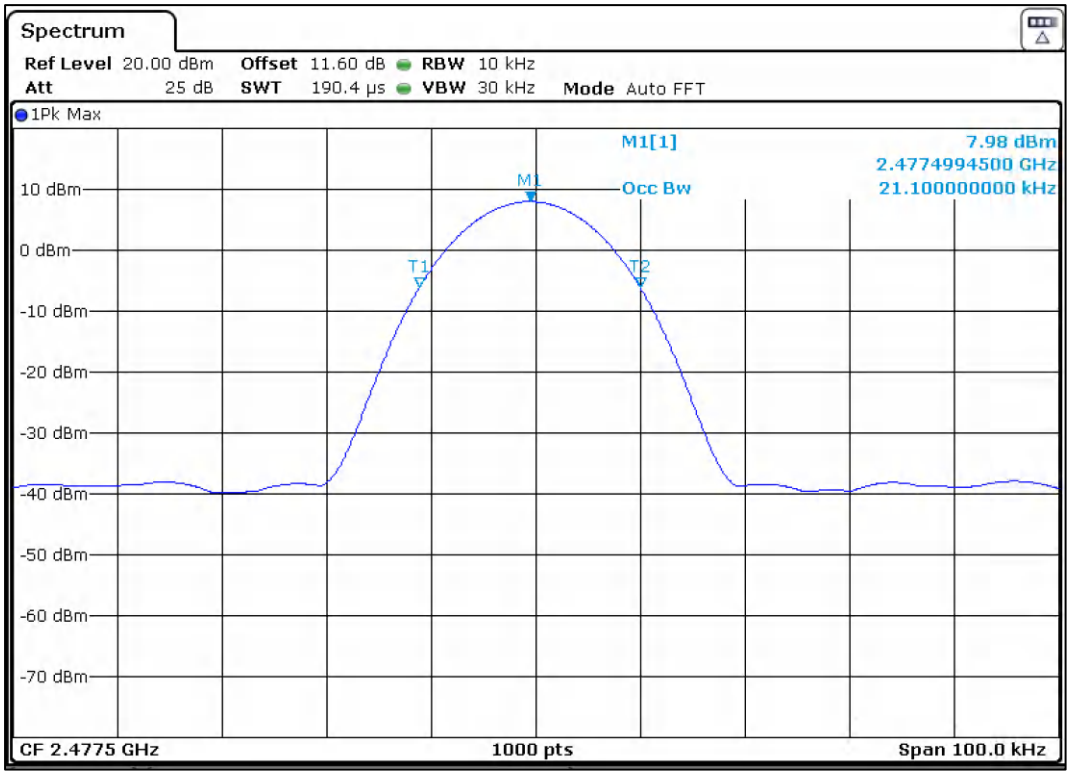
Channel Frequency: 2405MHz 20 dB Bandwidth



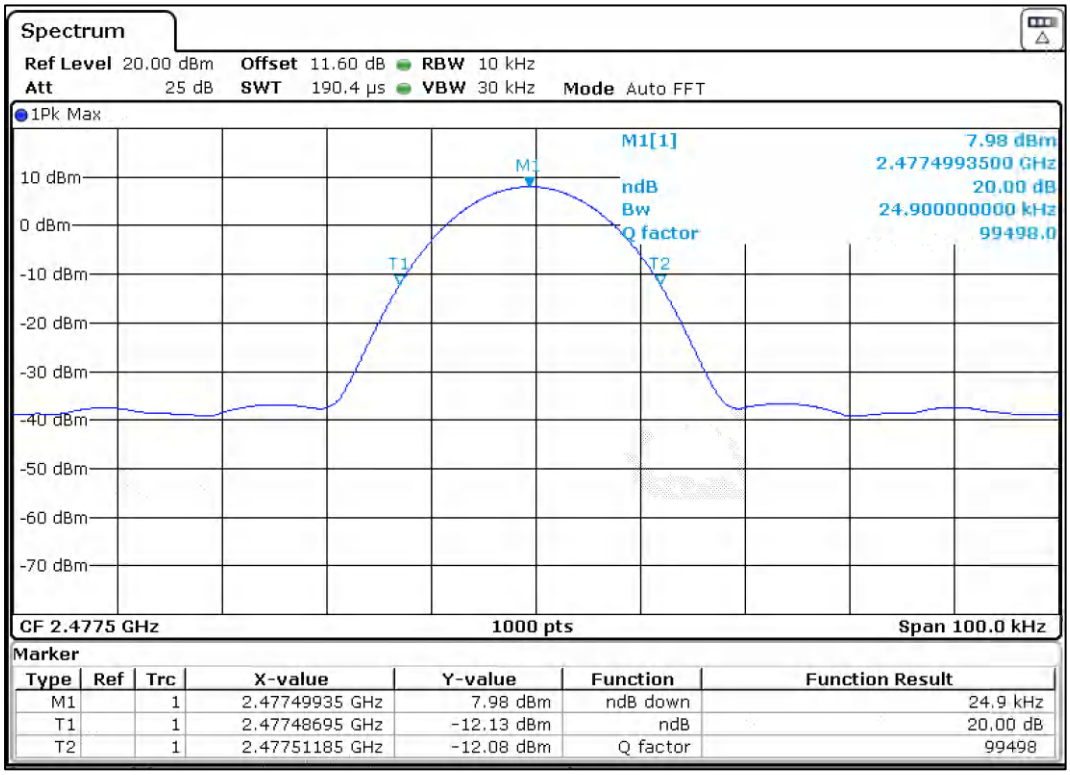
Channel Frequency: 2442.5MHz 99% Bandwidth



Channel Frequency: 2442.5MHz 20 dB Bandwidth



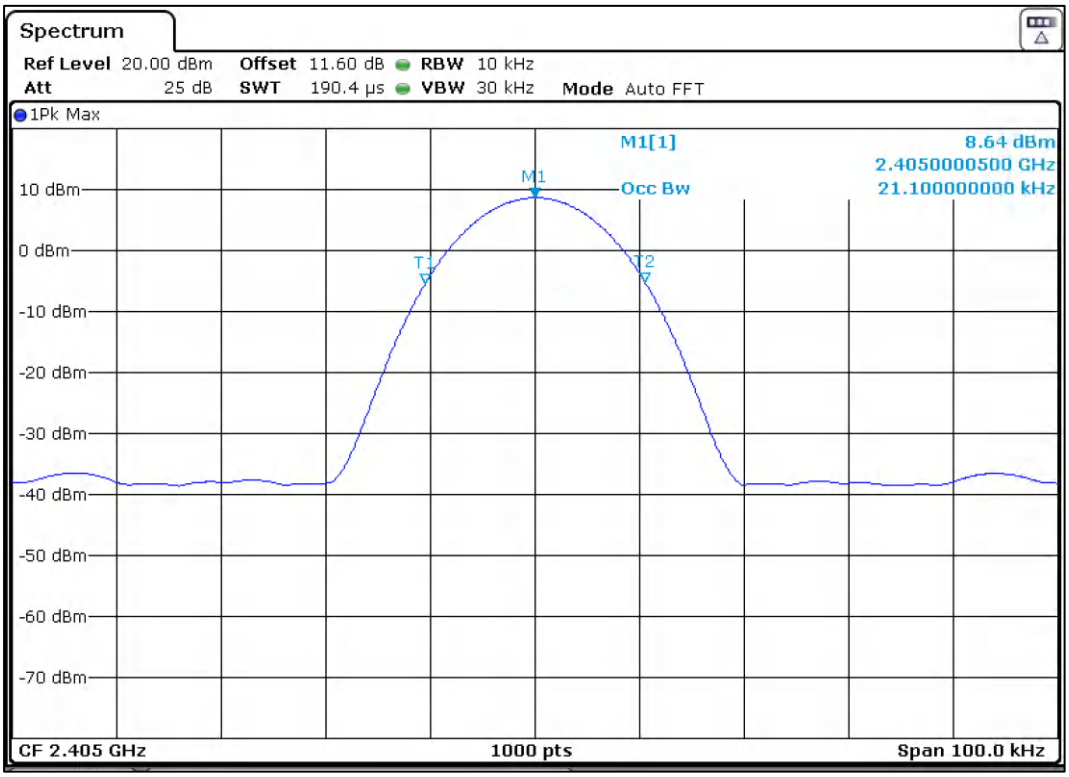
Channel Frequency: 2477.5MHz 99% Bandwidth



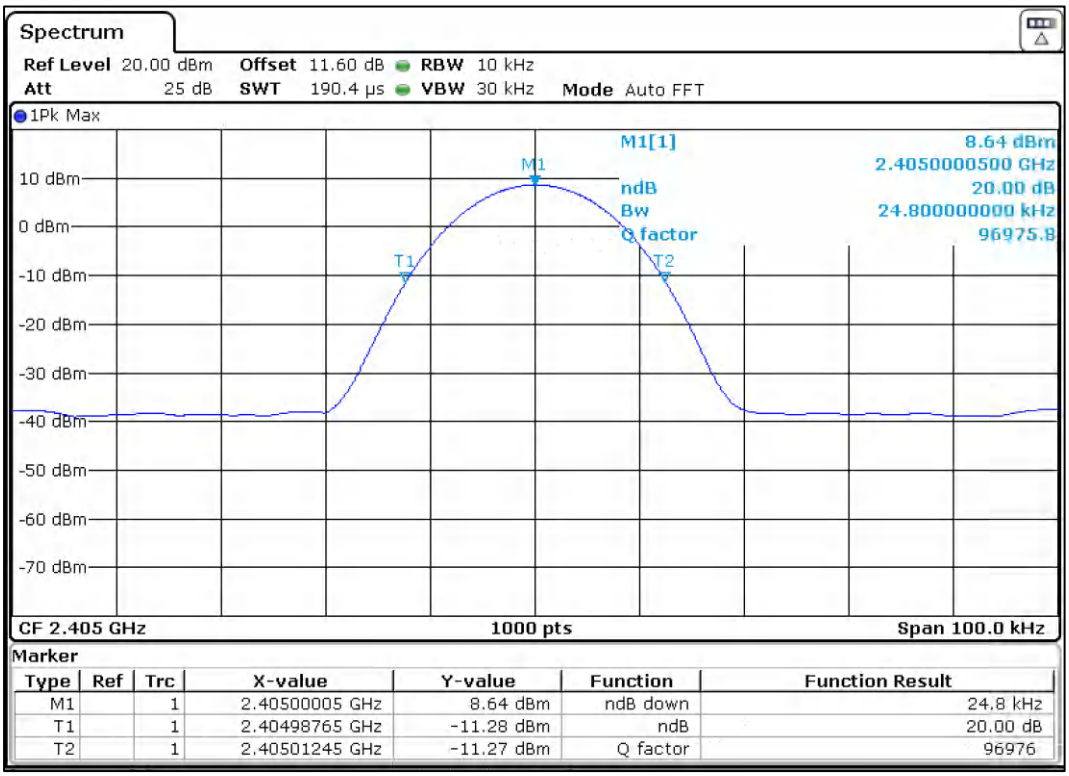
Channel Frequency: 2477.5MHz 20 dB Bandwidth

Antenna 2:

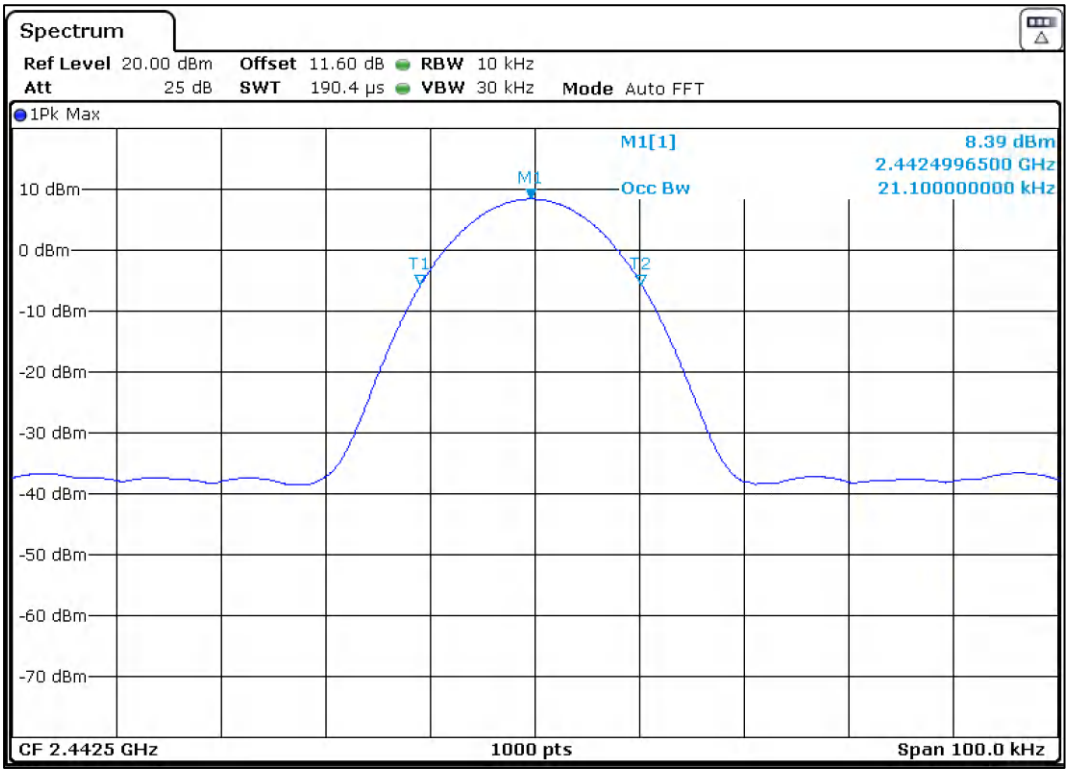
Channel Frequency (MHz)	**20 dB Bandwidth (KHz)**	**99% OBW (KHz)**
2405	24.80	21.10
2442.5	24.90	21.10
2477.5	24.80	21.20



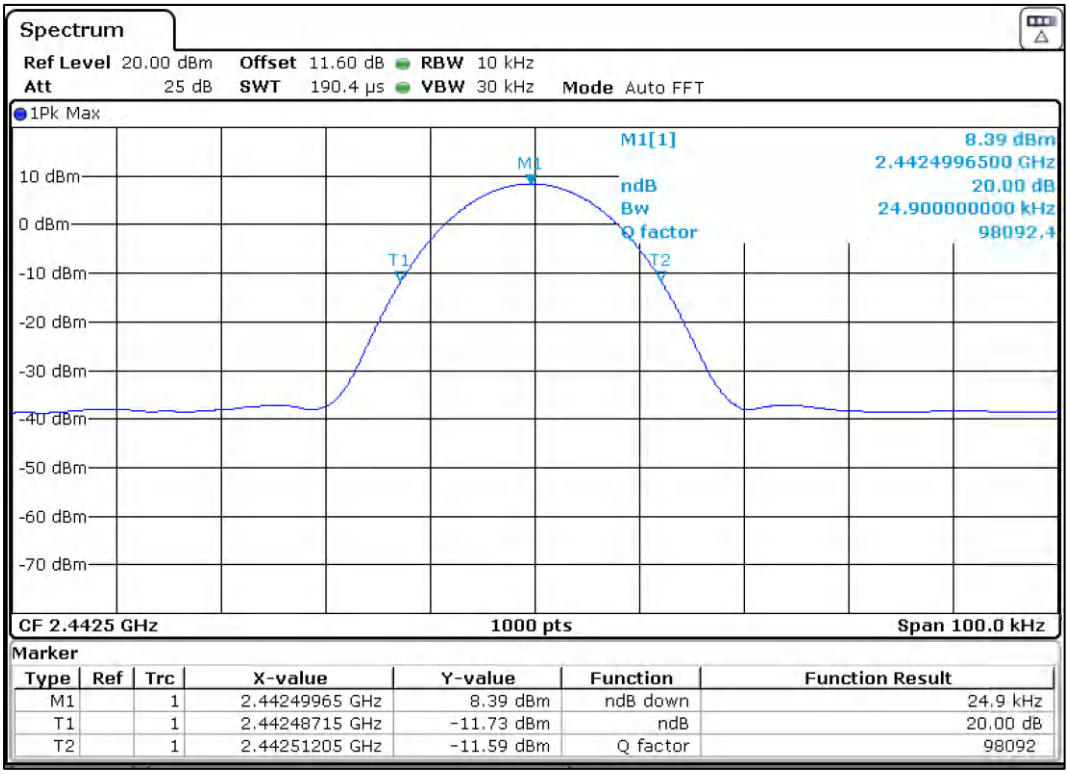
Channel Frequency: 2405MHz 99% Bandwidth



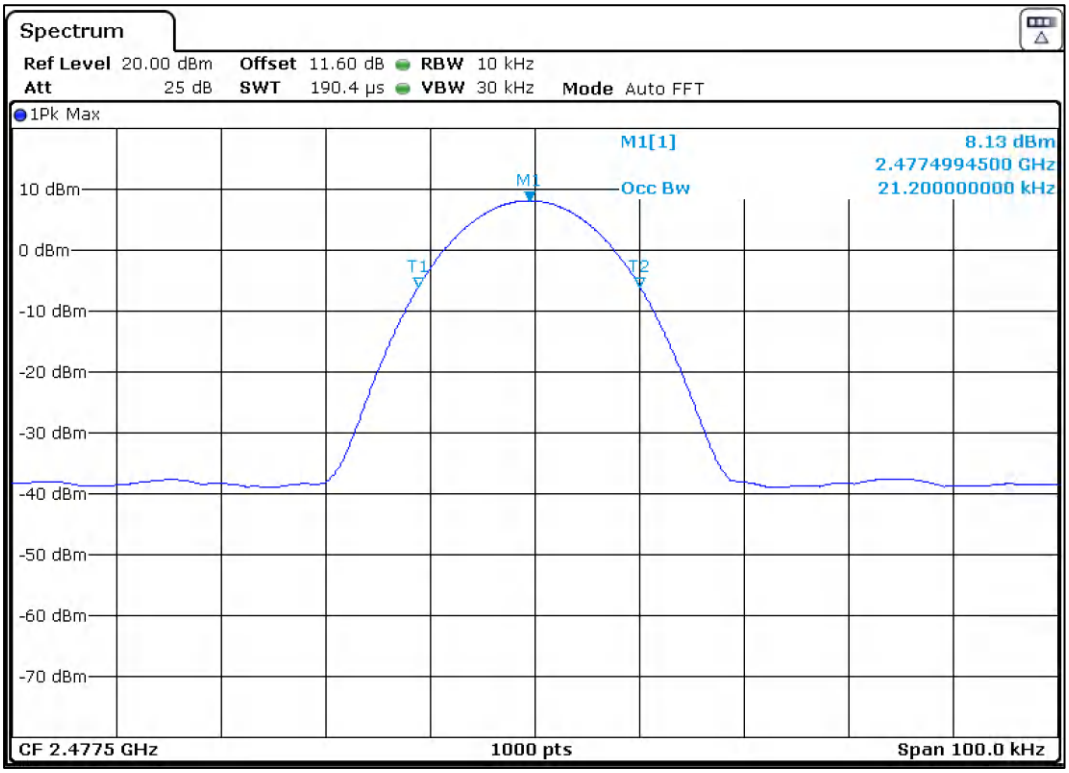
Channel Frequency: 2405MHz 20 dB Bandwidth



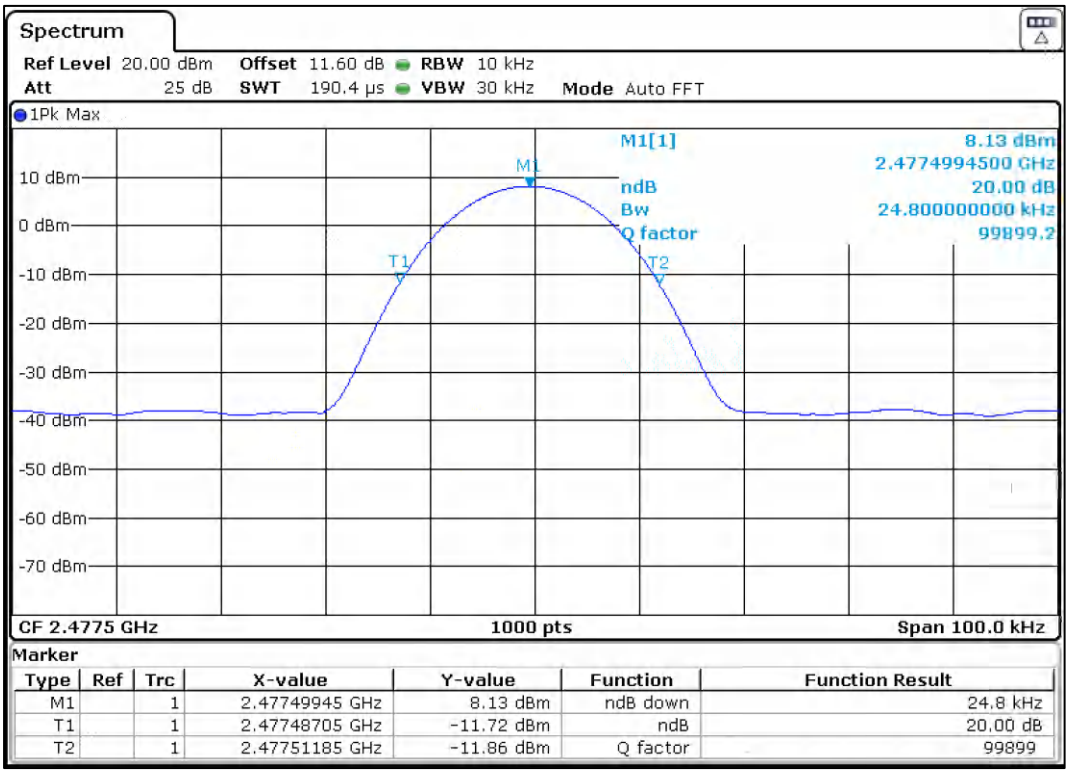
Channel Frequency: 2442.5MHz 99% Bandwidth



Channel Frequency: 2442.5MHz 20 dB Bandwidth



Channel Frequency: 2405MHz 99% Bandwidth



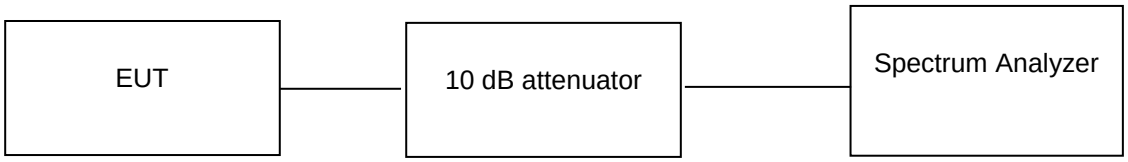
Channel Frequency: 2405MHz 20 dB Bandwidth

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:



*Note: RBW setting of 30 kHz is used because setting of 40.9 kHz to 41.5kHz (30% of 20 dB bandwidth) bandwidth in the reciever is not supported

Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.0 °C Voltage = 3.6V DC through DC Supply Relative humidity: 64%

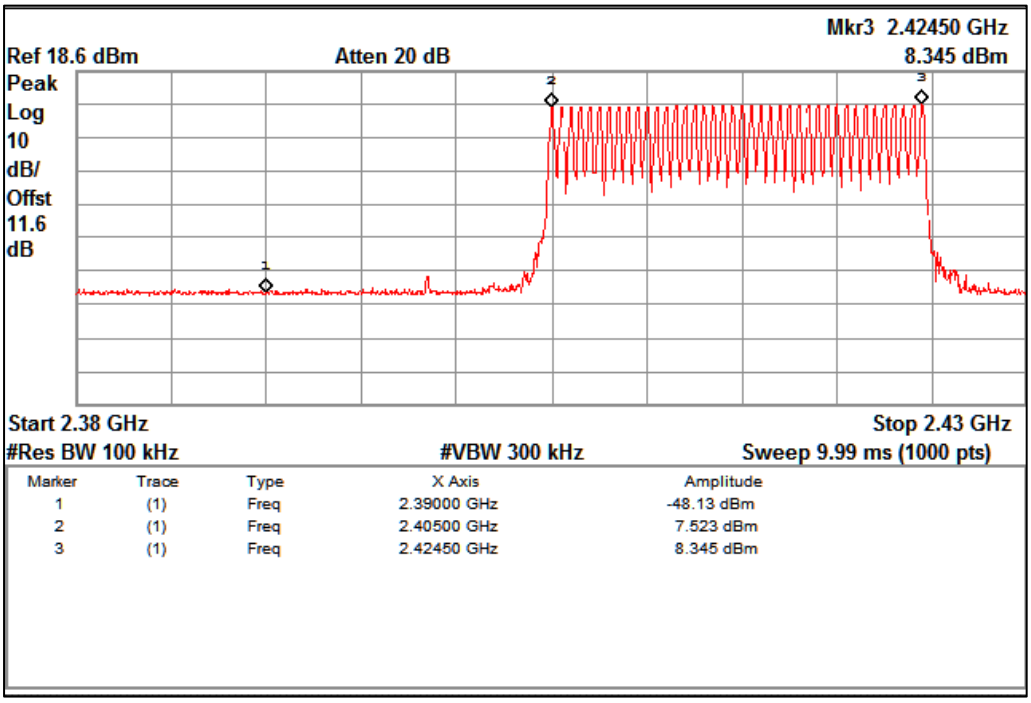
KDB Guidelines applied:

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

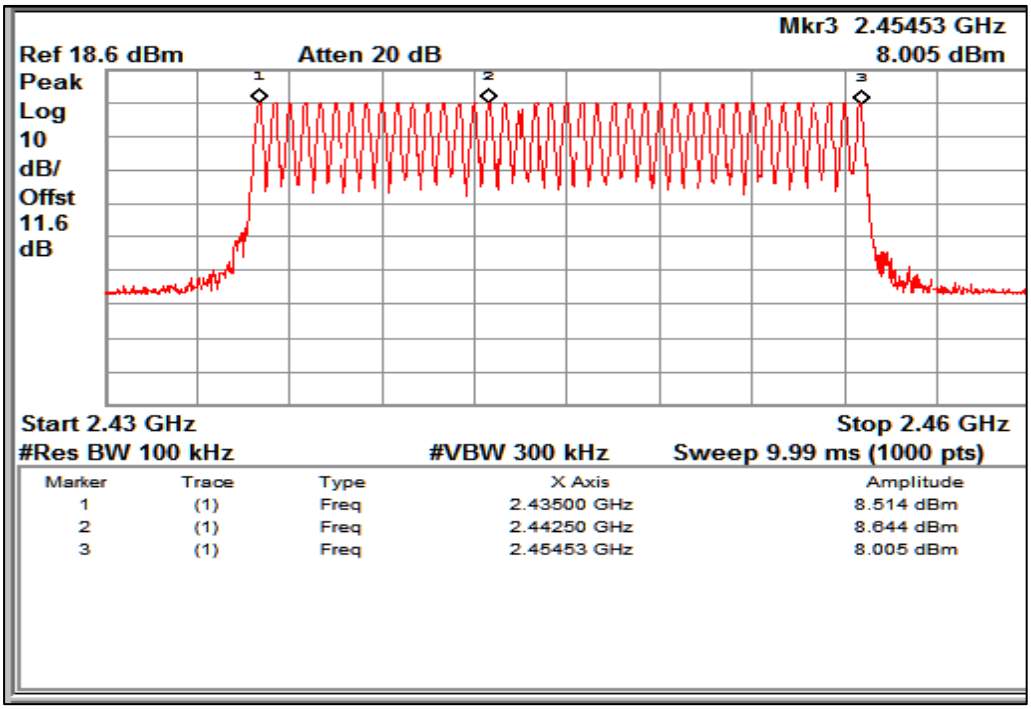
Test results:

Note:
1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (10dB) + Cable loss (1.6dB).

