



FCC / ISED Test Report

For:
Telular AMETEK

Model:
SHB6510

Product Description:
Asset tracking.

FCC ID: MTFSHB6510
IC ID: 2175D-SHB6510

Applied Rules and Standards:
47 CFR Part 15.247 (DTS)
RSS-247 Issue 2 (DTSs) & RSS-Gen Issue 5

REPORT #: EMC_TELUL-101-21001_FCC_15.247_ISM

DATE: 2022-01-12



A2LA Accredited

IC recognized #
3462B-1

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CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571



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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

Company	Description	Model #
Telular AMETEK	Asset tracking.	SHB6510

Responsible for Testing Laboratory:

2022-01-12	Compliance	Kevin Wang (EMC Lab Manager)	
Date	Section	Name	Signature

Responsible for the Report:

2022-01-12	Compliance	Cheng Song (EMC Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section 3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Kevin Wang
Responsible Project Leader:	Cathy Palacios

2.2 Identification of the Client

Client's Name:	Telular AMETEK
Street Address:	3225 Cumberland Blvd, Suite 300
City/Zip Code	Atlanta, GA, 30339
Country	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	SHB6510
HW Version :	A
SW Version :	EM.00.01.1096,BM.00.01.0061,CM.00.01.1026
FCC-ID :	MTFSHB6510
IC-ID:	2175D-SHB6510
PMN:	Kinnect
Product Description:	Asset tracking.
Radio Information:	<p>Cellular:</p> <ul style="list-style-type: none"> • Module: Telit ME910G1-W1 (CAT-M1 only) • FCC ID: RI7ME910G1W1, IC ID: 5131A-ME910G1W1 • Bands: LTE 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 27, 28, 66, 71, 75 <p>Bluetooth:</p> <ul style="list-style-type: none"> • Module: Laird BL654 (Bluetooth 5 LE) • FCC ID: SQGBL654, IC ID: 3147A-BL654 <p>ISM:</p> <ul style="list-style-type: none"> • Module: EFR32FG1P131F256GM32-C0 • Operating Frequency: 902-928 MHz <p>GPS / GNSS:</p> <ul style="list-style-type: none"> • Module: Quectel GNSS L86
Antenna Information:	<p>Cellular:</p> <ul style="list-style-type: none"> • Type: PCB Trace • Max Gain: LTE 2 (4.4 dBi), LTE 4 (4.4 dBi), LTE 12 (2.6 dBi) <p>Bluetooth:</p> <ul style="list-style-type: none"> • Type: PCB Trace • Max Gain: 0 dBi <p>ISM:</p> <ul style="list-style-type: none"> • Type: Pulse W3113, small helica • Max Gain: 0.8 dBi
Power Supply/ Rated Operating Voltage Range:	Battery Vmin: 6 VDC/ Vnom: 7 VDC / Vmax: 8.2 VDC
Operating Temperature Range	-40 °C to 70 °C
Sample Revision	<input type="checkbox"/> Prototype Unit; <input checked="" type="checkbox"/> Production Unit; <input type="checkbox"/> Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	SHB7ACHI213600010	A	EM.00.01.1096,BM.00.01.0061,CM.00.01.1026	Radiated Emissions
2	SHB5BLAG212615130	A	EM.00.01.1096,BM.00.01.0061,CM.00.01.1026	Conducted RF

3.3 Accessory Equipment (AE) details

AE #	Type
1	Communication Cable

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1	Radiated Emissions
2	EUT#2 + AE# 1	Conducted RF

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and highest possible duty cycle. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

This test report is to support a request for new equipment authorization under the

- FCC ID: MTFSHB6510
- IC ID: 2175D-SHB6510

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r02 – “GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES” - April 2, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.247(a)(1) RSS-247 5.2(a)	Emission Bandwidth	Nominal	ISM	■	□	□	Complies
§15.247(e) RSS-247 5.2(b)	Power Spectral Density	Nominal	ISM	■	□	□	Complies
§15.247(b)(1) RSS-247 5.4(d)	Maximum Conducted Output Power and EIRP	Nominal	ISM	■	□	□	Complies
§15.247(d) RSS-247 5.5	Band edge compliance Unrestricted Band Edges	Nominal	ISM	■	□	□	Complies
§15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10	Band edge compliance Restricted Band Edges	Nominal	ISM	■	□	□	Complies
§15.247(d); §15.209 RSS-Gen 6.13	TX Spurious emissions- Radiated	Nominal	ISM	■	□	□	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	-	□	□	■	Note 2

Note: NA= Not Applicable; NP= Not Performed.

Note 2: EUT powered by battery

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

Measurement System	EMC 1	EMC 2
Conducted Emissions (mains port)	1.12 dB	0.46 dB
Radiated Emissions		
(<30 MHz)	3.66 dB	3.88 dB
(30 MHz – 1 GHz)	3.17 dB	3.34 dB
(1 GHz – 3 GHz)	5.01 dB	4.45 dB
(> 3 GHz)	4.0 dB	4.79 dB

RF conducted measurement ±0.5 dB

According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: <http://physics.nist.gov/cuu/Uncertainty/typeb.html>. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3 dB to the limit.

6.1 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

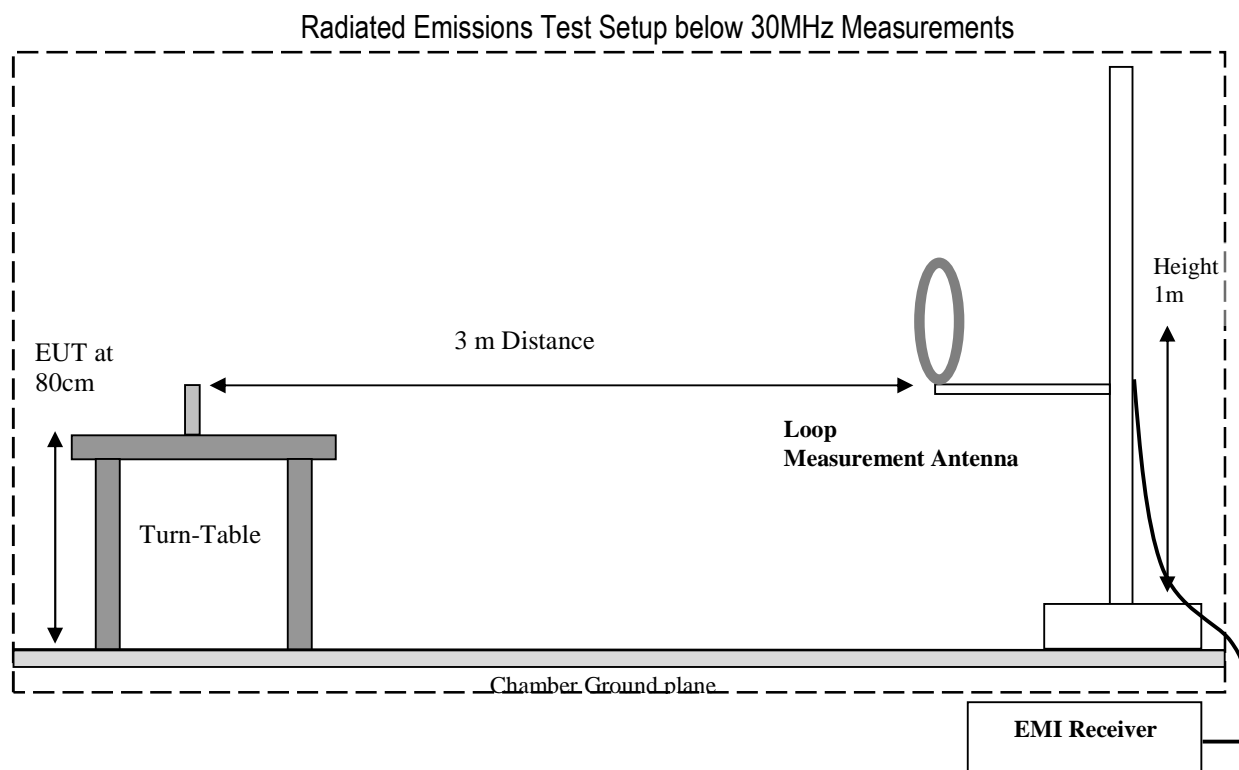
11/15/2021 - 11/30/2021

7 Measurement Procedures

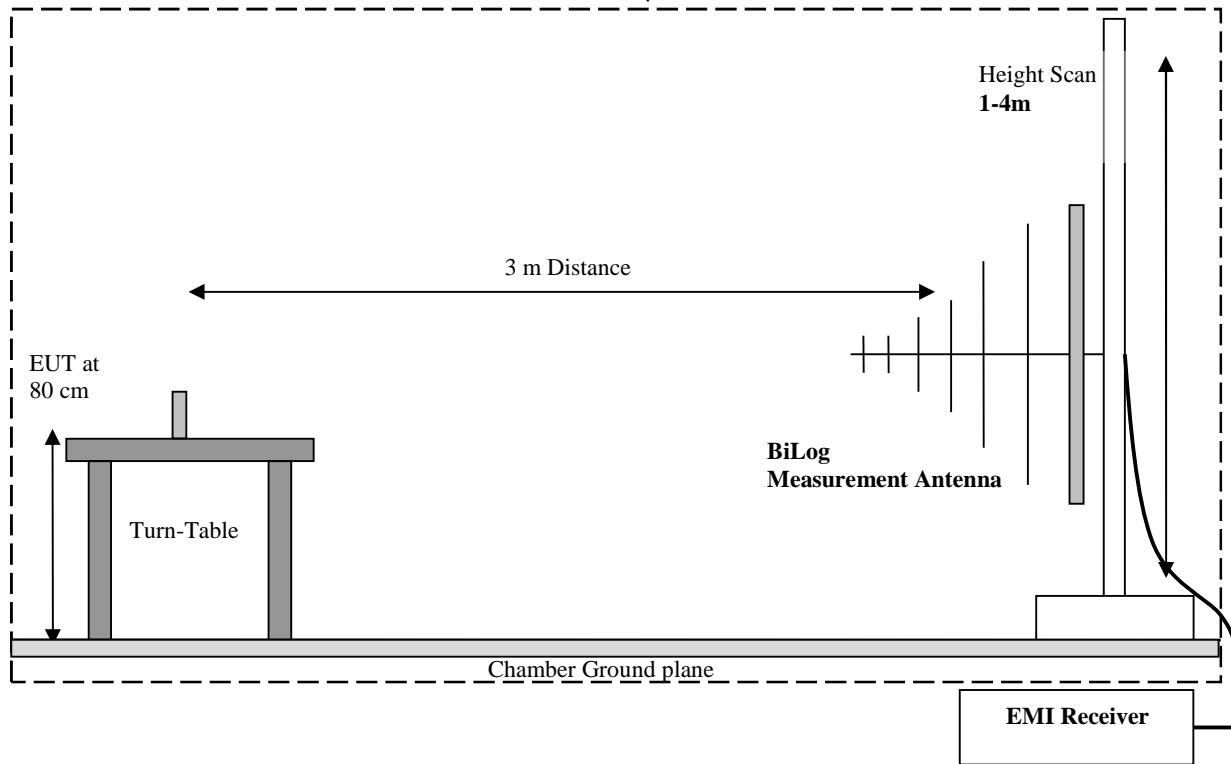
7.1 Radiated Measurement

The radiated measurement is performed according to ANSI C63.10 (2013)

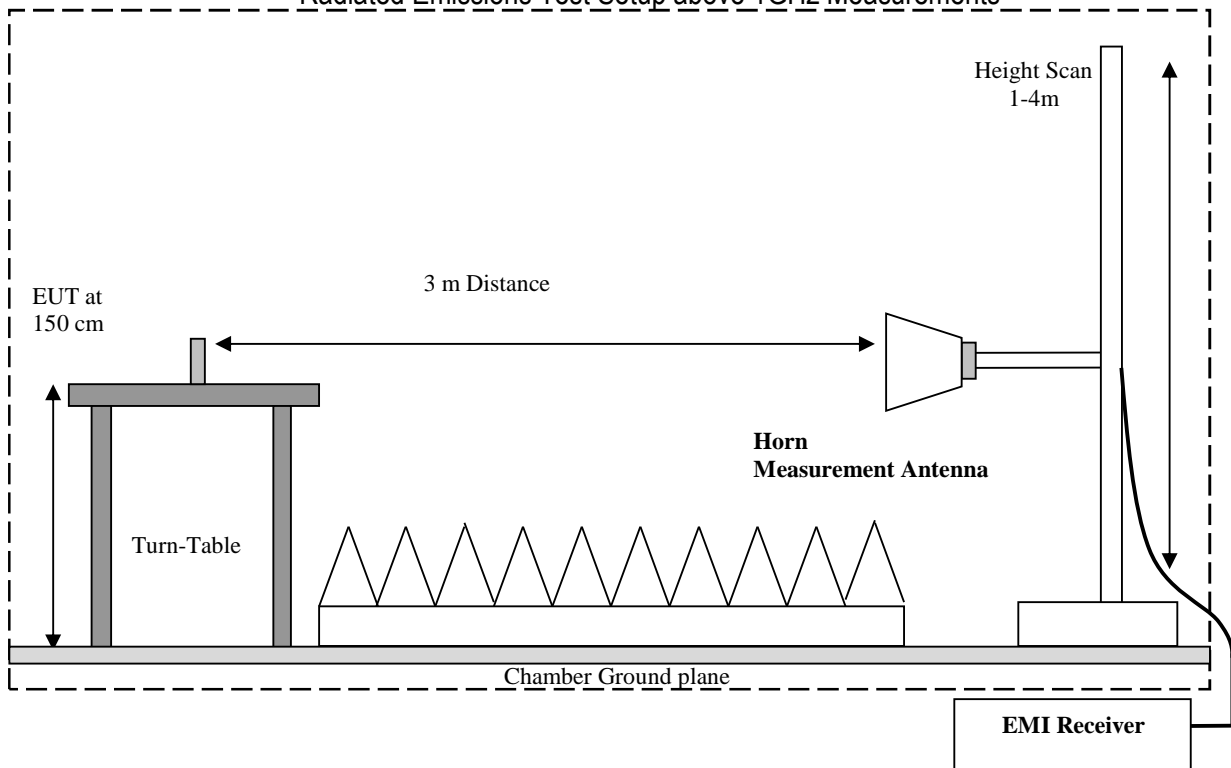
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dBμV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