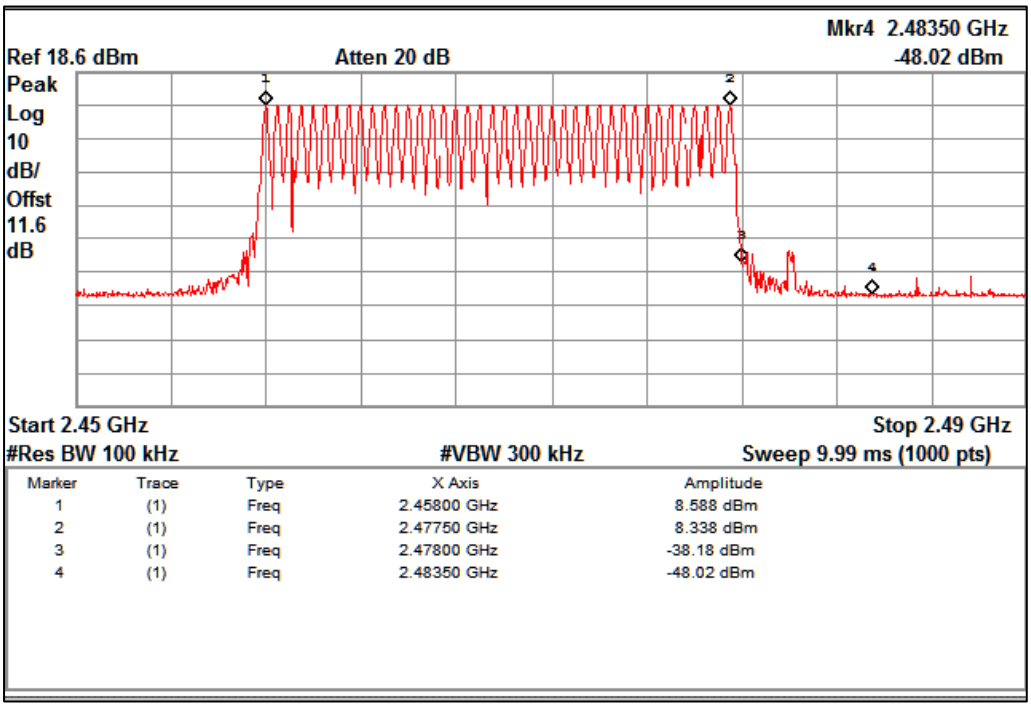
Antenna 1



Number of Hopping Frequencies 2405MHz-2425MHz



Number of Hopping Frequencies 2435MHz-2455MHz

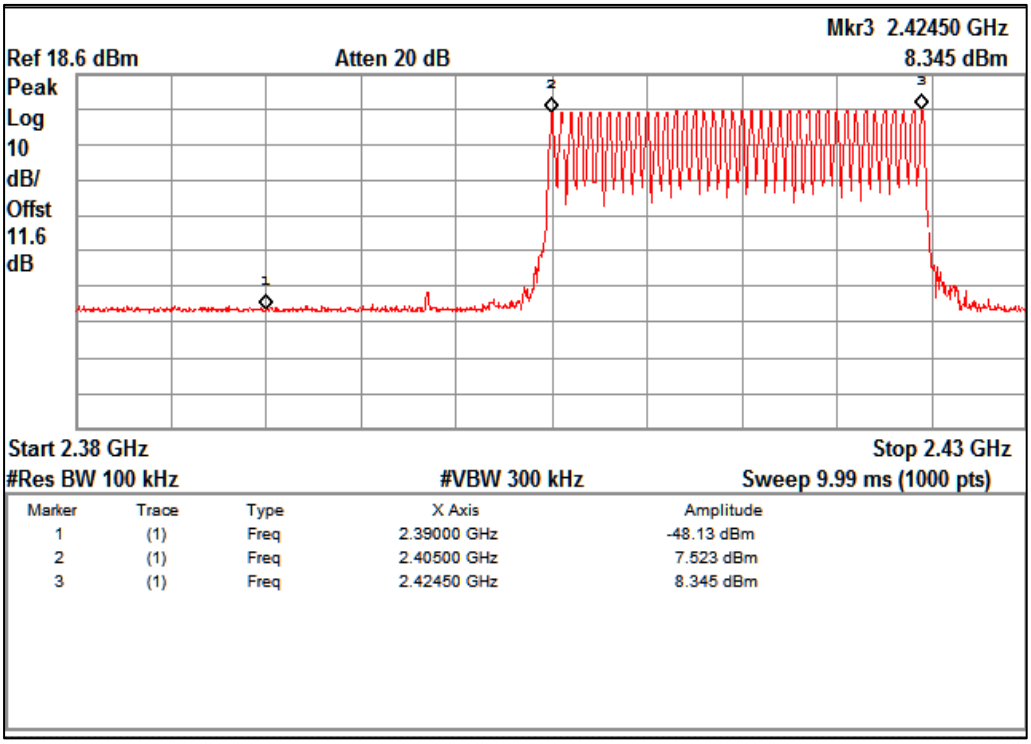


Number of Hopping Frequencies 2458MHz-2478MHz

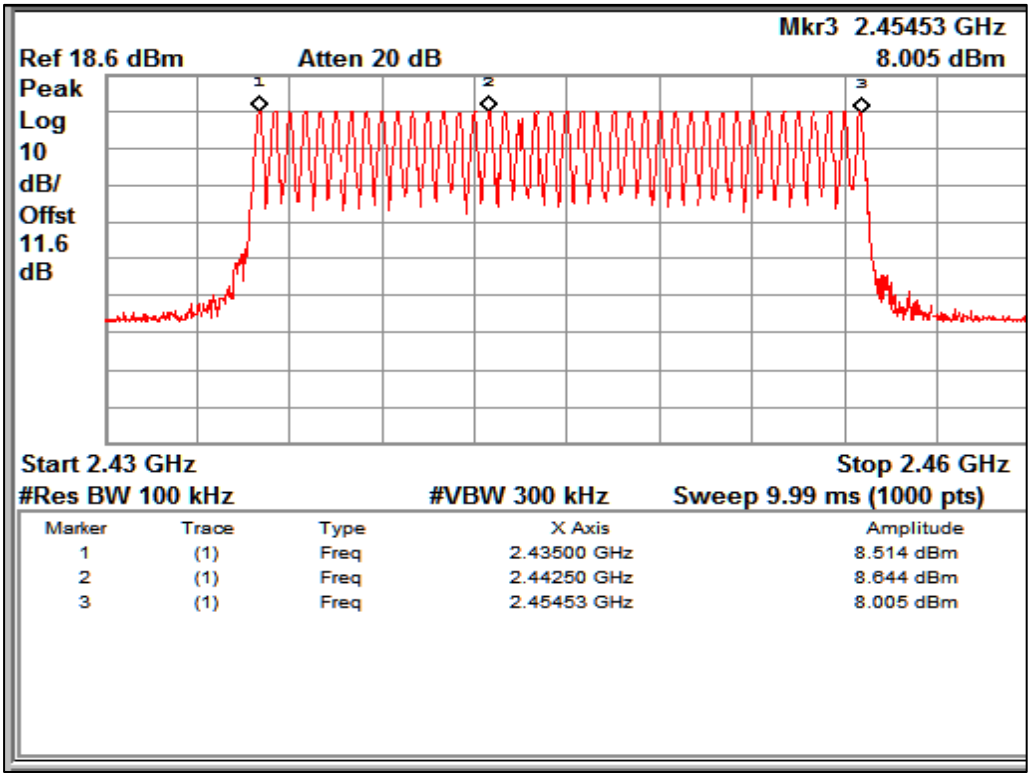
Start hopping Frequency Observed 2405 MHz
Stop hopping Frequency Observed 2477.5 MHz

Total Number of Hopping Channels Observed = 120

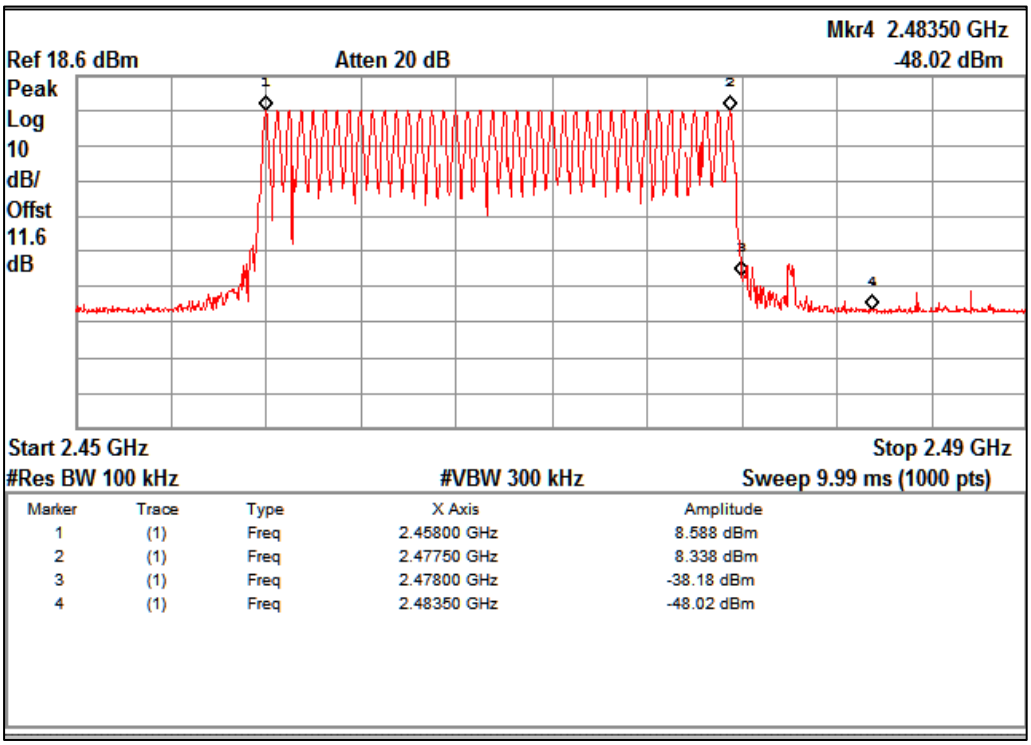
Antenna 2



Number of Hopping Frequencies 2405MHz-2425MHz



Number of Hopping Frequencies 2435MHz-2455MHz



Number of Hopping Frequencies 2458MHz-2478MHz

Start hopping Frequency Observed 2405 MHz
Stop hopping Frequency Observed 2477.5 MHz

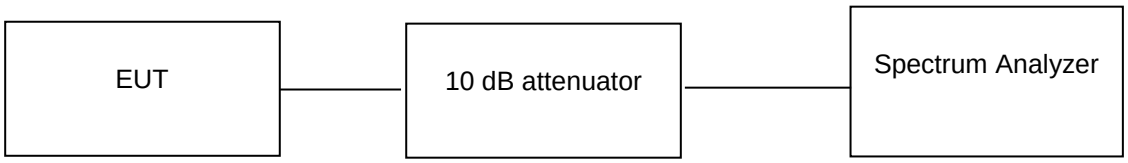
Total Number of Hopping Channels Observed = 120

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:



*Note: RBW setting of 100 kHz is used because setting of 40.9 kHz to 41.5kHz (30% of 20 dB bandwidth) bandwidth in the reciever is not supported

Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.0 °C Voltage = 3.6V DC through DC Supply Relative humidity: 64%

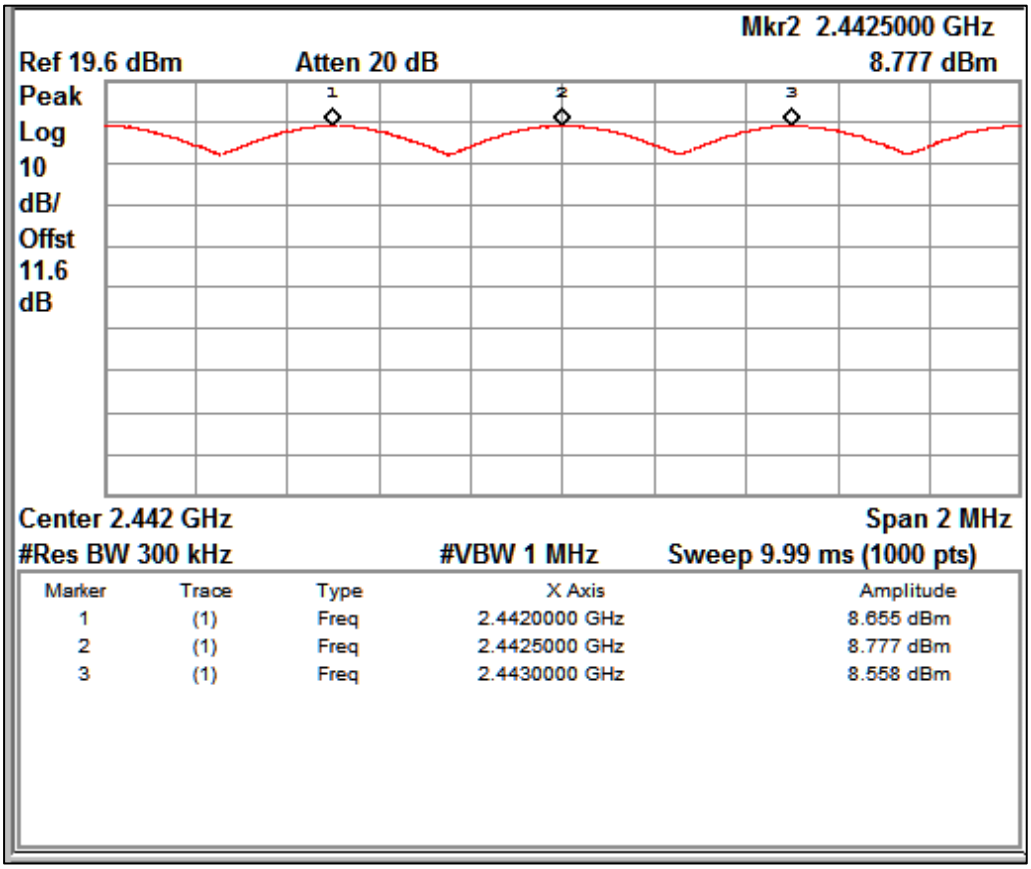
KDB Guidelines applied:

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

Test results:

Note:
1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (10dB) + Cable loss (1.6dB)
3. This product do not support additional beamforming gain / directional gain, it uses single antenna and hence Directional gain of the single antenna is 0.5 dBi.

Antenna 1



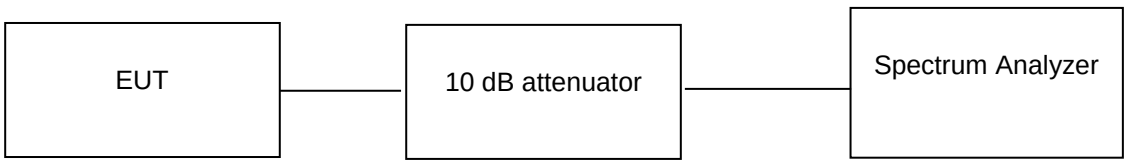
Frequency (MHz)	Channel spacing Observed (KHz)
2442	500
2442.5	500
2443	500

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) = + 23.0 °C Voltage = 3.6V DC through DC Supply Relative humidity: 64%

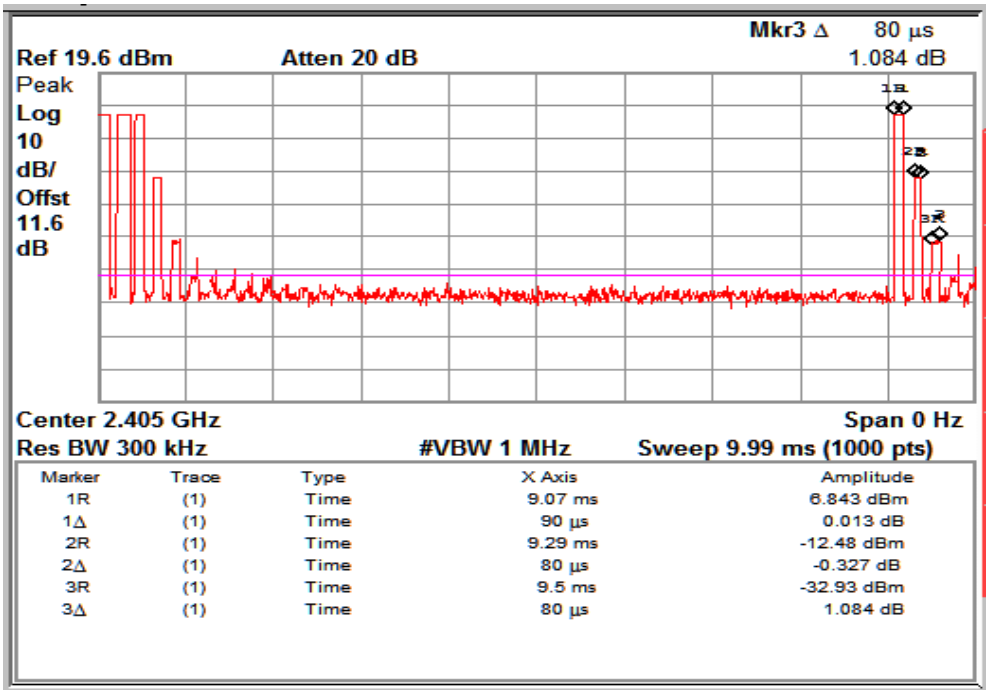
KDB Guidelines applied:

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

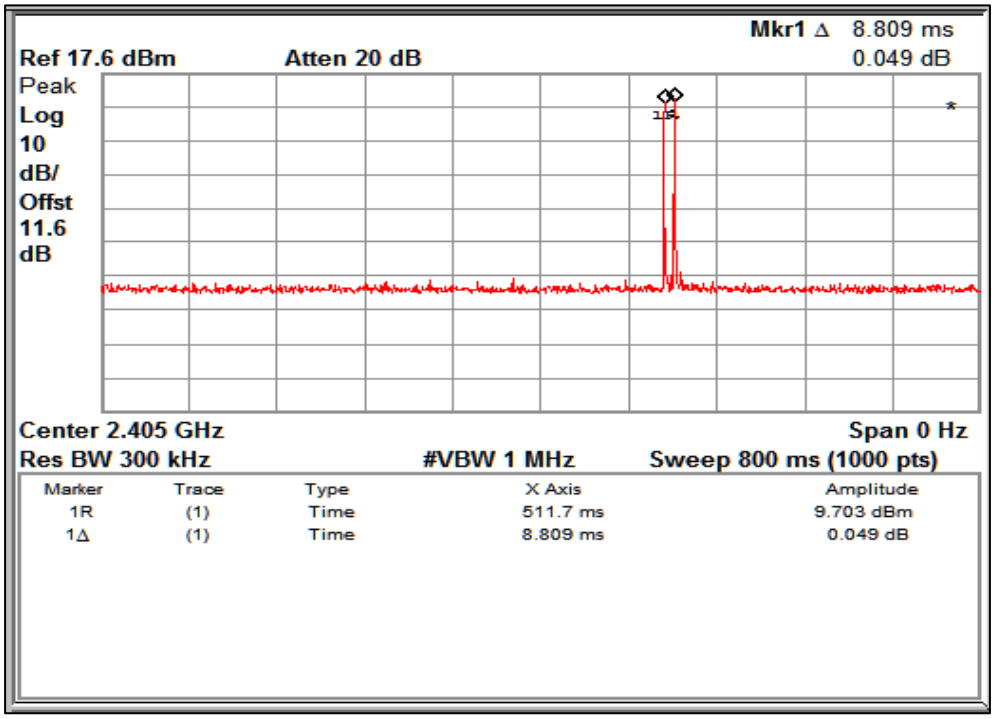
Test results:

Note:
1. All the losses are included during measurement and final values are mentioned in the test report
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (10dB) + Cable loss (1.6dB)

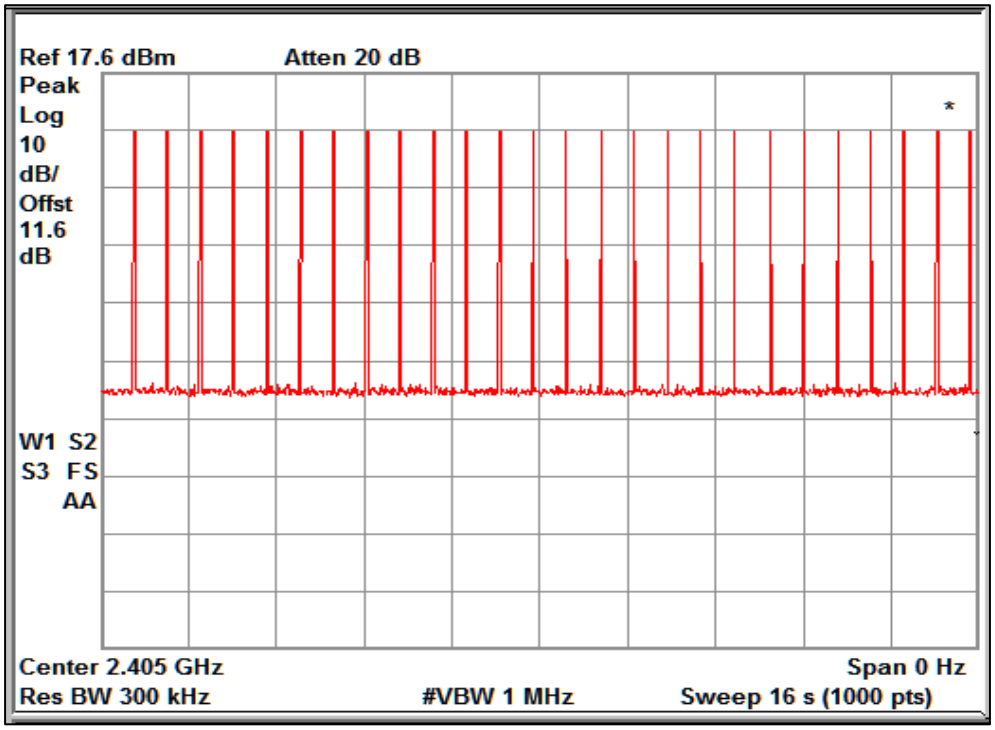
Antenna 1
Channel frequency:2405MHz



Dwell Time



0.8s Reference plot

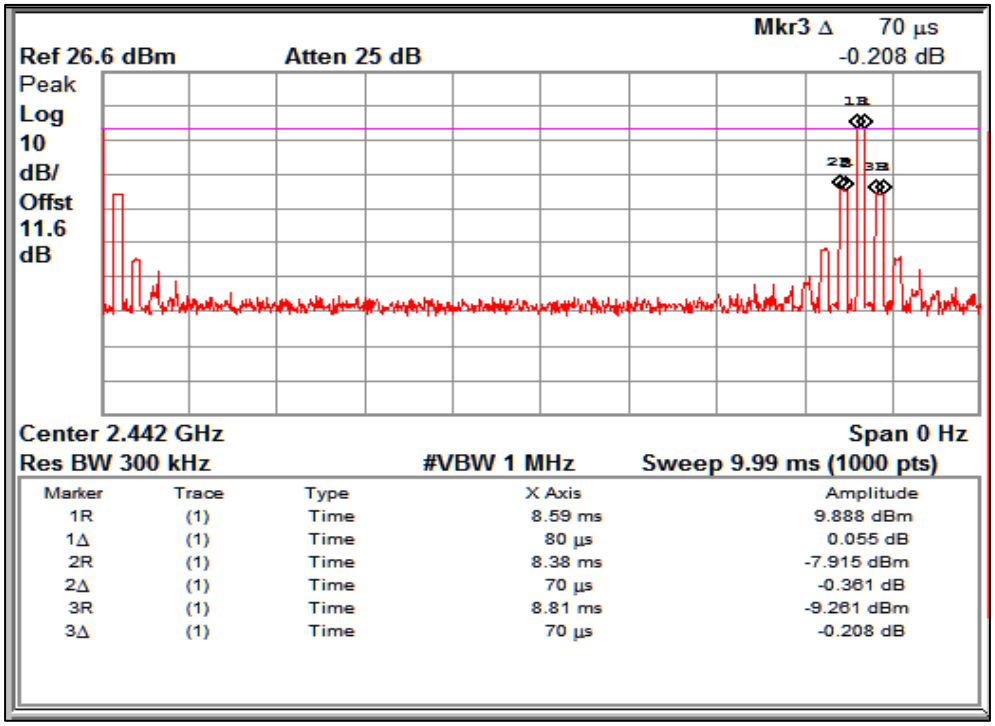


Number of Bins

Dwell Time = 250µs or 0.25ms
Total bins in 16 Sec =26
Max. Allowed time = 0.4s

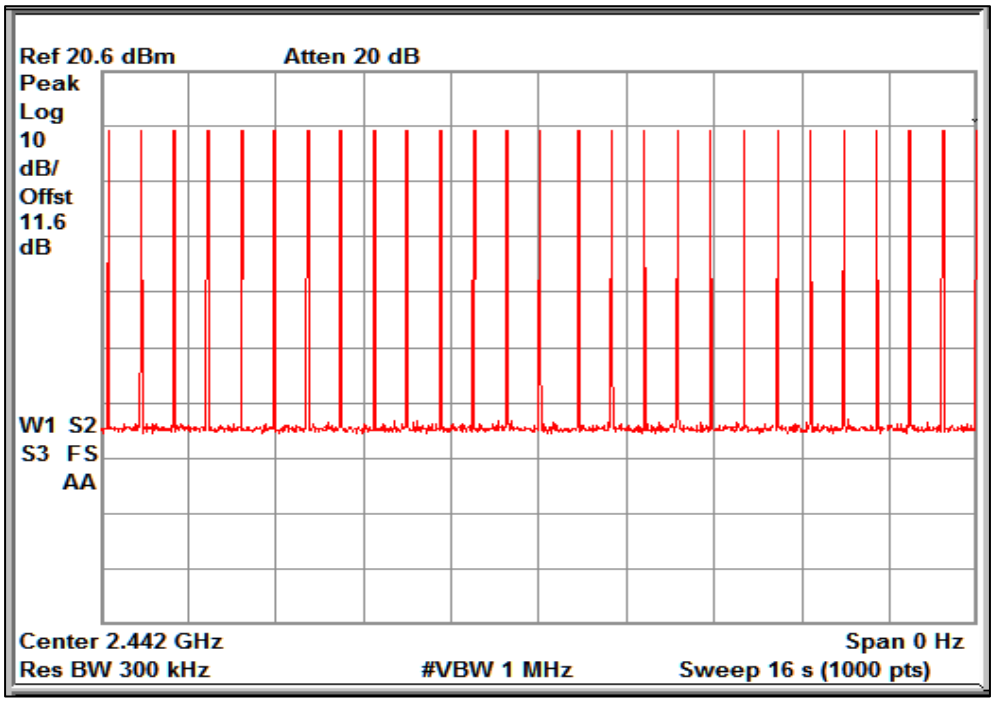
Total time occupancy in 16s = 250 * 26 = 6500µs or 6.50ms or 0.00650sec (which is less than 400ms)

Channel frequency:2442.5MHz



Marker	Trace	Type	X Axis	Amplitude
1R	(1)	Time	8.59 ms	9.888 dBm
1Δ	(1)	Time	80 µs	0.055 dB
2R	(1)	Time	8.38 ms	-7.915 dBm
2Δ	(1)	Time	70 µs	-0.361 dB
3R	(1)	Time	8.81 ms	-9.261 dBm
3Δ	(1)	Time	70 µs	-0.208 dB

Dwell Time

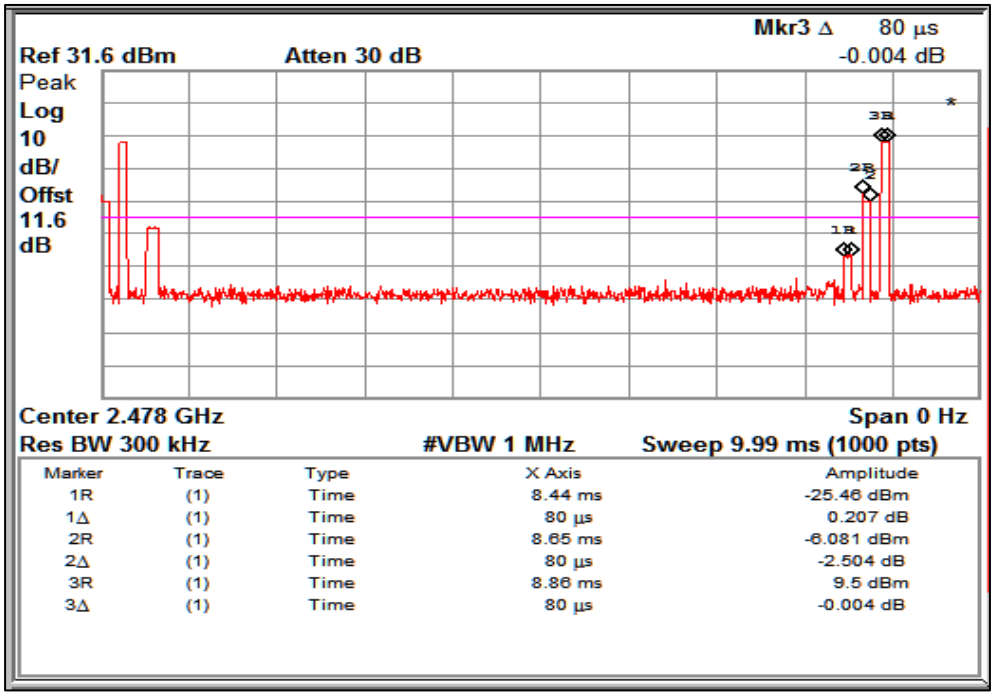


Number of Bins

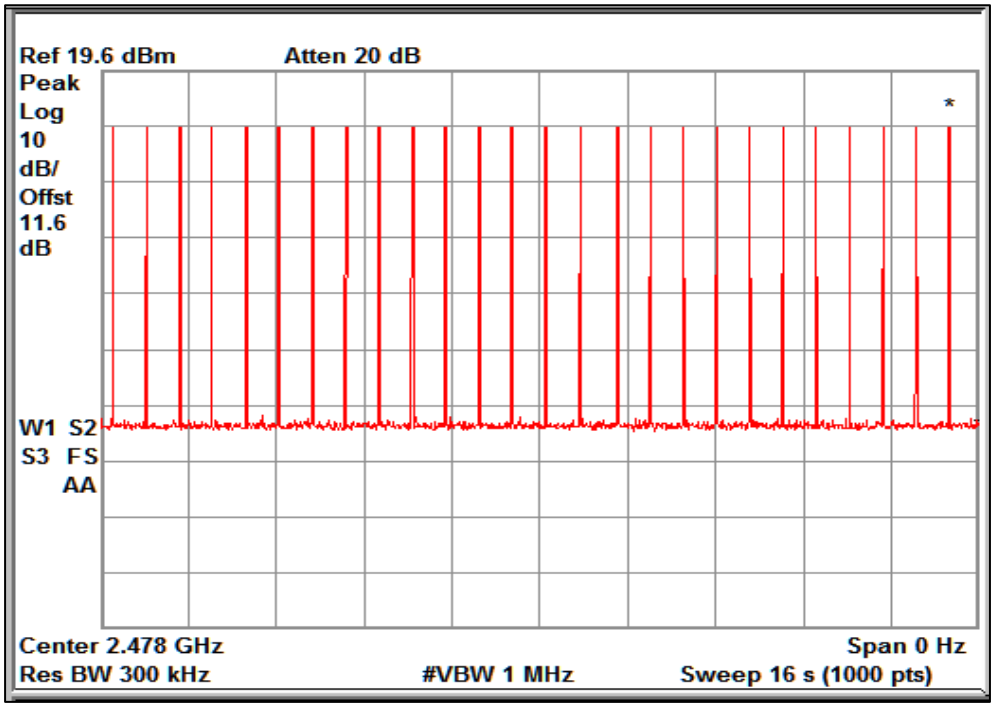
Dwell Time = 220µs or 0.22ms
Total bins in 16 Sec =27
Max. Allowed time = 0.4s

Total time occupancy in 16s = 220 * 27 = 5940µs or 5.94ms or 0.00594sec (which is less than 400ms)

Channel frequency:2477.5MHz



Dwell Time

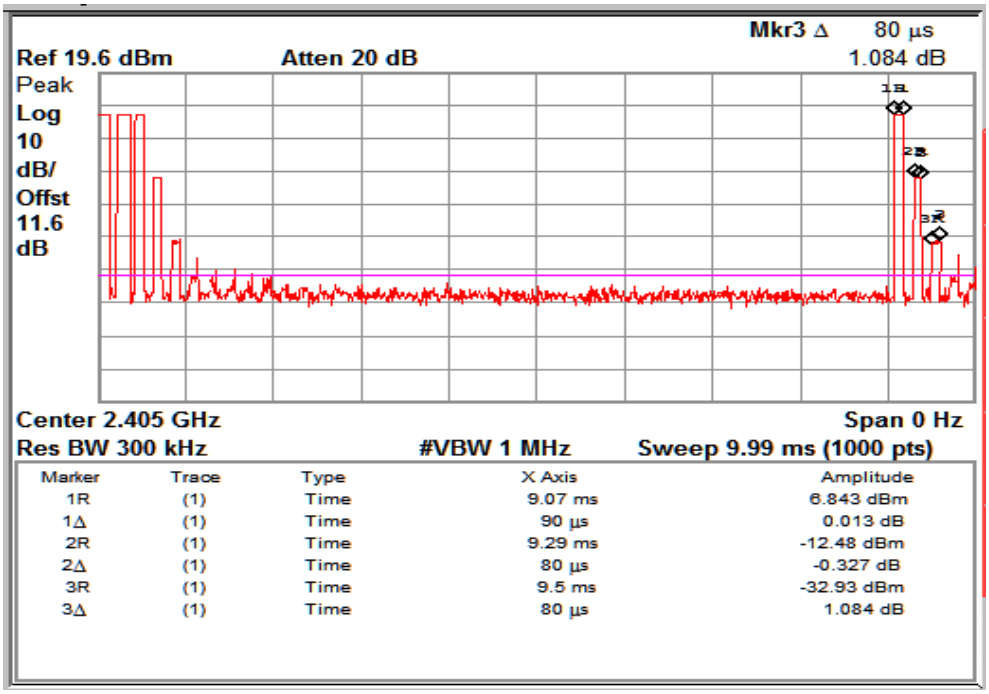


Number of Bins

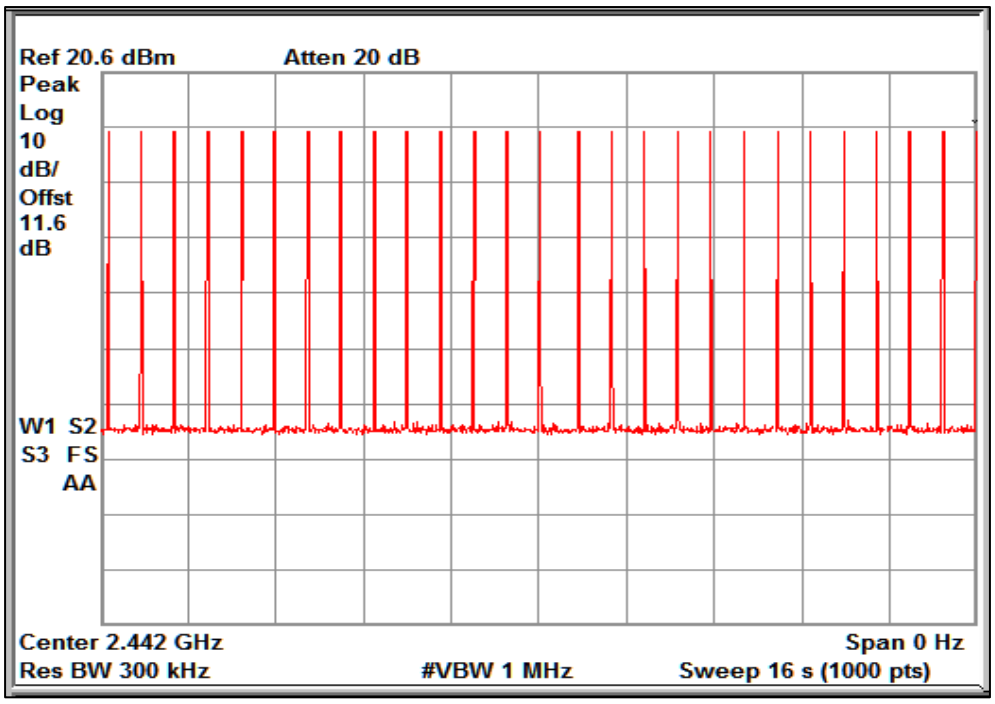
Dwell Time = 240µs or 0.24ms
Total bins in 16 Sec =26
Max. Allowed time = 0.4s