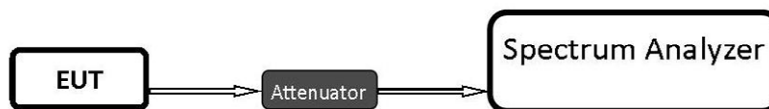
Frequency (MHz)	Measured SA (dBμV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBμV/m)
1000	80.5	3.5	14	98.0

7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

7.3 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r02 – “GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES” - April 2, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

8 Test Result Data

8.1 Maximum Peak Conducted Output Power

8.1.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings:

- RBW \geq DTS bandwidth
- VBW \geq 3 x RBW
- Span \geq 3 x RBW
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use peak marker function to determine the peak amplitude level

8.1.2 Limits:

Maximum Peak Output Power:

- FCC §15.247 (b)(1): 1 W
- IC RSS-247: 1 W

8.1.3 Test conditions and setup:

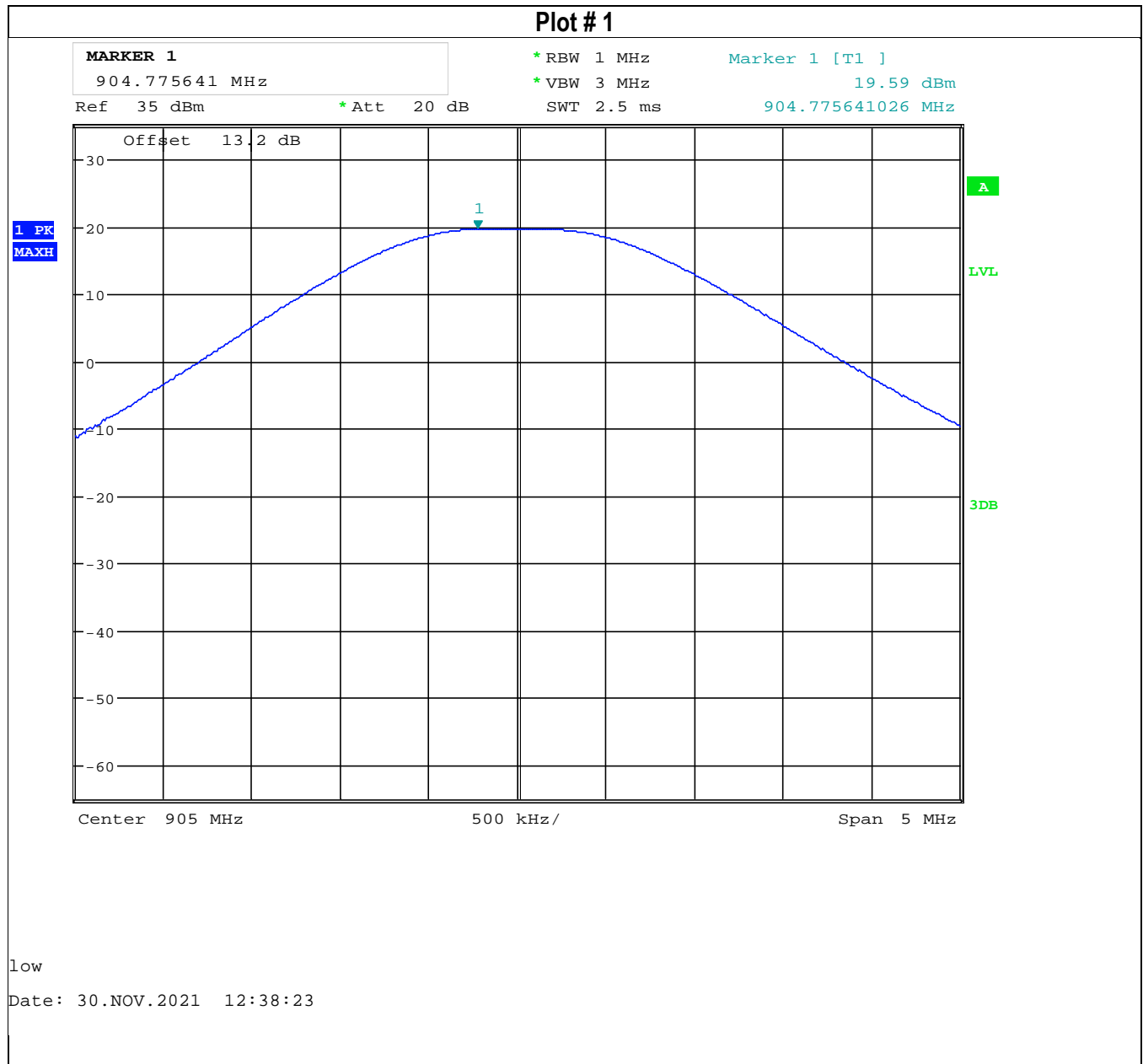
Ambient Temperature	EUT Set-Up #	Power Input	Antenna Gain
22° C	2	Battery	0.8 dBi

8.1.4 Measurement result:

Plot #	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	EIRP (dBm)	Limit (dBm)	Result
1	905	19.59	20.39	30 (Pk) / 36 (EIRP)	Pass
2	915	10.01	10.81	30 (Pk) / 36 (EIRP)	Pass
3	924	19.70	20.50	30 (Pk) / 36 (EIRP)	Pass



8.1.5 Measurement Plots:





Plot # 2

MARKER 1

915.1522436 MHz

*RBW 1 MHz

Marker 1 [T1]

*VBW 3 MHz

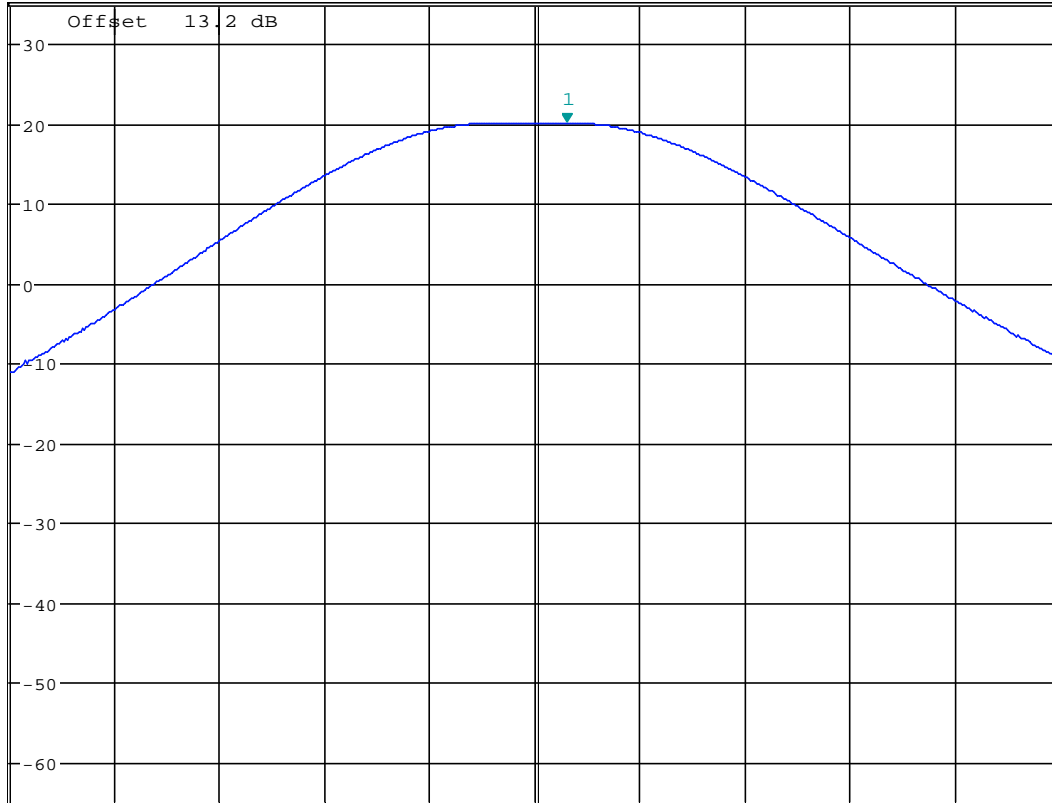
20.01 dBm

Ref 35 dBm

*Att 20 dB

SWT 2.5 ms

915.152243590 MHz



Center 915 MHz

500 kHz/

Span 5 MHz

low

Date: 30.NOV.2021 12:36:57



Plot # 3

MARKER 1

924.1682692 MHz

* RBW 1 MHz

Marker 1 [T1]

* VBW 3 MHz

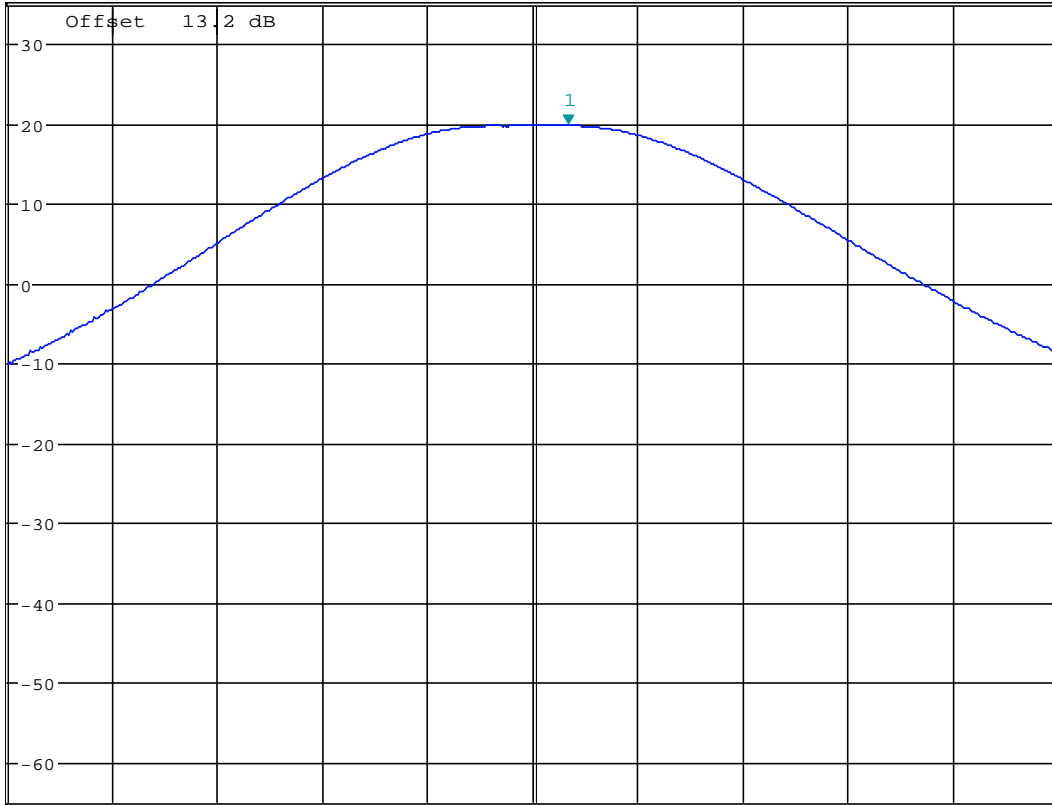
19.70 dBm

Ref 35 dBm

* Att 20 dB

SWT 2.5 ms

924.168269231 MHz



Center 924 MHz

500 kHz/

Span 5 MHz

low

Date: 30.NOV.2021 12:20:37

8.2 Power Spectral Density

8.2.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings for Peak PSD method:

- Set analyzer center frequency to DTS channel center frequency
- Set the span to 1.5 x DTS bandwidth
- Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- Set the VBW $\geq 3 \times \text{RBW}$
- Detector = Peak
- Sweep time = Auto couple
- Trace mode = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level within the RBW
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat

8.2.2 Limits:

FCC§15.247(e) & RSS-247 5.2(b)

- For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2.3 Test conditions and setup:

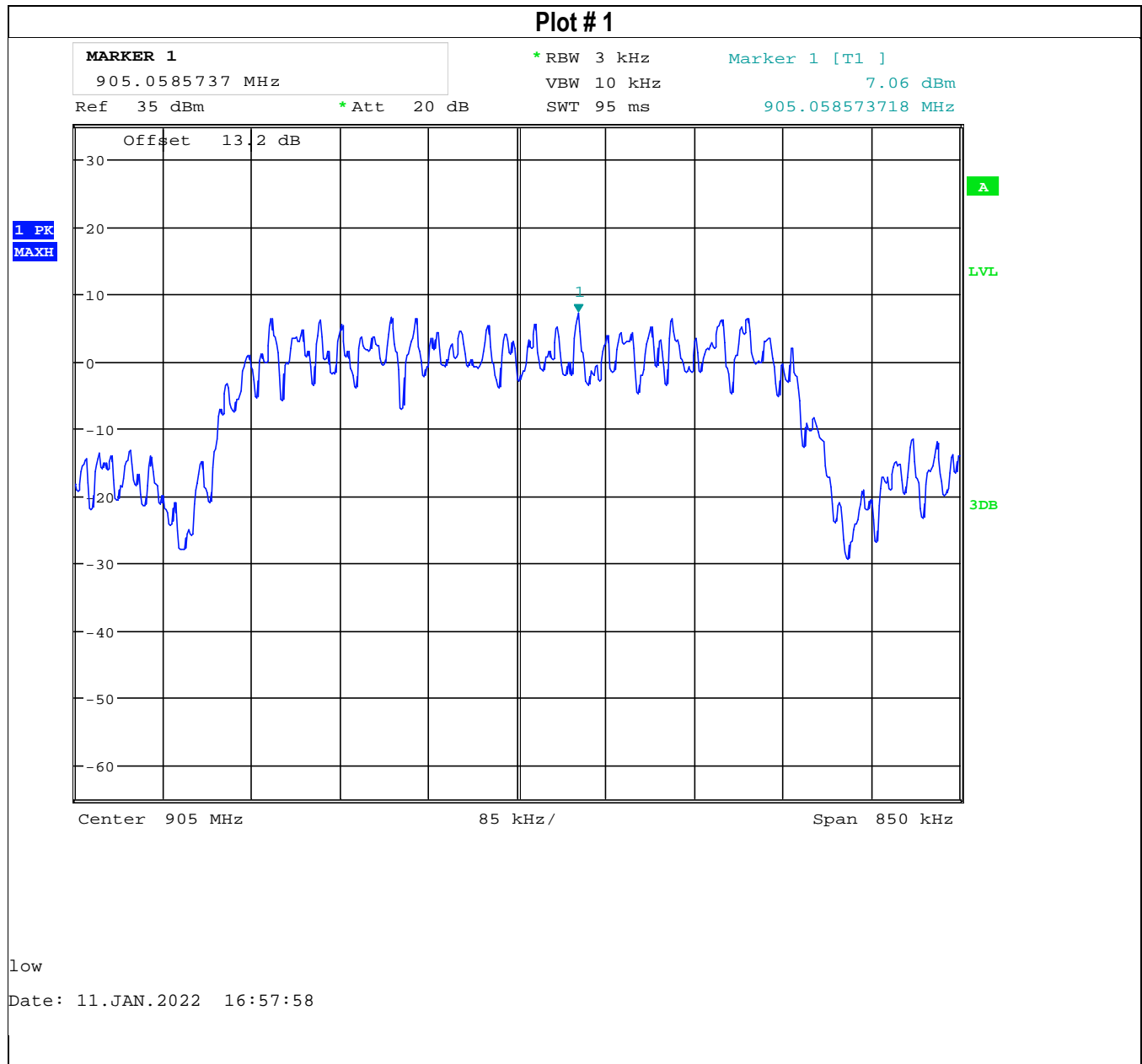
Ambient Temperature	EUT Set-Up #	Power Input	Antenna Gain
22° C	2	Battery	0.8 dBi