Total time occupancy in 16s = 240 * 26 = 6240µs or 6.24ms or 0.00624 (which is less than 400ms)

Antenna 2
Channel frequency: 2405MHz



Dwell Time

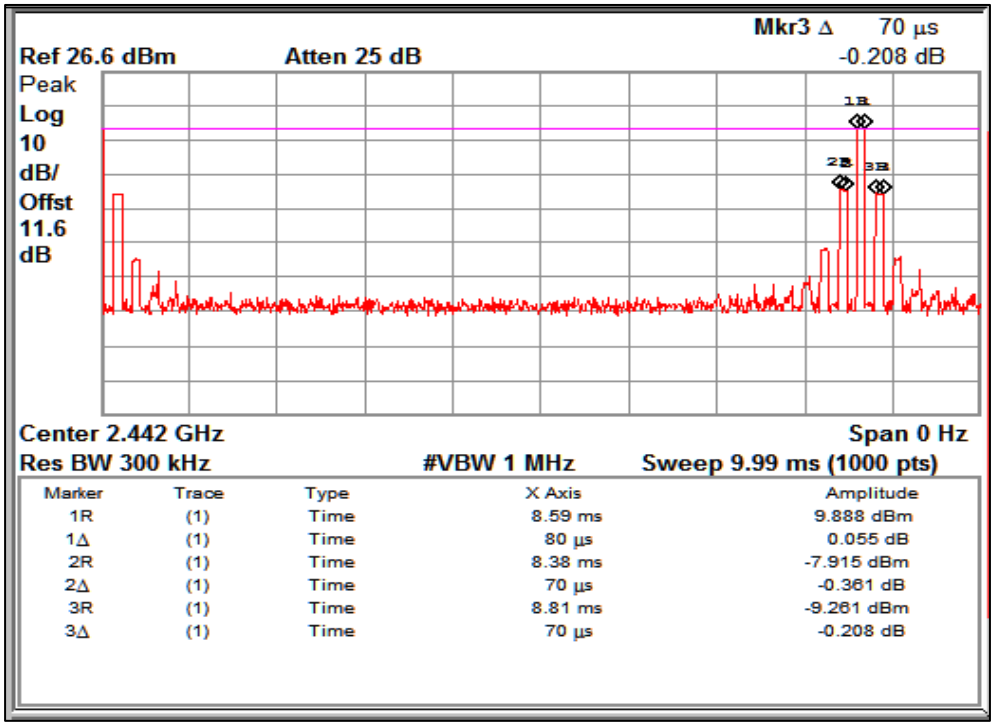


Number of Bins

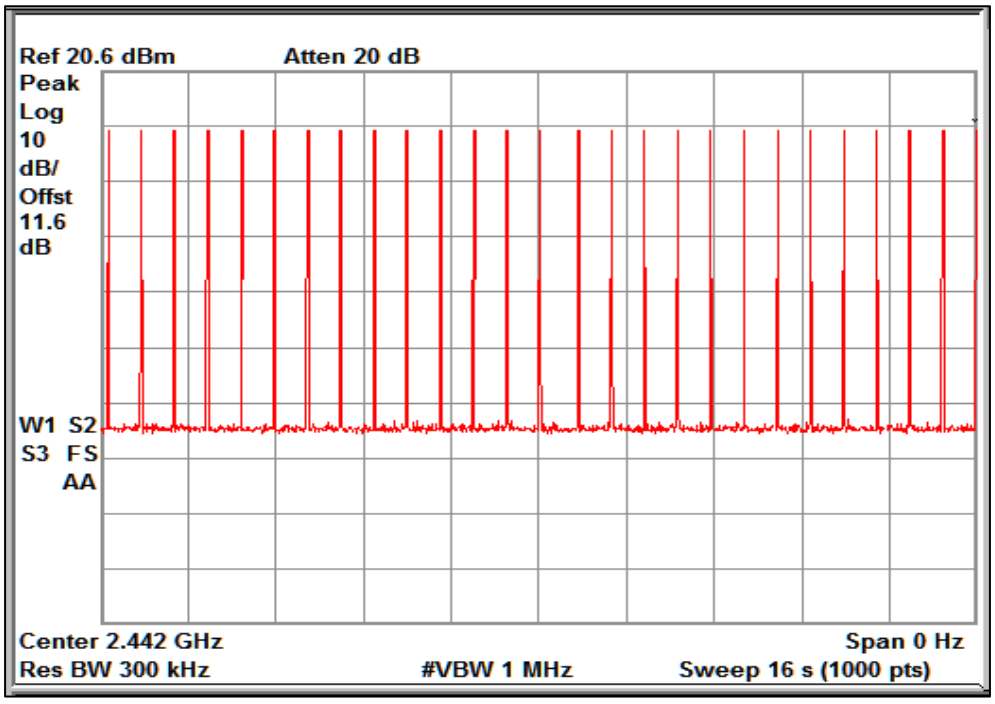
Dwell Time = 250µs or 0.25ms
Total bins in 16 Sec =26
Max. Allowed time = 0.4s

Total time occupancy in 16s = 250 * 26 = 6500µs or 6.50ms or 0.00650sec (which is less than 400ms)

Channel frequency:2442.5MHz



Dwell Time

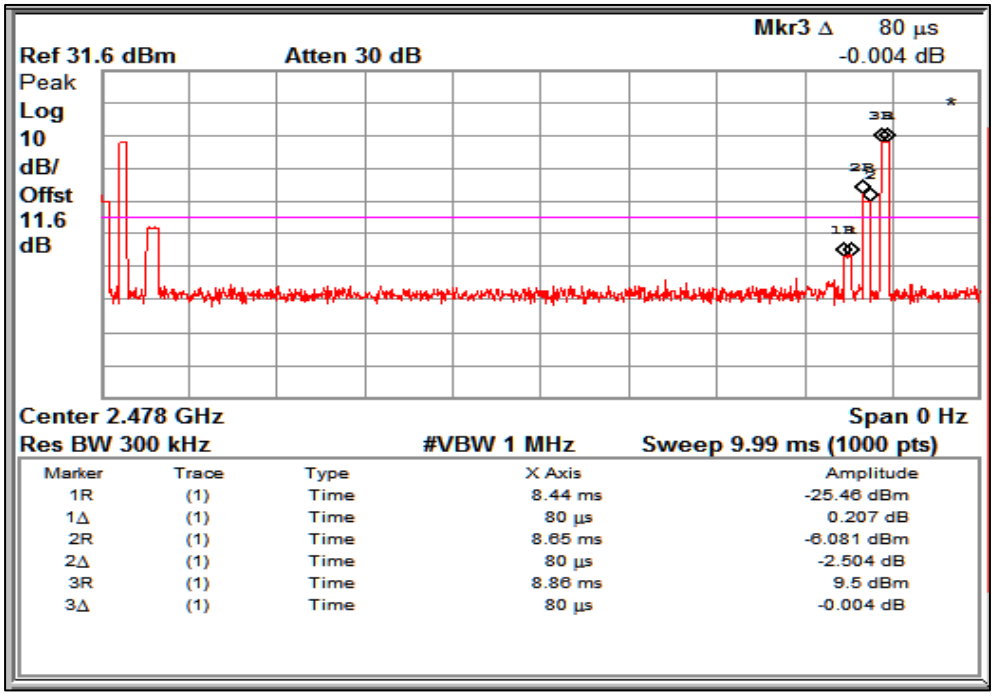


Number of Bins

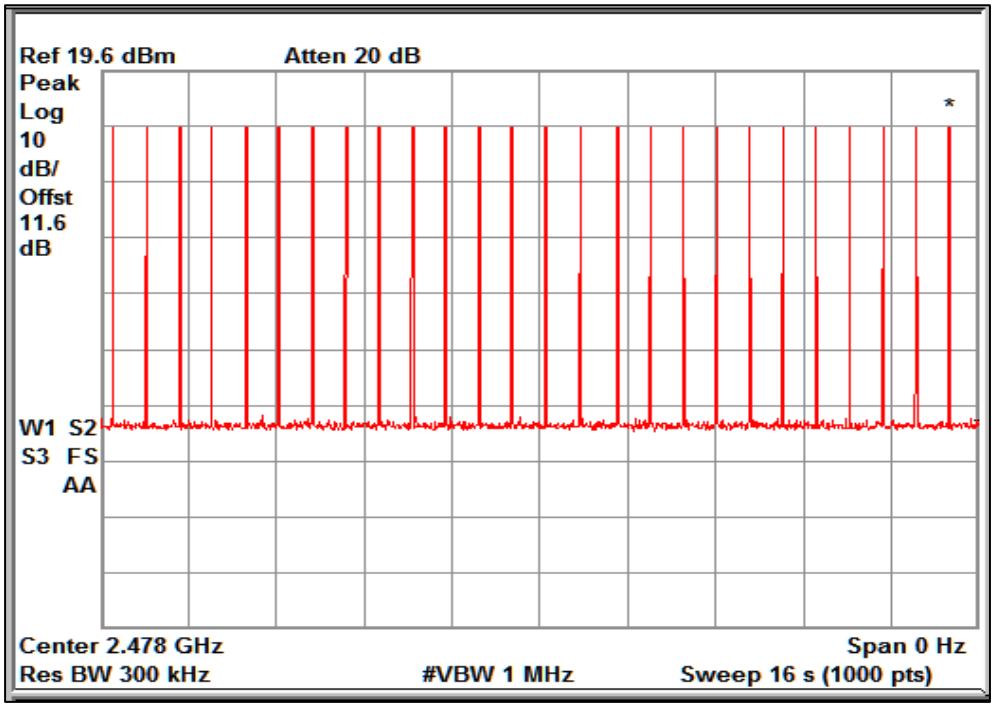
Dwell Time = 220µs or 0.22ms
Total bins in 16 Sec =27
Max. Allowed time = 0.4s

Total time occupancy in 16s = 220 * 27 = 5940µs or 5.94ms or 0.00594sec (which is less than 400ms)

Channel frequency:2477.5MHz



Dwell Time



Number of Bins

Dwell Time = 240µs or 0.24ms
Total bins in 16 Sec =26
Max. Allowed time = 0.4s

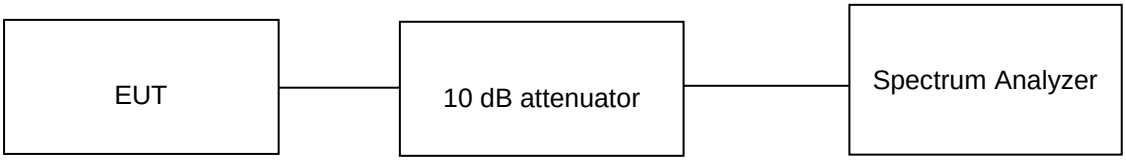
Total time occupancy in 16s = 240 * 26 = 6240µs or 6.24ms or 0.00624 (which is less than 400ms)

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) = + 23.0 °C Voltage = 3.6V DC through DC Supply Relative humidity: 64%

KDB Guidelines applied:

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

Test results:

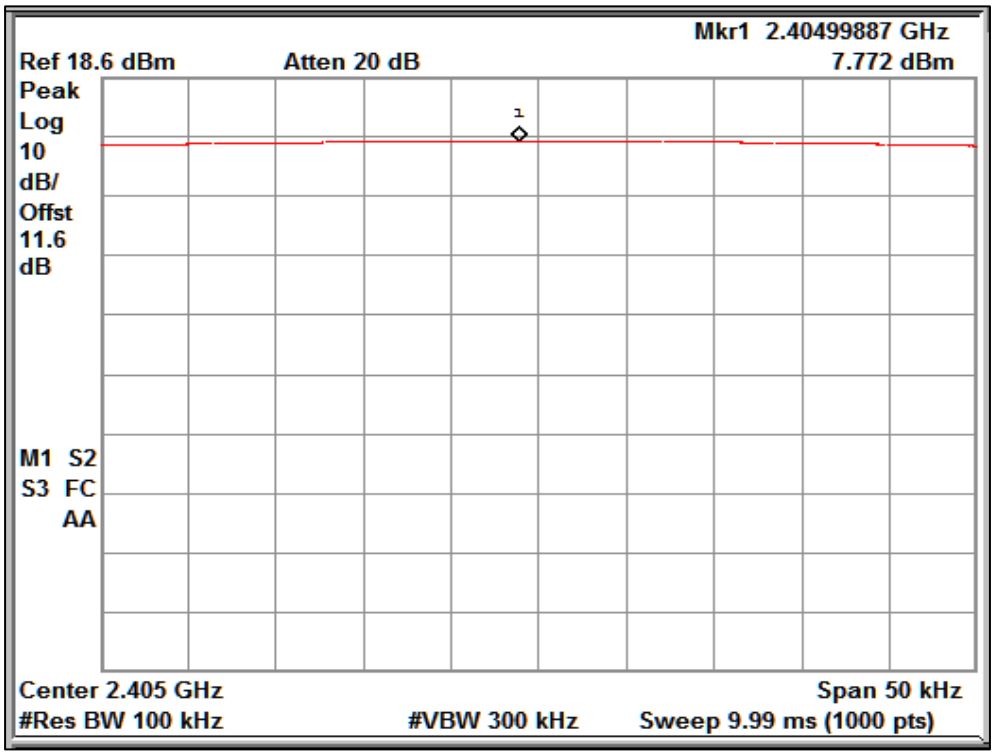
Note:

1. All the losses are included during measurement and final values are mentioned in the test report
2. Final Value (dBm) = Measured Value (dBm) + Attenuator factor (10dB) + Cable loss (1.6dB)
3. This product do not support additional beamforming gain / directional gain, it uses single antenna and hence Directional gain of the single antenna is 0.5 dBi
4. Only worst case results are reported

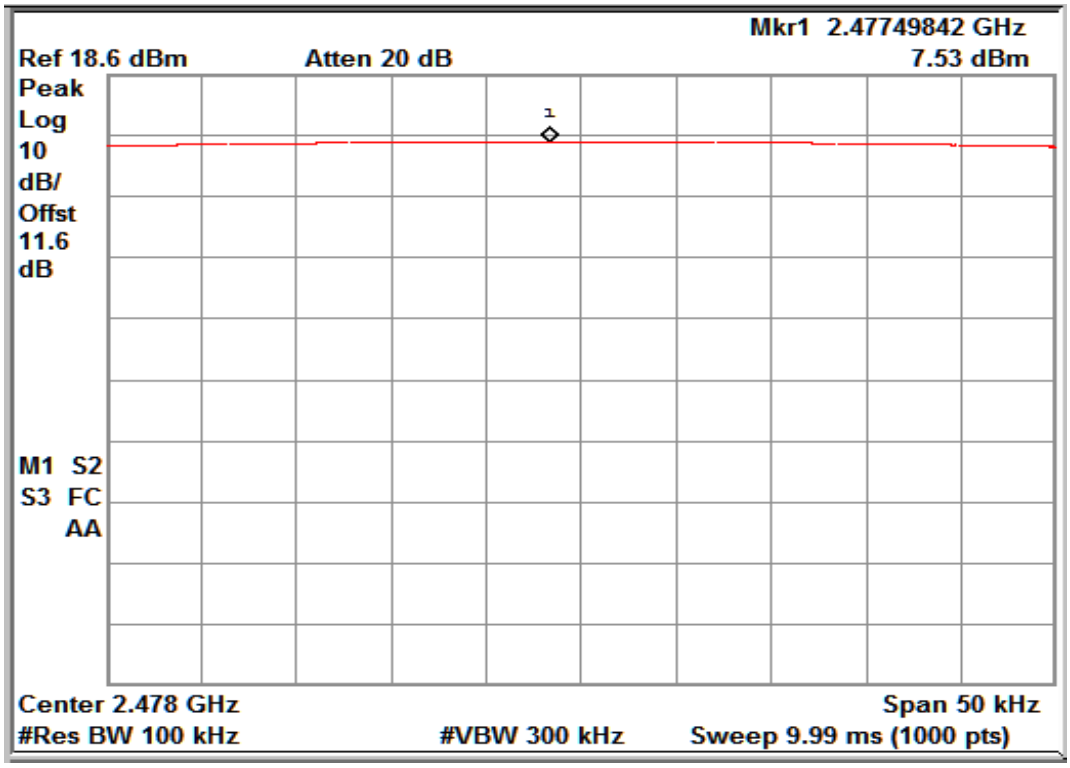
8.6.1 Band edge and reference plots

Antenna 1:

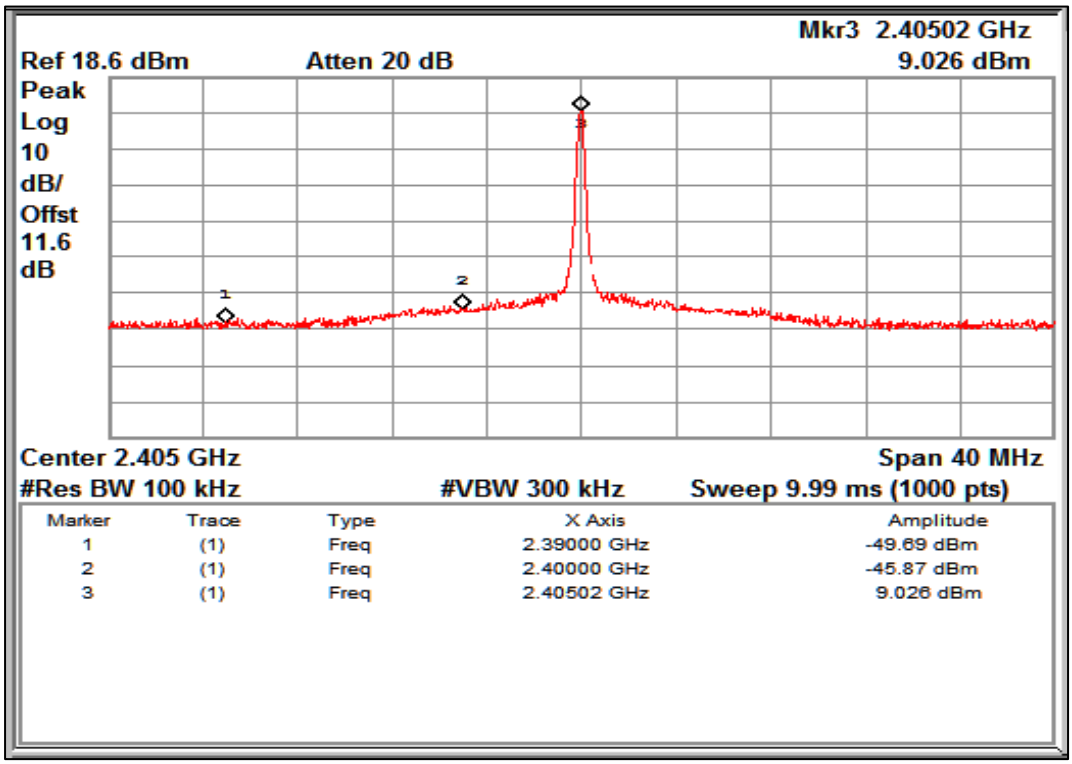
Channel Frequency (MHz)	Reference Value (B) (dBm)	Band edge Frequency (MHz)	Value at Band edge (A) (dBm)	A-B (dBc)	Minimum Limit (dBc)
2405	7.77	2400.00	-45.87	-53.64	-20
2477.5	7.53	2483.50	-51.84	-59.37	-20



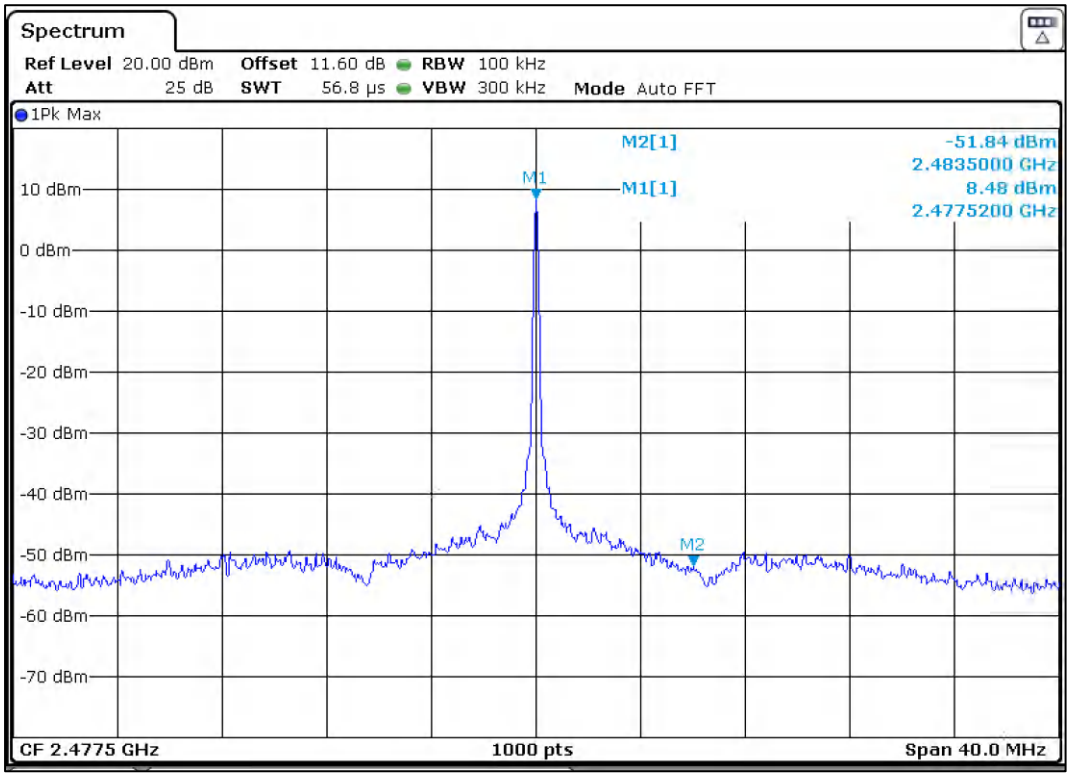
Reference plot for 2405MHz



Reference plot for 2477.5MHz



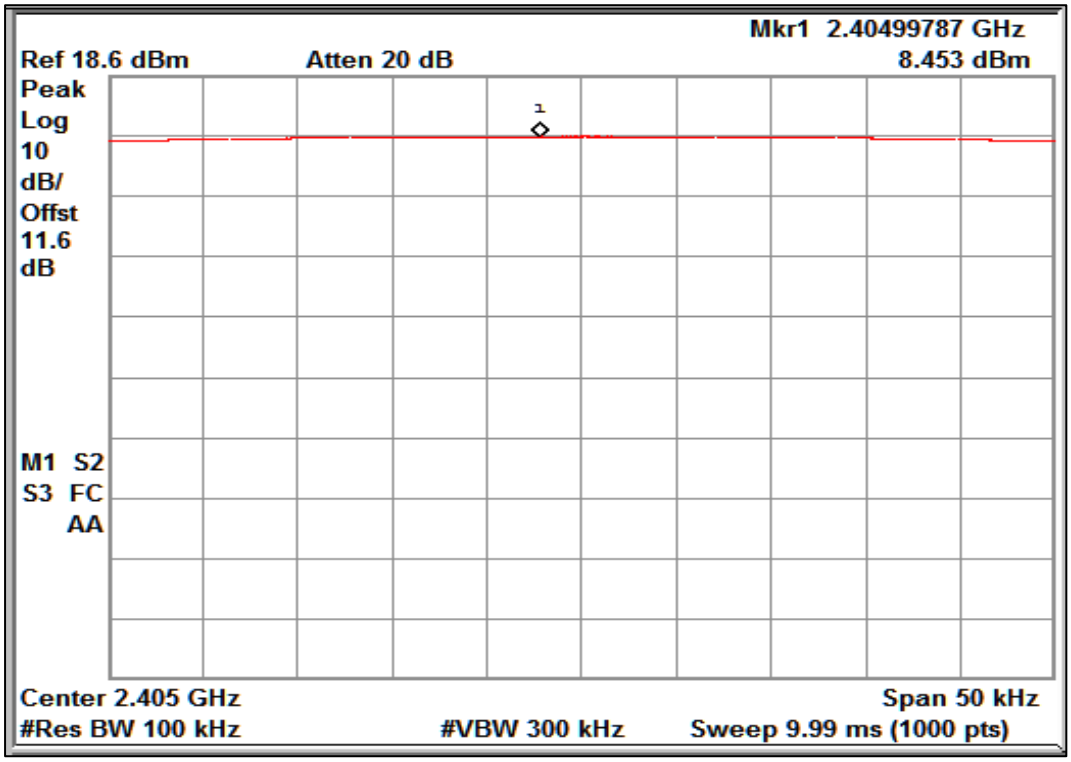
Band edge Channel Frequency 2405MHz



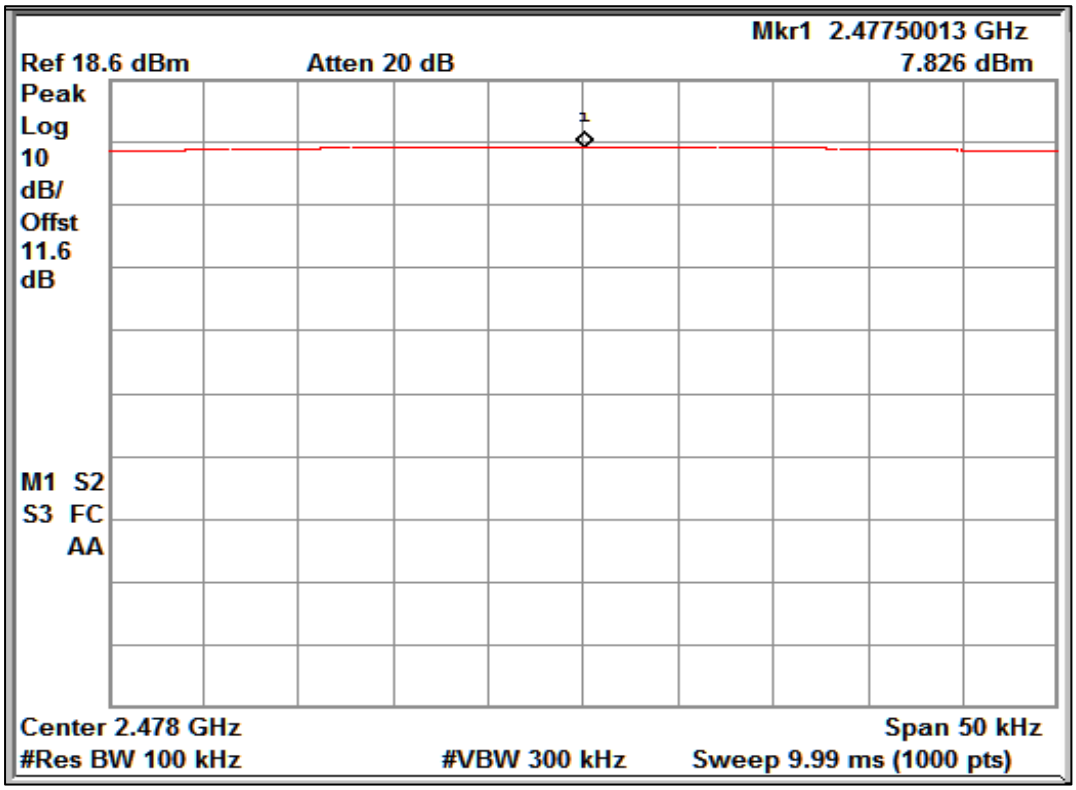
Band edge Channel Frequency 2477.5MHz

Antenna 2:

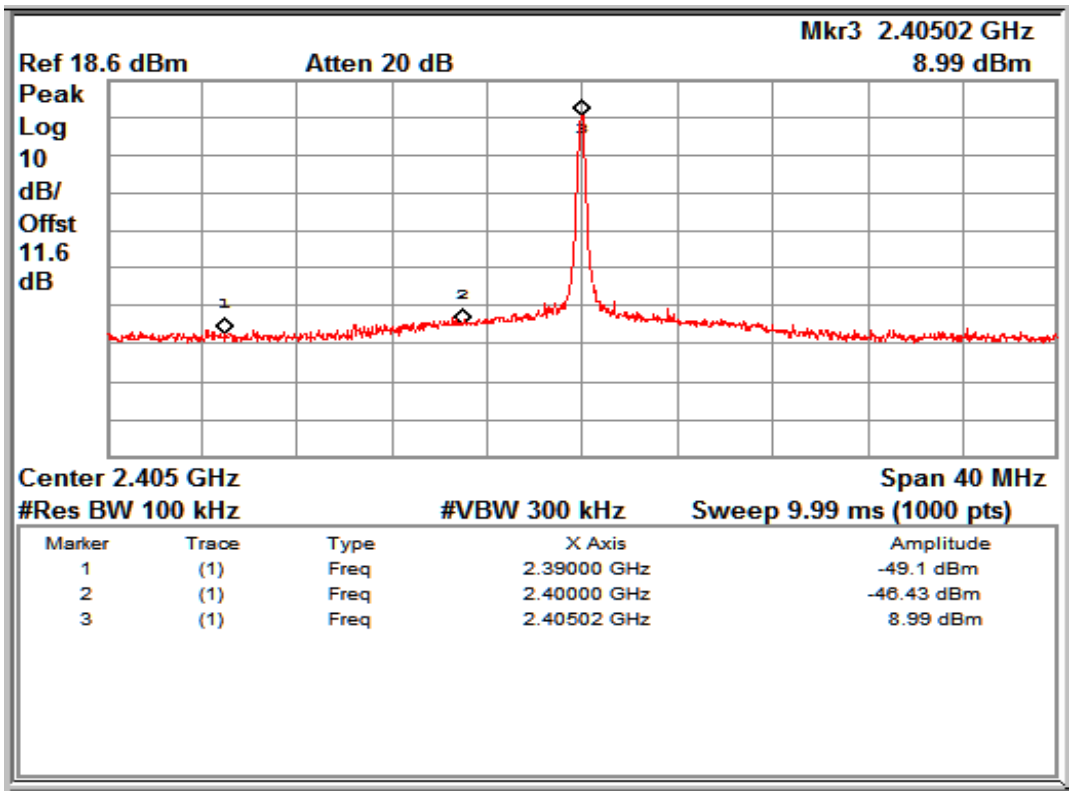
Channel Frequency (MHz)	Reference Value (B) (dBm)	Band edge Frequency (MHz)	Value at Band edge (A) (dBm)	A-B (dBc)	Minimum Limit (dBc)
2405	8.45	2400.00	-46.43	-54.88	-20
2477.5	7.82	2483.50	-52.02	-59.84	-20