8.2.4 Measurement result:

Plot #	Frequency (MHz)	Maximum Power Spectral Density (dBm/3 kHz)	Limit (dBm / 3 kHz)	Result
1	905	7.06	8	Pass
2	915	7.57	8	Pass
3	924	7.25	8	Pass



8.2.5 Measurement Plots:





Plot # 2

MARKER 1

915.0585737 MHz

*RBW 3 kHz

Marker 1 [T1]

VBW 10 kHz

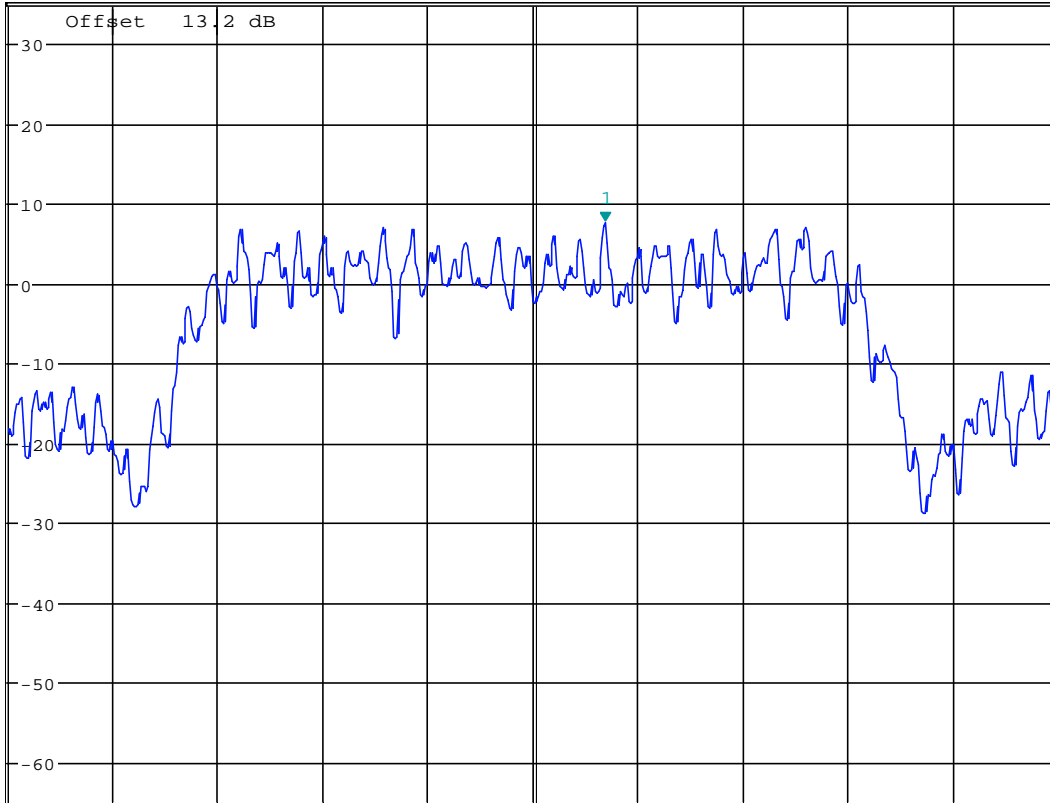
7.57 dBm

Ref 35 dBm

*Att 20 dB

SWT 95 ms

915.058573718 MHz



low

Date: 11.JAN.2022 16:56:32



Plot # 3

MARKER 1

924.0585737 MHz

*RBW 3 kHz

Marker 1 [T1]

VBW 10 kHz

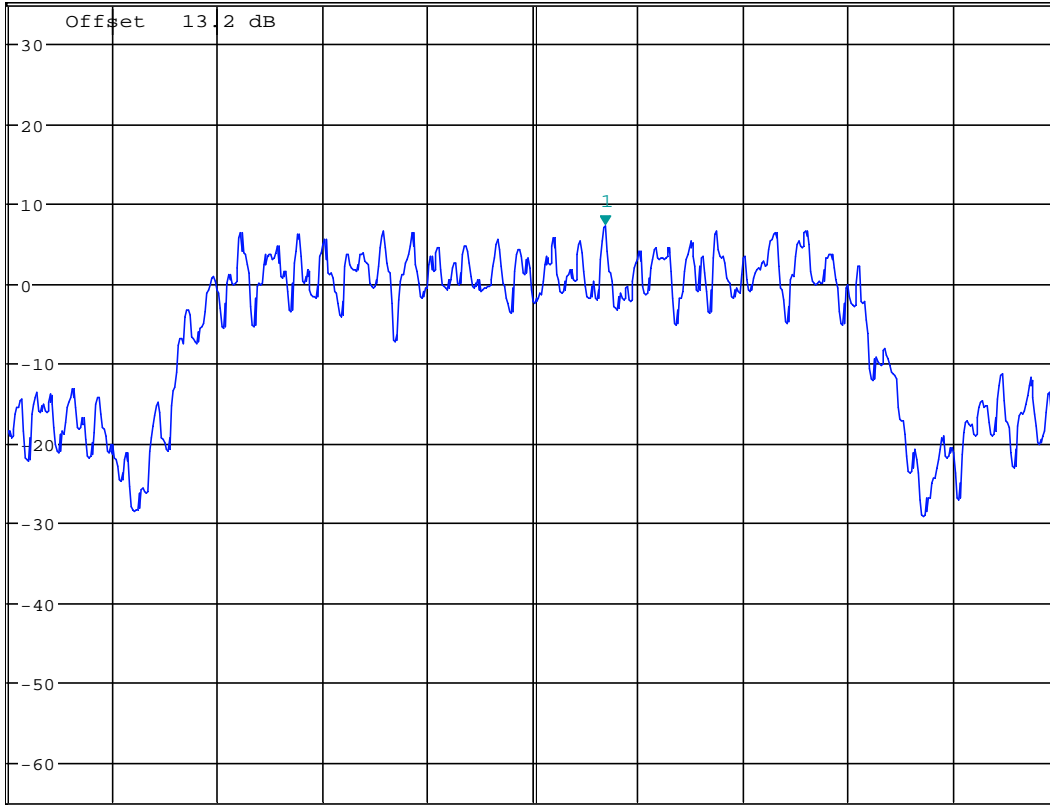
7.25 dBm

Ref 35 dBm

*Att 20 dB

SWT 95 ms

924.058573718 MHz



Center 924 MHz

85 kHz/

Span 850 kHz

low

Date: 11.JAN.2022 16:55:08

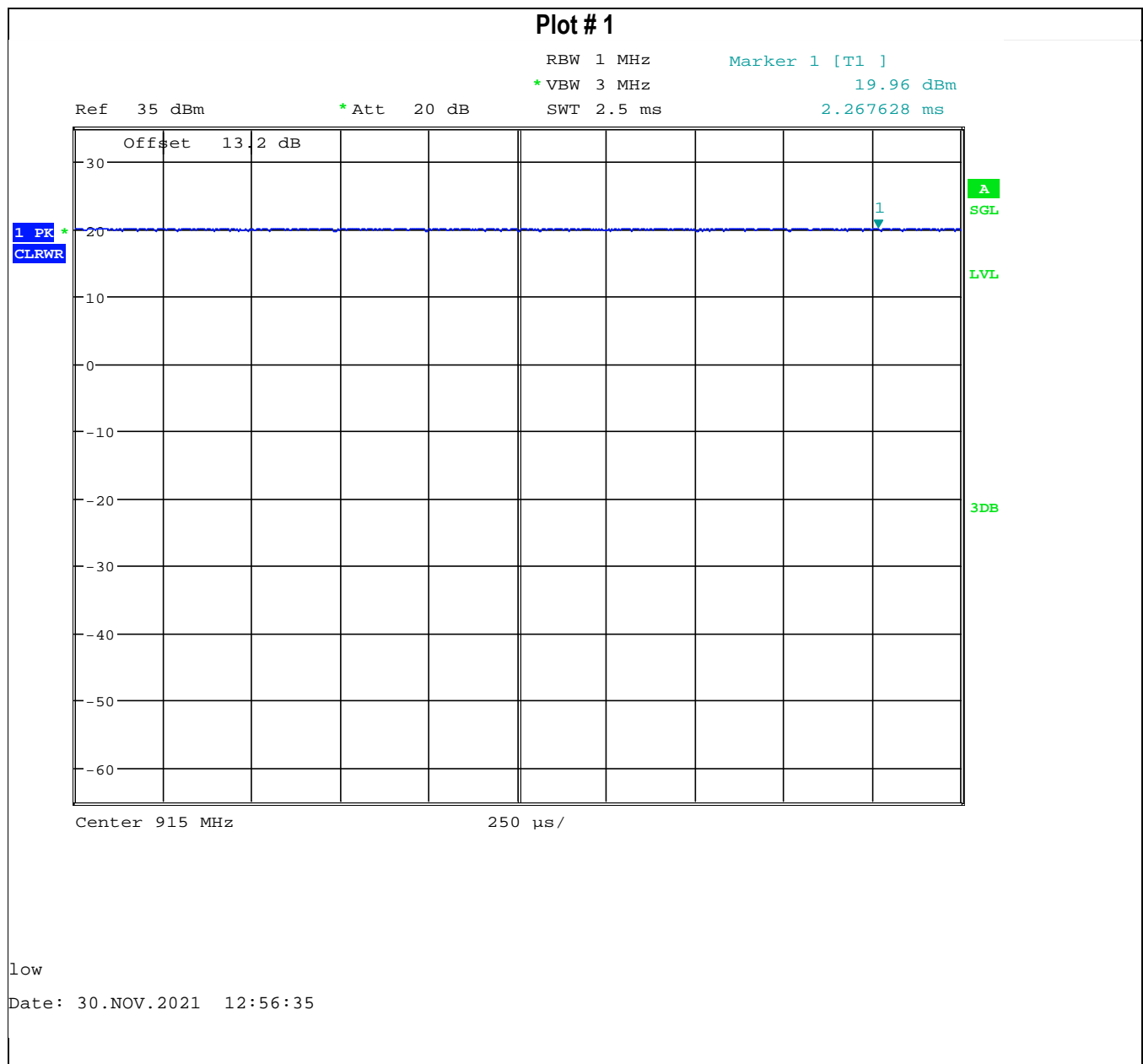
8.3 Duty cycle

8.3.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings:

- Set the center frequency and of the instrument to the center frequency of the transmission
- Zero span
- Set RBW \geq OBW if possible; otherwise, set RBW to the largest available value
- Detector = Peak or average

8.3.2 Measurement result



Duty cycle = 100%, Duty cycle correction factor = $10 \cdot \log(1/1) = 0$ dB

8.4 Band Edge Compliance

8.4.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings for band edge:

- Set the center frequency and span to encompass frequency range to be measured
- RBW = 100 kHz
- VBW $\geq 3 \times$ RBW
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level
- Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge

8.4.2 Limits non restricted band:

FCC§15.247 (d)

- In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247 5/5

- In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB.

Spectrum Analyzer settings for restricted band:

- Peak measurements are made using a peak detector and RBW=1 MHz

8.4.3 Limits restricted band §15.247/15.209/15.205 and RSS-Gen 8.9/8.10

- *PEAK LIMIT= 74 dBµV/m @3m =-21.23 dBm
- *AVG. LIMIT= 54 dBµV/m @3m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205 & RSS-Gen 8.10
- Measurements with a peak detector were used to show compliance to average limits, thus showing compliance to both peak and average limits.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

8.4.4 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	Power Input	Antenna Gain
22° C	2	Battery	0.8 dBi

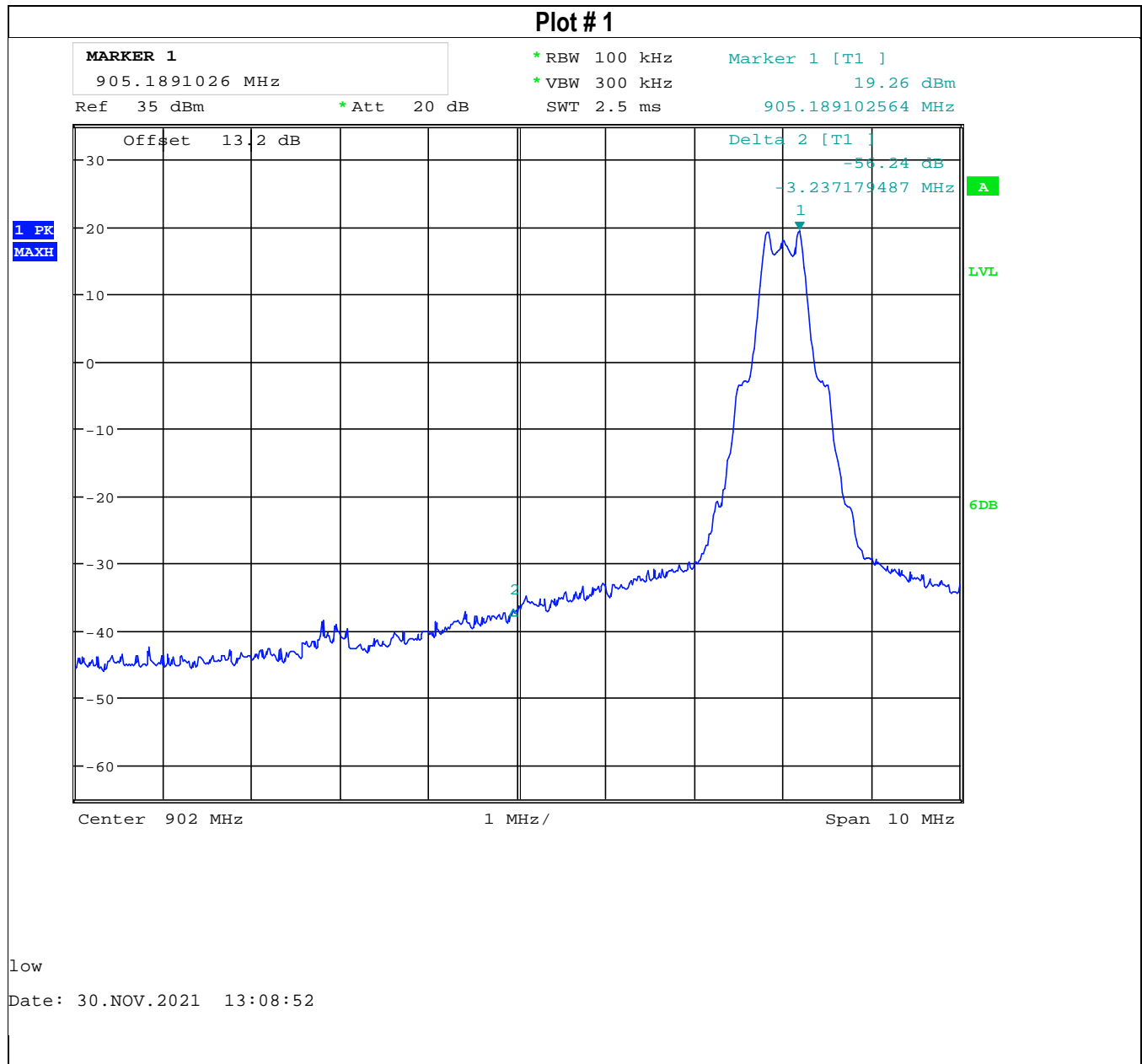
8.4.5 Measurement result:

Plot #	Band Edge	Band Edge Delta (dBc)	Limit (dBc)	Result
1	Lower, Non-restricted	-56.24	-20	Pass

Plot #	Band Edge	Measured Peak Value (dBm)	Corrected by duty cycle	Corrected by Antenna Gain (dBm)	Limit (dBm)	Result
2	Upper Restricted Peak	-39.97	-39.97	-39.17	-21.23 Peak	Pass
3	Upper Restricted AVG	-49.51	-49.51	-48.74	-41.23 AVG	Pass



8.4.6 Measurement Plots:





Plot # 2

MARKER 1

978.4615385 MHz

* RBW 1 MHz

Marker 1 [T1]

* VBW 3 MHz

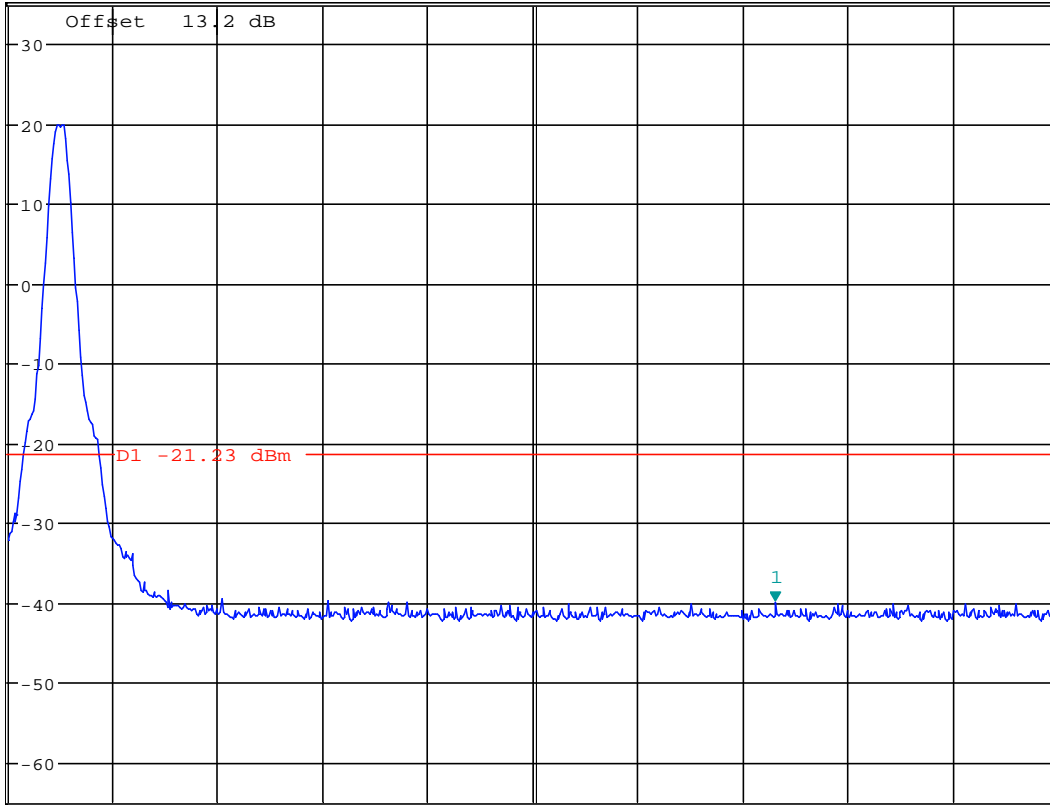
-39.97 dBm

Ref 35 dBm

* Att 20 dB

SWT 2.5 ms

978.461538462 MHz



low

Date: 30.NOV.2021 13:26:14



Plot # 3

MARKER 1

997.4358974 MHz

* RBW 1 MHz

Marker 1 [T1]

* VBW 3 MHz

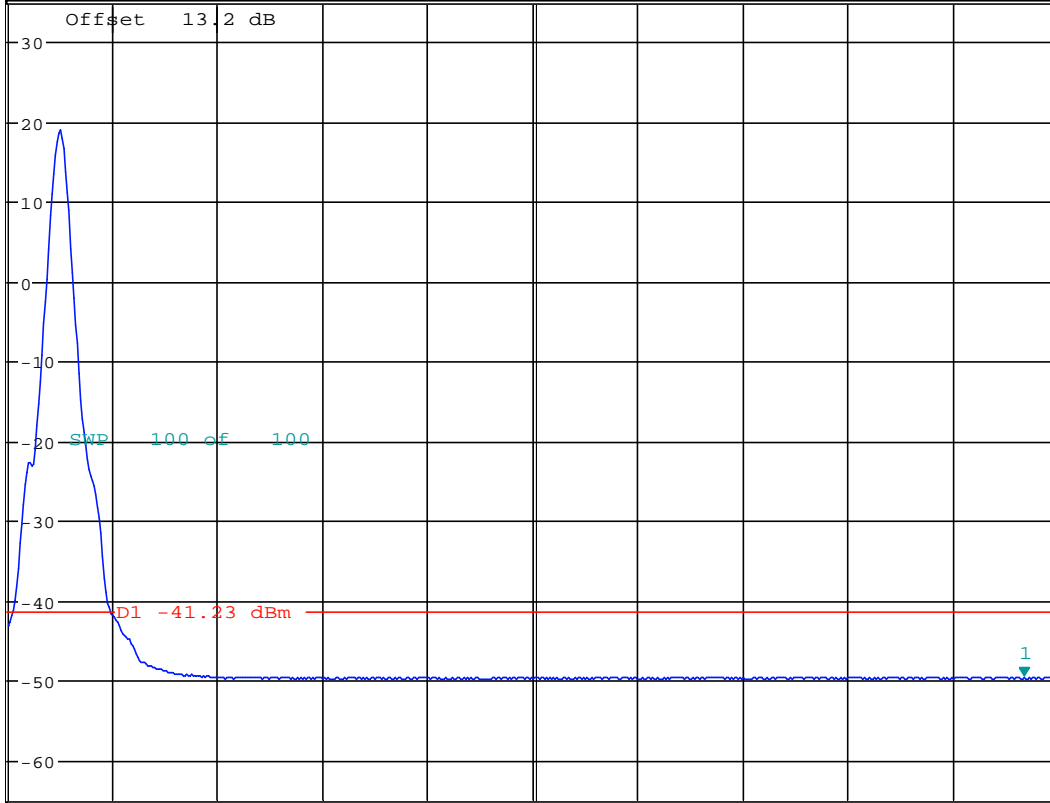
-49.51 dBm

Ref 35 dBm

* Att 20 dB

SWT 2.5 ms

997.435897436 MHz



Center 960 MHz

8 MHz/

Span 80 MHz

low

Date: 30.NOV.2021 13:30:33

8.5 Emission Bandwidth 6dB and 99% Occupied Bandwidth

8.5.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings:

6dB (DTS) Bandwidth:

- Set RBW = 100 kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

99% Occupied Bandwidth:

- Set frequency = nominal EUT channel center frequency
- Set Span = 1.5 x to 5.0 x OBW
- Set RBW = 1% to 5% of OBW
- Set the video bandwidth (VBW) $\approx 3 \times$ RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth
- If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

8.5.2 Limits:

FCC §15.247(a)(2) and RSS-247 5.2(a)

- Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.5.3 Test conditions and setup:

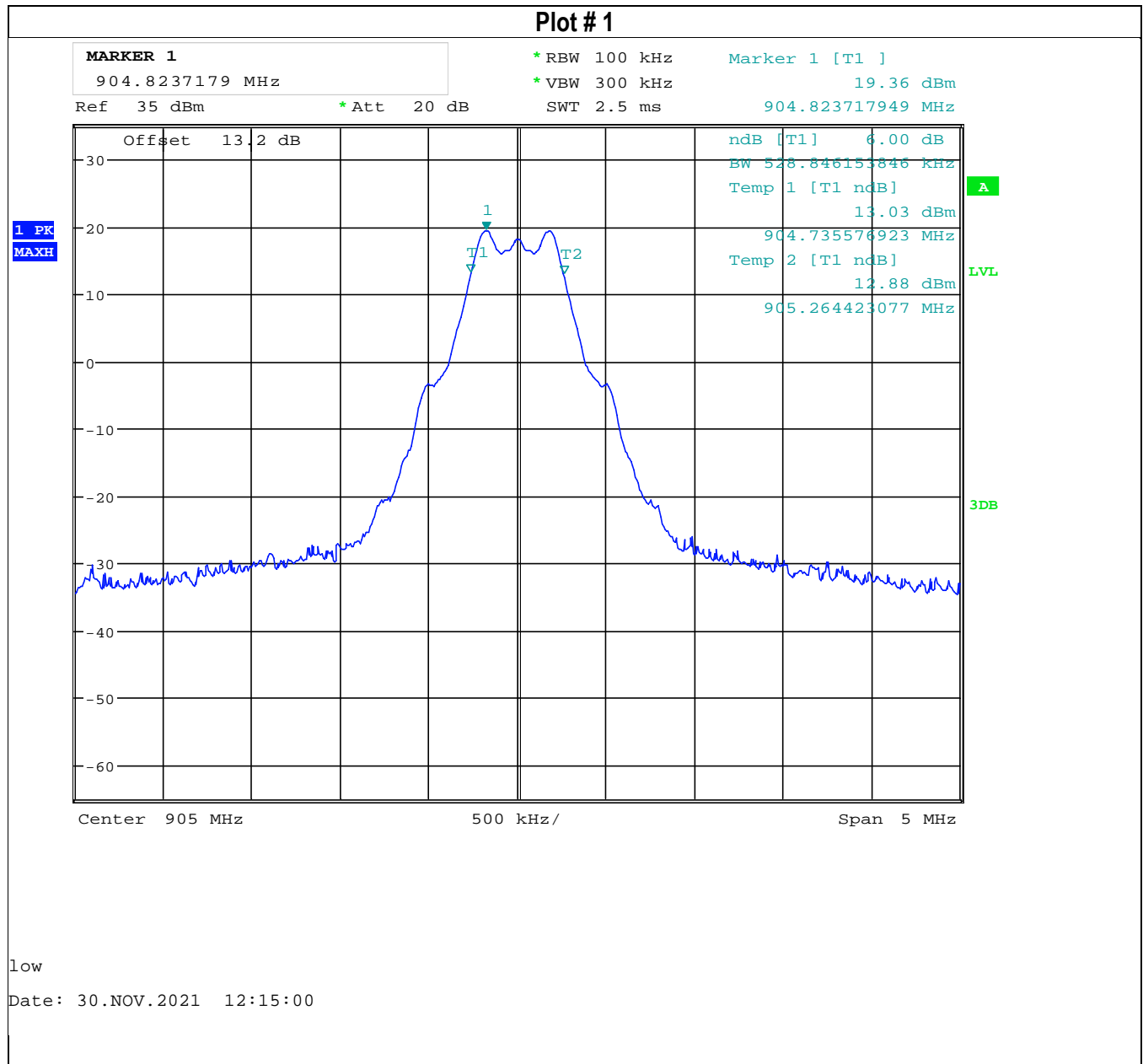
Ambient Temperature	EUT Set-Up #	Power Input
22° C	2	Battery

8.5.4 Measurement result:

Plot #	Frequency (MHz)	6dB Emissions Bandwidth (MHz)	Limit (MHz)	Result
1	905	0.529	> 0.5	Pass
2	915	0.521	> 0.5	Pass
3	924	0.521	> 0.5	Pass