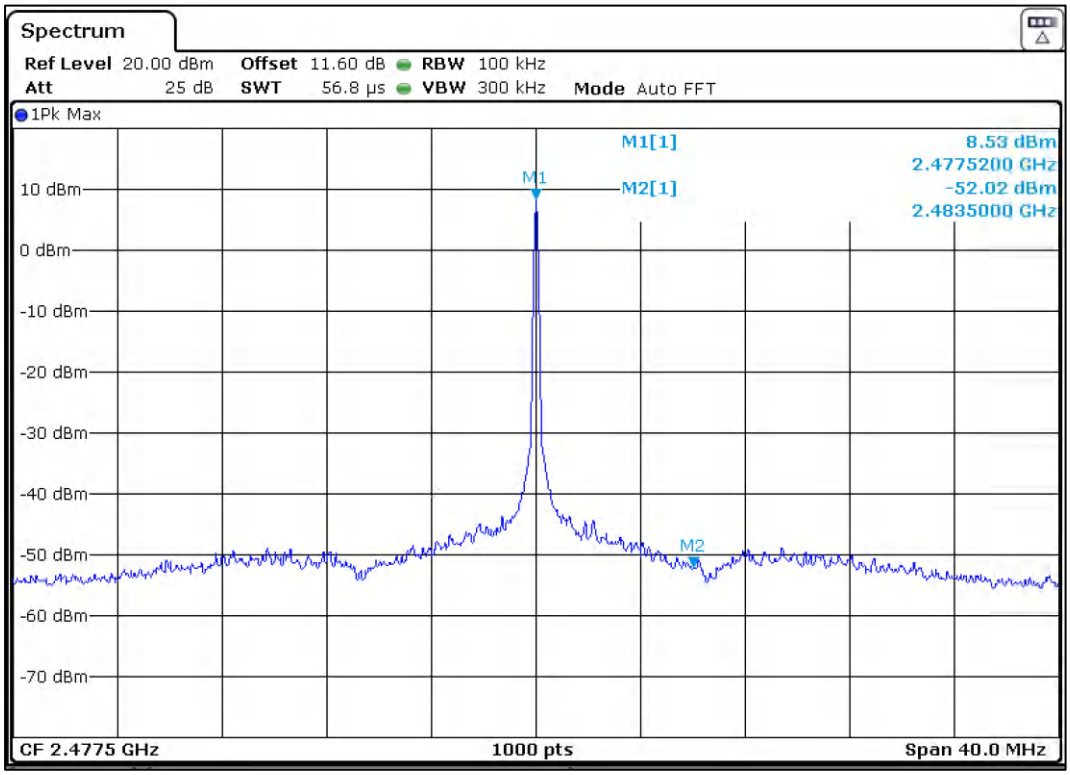
Reference plot for 2405MHz



Reference plot for 2477.5MHz



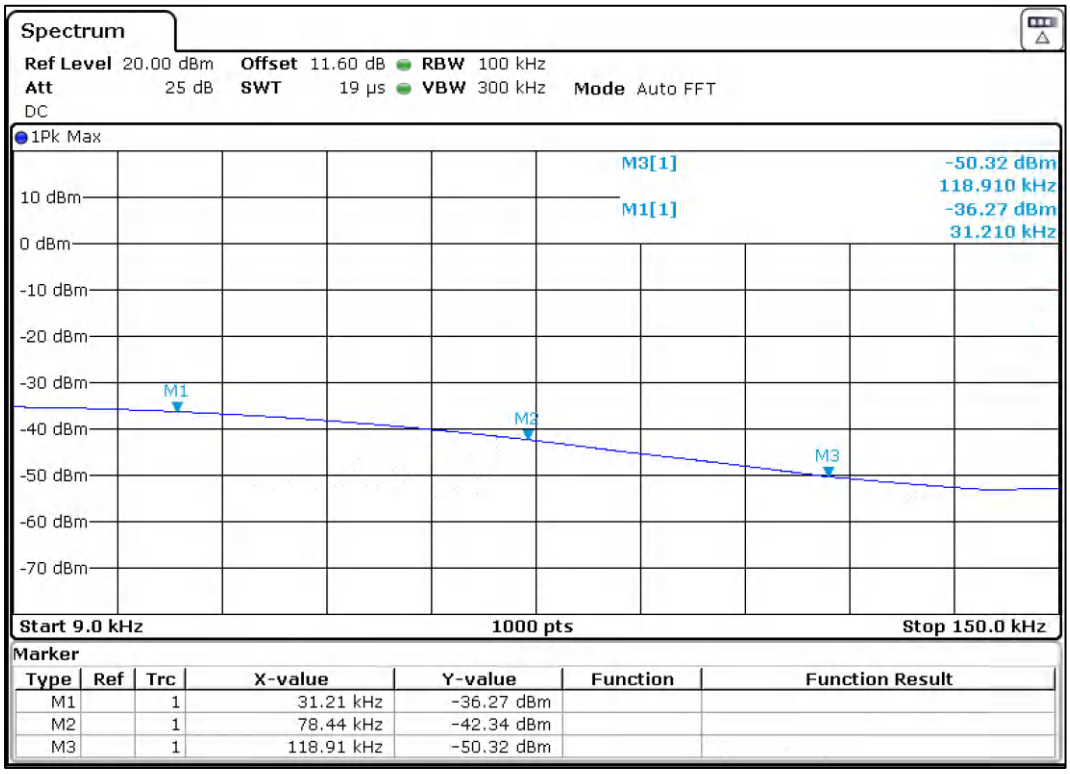
Band edge Channel Frequency 2405MHz



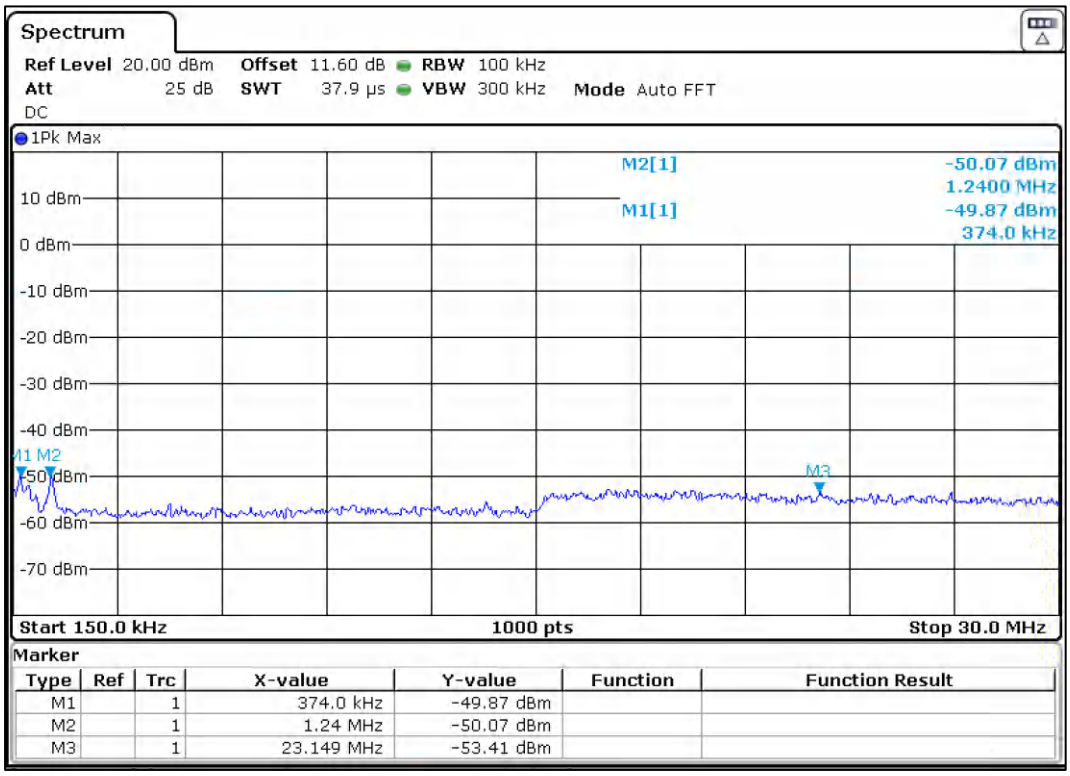
Band edge Channel Frequency 2477.5MHz

8.6.2 Out-Of-Band Emissions

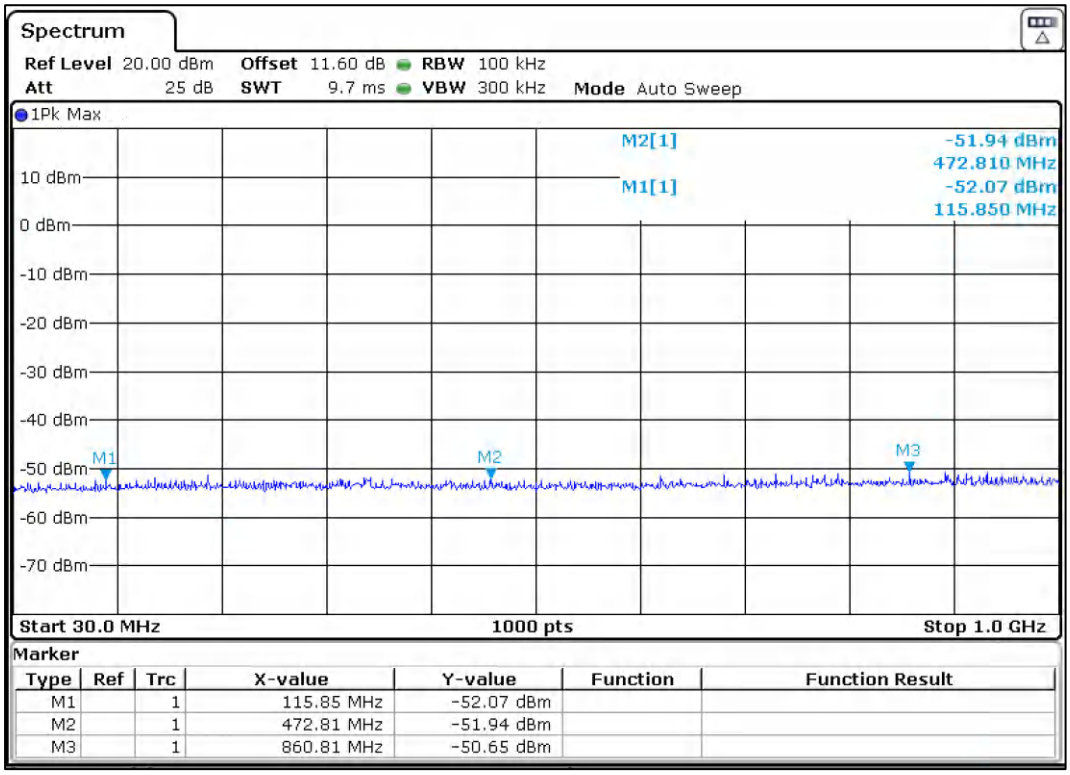
Antenna1:



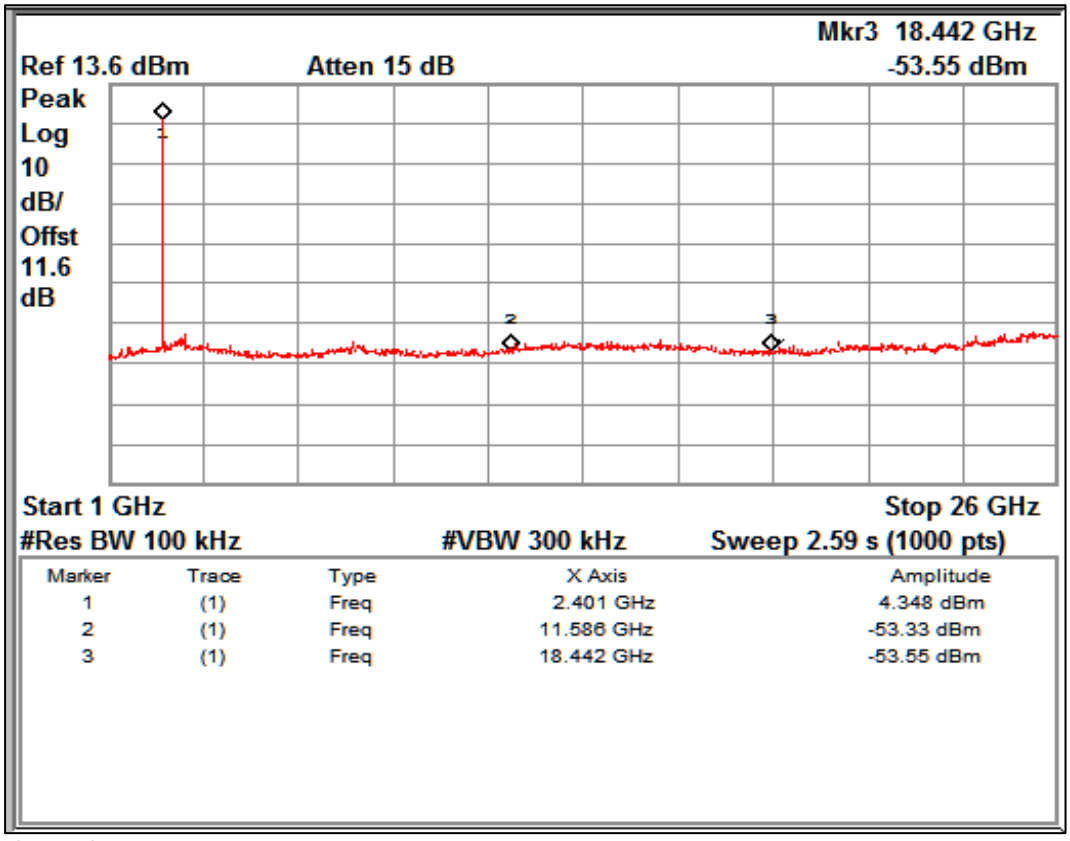
Channel Frequency 2405MHz Frequency Range 9KHz – 150KHz



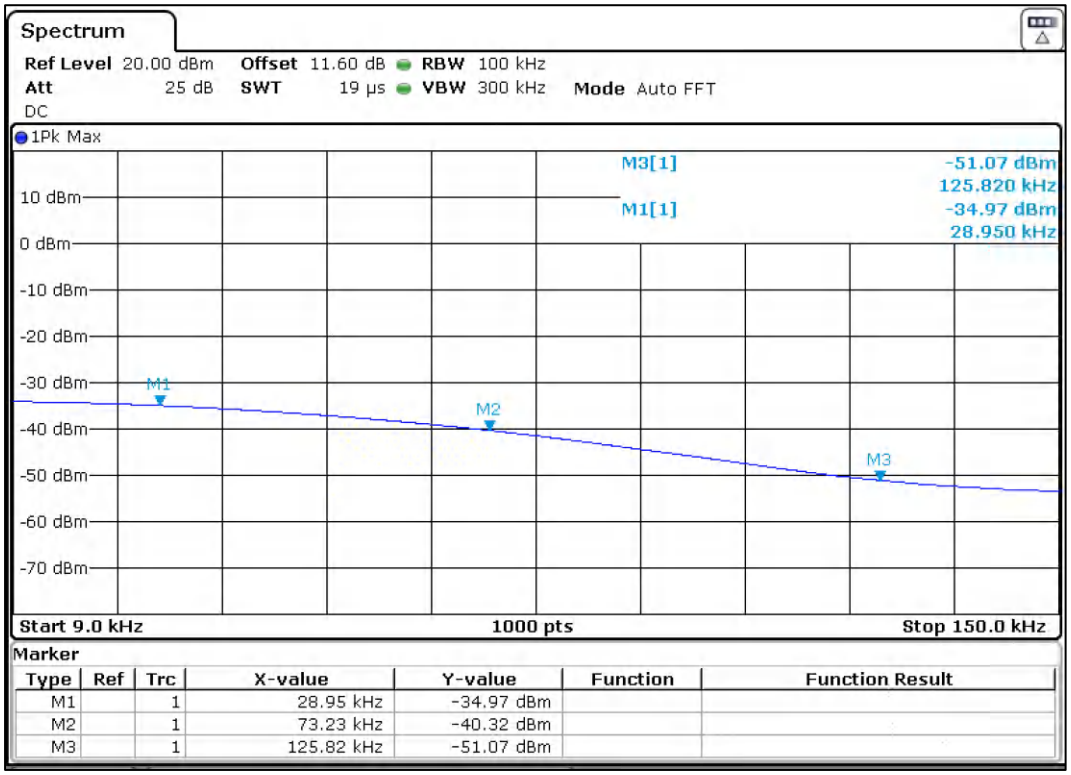
Channel Frequency 2405MHz Frequency Range 150KHz – 30MHz



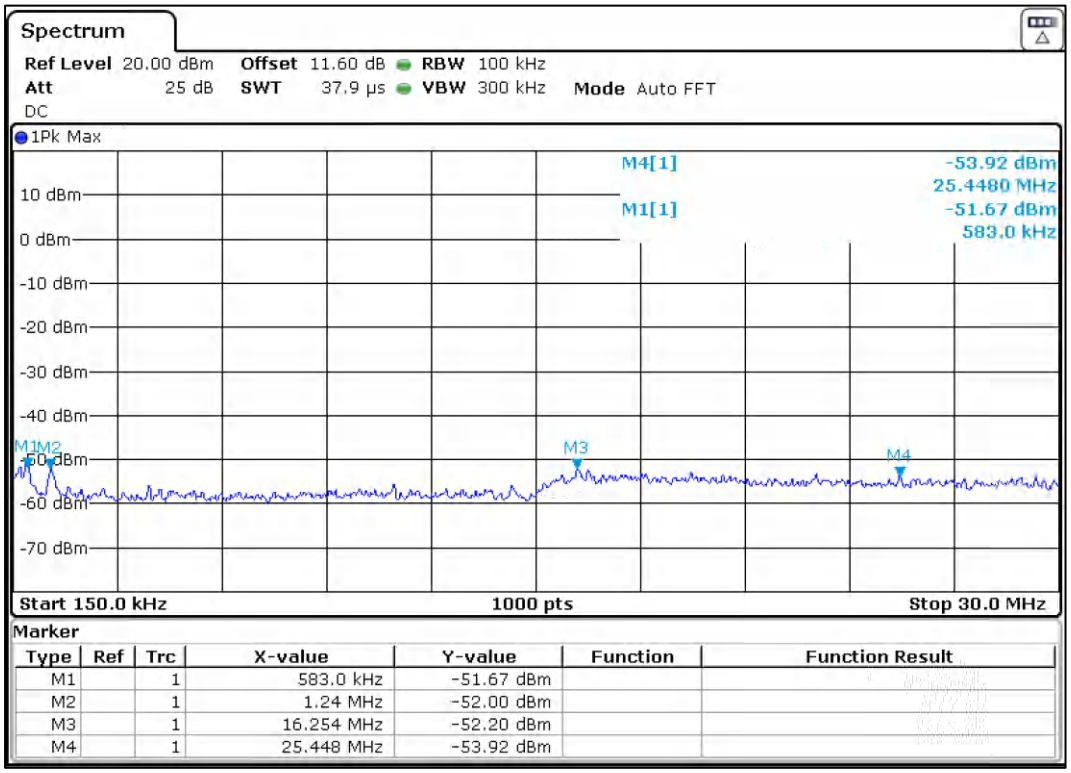
Channel Frequency 2405MHz Frequency Range 30MHz – 1GHz



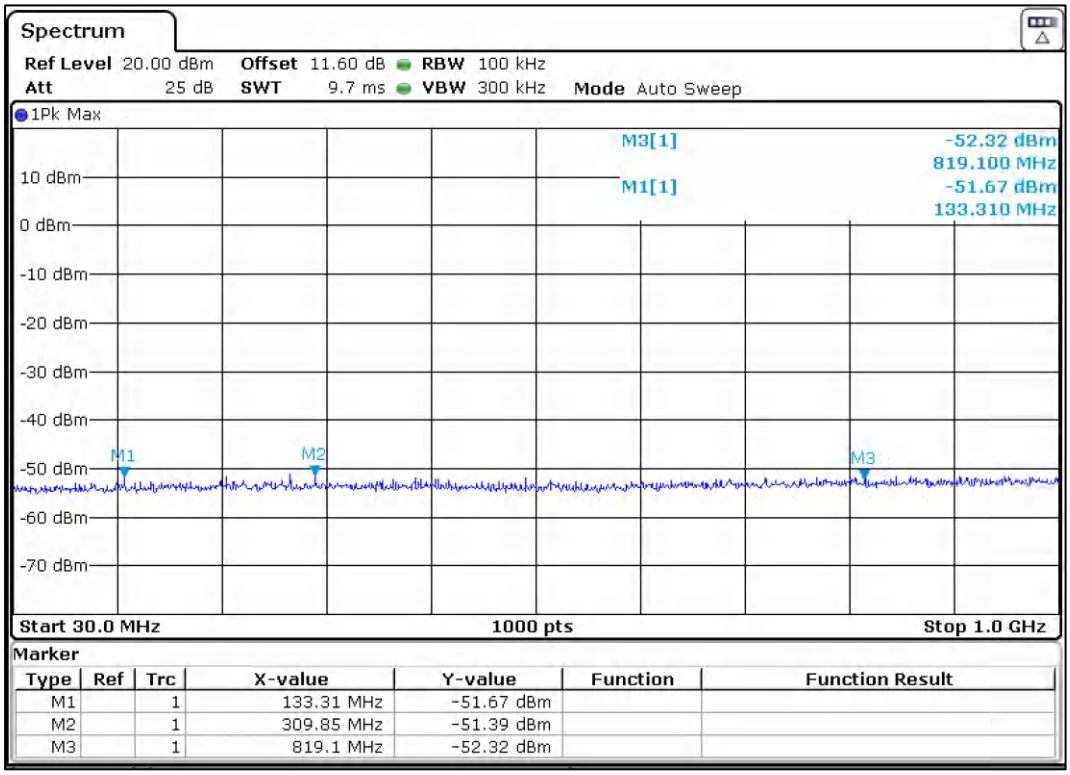
Channel Frequency 2405MHz Frequency Range 1GHz – 26GHz



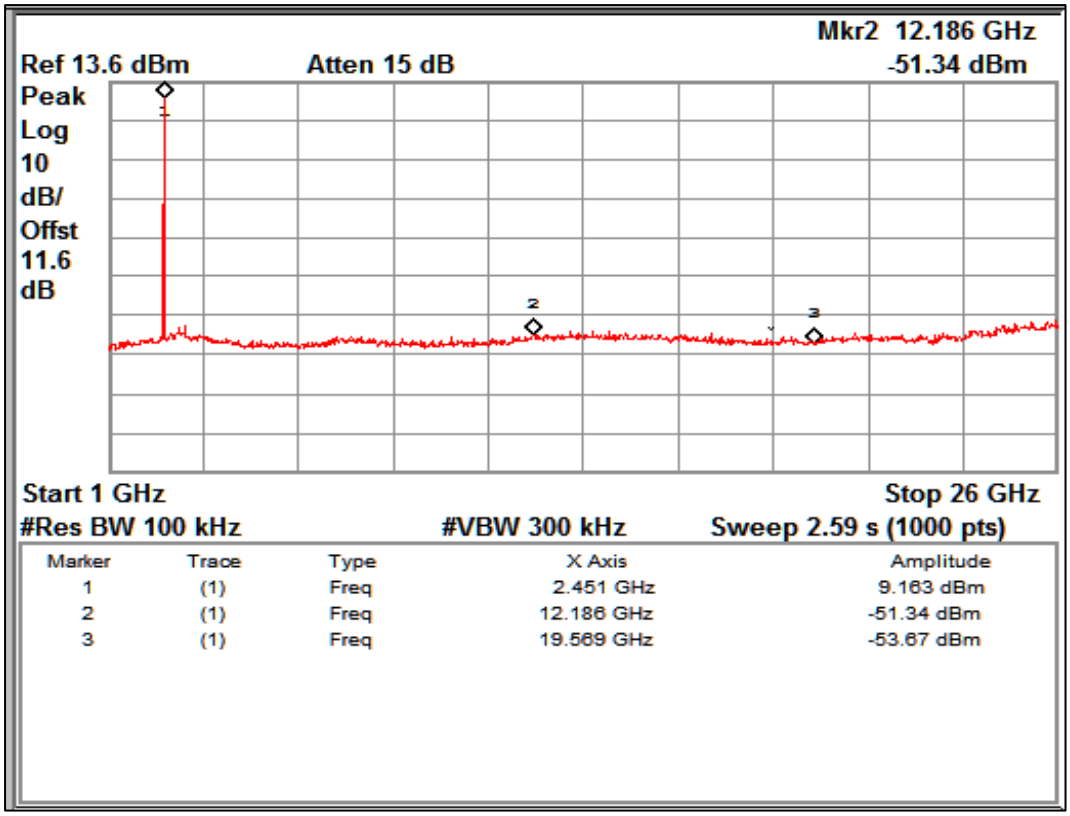
Channel Frequency 2442.5MHz Frequency Range 9KHz – 150KHz



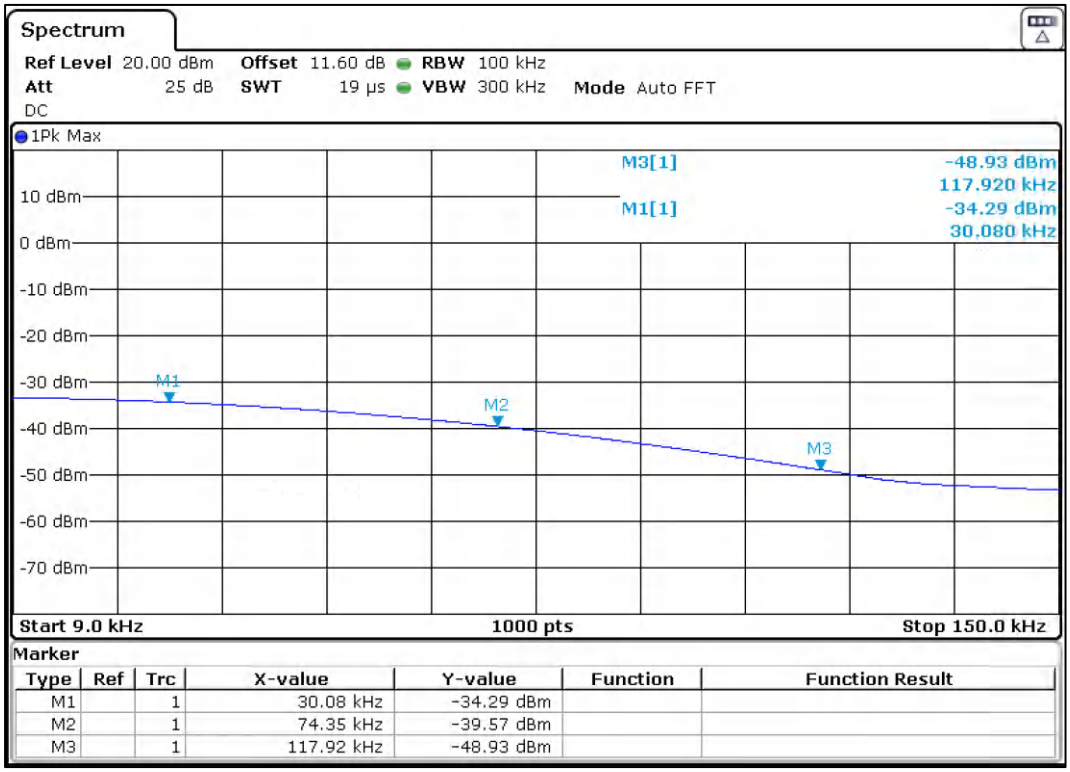
Channel Frequency 2442.5MHz Frequency Range 150KHz – 30MHz



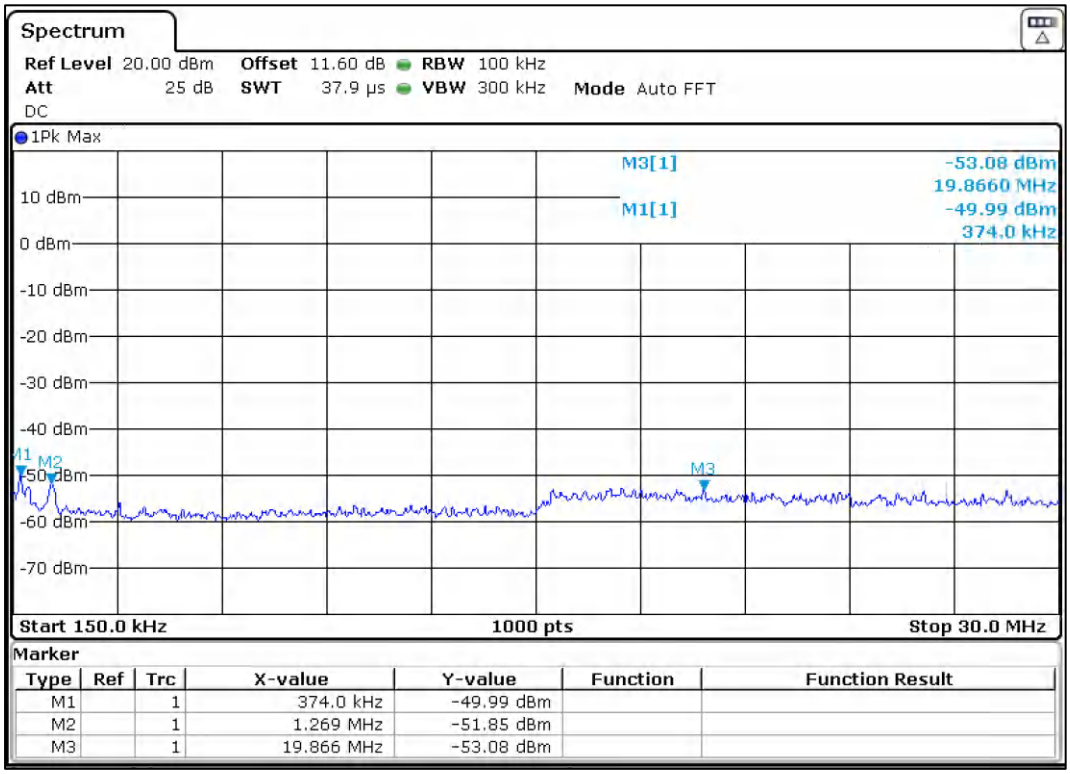
Channel Frequency 2442.5MHz Frequency Range 30MHz – 1GHz