Plot #	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
4	905	0.587	> 0.5	Pass
5	915	0.583	> 0.5	Pass
6	924	0.583	> 0.5	Pass

8.5.5 Measurement Plots:





Plot # 2

MARKER 1

915.1762821 MHz

* RBW 100 kHz

Marker 1 [T1]

* VBW 300 kHz

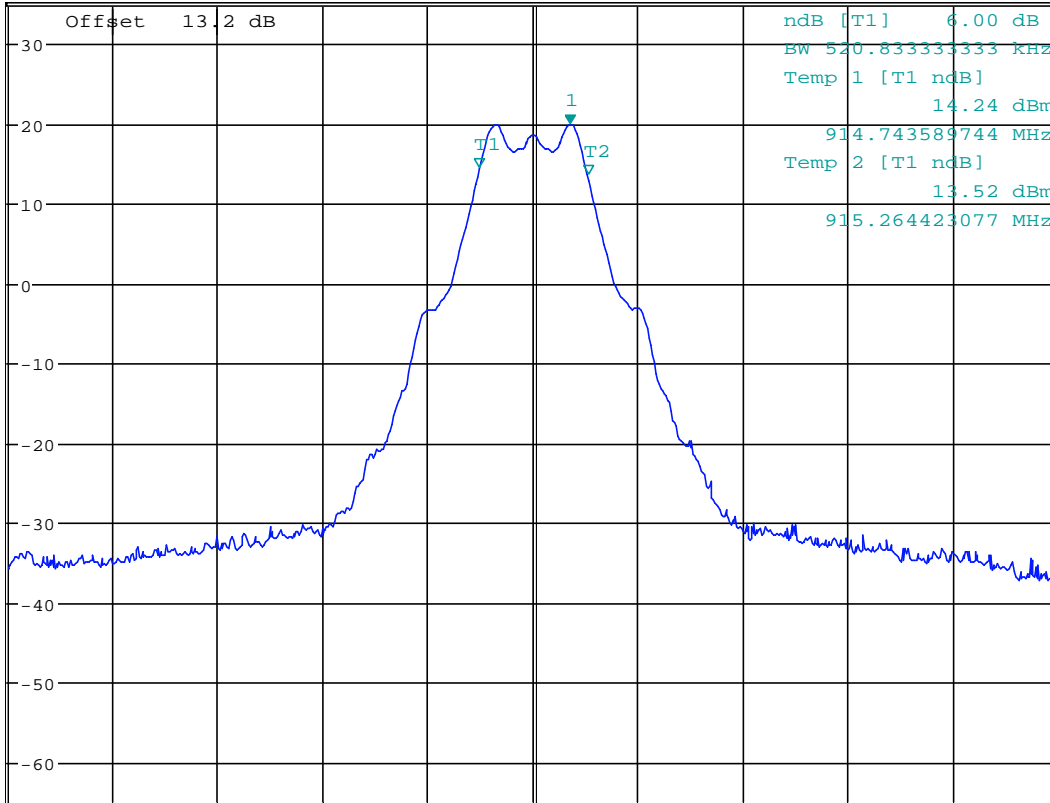
19.80 dBm

Ref 35 dBm

* Att 20 dB

SWT 2.5 ms

915.176282051 MHz



Center 915 MHz

500 kHz/

Span 5 MHz

low

Date: 30.NOV.2021 12:16:53



Plot # 3

MARKER 1

924.1762821 MHz

*RBW 100 kHz

Marker 1 [T1]

*VBW 300 kHz

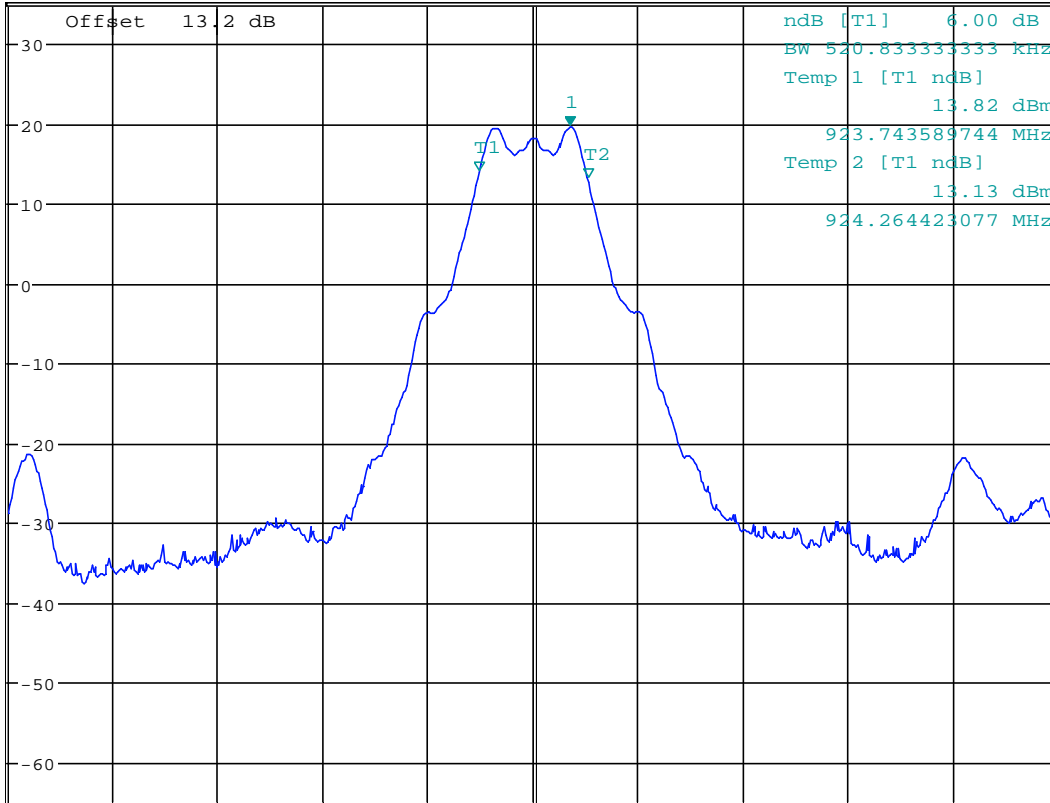
19.48 dBm

Ref 35 dBm

*Att 20 dB

SWT 2.5 ms

924.176282051 MHz



Center 924 MHz

500 kHz/

Span 5 MHz

1 PK
MAXH

A

LVL

3DB

low

Date: 30.NOV.2021 12:18:40



Plot # 4

MARKER 1

904.8012821 MHz

*RBW 20 kHz

Marker 1 [T1]

VBW 50 kHz

15.04 dBm

Ref 35 dBm

*Att 20 dB

SWT 20 ms

904.801282051 MHz

Offset 13.2 dB

OBW586.538461538 kHz

Temp 1 [T1 OBW]

-0.96 dBm

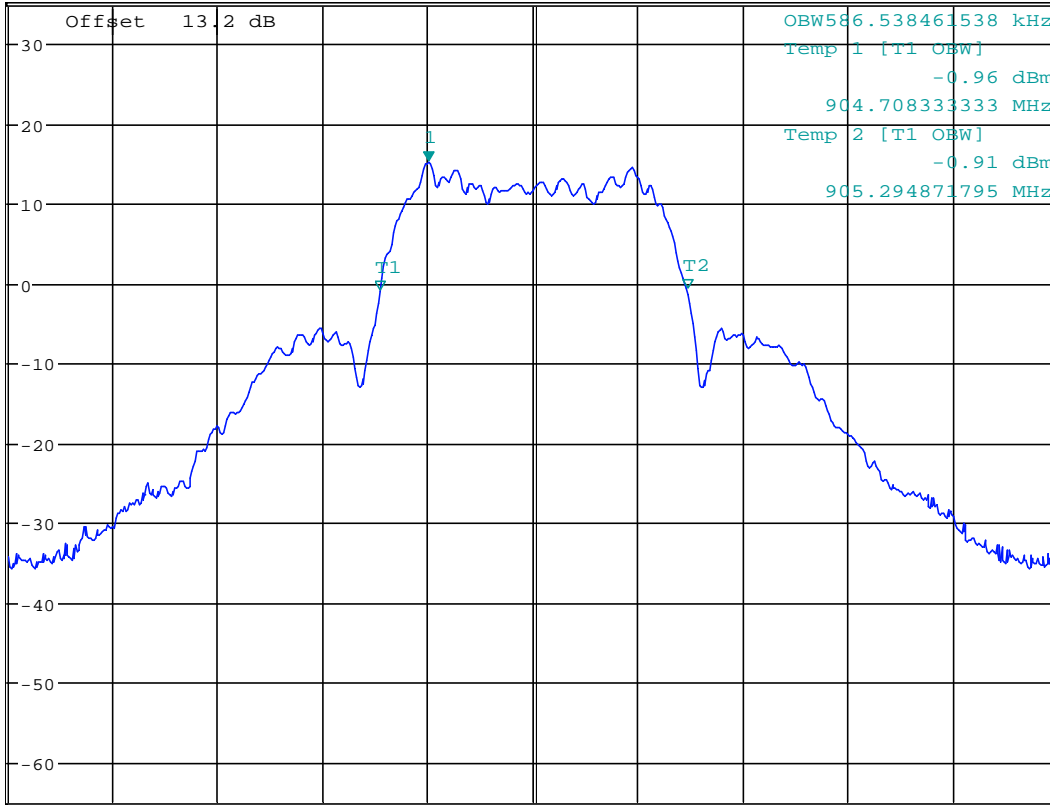
904.708333333 MHz

Temp 2 [T1 OBW]

-0.91 dBm

905.294871795 MHz

1 PK
MAXH



Center 905 MHz

200 kHz/

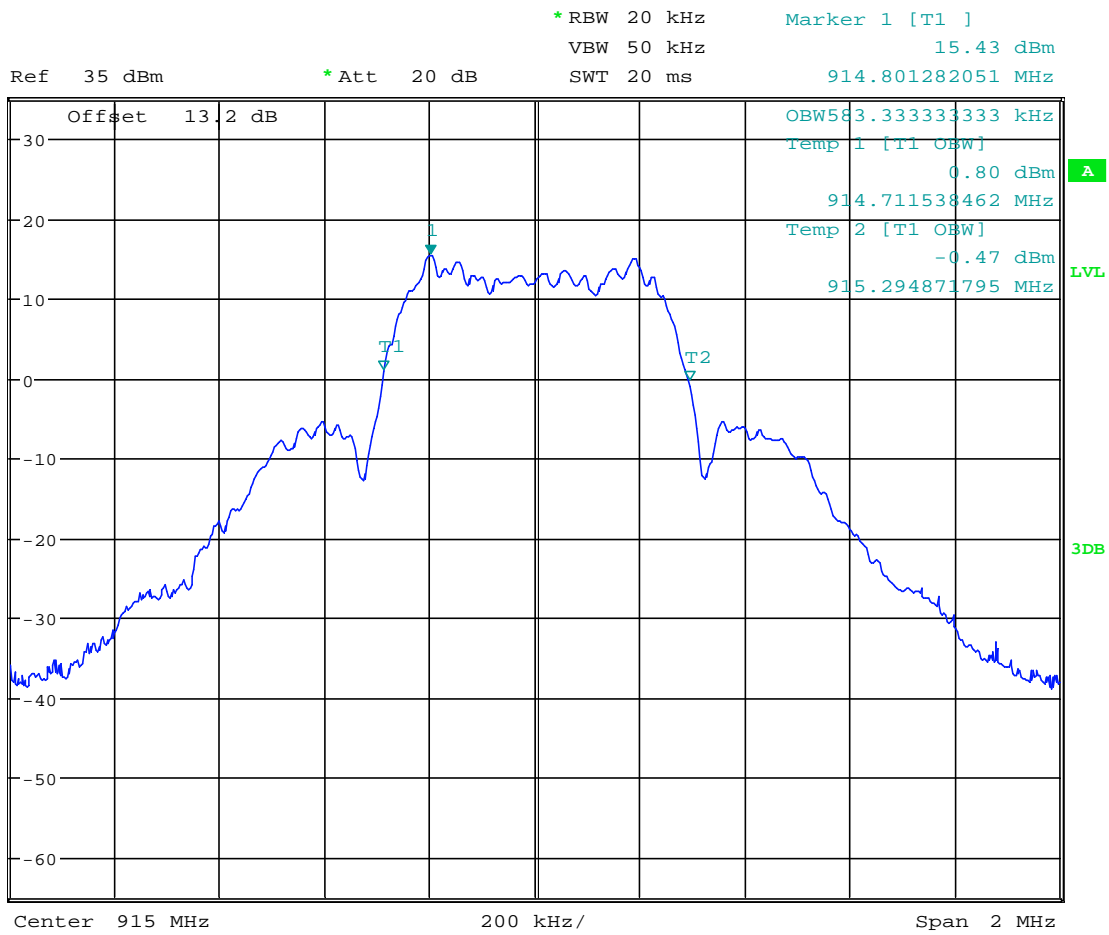
Span 2 MHz

low

Date: 11.JAN.2022 16:46:53



Plot # 5



low

Date: 11.JAN.2022 16:50:16



Plot # 6

MARKER 1

923.7980769 MHz

*RBW 20 kHz

Marker 1 [T1]

VBW 50 kHz

15.08 dBm

Ref 35 dBm

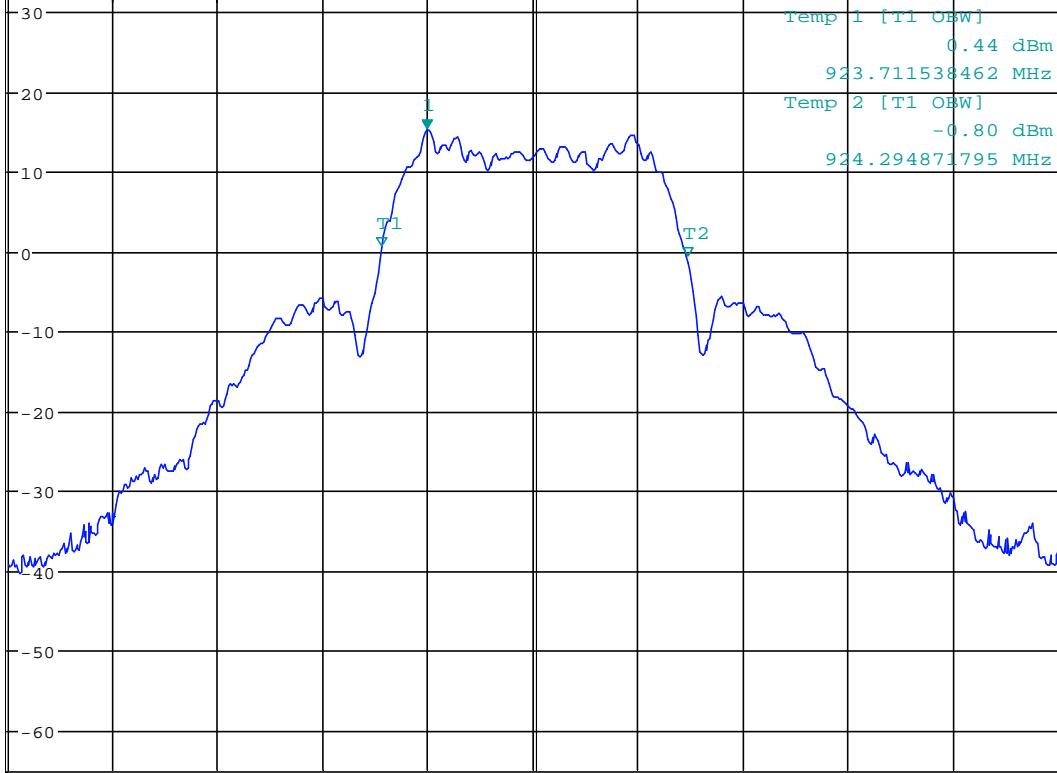
*Att 20 dB

SWT 20 ms

923.798076923 MHz

Offset 13.2 dB

OBW583.333333333 kHz



1 PK
MAXH

A

LVL

3DB

Center 924 MHz

200 kHz/

Span 2 MHz

low

Date: 11.JAN.2022 16:51:33

8.6 Radiated Transmitter Spurious Emissions and Restricted Bands

8.6.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing frequencies below 30 MHz at distance other than the specified in the standard, the limit conversion is calculated by using the FCC materials for the ANSI 63 committee issued on January, 27 1991.

8.6.2 Limits:

FCC §15.247

- In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).



FCC §15.209 & RSS-Gen 8.9

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009–0.490	2400/F(kHz) / -----	300	-
0.490–1.705	24000/F(kHz) / -----	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBµV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBµV/m
Above 960	500	3	54 dBµV/m

FCC §15.205 & RSS-Gen 8.10

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
 - *PEAK LIMIT= 74 dBµV/m
 - *AVG. LIMIT= 54 dBµV/m

8.6.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	Power Input
22° C	1	Battery

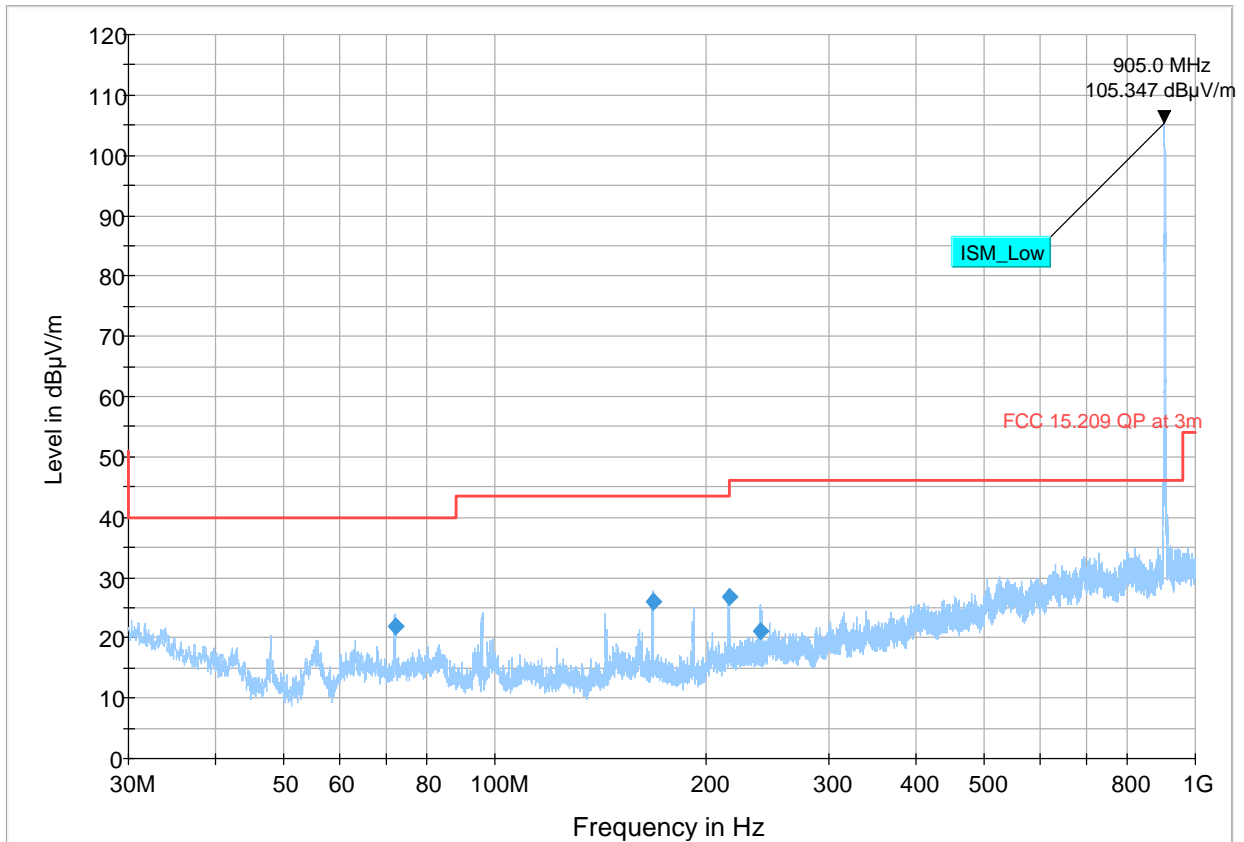
8.6.4 Measurement result:

Plot #	Channel #	Scan Frequency	Result
1-3	Low	30 MHz – 18 GHz	Pass
4-7	Mid	9 kHz – 18 GHz	Pass
8-10	High	30 MHz – 18 GHz	Pass

8.6.5 Measurement Plots:

Plot # 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
72.041	21.98	40.00	18.02	500.0	120.000	179.0	V	19.0	11.8	
168.057	26.07	43.50	17.43	500.0	120.000	255.0	H	271.0	13.9	
216.008	26.75	46.02	19.27	500.0	120.000	138.0	H	252.0	15.4	
239.570	21.10	46.02	24.92	500.0	120.000	125.0	H	109.0	17.0	

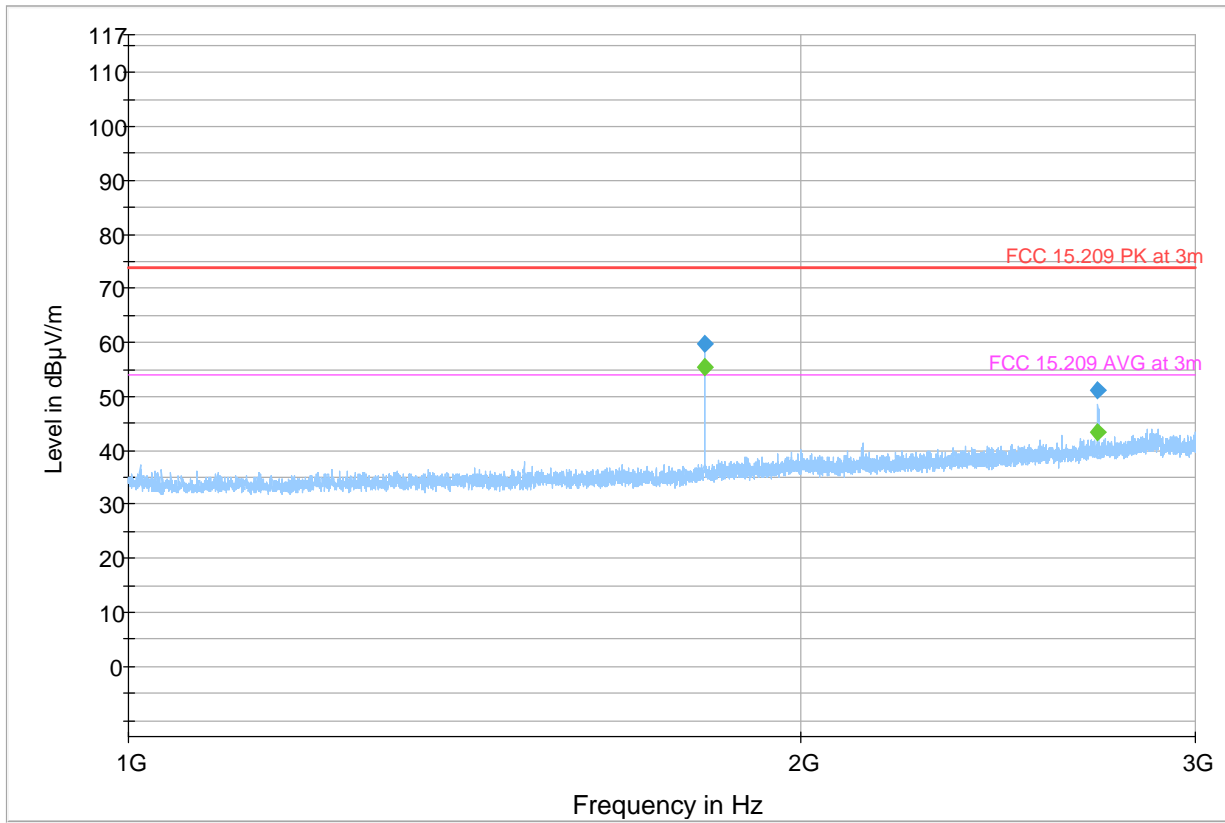


— Preview Result 1-PK+
 — FCC 15.209 QP at 3m
 ◆ Final_Result QPK



Plot # 2

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1810.286	59.70	---	73.98	14.28	500.0	1000.000	158.0	V	270.0	4.2
1810.286	---	55.43	53.98	-1.45	500.0	1000.000	158.0	V	270.0	4.2
2714.571	51.18	---	73.98	22.80	500.0	1000.000	125.0	V	220.0	7.2
2714.571	---	43.39	53.98	10.59	500.0	1000.000	125.0	V	220.0	7.2



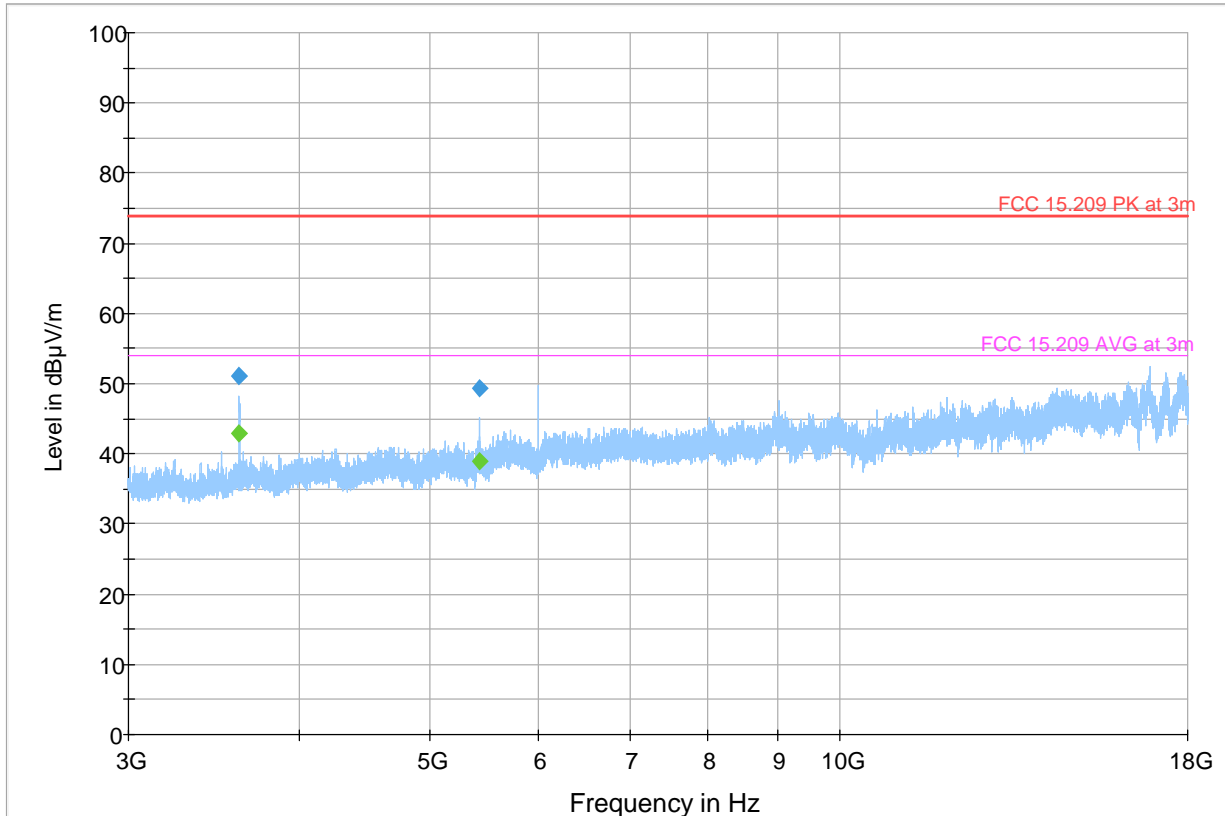
— Preview Result 2-AVG — Preview Result 1-PK+ — FCC 15.209 PK at 3m
— FCC 15.209 AVG at 3m ◆ Final_Result PK+ ◆ Final_Result CAV

Note: 1810.286 MHz not within restricted bands of operation according to FCC 15.205.