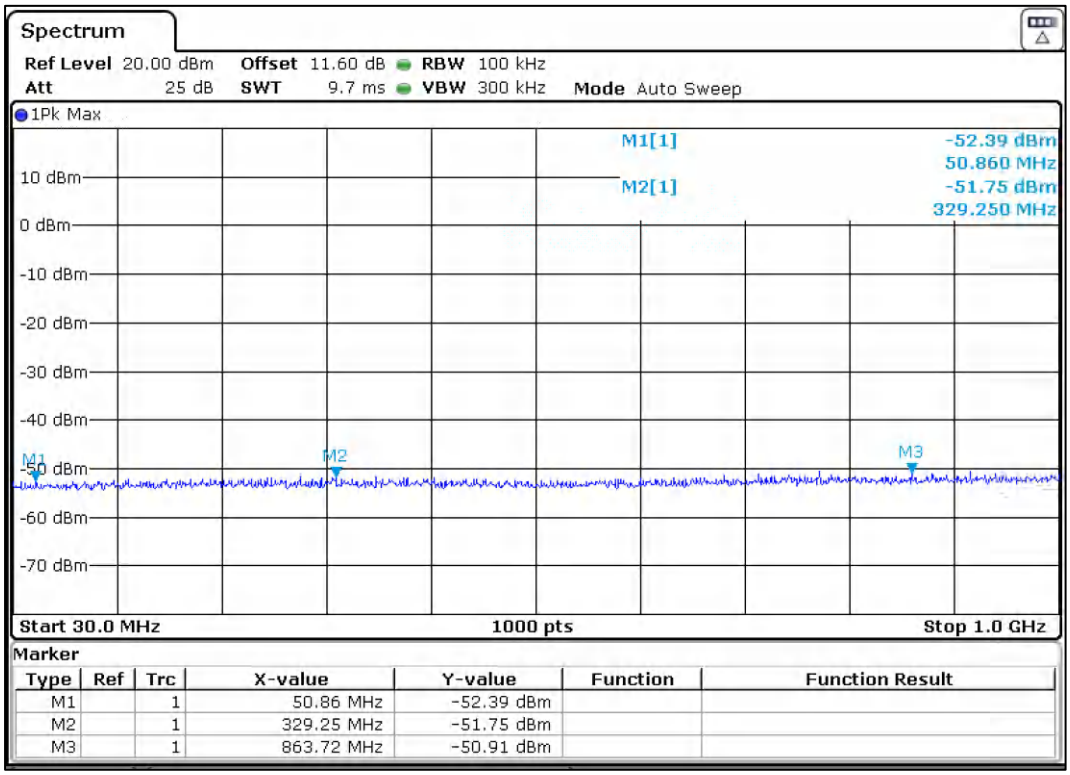
Channel Frequency 2442.5MHz Frequency Range 1GHz – 26GHz



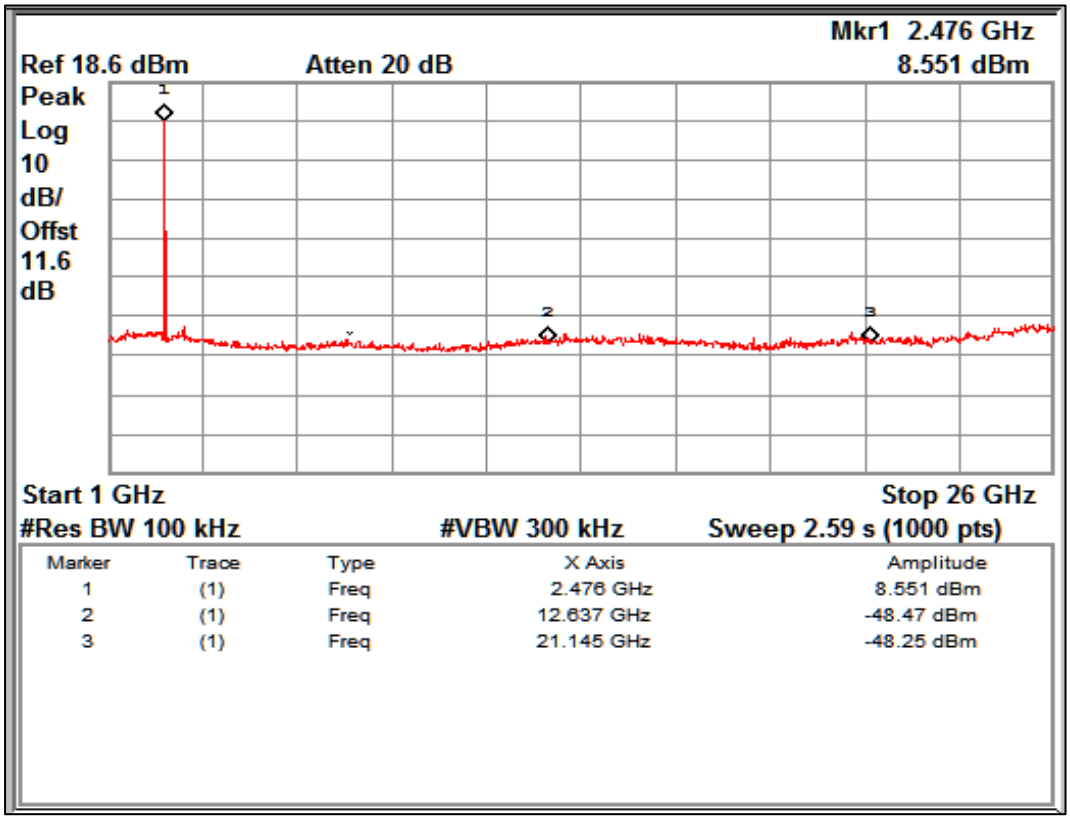
Channel Frequency 2477.5MHz Frequency Range 9KHz – 150KHz



Channel Frequency 2477.5MHz Frequency Range 150KHz – 30MHz

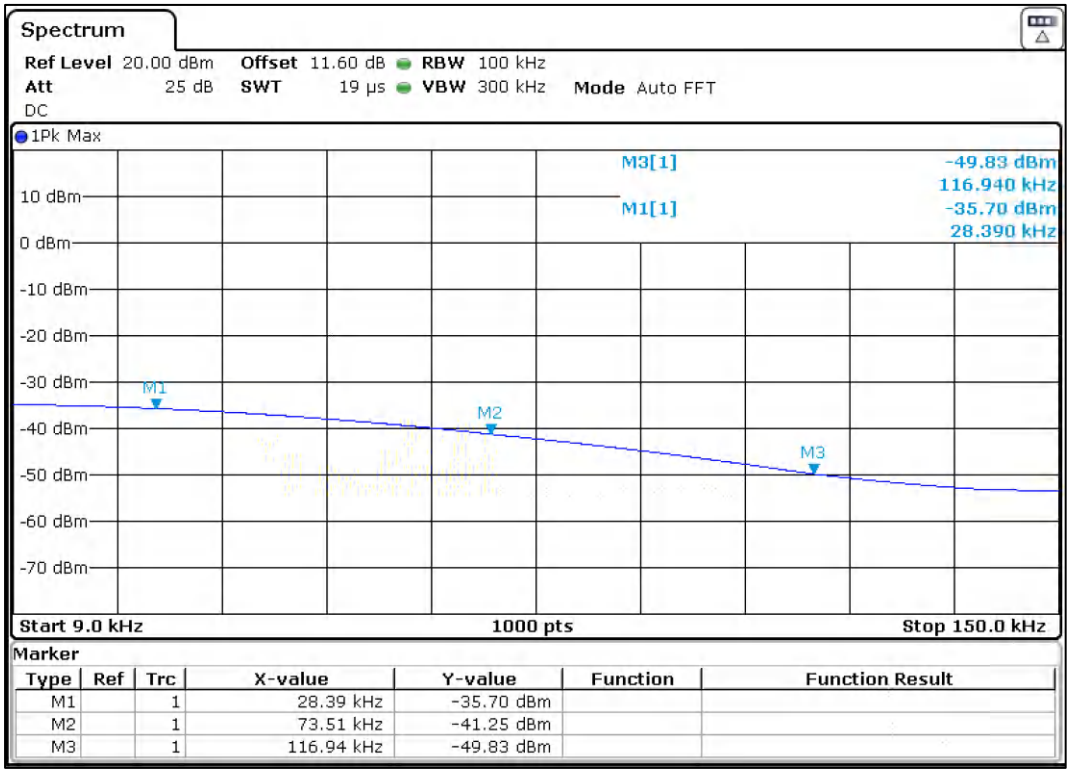


Channel Frequency 2477.5MHz Frequency Range 30MHz – 1GHz

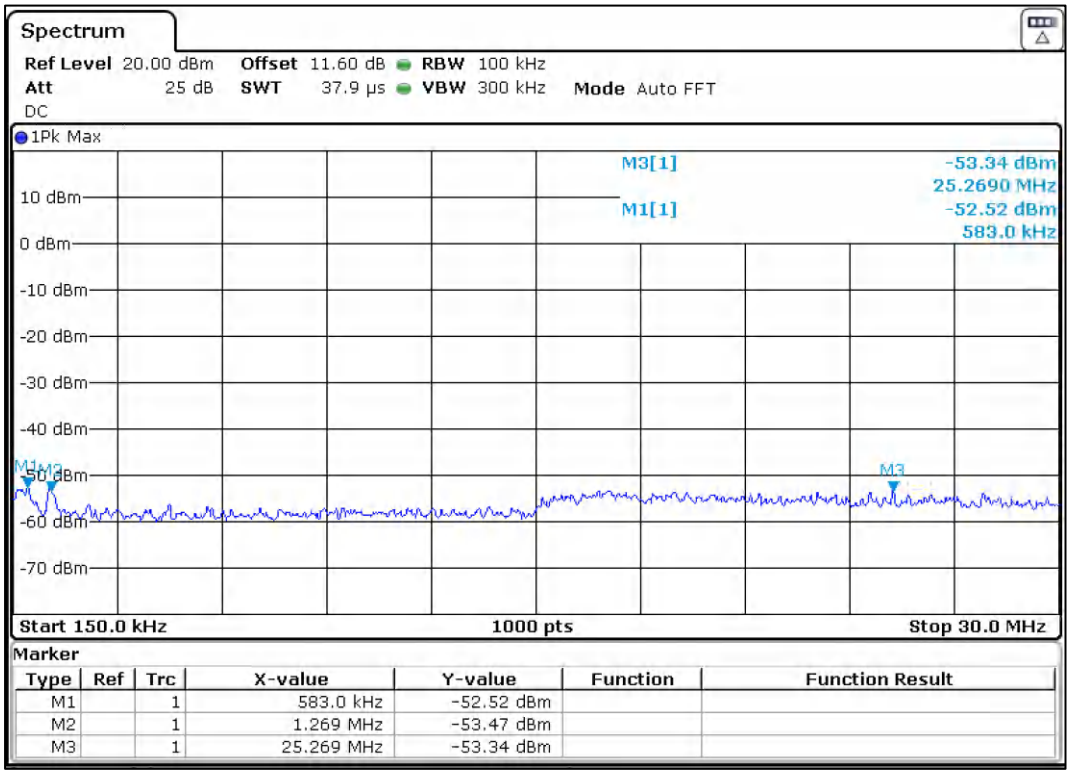


Channel Frequency 2477.5MHz Frequency Range 1GHz – 26GHz

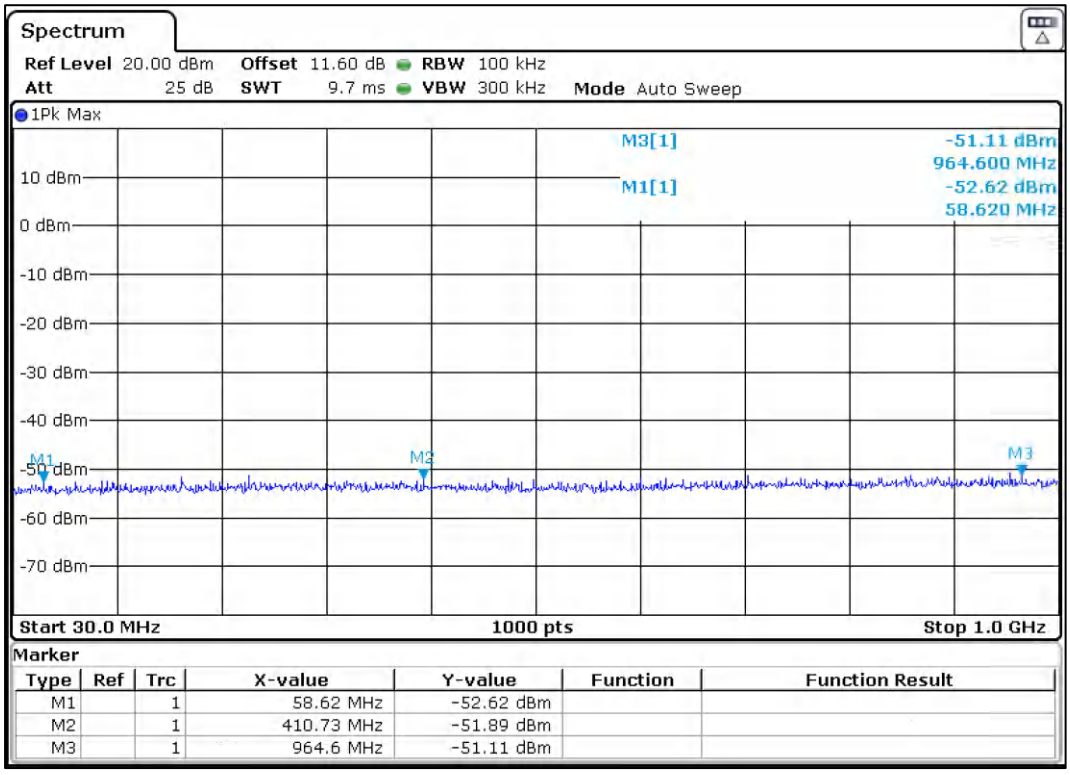
Antenna 2:



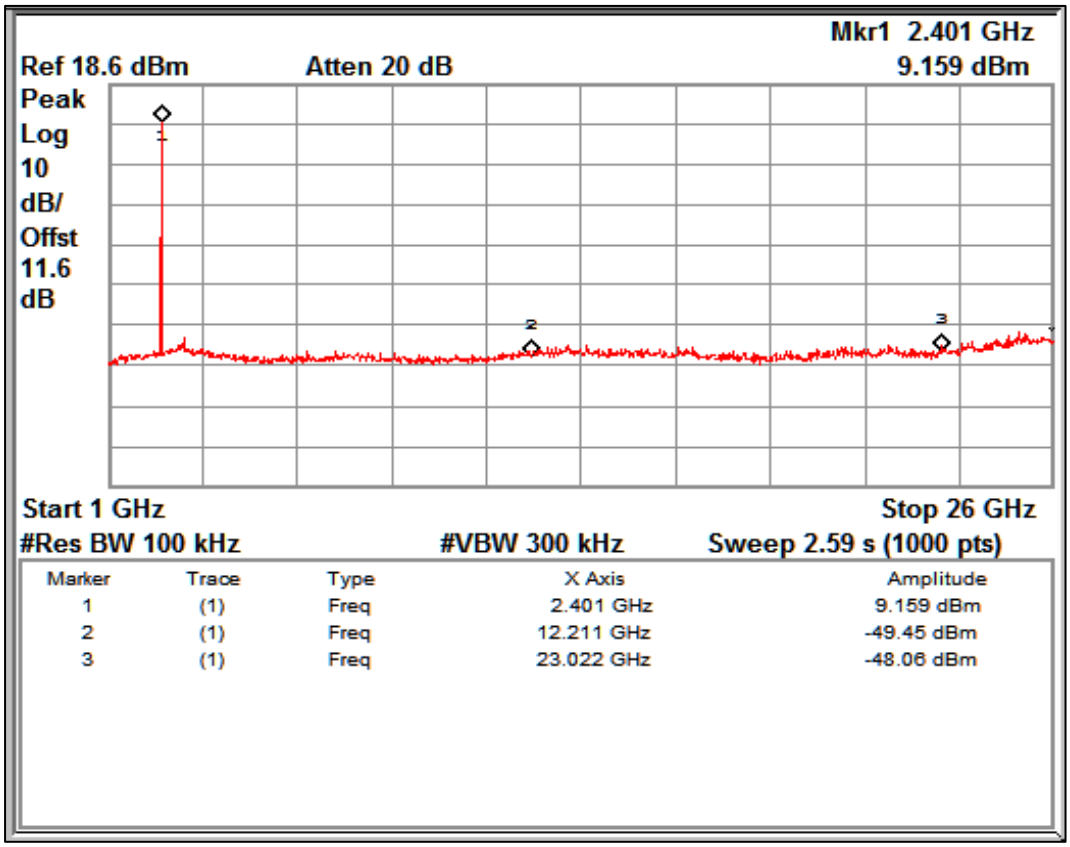
Channel Frequency 2405MHz Frequency Range 9KHz – 150KHz



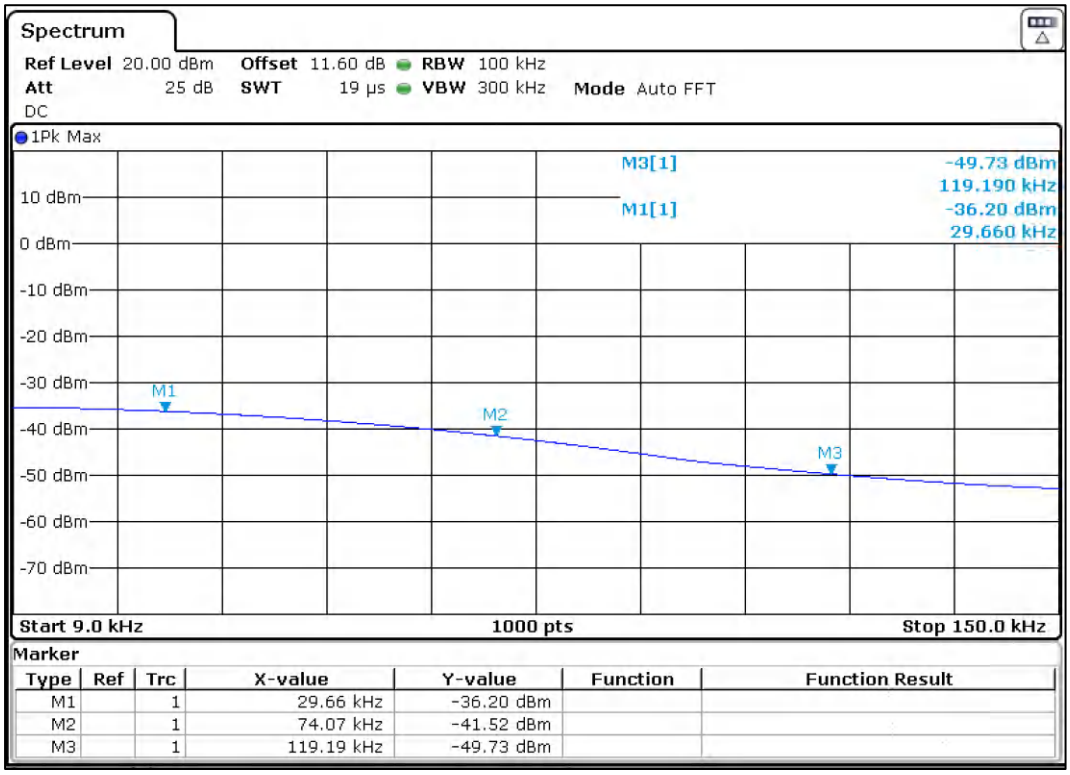
Channel Frequency 2405MHz Frequency Range 150KHz – 30MHz



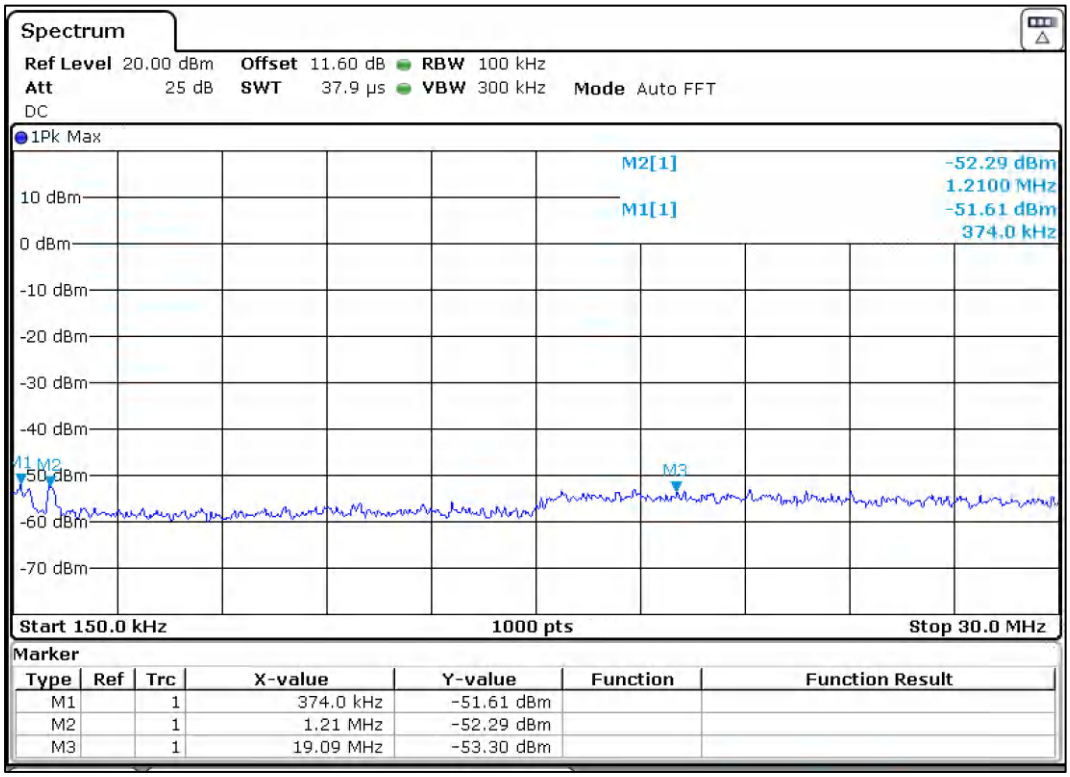
Channel Frequency 2405MHz Frequency Range 30MHz – 1GHz



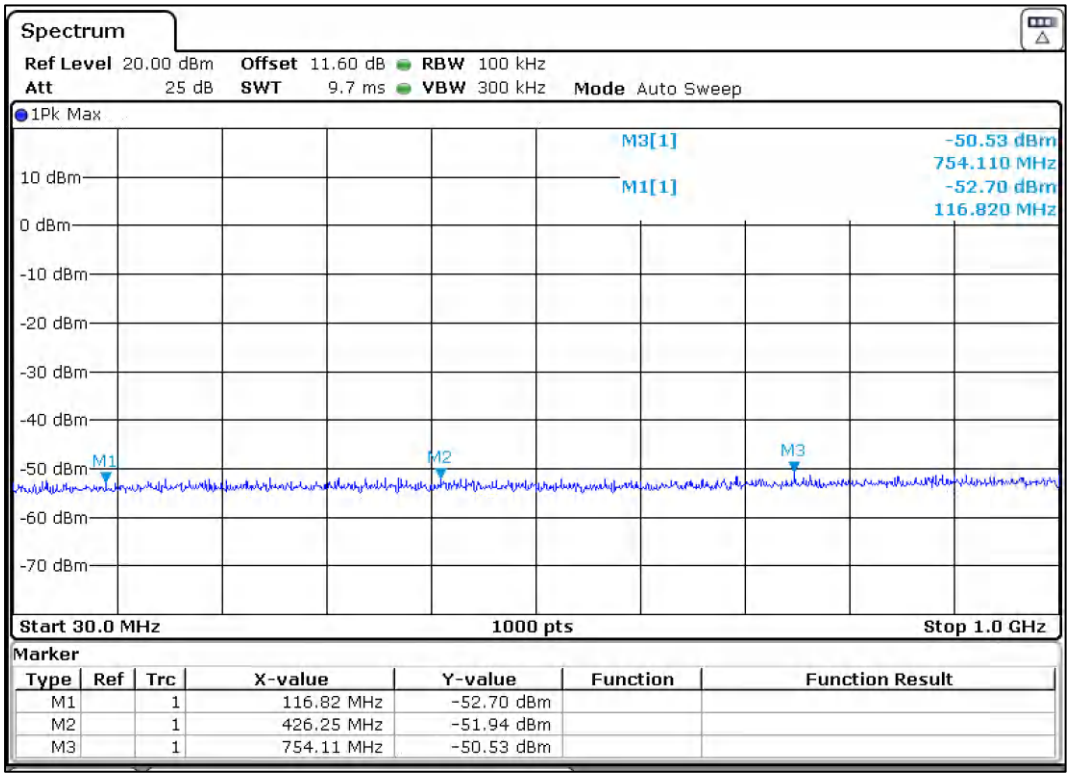
Channel Frequency 2405MHz Frequency Range 1GHz – 26GHz



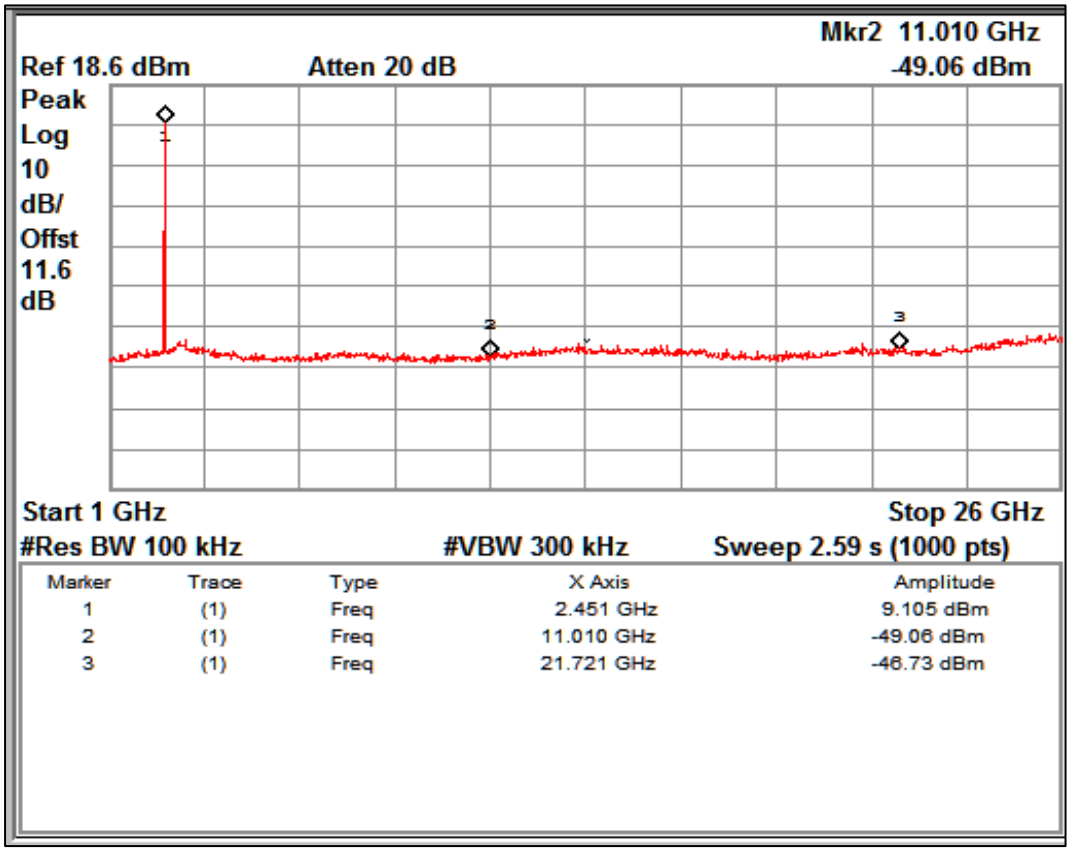
Channel Frequency 2442.5MHz Frequency Range 9KHz – 150KHz



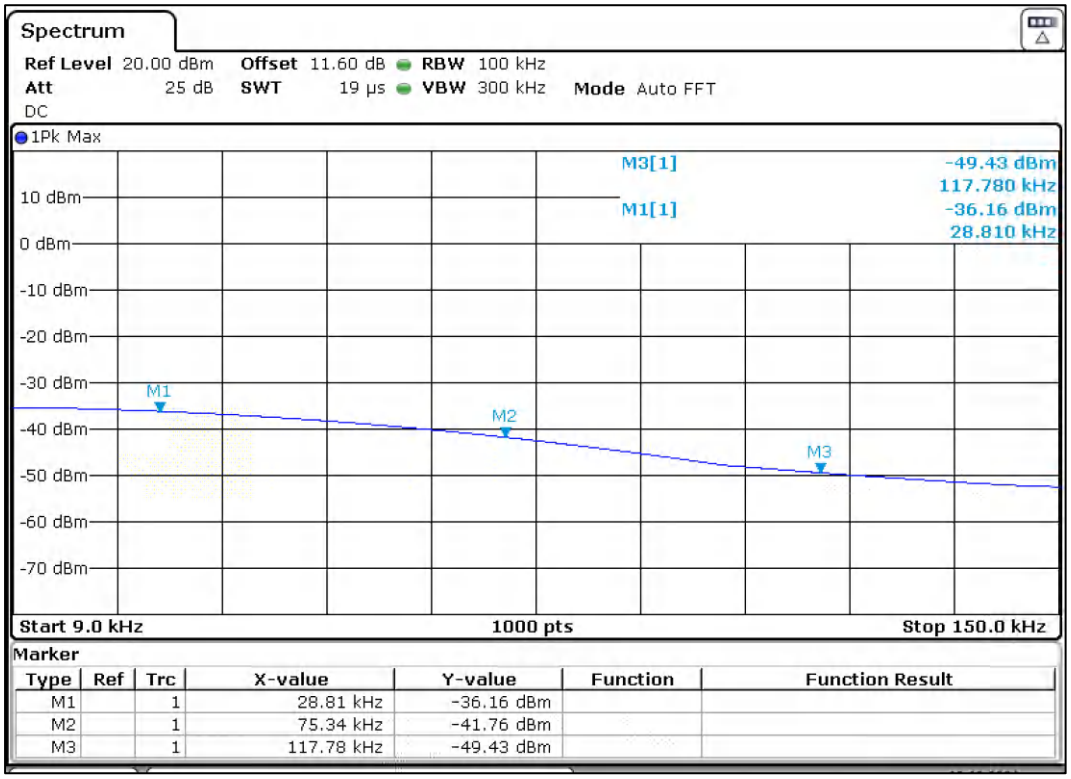
Channel Frequency 2442.5MHz Frequency Range 150KHz – 30MHz