Plot # 3

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3619.500	---	42.94	53.98	11.03	500.0	1000.000	129.0	H	117.0	-6.0
3619.500	51.19	---	73.98	22.79	500.0	1000.000	129.0	H	117.0	-6.0
5430.750	---	38.91	53.98	15.07	500.0	1000.000	118.0	V	326.0	-2.5
5430.750	49.40	---	73.98	24.58	500.0	1000.000	118.0	V	326.0	-2.5

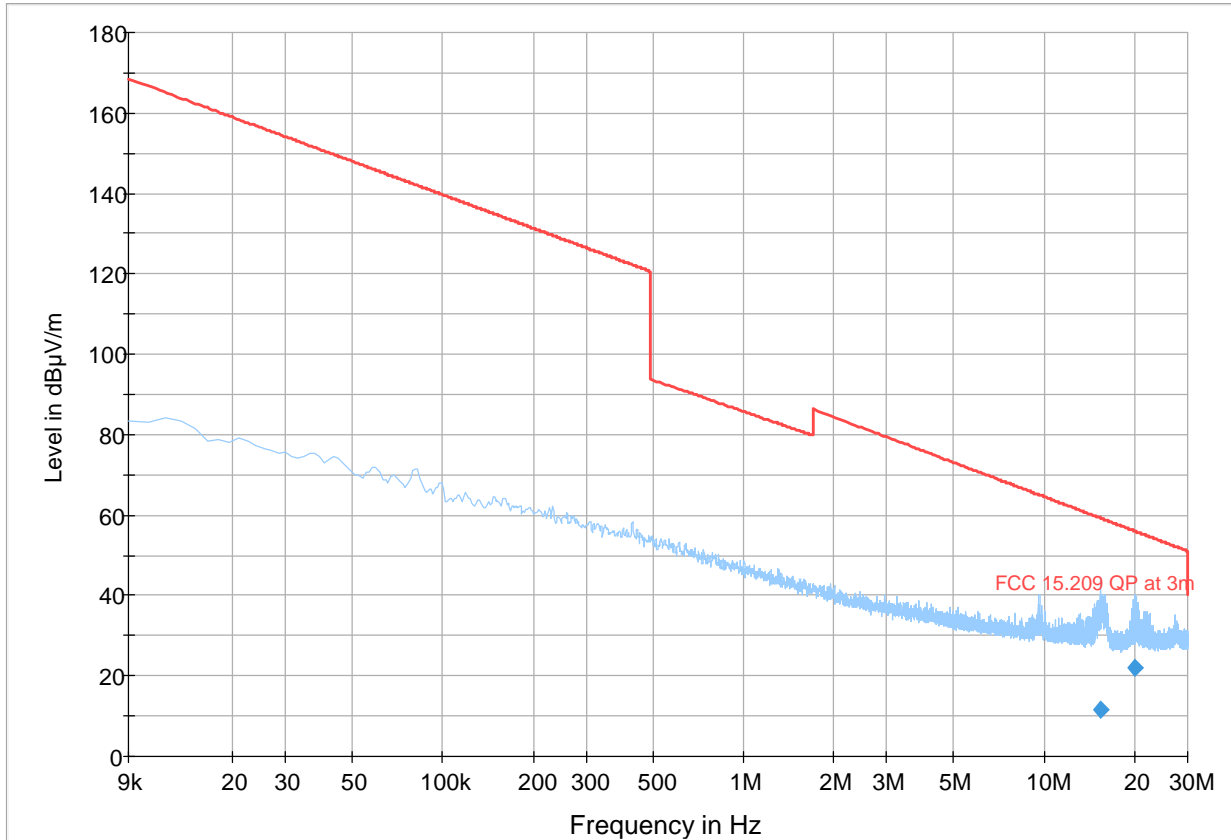


— Preview Result 2-AVG — Preview Result 1-PK+ — FCC 15.209 PK at 3m
— FCC 15.209 AVG at 3m ◆ Final_Result PK+ ◆ Final_Result CAV



Plot # 4

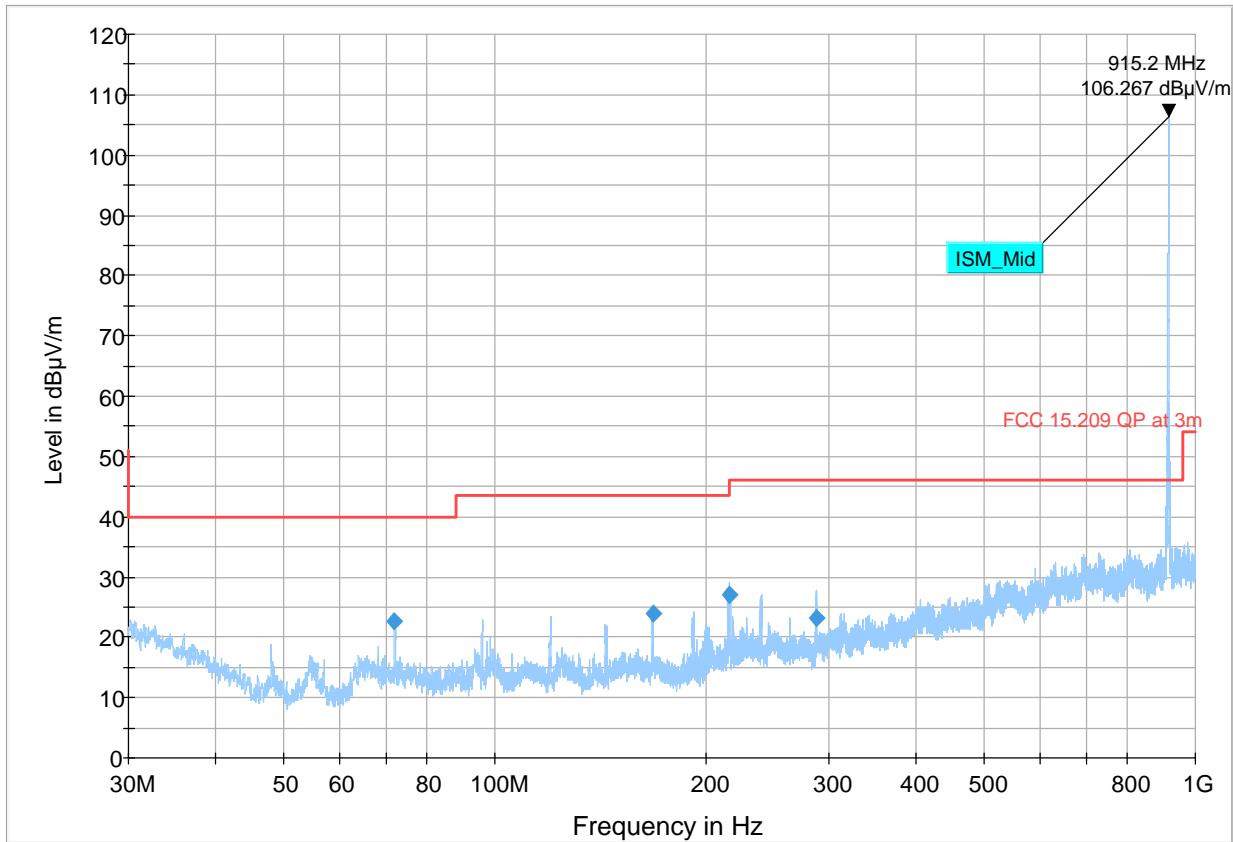
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
15.459	11.41	59.20	47.79	500.0	0.200	176.0	V	46.0	16.7	
20.134	22.19	55.95	33.76	500.0	0.200	130.0	V	184.0	16.4	



— Preview Result 1-PK+
 — FCC 15.209 QP at 3m
 ◆ Final_Result QPK

Plot # 5

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
71.987	22.55	40.00	17.45	500.0	120.000	202.0	V	166.0	11.7	
168.251	24.08	43.50	19.42	500.0	120.000	208.0	H	263.0	13.9	
216.002	27.03	46.02	18.99	500.0	120.000	150.0	H	255.0	15.4	
288.084	23.09	46.02	22.93	500.0	120.000	125.0	H	288.0	17.9	

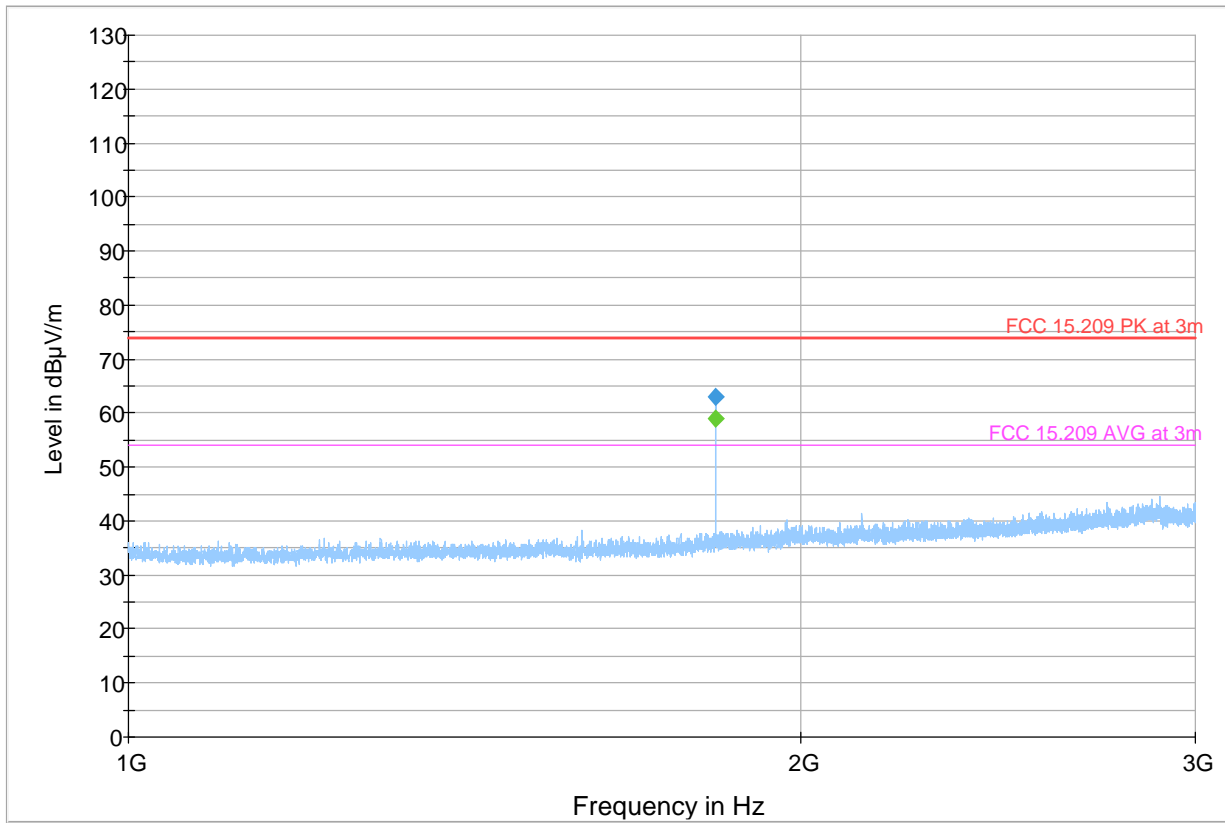


— Preview Result 1-PK+ — FCC 15.209 QP at 3m ◆ Final_Result QPK



Plot # 6

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1830.286	---	59.07	53.98	-5.09	500.0	1000.000	193.0	V	287.0	4.4
1830.286	62.85	---	73.98	11.13	500.0	1000.000	193.0	V	287.0	4.4



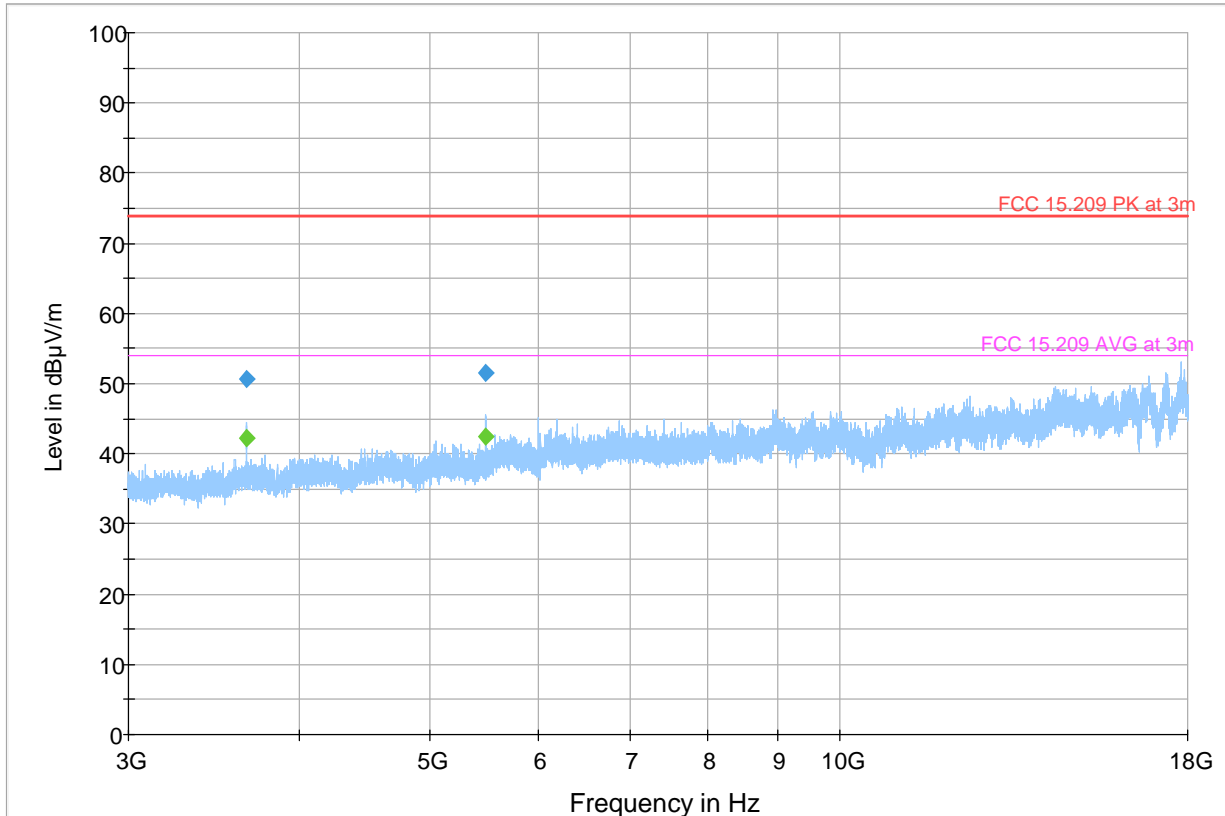
— Preview Result 2-AVG — Preview Result 1-PK+ — FCC 15.209 PK at 3m
— FCC 15.209 AVG at 3m ◆ Final_Result PK+ ◆ Final_Result CAV

Note: 1830.286 MHz not within restricted bands of operation according to FCC 15.205.