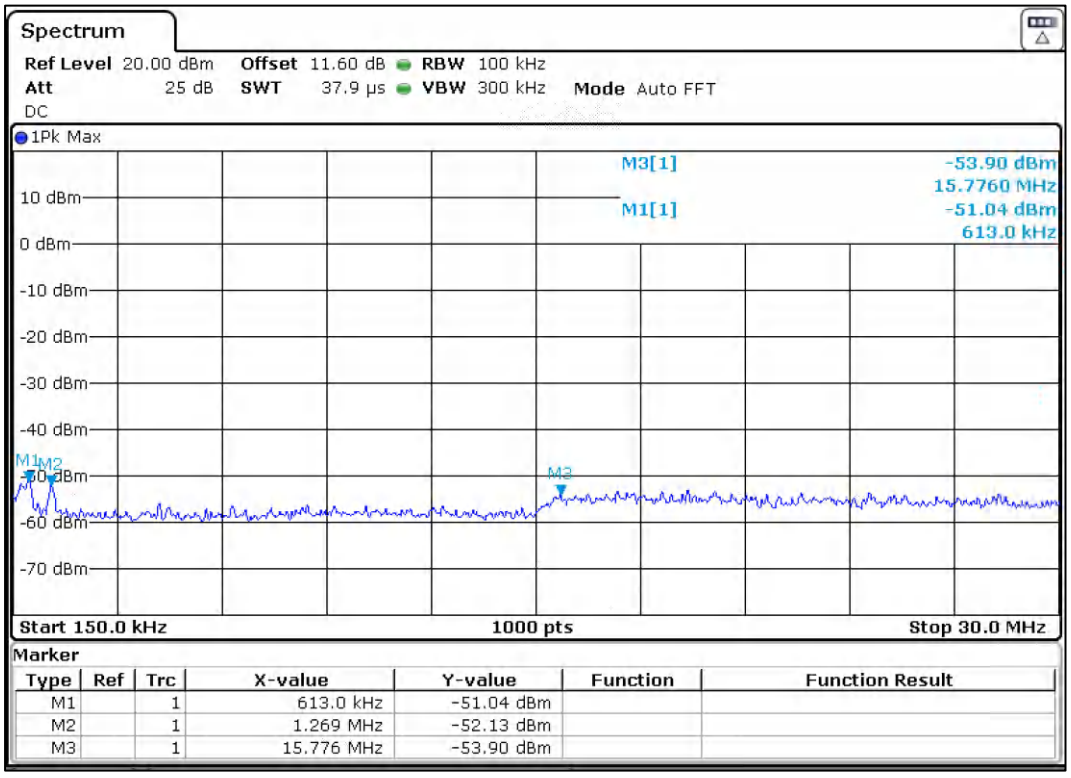
Channel Frequency 2442.5MHz Frequency Range 30MHz – 1GHz



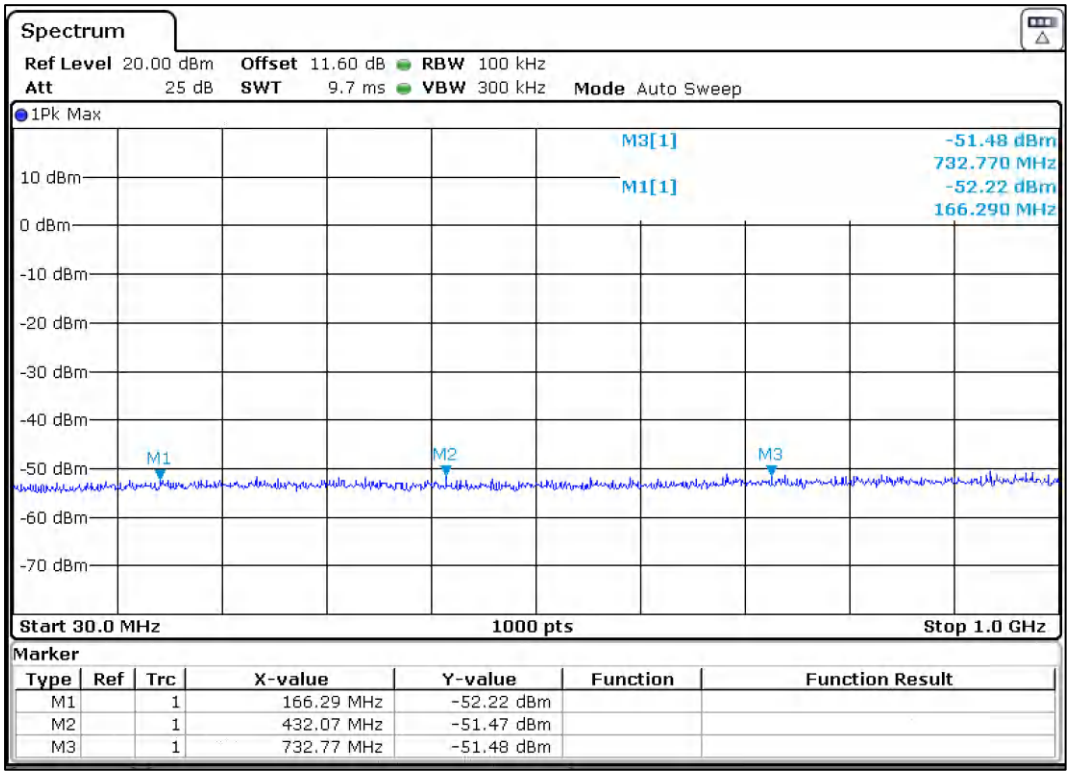
Channel Frequency 2442.5MHz Frequency Range 1GHz – 26GHz



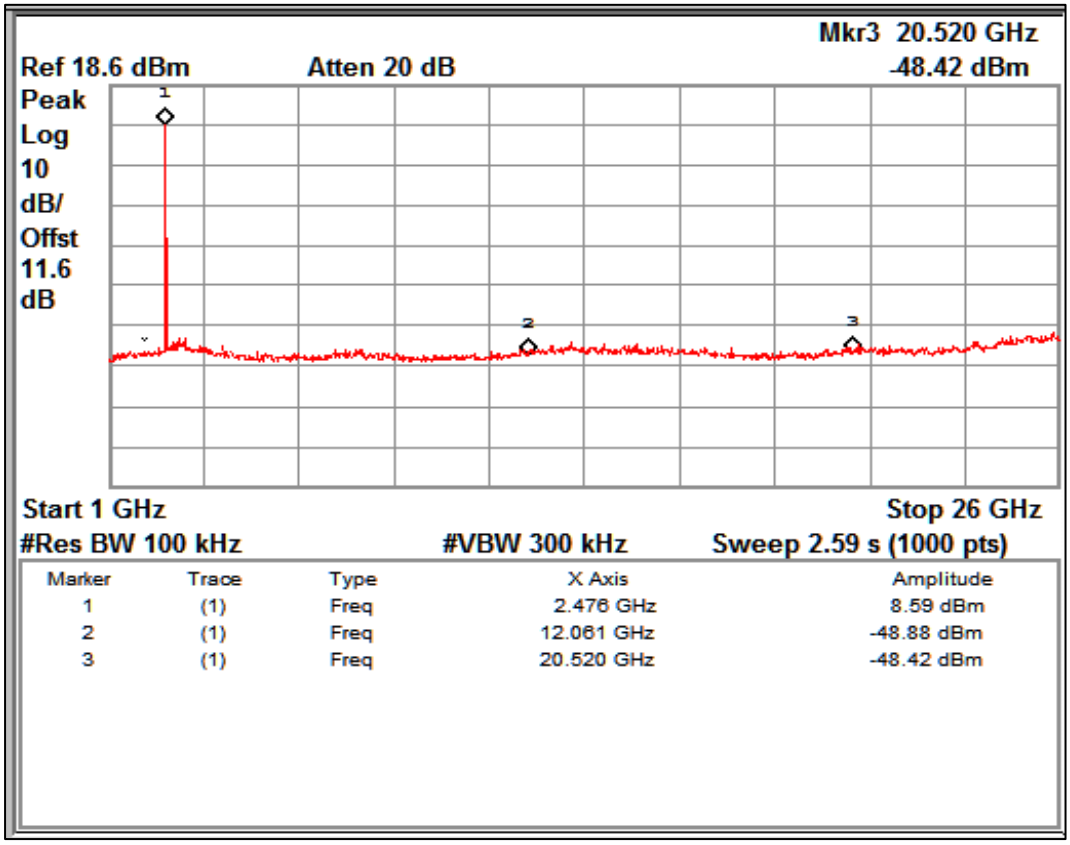
Channel Frequency 2477.5MHz Frequency Range 9KHz – 150KHz



Channel Frequency 2477.5MHz Frequency Range 150KHz – 30MHz



Channel Frequency 2477.5MHz Frequency Range 30MHz – 1GHz



Channel Frequency 2477.5MHz Frequency Range 1GHz – 26GHz

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	Semi Anechoic Chamber 30MHz - 1 GHz Fully Anechoic Chamber 1 GHz - 40GHz
Measurement Bandwidth	100 kHz for frequency range < 1GHz 1 MHz for Frequency range >1GHz
Detector	Refer remarks below
Measuring Distance	3 m
Requirement	As per the limits mentioned in the below table
Test setup	Refer 7 TEST METHODOLOGY

Table 6: Transmitter limits for Radiated emission

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

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

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

Test Conditions:

Temperature (Norm) = + 23.5 °C Voltage = 3.3V DC Supply Relative humidity: 63%

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

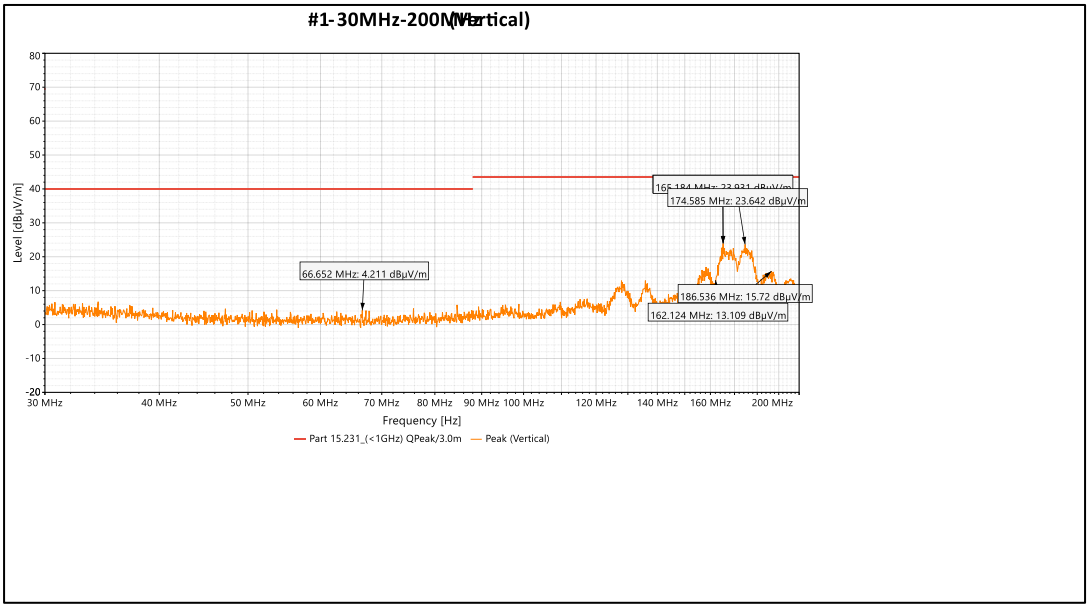
Test results for frequency range 9kHz – 30MHz

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

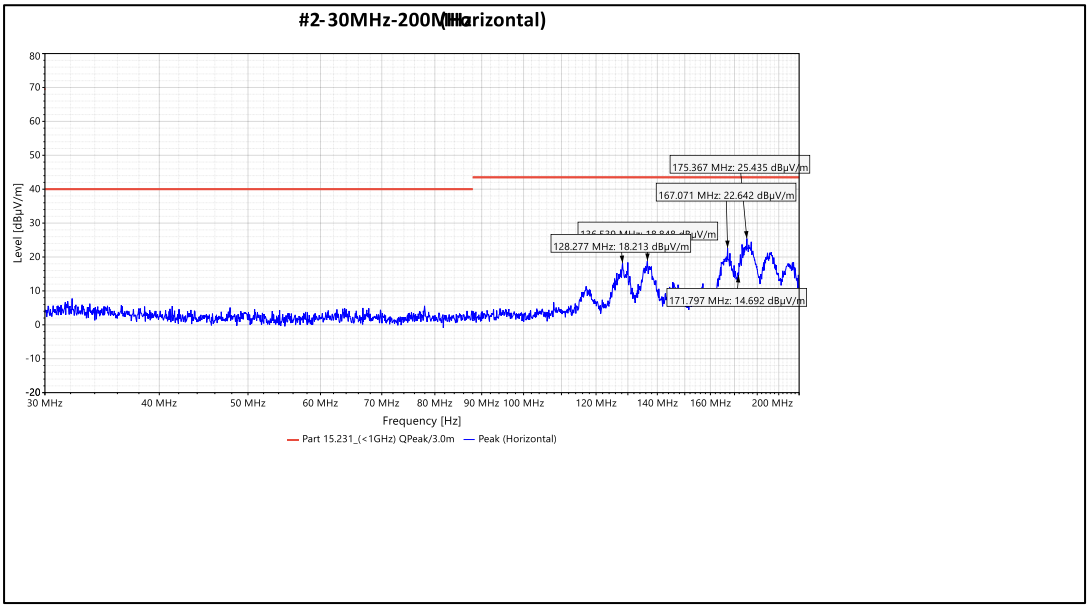
Antenna 1

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

Antenna Polarization	Measured Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	66.65(Pk)	4.21	40.00	-35.79
	162.12(Pk)	13.10	43.50	-30.40
	165.18(Pk)	23.83	43.50	-19.67
	174.58(Pk)	23.64	43.50	-19.86
	186.53(Pk)	15.72	43.50	-27.78
Horizontal	128.27(Pk)	18.21	43.50	-25.29
	136.53(Pk)	18.84	43.50	-24.66
	167.07(Pk)	22.64	43.50	-20.86
	171.79(Pk)	25.43	43.50	-18.07
	175.36(Pk)	14.69	43.50	-28.81



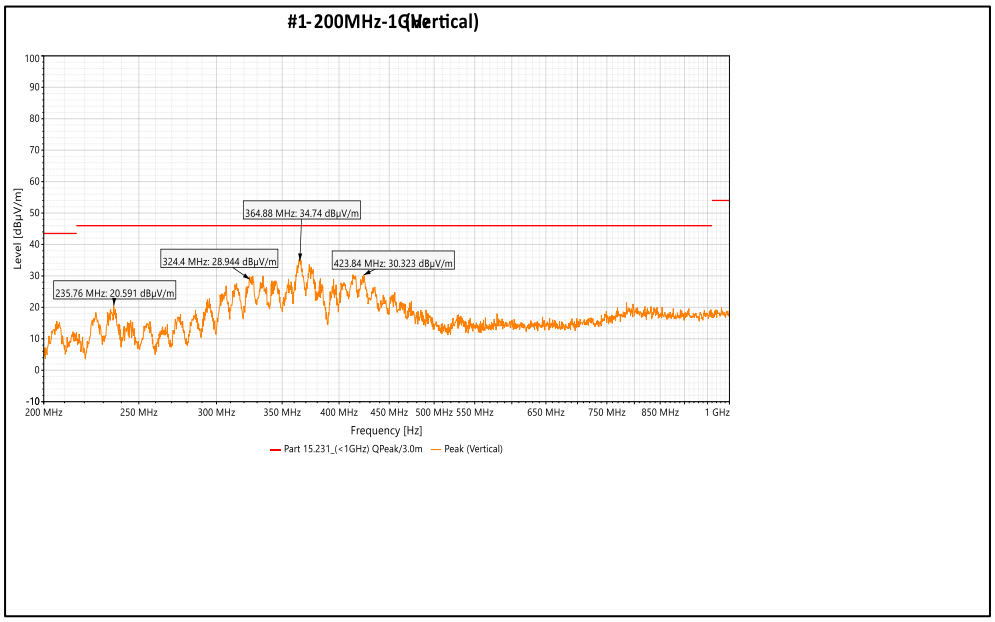
Channel Frequency 30MHz – 200MHz **Polarization Vertical**



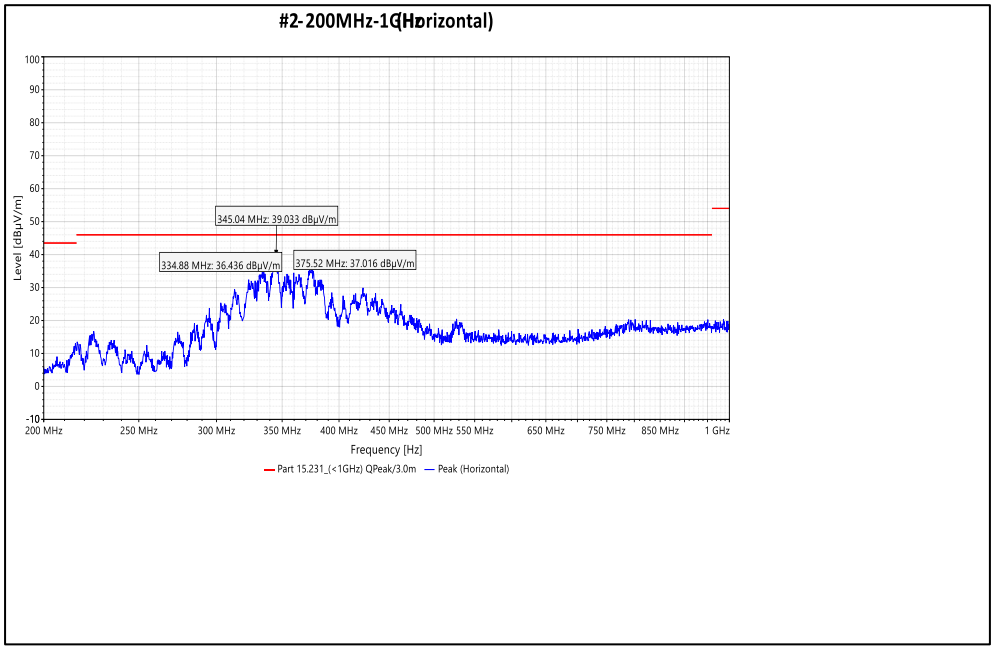
Channel Frequency 30MHz – 200MHz **Polarization Horizontal**

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

Antenna Polarization	Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	235.76	20.59	46	-25.41
	324.4	28.94	46	-17.06
	364.88	34.74	46	-11.26
	423.84	30.32	46	-15.68
Horizontal	334.88	36.43	46	-9.57
	345.04	39.03	46	-6.97
	375.52	37.01	46	-8.99



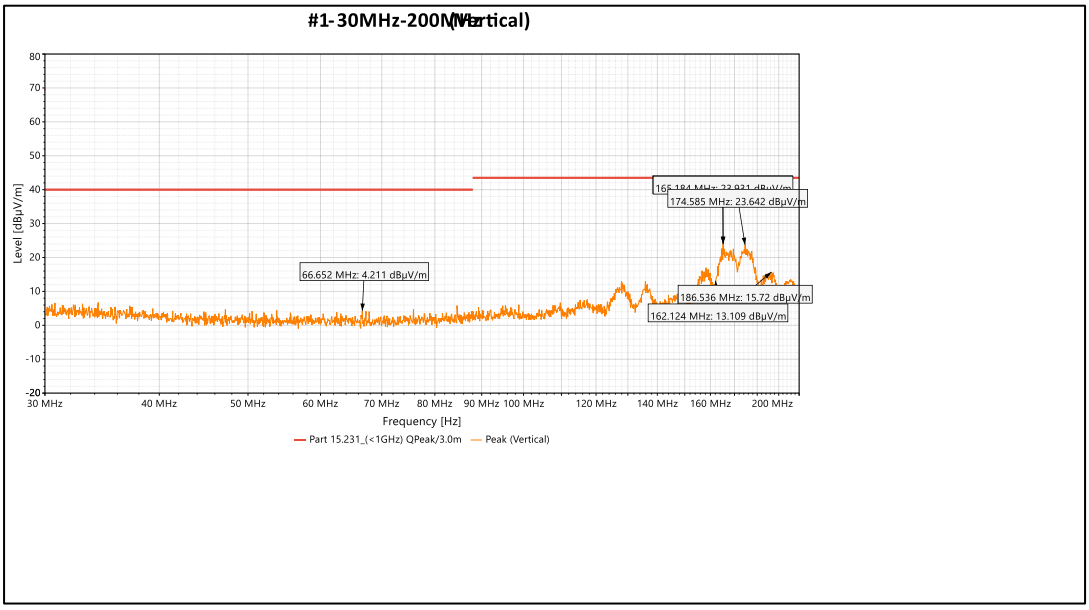
Channel Frequency 200MHz – 1GHz **Polarization Vertical**



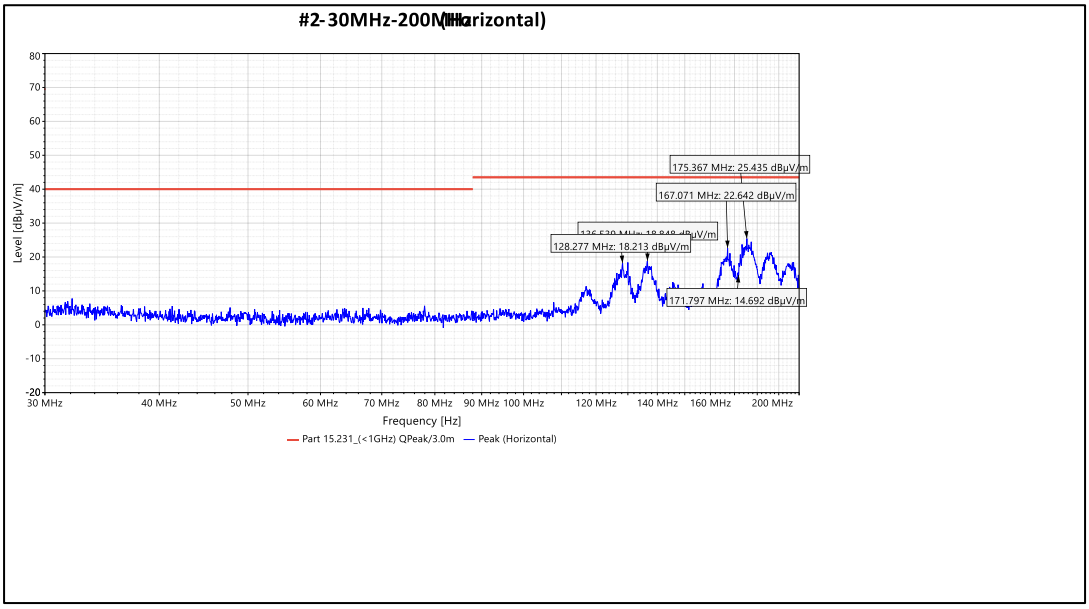
Channel Frequency 200MHz – 1GHz **Polarization Horizontal**

Table 9: Test results for frequency range 30MHz – 200MHz

Antenna Polarization	Measured Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	66.65(Pk)	4.21	40.00	-35.79
	162.12(Pk)	13.10	43.50	-30.40
	165.18(Pk)	23.83	43.50	-19.67
	174.58(Pk)	23.64	43.50	-19.86
	186.53(Pk)	15.72	43.50	-27.78
Horizontal	128.27(Pk)	18.21	43.50	-25.29
	136.53(Pk)	18.84	43.50	-24.66
	167.07(Pk)	22.64	43.50	-20.86
	171.79(Pk)	25.43	43.50	-18.07
	175.36(Pk)	14.69	43.50	-28.81



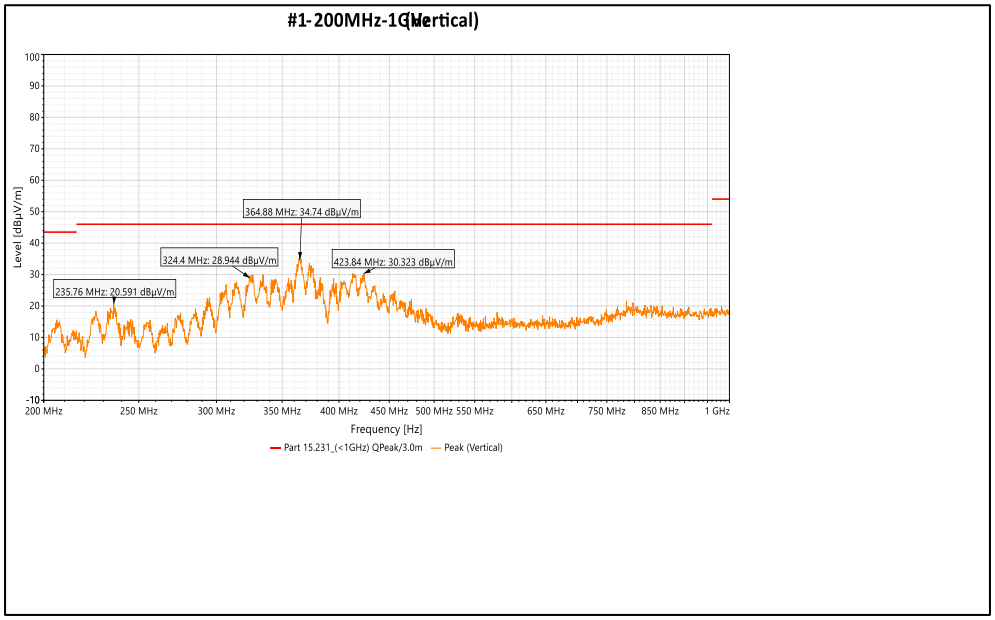
Channel Frequency 30MHz – 200MHz **Polarization Vertical**



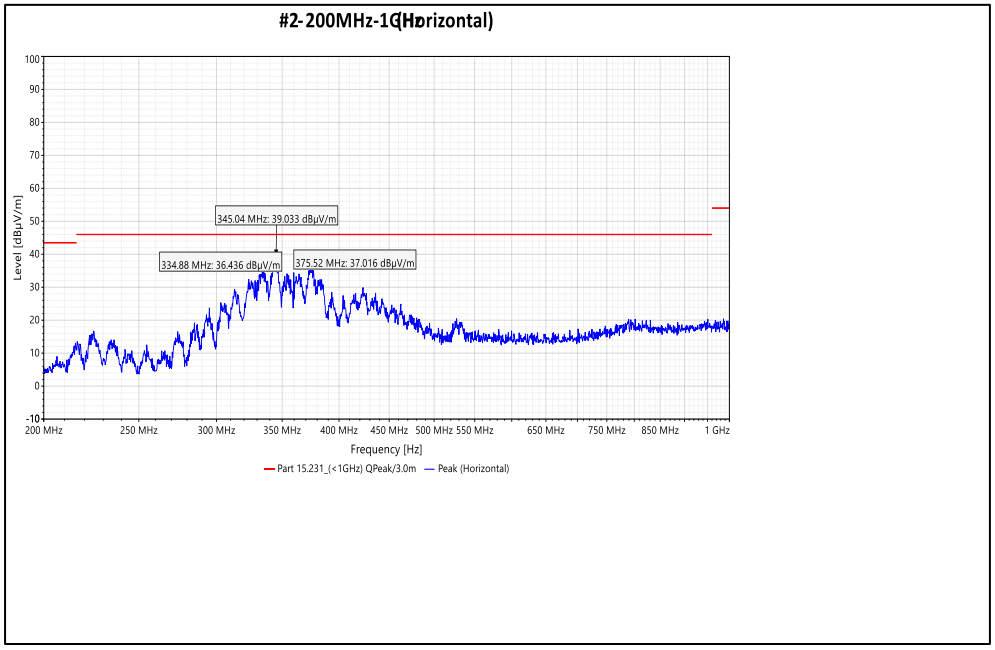
Channel Frequency 30MHz – 200MHz **Polarization Horizontal**

Table 10: Test results for frequency range 200MHz – 1GHz

Antenna Polarization	Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	235.76	20.59	46	-25.41
	324.4	28.94	46	-17.06
	364.88	34.74	46	-11.26
	423.84	30.32	46	-15.68
Horizontal	334.88	36.43	46	-9.57
	345.04	39.03	46	-6.97
	375.52	37.01	46	-8.99



Channel Frequency 200MHz – 1GHz **Polarization Vertical**



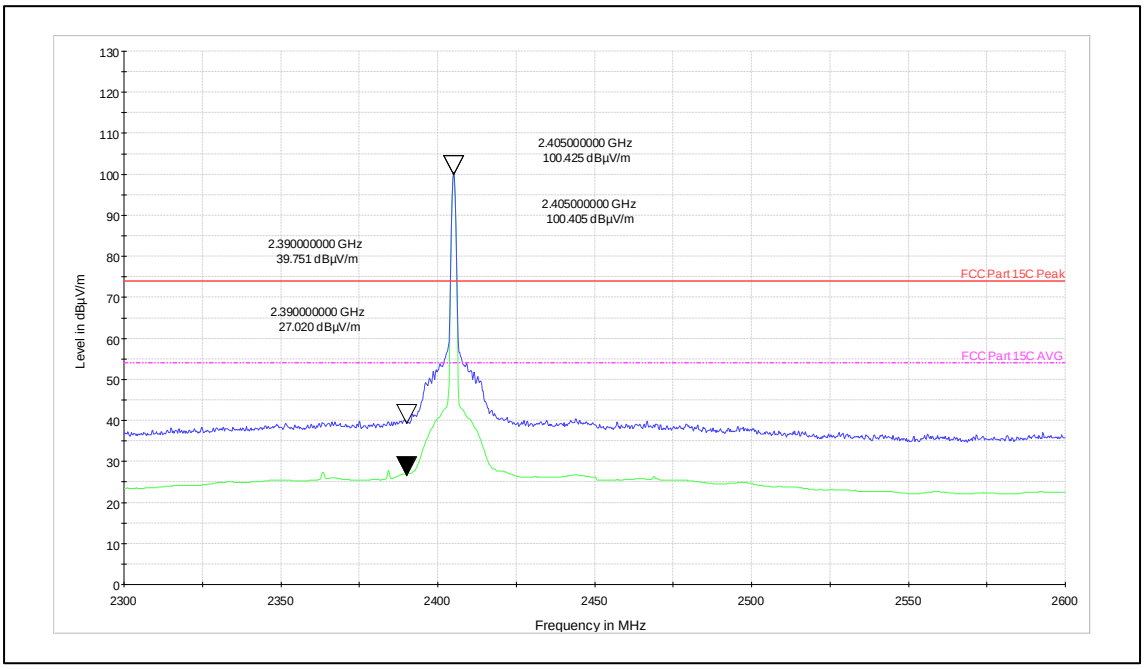
Channel Frequency 200MHz – 1GHz **Polarization Horizontal**

Table 11: Test results for the frequencies above 1GHz:

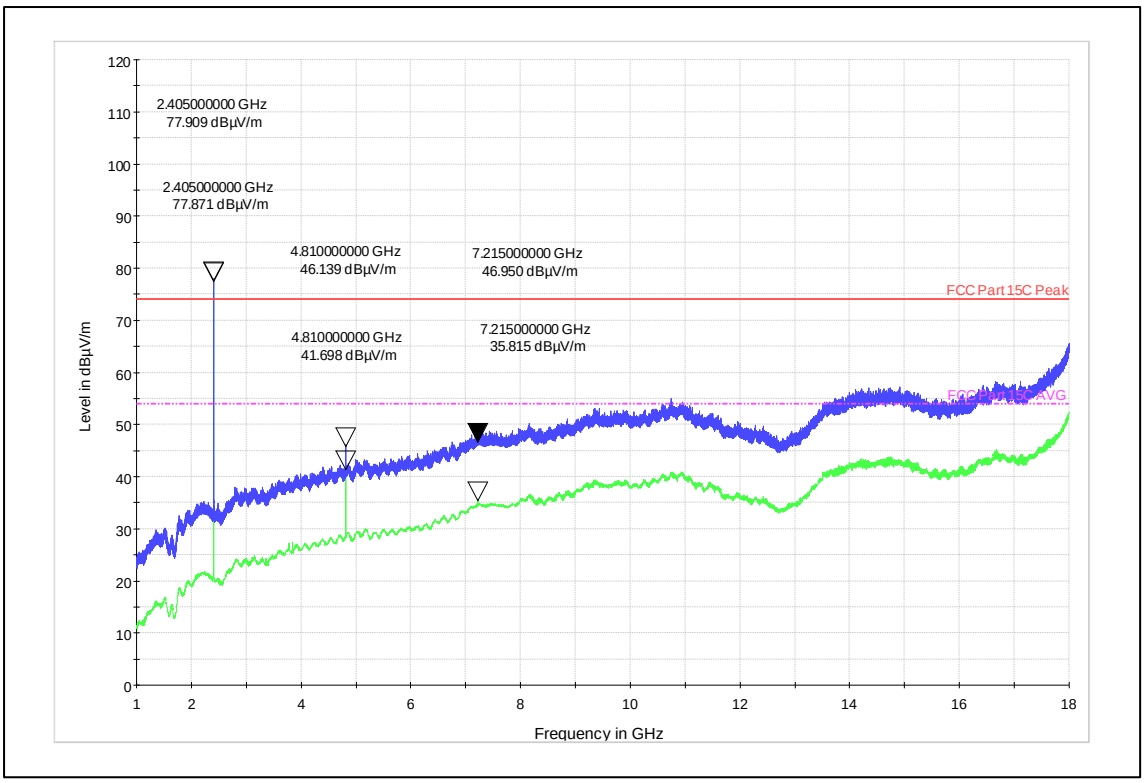
Antenna 1:

Channel Frequency (MHz)	Frequency (MHz)	Polarization	Emission (dBµV/m)	Limit (dBm)	Margin (dB)
2405	2405(Pk)	Vertical	100.42	*	-
	2405(Av)		100.40	*	-
	2390(Pk)		39.75	74	-34.25
	2390(Av)		27.02	54	-26.98
	4810(Pk)		46.13	74	-27.87
	4810(Av)		41.69	54	-12.31
	7215(Pk)		46.95	74	-27.05
	7215(Av)		35.81	54	-18.19
	2405(Pk)	Horizontal	98.59	*	-
	2405(Av)		98.58	*	-
	2390(Pk)		38.96	74	-35.04
	2390(Av)		25.70	54	-28.30
	4810(Pk)		41.19	74	-32.81
	4810(Av)		30.37	54	-23.63
	7215(Pk)		47.69	74	-26.31
	7215(Av)		37.19	54	-16.81
2442.5	2442.5(Pk)	Vertical	99.64	*	-
	2442.5(Av)		99.61	*	-
	4885(Pk)		45.76	74	-28.24
	4885(Av)		40.72	54	-13.28
	7327.5(Pk)		46.78	74	-27.22
	7327.5(Av)		35.92	54	-18.08
	2442.5(Pk)	Horizontal	98.79	*	-
	2442.5(Av)		98.74	*	-
	4885(Pk)		42.42	74	-31.58
	4885(Av)		31.49	54	-22.51
	7327.5(Pk)		47.14	74	-26.86
	7327.5(Av)		37.19	54	-16.81
2477.5	2483.5(Pk)	Vertical	46.49	74	-27.51
	2483.5(Av)		35.40	54	-18.60
	2477.5(Pk)		100.79	*	-
	2477.5(Av)		100.77	*	-
	4955(Pk)		43.98	74	-30.02
	4955(Av)		31.68	54	-22.32
	7432.5(Pk)		50.15	74	-23.85
	7432.5(Av)		41.48	54	-12.52
	2483.5(Pk)	Horizontal	45.36	74	-28.64
	2483.5(Av)		33.98	54	-20.02
	2477.5(Pk)		98.99	*	-
	2477.5(Av)		98.97	*	-
	4955(Pk)		43.62	74	-30.38
	4955(Av)		36.04	54	-17.96
	7432.5(Pk)		47.41	74	-26.59
	7432.5(Av)		37.46	54	-16.54

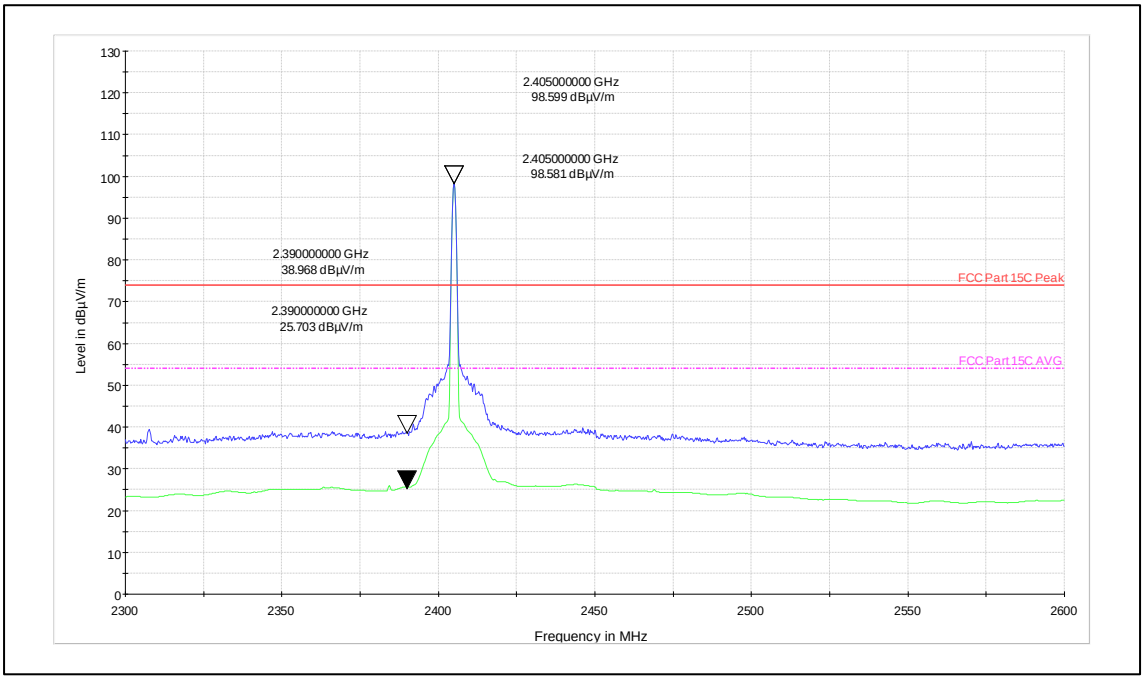
Pk: Peak Detector;
Av: Average Detect



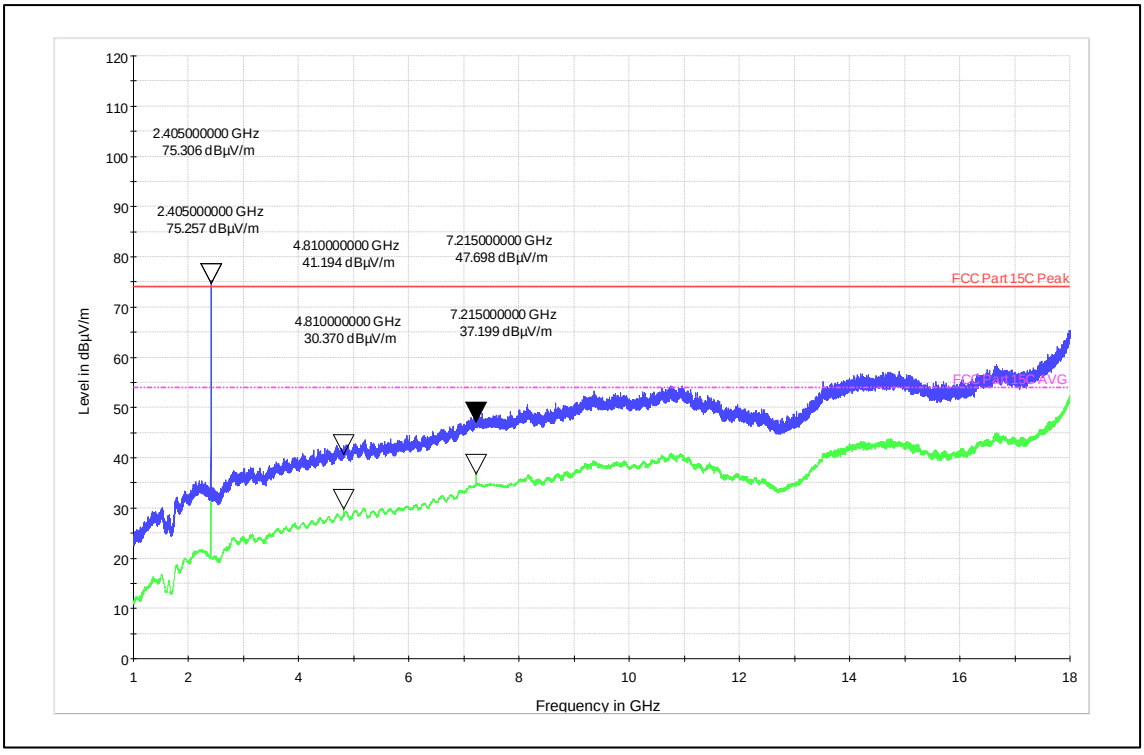
Channel Frequency: 2405GHz Polarization: Vertical



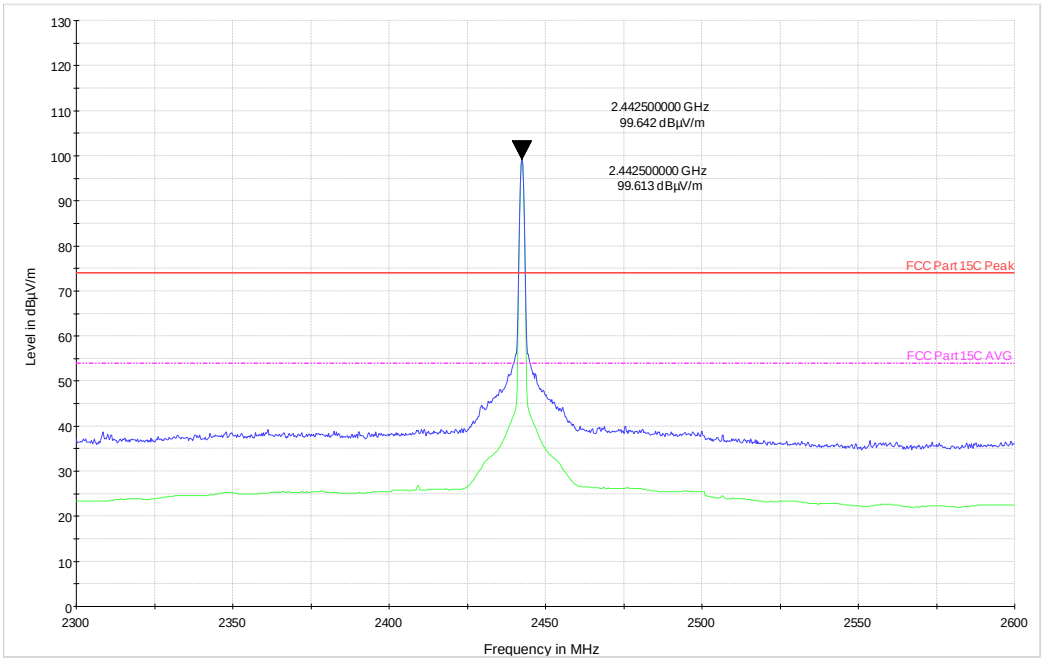
Channel Frequency: 1GHz -18GHz Polarization: Vertical



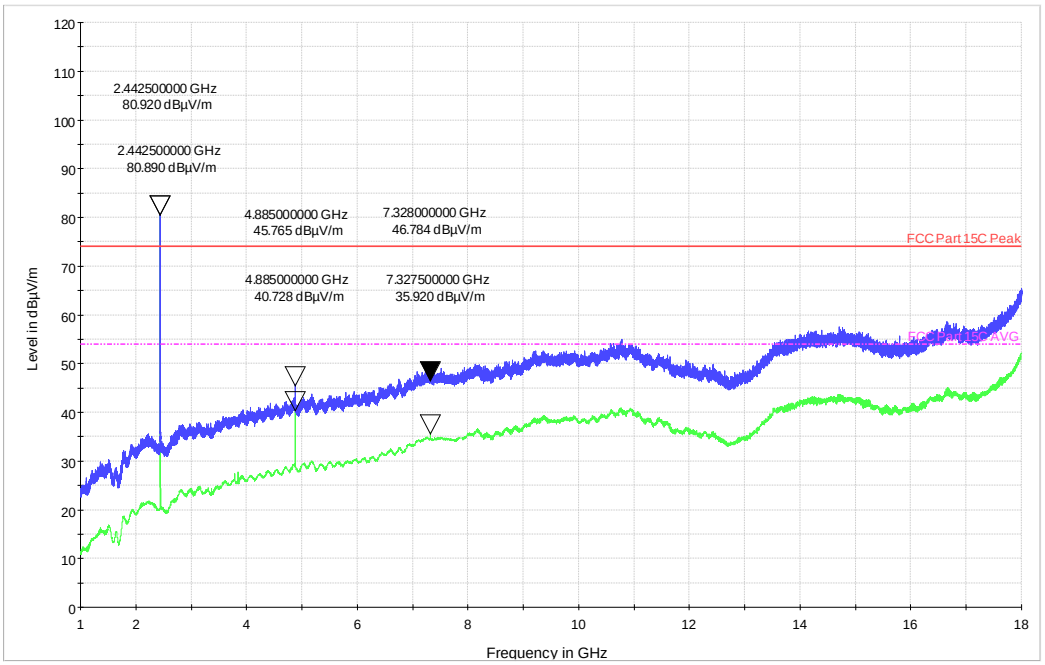
Channel Frequency: 2405GHz Polarization: Horizontal



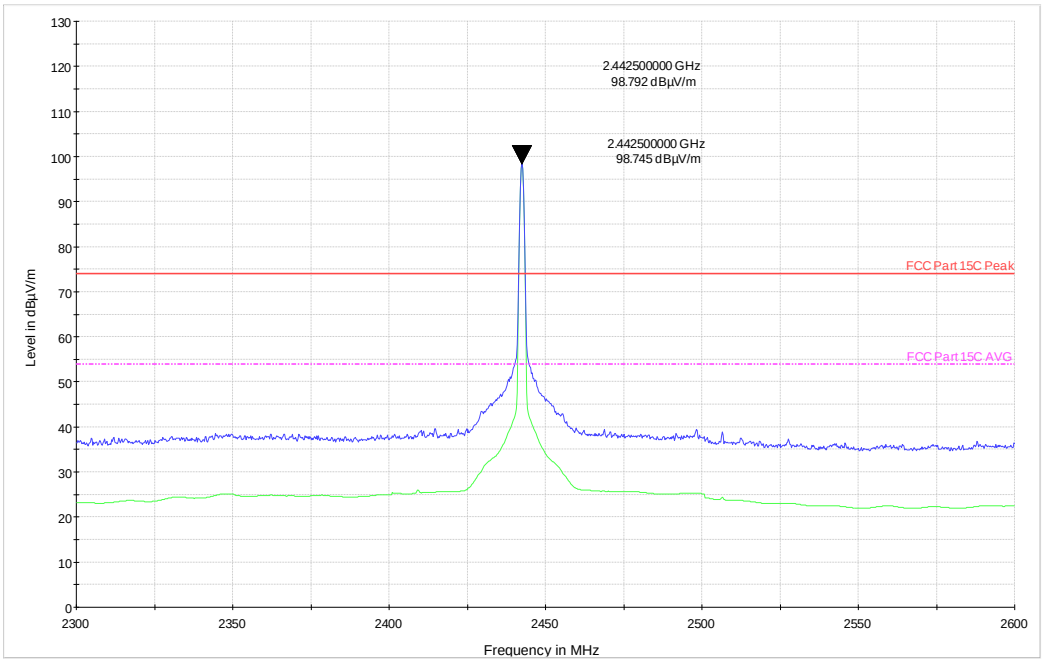
Channel Frequency: 1GHz -18GHz Polarization: Horizontal



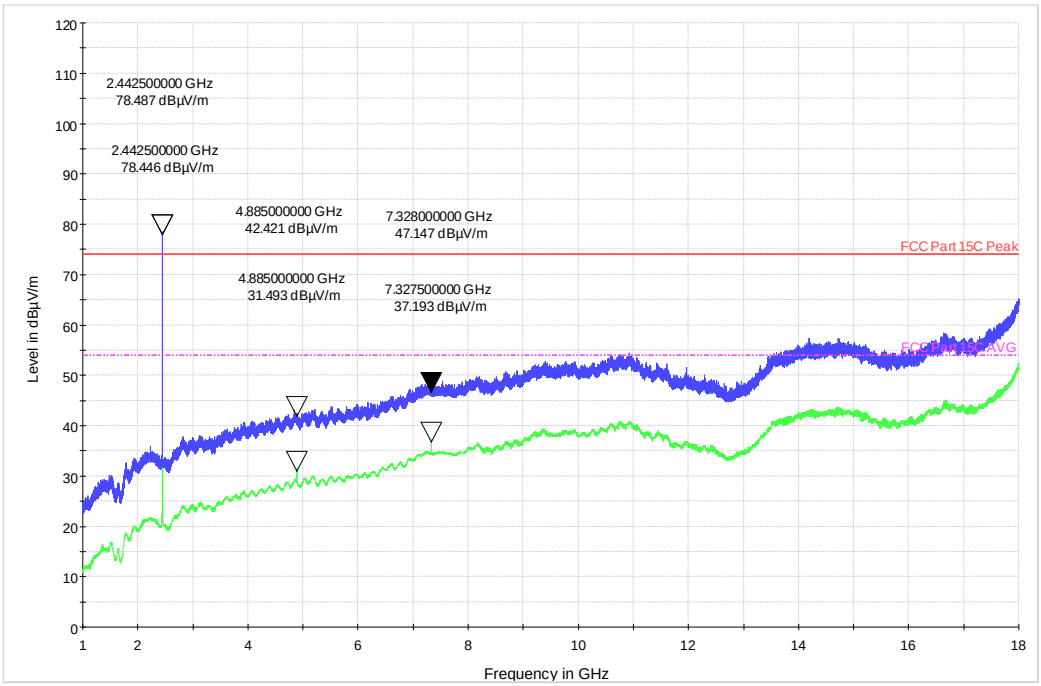
Channel Frequency: 2442.5GHz Polarization: vertical



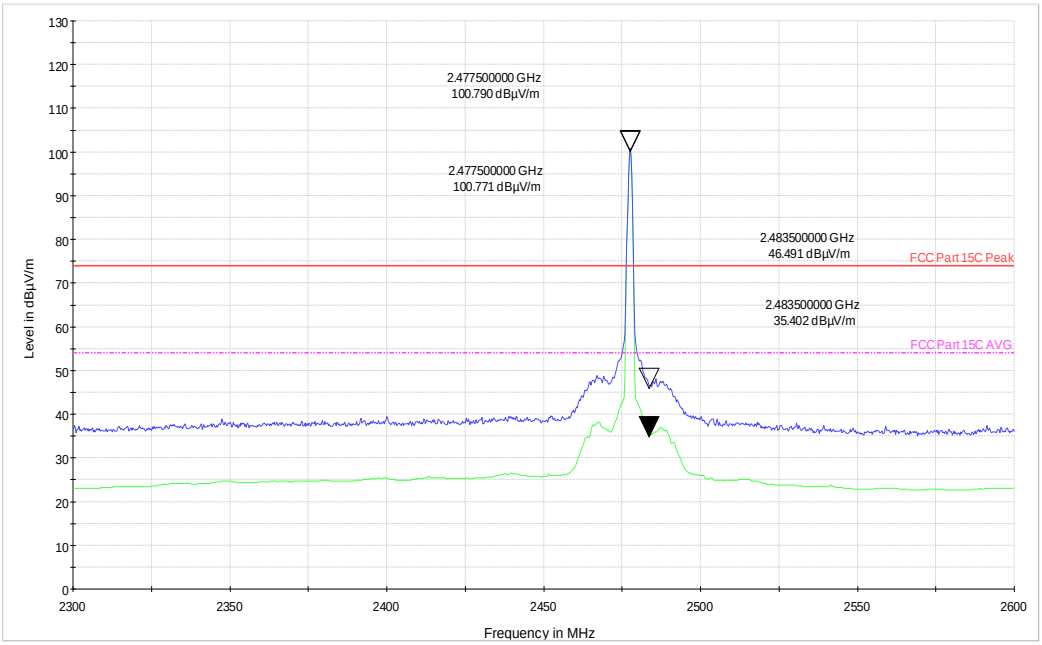
Channel Frequency: 1GHz -18GHz Polarization: vertical



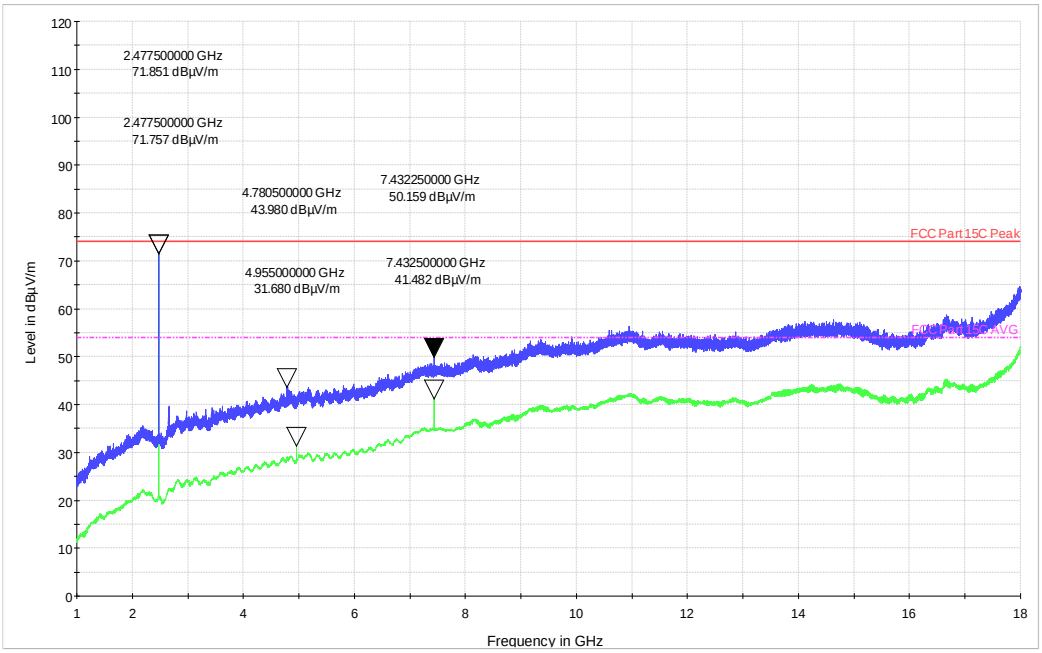
Channel Frequency: 2442.5GHz Polarization: Horizontal



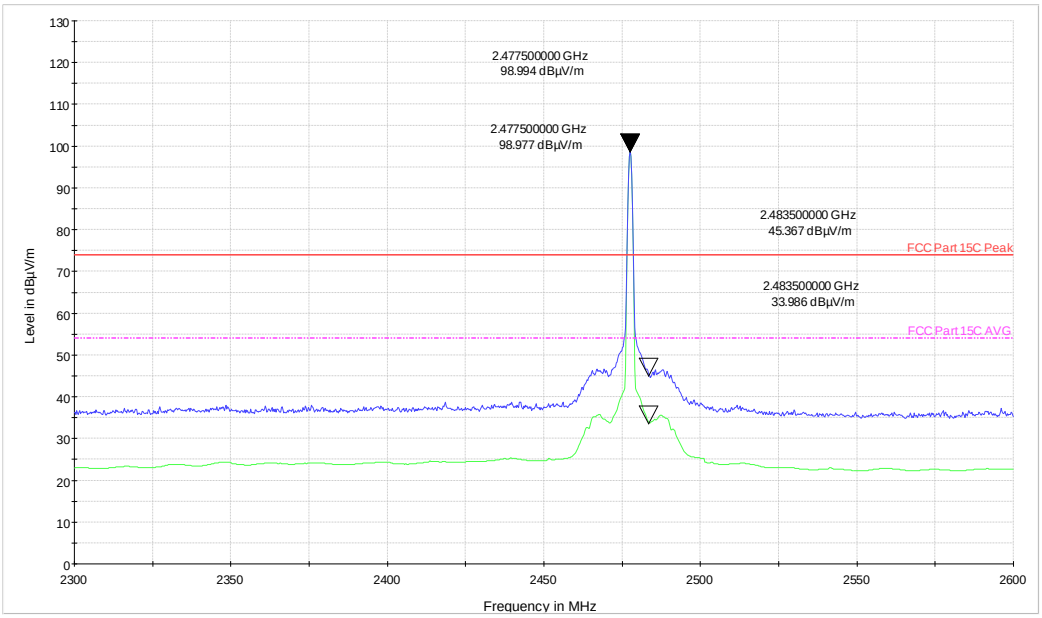
Channel Frequency: 1GHz -18GHz Polarization: Horizontal



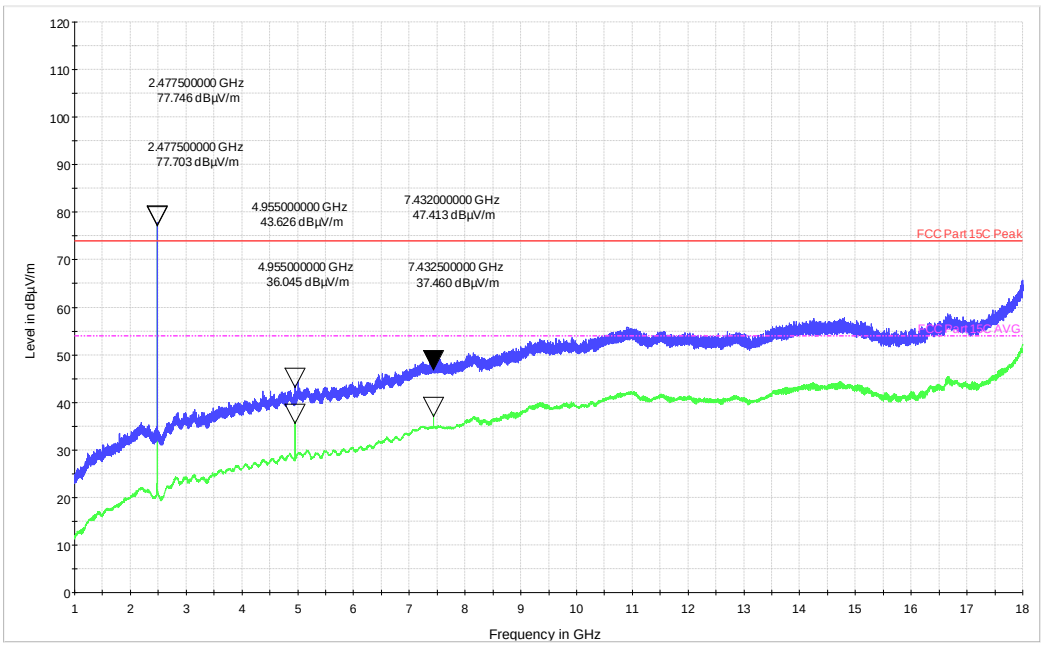
Channel Frequency: 2477.5GHz Polarization: vertical



Channel Frequency: 1GHz -18GHz Polarization: vertical



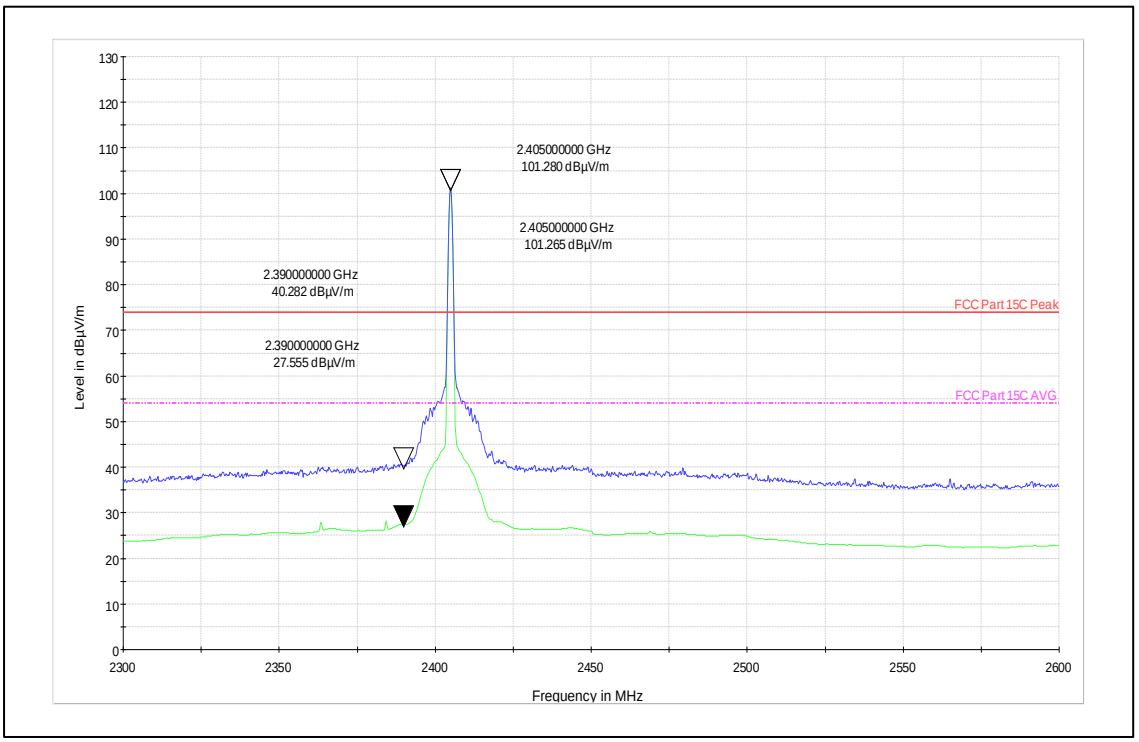
Channel Frequency: 2477.5GHz Polarization: Horizontal