Plot # 7

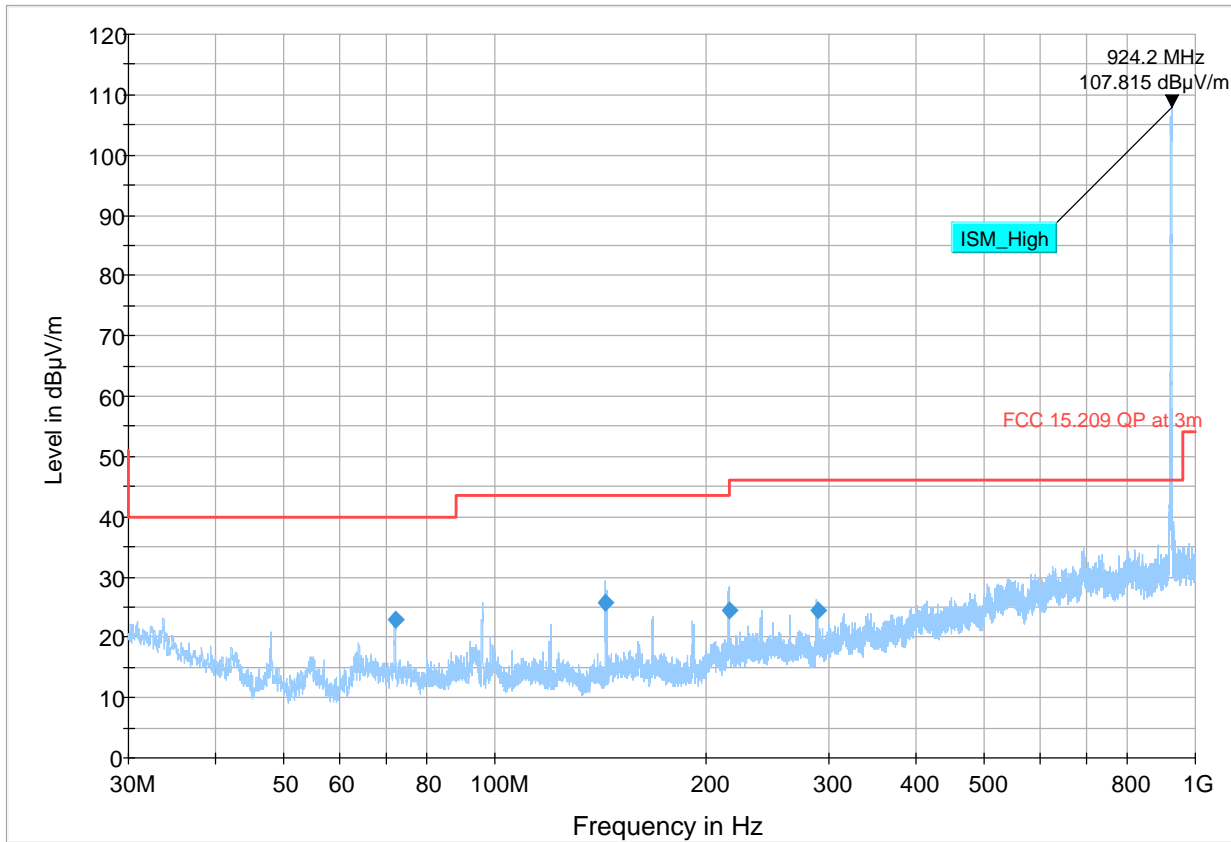
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3660.500	50.65	---	73.98	23.33	500.0	1000.000	126.0	H	118.0	-5.8
3660.500	---	42.36	53.98	11.62	500.0	1000.000	126.0	H	118.0	-5.8
5491.000	---	42.41	53.98	11.57	500.0	1000.000	275.0	V	262.0	-2.6
5491.000	51.49	---	73.98	22.49	500.0	1000.000	275.0	V	262.0	-2.6



— Preview Result 2-AVG — Preview Result 1-PK+ — FCC 15.209 PK at 3m
— FCC 15.209 AVG at 3m ◆ Final_Result PK+ ◆ Final_Result CAV

Plot # 8

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
72.027	22.93	40.00	17.07	500.0	120.000	143.0	V	6.0	11.8	
144.025	25.70	43.50	17.80	500.0	120.000	308.0	H	88.0	13.2	
216.299	24.37	46.02	21.65	500.0	120.000	125.0	H	111.0	15.4	
288.579	24.36	46.02	21.66	500.0	120.000	139.0	H	49.0	18.0	

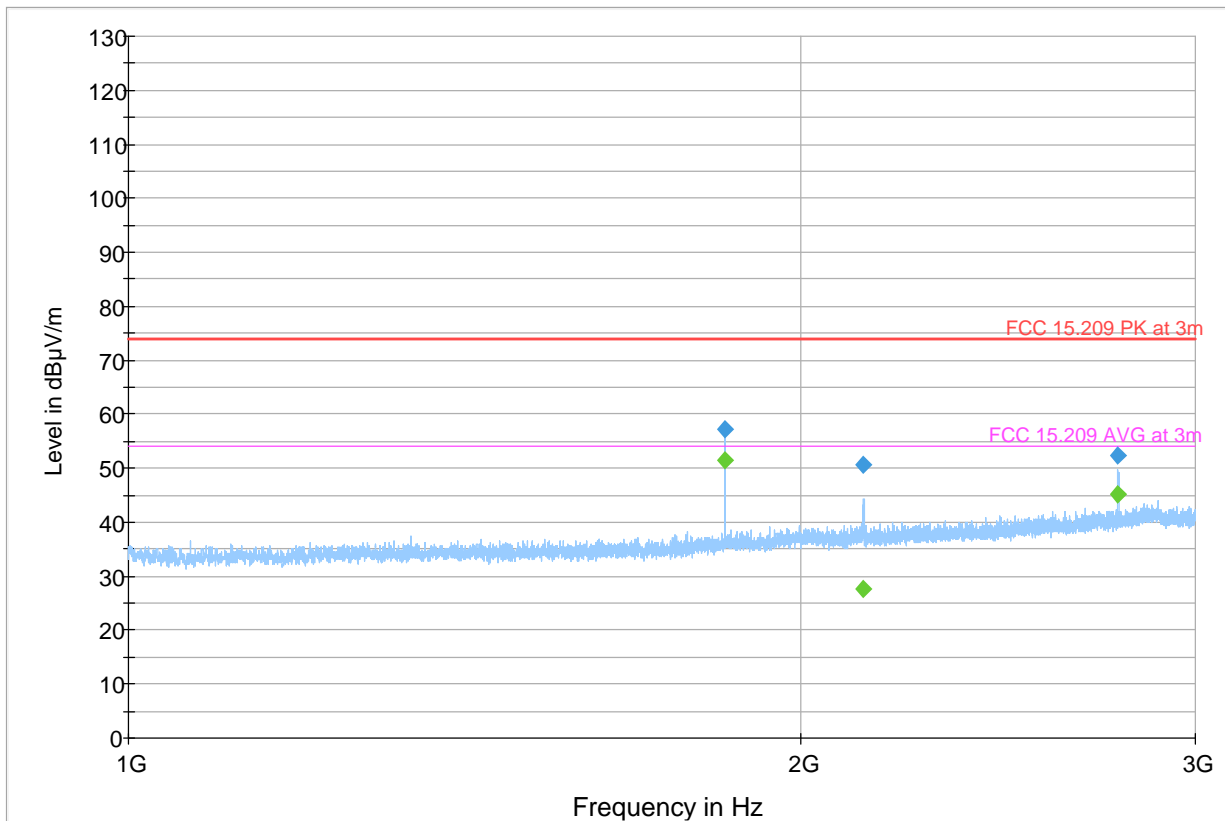


— Preview Result 1-PK+
 — FCC 15.209 QP at 3m
 ◆ Final_Result QPK



Plot # 9

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1847.571	57.21	---	73.98	16.77	500.0	1000.000	141.0	V	49.0	4.4
1847.571	---	51.61	53.98	2.37	500.0	1000.000	141.0	V	49.0	4.4
2132.286	---	27.48	53.98	26.50	500.0	1000.000	150.0	V	32.0	5.3
2132.286	50.66	---	73.98	23.32	500.0	1000.000	150.0	V	32.0	5.3
2771.571	---	45.19	53.98	8.79	500.0	1000.000	330.0	V	255.0	7.4
2771.571	52.47	---	73.98	21.51	500.0	1000.000	330.0	V	255.0	7.4

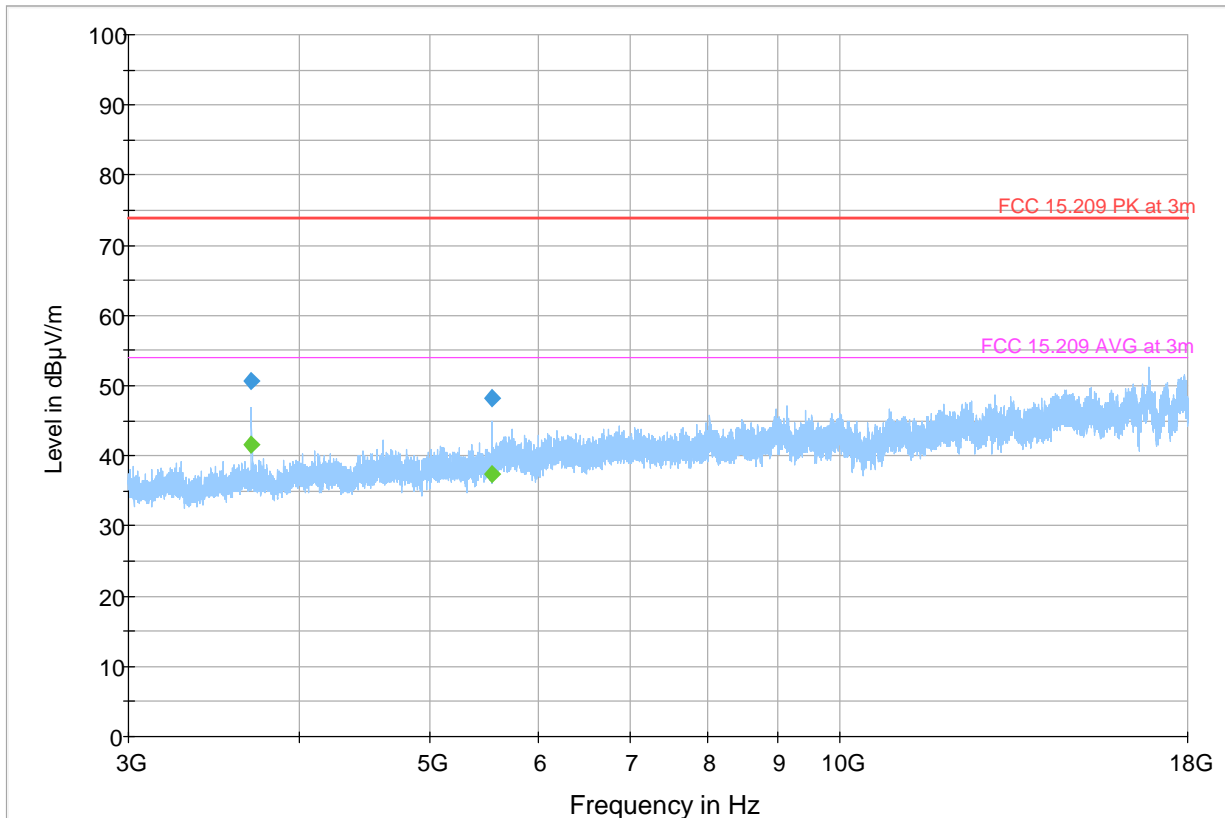


— Preview Result 2-AVG — Preview Result 1-PK+ — FCC 15.209 PK at 3m
— FCC 15.209 AVG at 3m ◆ Final_Result PK+ ◆ Final_Result CAV



Plot # 10

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3695.250	---	41.49	53.98	12.49	500.0	1000.000	125.0	H	118.0	-5.3
3695.250	50.57	---	73.98	23.41	500.0	1000.000	125.0	H	118.0	-5.3
5544.750	---	37.36	53.98	16.62	500.0	1000.000	100.0	V	119.0	-2.4
5544.750	48.15	---	73.98	25.83	500.0	1000.000	100.0	V	119.0	-2.4



— Preview Result 2-AVG
 — Preview Result 1-PK+
 — FCC 15.209 PK at 3m
— FCC 15.209 AVG at 3m
 ◆ Final_Result PK+
 ◆ Final_Result CAV

9 Test setup photos

Setup photos are included in supporting file name: "EMC_TELUL-101-21001_FCC_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Name/Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Biconilog Antenna	A.H. Systems	BiLA2G	569343	2 years	12/01/2020
Horn Antenna	ETS Lindgren	3115	35114	2 years	10/10/2020
Horn Antenna	ETS Lindgren	3117-PA	215984	2 years	01/31/2021
Active Loop Antenna	ETS Lindgren	6507	161344	2 years	10/30/2020
Spectrum Analyzer	R&S	ESU40	100251	2 years	09/13/2021
Thermometer Humidity Monitor	CONTROL COMPANY	36934-164	191871986	2 years	10/20/2021

Note:

1. Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.



11 History

Date	Template Revision	Changes to report	Prepared by
2022-01-12	EMC_TELUL-101-21001_FCC_15.247_ISM	Initial Version	Cheng Song

<<< The End >>>