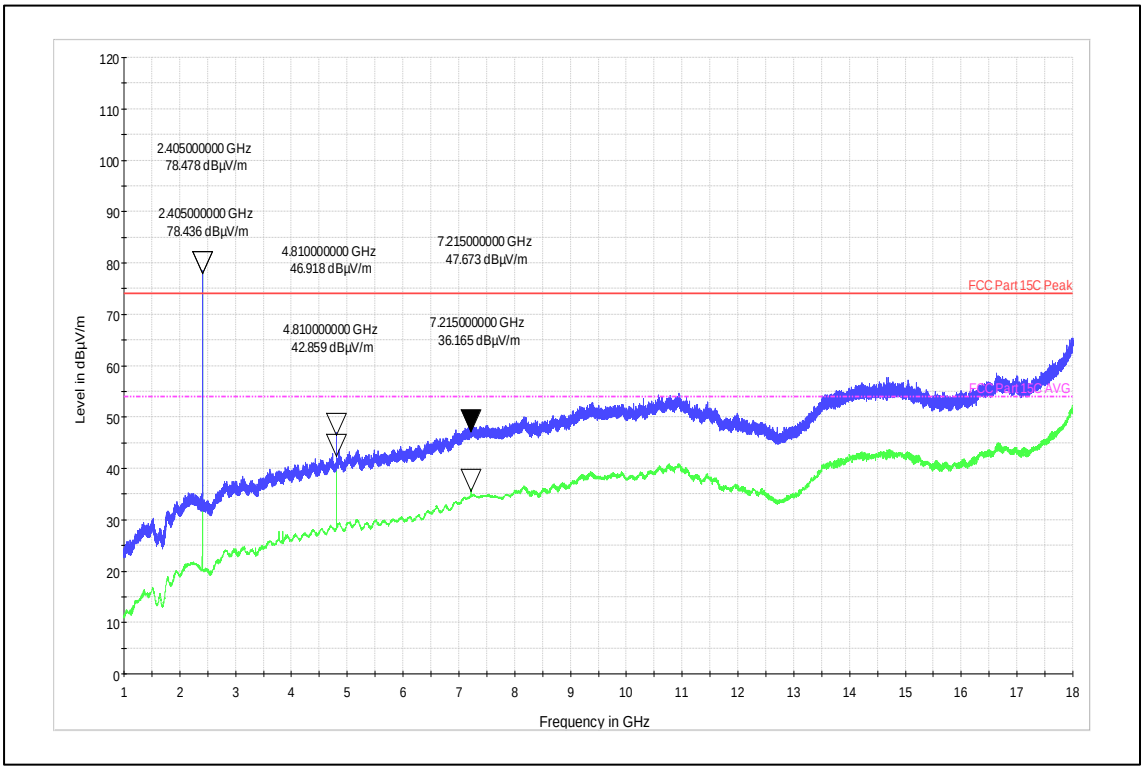
Channel Frequency: 1GHz -18GHz Polarization: Horizontal

Antenna 2:

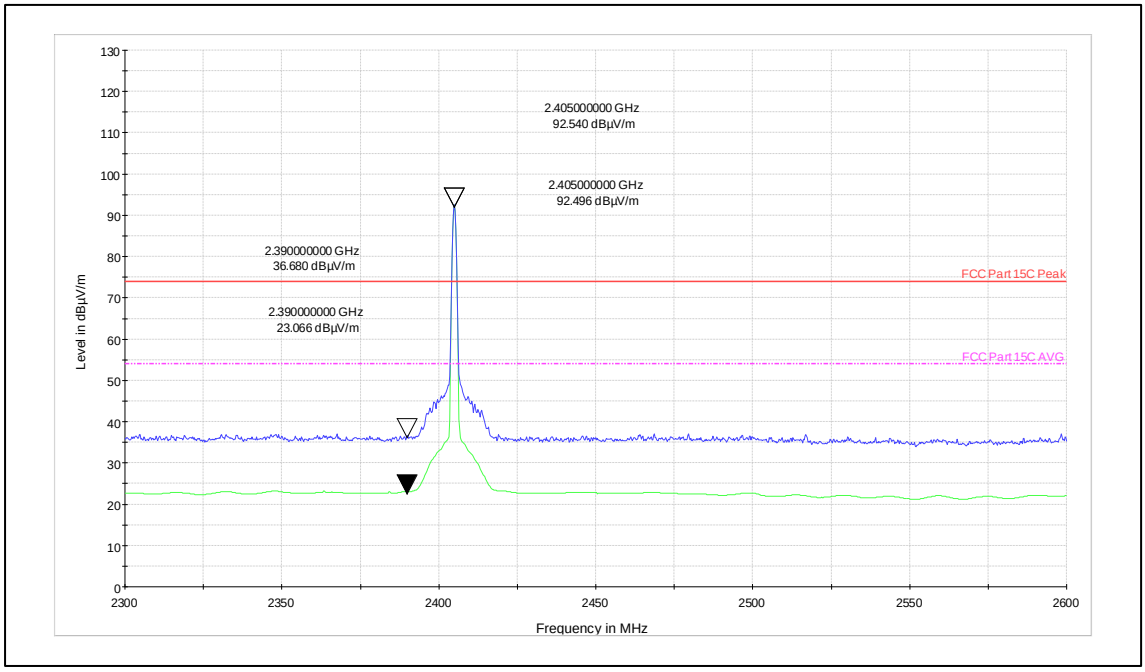
Channnel Frequency (MHz)	Frequency (MHz)	Polarization	Emission (dBµV/m)	Limit (dBm)	Margin (dB)
2405	2405(Pk)	Vertical	101.28	*	-
	2405(Av)		101.26	*	-
	2390(Pk)		40.28	74	-33.72
	2390(Av)		27.55	54	-26.45
	4810(Pk)		46.91	74	-27.09
	4810(Av)		42.85	54	-11.15
	7215(Pk)		47.67	74	-26.33
	7215(Av)		36.16	54	-17.84
	2405(Pk)	Horizontal	92.54	*	-
	2405(Av)		92.49	*	-
	2390(Pk)		36.68	74	-37.32
	2390(Av)		23.06	54	-30.94
	4810(Pk)		41.37	74	-32.63
	4810(Av)		31.48	54	-22.52
	7215(Pk)		48.49	74	-25.51
	7215(Av)		38.85	54	-15.15
2442.5	2442.5(Pk)	Vertical	101.34	*	-
	2442.5(Av)		101.30	*	-
	4885(Pk)		41.77	74	-32.23
	4885(Av)		31.12	54	-22.88
	7327.5(Pk)		50.03	74	-23.97
	7327.5(Av)		40.85	54	-13.15
	2442.5(Pk)	Horizontal	94.57	*	-
	2442.5(Av)		94.49	*	-
	4885(Pk)		41.38	74	-32.62
	4885(Av)		31.49	54	-22.51
	7327.5(Pk)		47.46	74	-26.54
	7327.5(Av)		39.03	54	-14.97
2477.5	2483.5(Pk)	Vertical	47.65	74	-26.35
	2483.5(Av)		35.98	54	-18.02
	2477.5(Pk)		101.19	*	-
	2477.5(Av)		101.17	*	-
	4955(Pk)		45.08	74	-28.92
	4955(Av)		39.49	54	-14.51
	7432.5(Pk)		47.25	74	-26.75
	7432.5(Av)		35.63	54	-18.37
	2483.5(Pk)	Horizontal	41.77	74	-32.23
	2483.5(Av)		26.77	54	-27.23
	2477.5(Pk)		90.32	*	-
	2477.5(Av)		90.25	*	-
	4955(Pk)		40.73	74	-33.27
	4955(Av)		29.50	54	-24.50
	7432.5(Pk)		47.65	74	-26.35
	7432.5(Av)		39.17	54	-14.83



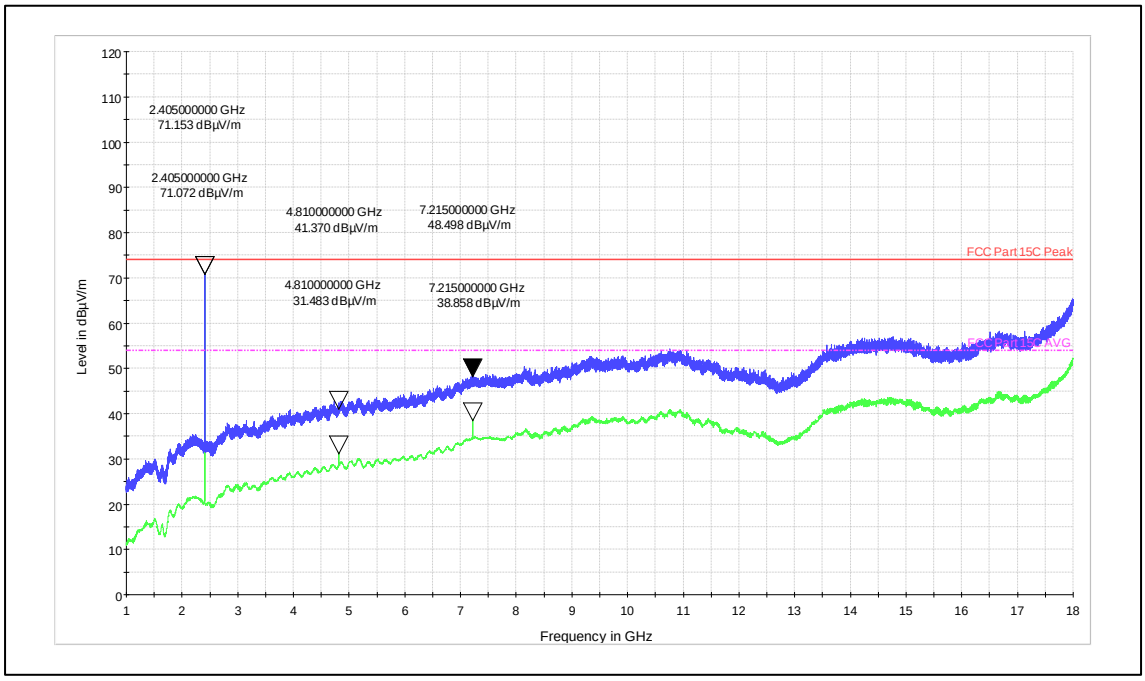
Channel Frequency: 2405GHz Polarization: Vertical



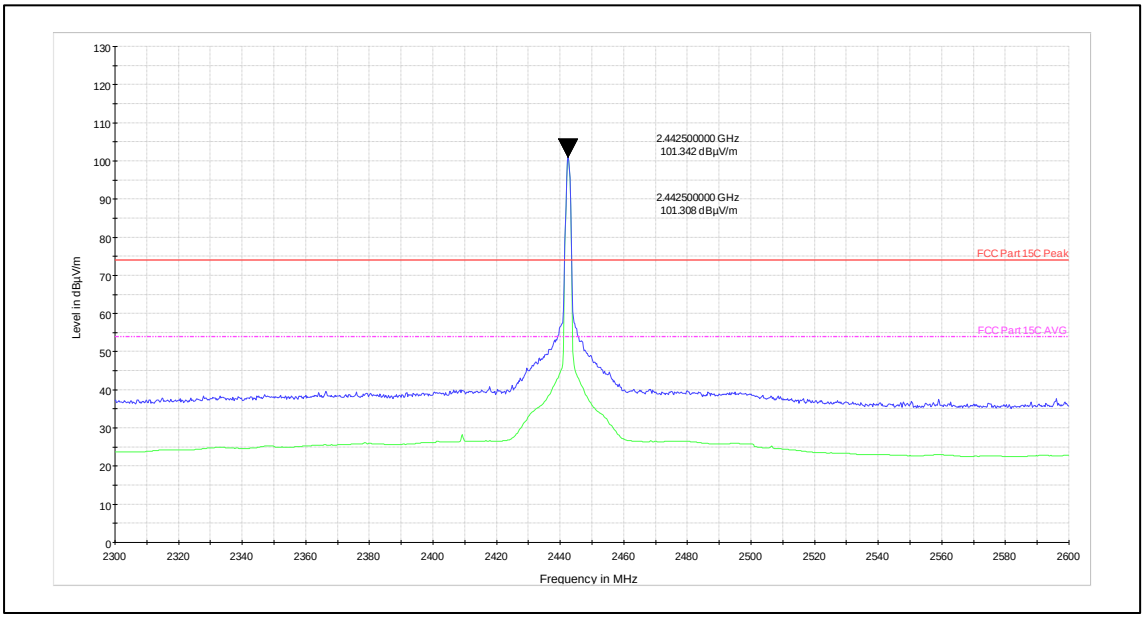
Channel Frequency: 1GHz -18GHz Polarization: Vertical



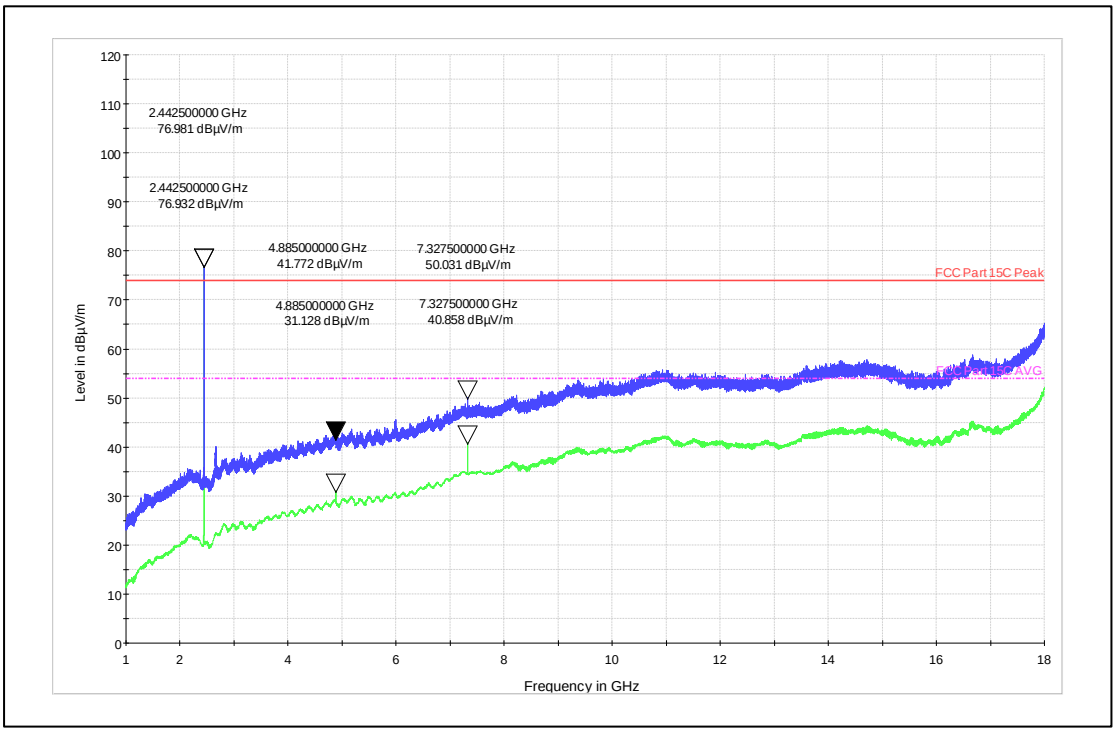
Channel Frequency: 2405GHz Polarization: Horizontal



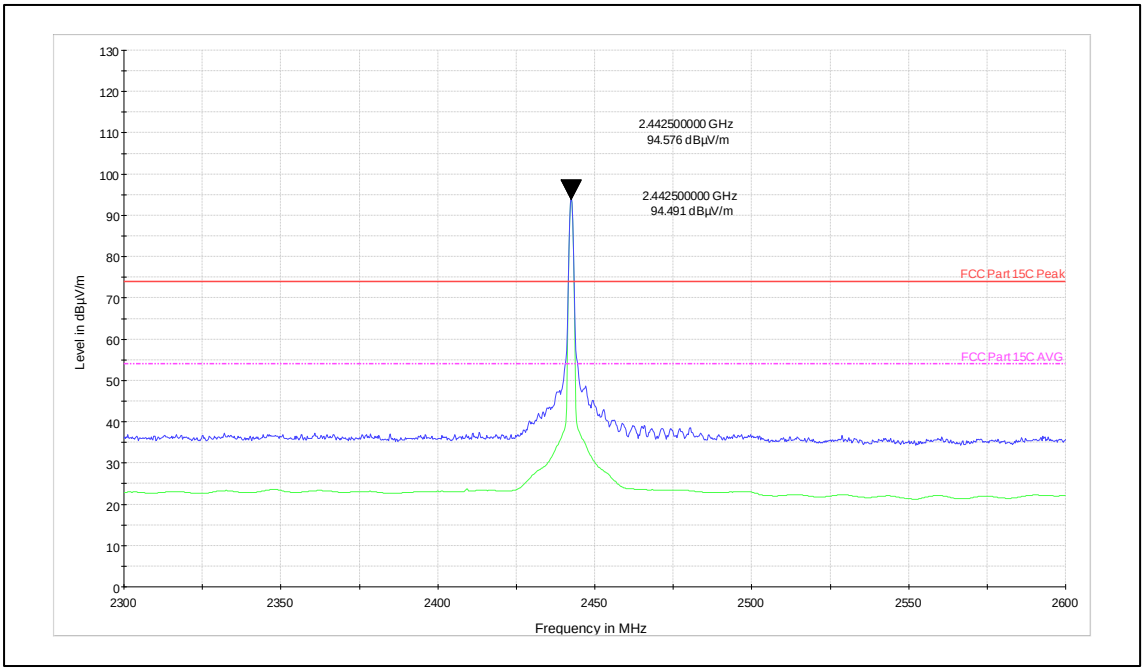
Channel Frequency: 1GHz -18GHz Polarization: Horizontal



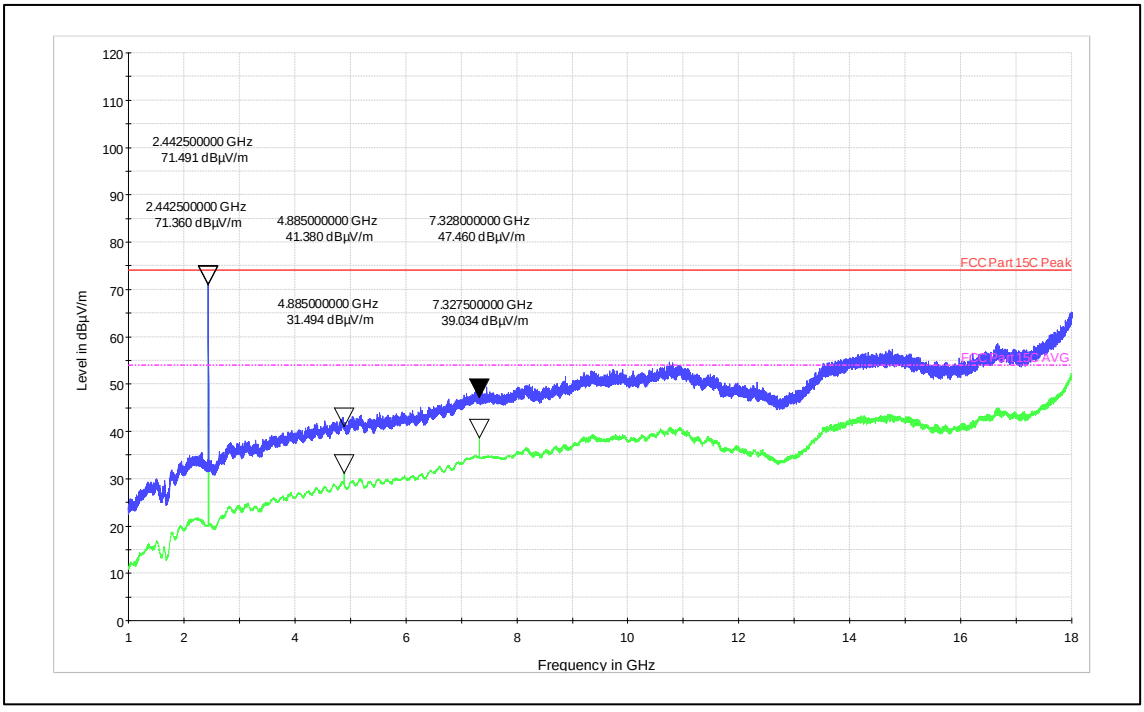
Channel Frequency: 2442.5GHz Polarization: vertical



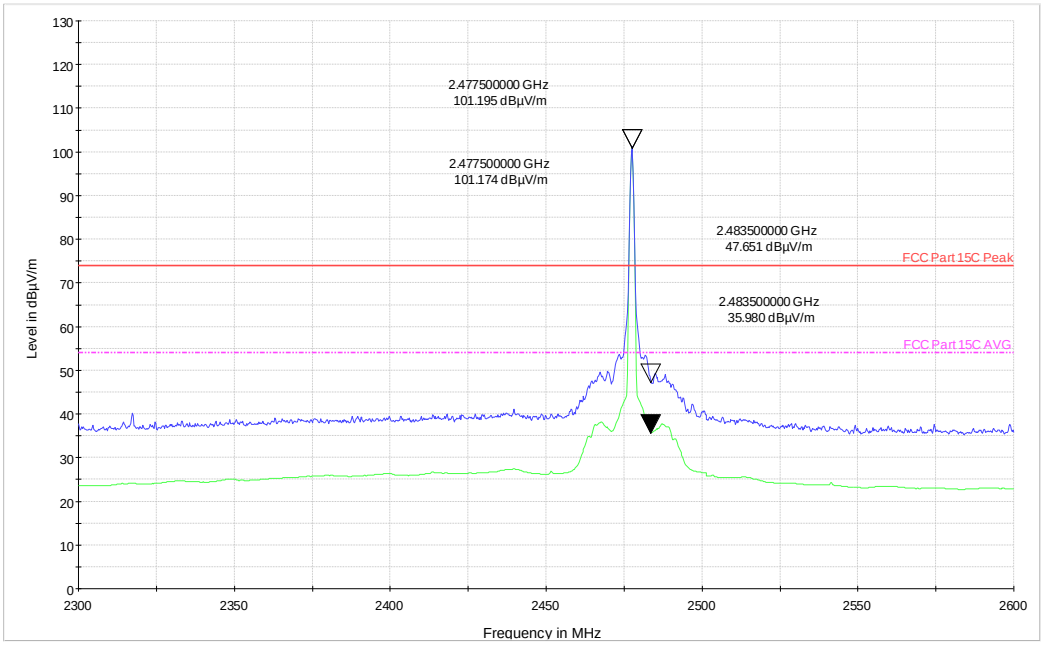
Channel Frequency: 1GHz -18GHz Polarization: vertical



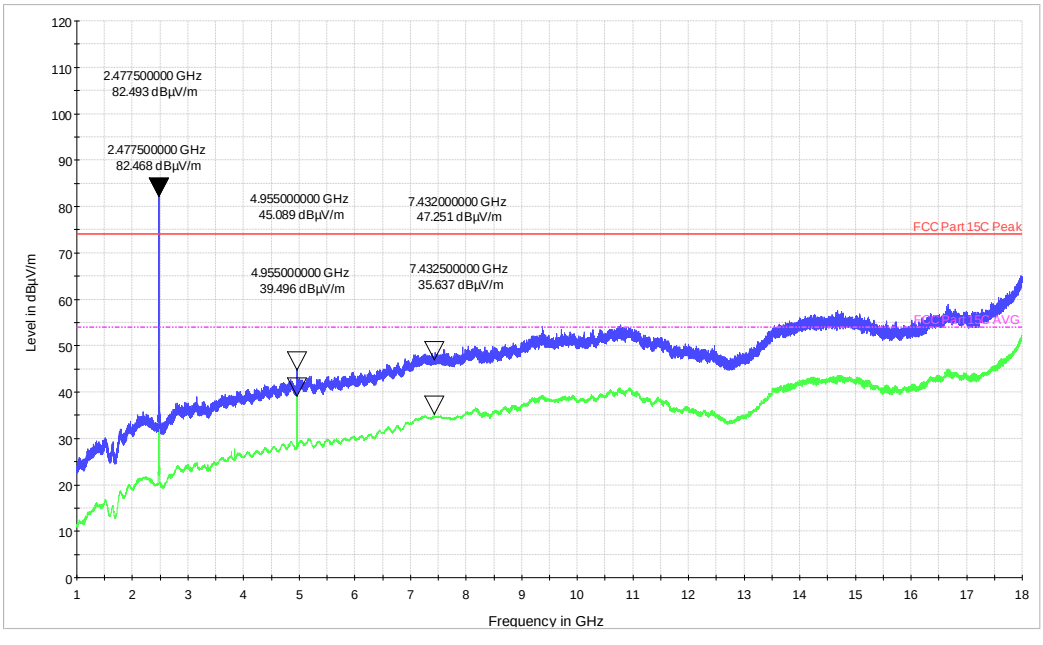
Channel Frequency: 2442.5GHz Polarization: Horizontal



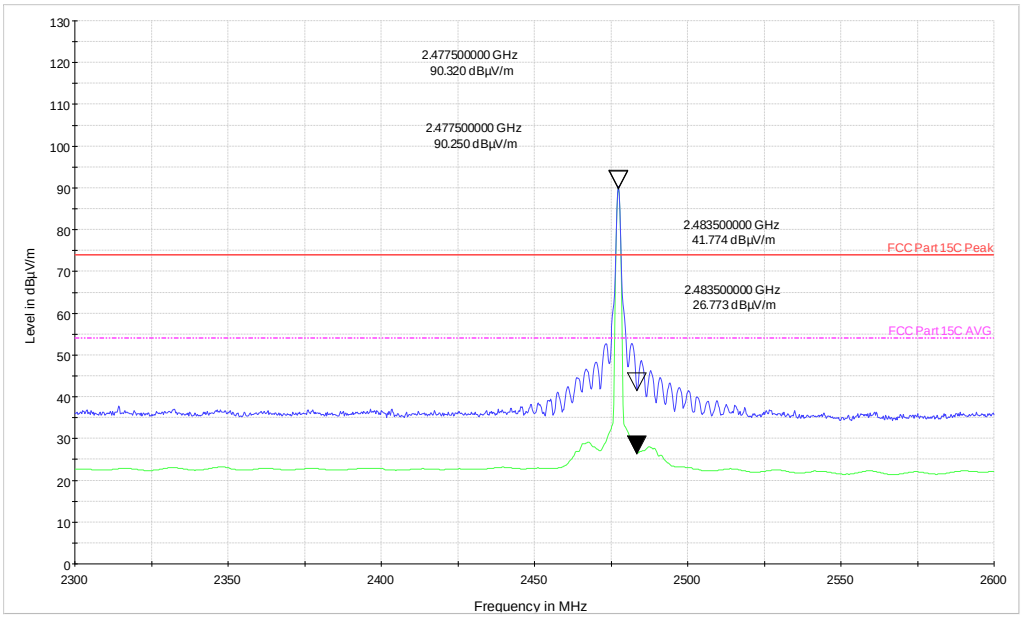
Channel Frequency: 1GHz -18GHz Polarization: Horizontal



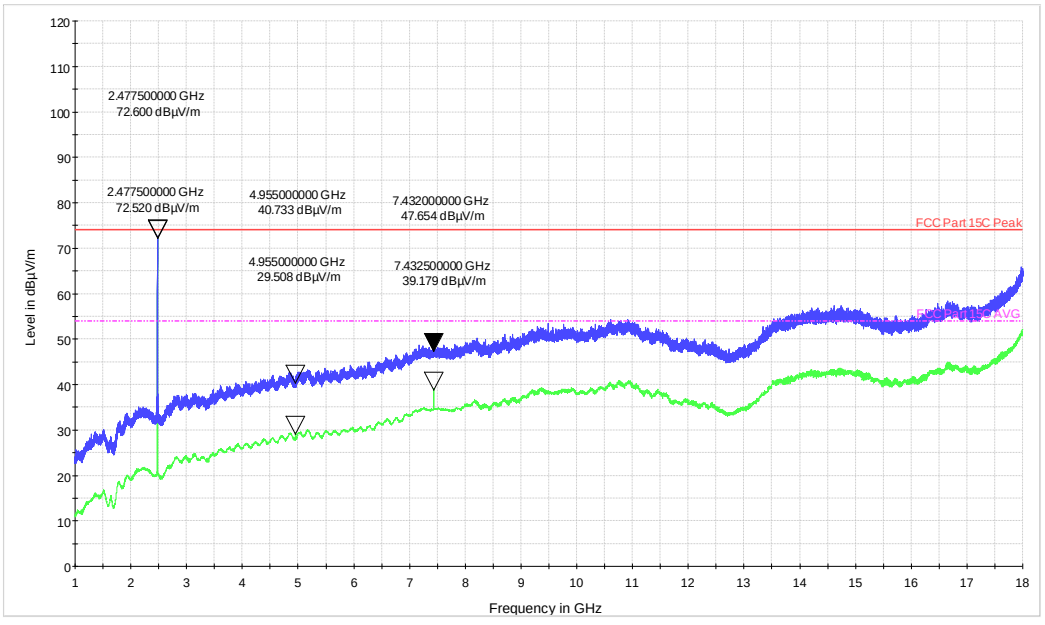
Channel Frequency: 2477.5GHz Polarization: vertical



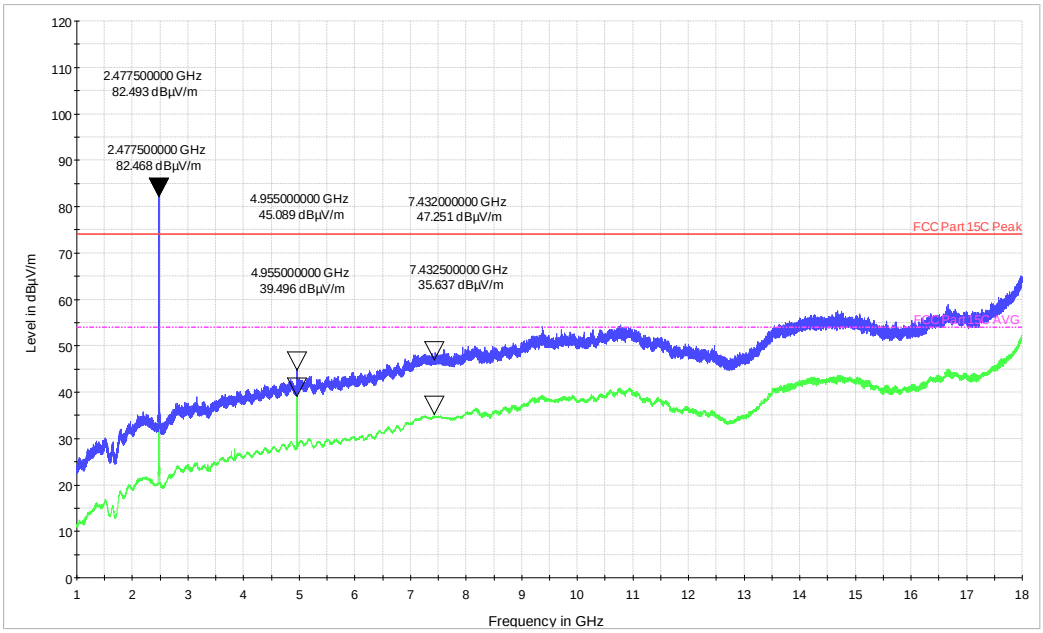
Channel Frequency: 1GHz -18GHz Polarization: vertical



Channel Frequency: 2477.5GHz Polarization: Horizontal



Channel Frequency: 1GHz -18GHz Polarization: Horizontal



Channel Frequency: 18GHz -26.5GHz Polarization: vertical

9 LIST OF TABLES

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