FCC Test Report

For:
Qwake Technologies Inc.

Brand:
Qwake Tech

Marketing Name:
CThru Navigator

Model Number:
Navigator 1

Product Description:
Wireless Firefighter Vision and Communication Assistant

FCC ID: 2BH7A-QW-NAV-1R0-24

Applied Rules and Standards:
Title 47 CFR Part 15.225

REPORT #: EMC_QWAKE_003_25001_FCC_15_225

DATE: 7/21/2025

A2LA Accredited

IC recognized # 3462B

***CETECOM* Inc.**
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1 Assessment

The following equipment (as further described in section 3 of this report) was evaluated against the applicable criteria specified in the Code of Federal Regulations Title 47 CFR Part 15.225

No deficiencies were ascertained.

According to section 7 of this report, the overall result is PASS.

Company	Description	Model #
Qwake Technologies Inc.	Wireless Firefighter Vision and Communication Assistant	Navigator 1

Responsible for Testing Laboratory:

Date	Section	Name	Signature
7/21/2025	Compliance	Ilarina, Alvin (Senior Manager Regulatory Services)	Alvin ILARINA Digitally signed by Alvin ILARINA Date: 2025.07.22 09:01:23 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
7/21/2025	Compliance	Ghanma, Issa (Lab Manager EMC)	Issa Ghanma Digitally signed by: Issa Ghanma DN: CN = Issa Ghanma email = Issa.Ghanma@cetecom.com C = US O = CETECOM Inc. OU = EMC Date: 2025.07.21 14:17:03 -07'00'

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

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
Senior Manager Regulatory Services:	Ilarina, Alvin
Responsible Project Leader:	Hao, Shane

2.2 Identification of the Client

Applicant's Name:	Qwake Technologies Inc.
Street Address:	2632 Larkin St, Apt #6
City/Zip Code	San Francisco, CA 94109
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

Brand:	Qwake Tech
Model No:	Navigator 1
Marketing name:	CThru Navigator
FCC-ID:	• 2BH7A-QW-NAV-1R0-24 • Contains FCC ID: o XMR202008EC25AFXD
Hardware Version:	1.0.0
Software Version:	1.0.30
Firmware Version	47-1.3.1
Product Description:	Wireless Firefighter Vision and Communication Assistant
Radio Information	• NFC: NXP PN7160A1HN/C100E, 13.56 MHz o Modulation: ASK o Antenna: Molex Part Number 1462360001
Other radios included in the device (If any):	• Cellular: Quectel EC25-AFXD (FCC ID: XMR202008EC25AFXD) o LTE 2, 4, 5, 12, 13, 14, 66, 71 o UMTS II, IV, V (Disabled) • BT BR/EDR, BT LE, WLAN 2.4 & 5 GHz, and GPS: Lantronix Open-Q 865XR SOM (FCC ID: R68OQ865S) o BT BR/EDR, BT LE, WLAN, GPS (Disabled)
Power Specifications:	3.2 V LiFePO4 battery. 110V 60Hz AC for USB-C Charger.
Operating Temperature Range:	T min: 0 ºC / T Nom: 20 ºC / T max: +95 ºC
Sample Revision:	☐ Production Unit; ☑ Pre-Production
Product dimensions [cm]:	Approx 46 long x 29 wide x 10 tall
Note: The information of the EUT specifications in the table above is provided by the client. Refer to the operational description '*Operational Description R1.2*'	

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Details	Notes/Comments
1	CM: 246800046	1.0.0	1.0.30	Part number: 9341-16254-001/A IMEI: 862044070555110	CM: Compute Module
2	CM: 246800045	1.0.0	1.0.30	Part number: 9341-16254-001/A IMEI: 868260057904162	CM: Compute Module
3	CM: 246800066	1.0.0	1.0.30	Part number: 9341-16254-001/A IMEI: 868260057893621	CM: Compute Module
4	RFID: 246900043	1.0.0	1.0.30	Part number: 9341-16256-001/A	Tag
5	VM: 246600214	1.0.0	1.0.30	Part number: 9341-16251-900 With ferrite # 0461167281	VM: Vision Module

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	S/N	Notes/Comments
1	AC Adapter	AQ15A-050B	PHIHONG	V241201094A1	Input: 100-240V ~50-60Hz 0.5A Output: 5.0V 3.0A 15W
2	USB-C to USB-C cable	-	-	-	2.0 Generic 6 Feet long

3.4 Test Sample Configuration

Set-up #	EUT / AE used for set-up	Notes/Comments
1	EUT # 1 + EUT # 4 + EUT # 5	Radiated Emission
2	EUT # 1 + EUT # 4 + AE # 1 + AE # 2	AC conducted emissions
3	EUT # 3 + EUT # 4	Frequency stability, 20 dB bandwidth
4	EUT # 2 + EUT # 4 + EUT # 5	Field strength in band mask

3.5 Mode of Operation details

Mode of Operation	Description of Operating modes	Additional Information
Op. 1	NFC read continuously	• The Compute Module (CM) is mounted on the helmet, reading the tag continuously and connected through the USB-C port to the Vision Module (VM). • The Vision Module (VM) camera is projecting on the vision projector. The LED lights on the Compute Module (CM) are on. A ferrite # 0461167281 was clamped on the cable between the VM and CM. • The cellular radio is active (ON) and not connected.
Op. 2	Charging	• The Compute Module (CM) is charging and powered up through the USB-C port connected to the AC adapter by a USB-C to USB-C cable. • The Compute Module (CM) is mounted on the helmet, reading the tag continuously, and the cellular radio is active (ON) and not connected.
Op.3	Conducted	• The Compute Module (CM) is mounted on the helmet, reading the tag continuously and connected through the USB-C port to the Vision Module (VM), and the RFID RF conducted port (SMA) is connected to a spectrum analyzer. • The cellular radio is active (ON) and not connected.
Op.4	Radios disabled	• The Compute Module (CM) is mounted on the helmet and connected through the USB-C port to the Vision Module (VM) • The Vision Module (VM) camera is projecting on the vision projector. The LED lights on the Compute Module (CM) are on. A ferrite # 0461167281 was clamped on the cable between the VM and CM. • The NFC and cellular radios are disabled using scripts provided by the client.

3.6 Justification for Mode of Operation

For each test case in this report, the worst-case mode of operation was chosen based on the mode that exhibited the least margin relative to the specified limit or requirement derived from the conducted tests or module reports.

The operational mode(s) outlined in section 3.5 of this document and specified in the “Test conditions and setup” section of each test within this document.

For radiated measurements, all data in this report show the worst case between horizontal and vertical antenna polarizations and EUT orientation.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to evaluate the compliance of the EUT against the relevant requirements specified in the Code of Federal Regulations Title 47 CFR Part 15.225, 15.207, 15.209, 15.215

5 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=2.

Measurement System		EMC-Lab 1	EMC-Lab 2
Conducted emissions (mains port)	150 kHz – 30 MHz	2.47 dB	N/A
Radiated emissions	9 kHz – 30 MHz	2.68 dB	2.53 dB
	30 – 100 MHz	4.39 dB	3.85 dB
	100 MHz – 1 GHz	5.65 dB	5.24 dB
	1 – 6 GHz	5.0 dB	4.88 dB
	6 – 18 GHz	4.76 dB	4.58 dB
	18 – 40 GHz	4.65 dB	4.61 dB

RF antenna port measurement ±0.5 dB

5.1 Environmental Conditions during Testing:

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

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

Deviating test conditions are indicated in individual test descriptions where applicable.

5.2 Date of Testing:

5/27/2025 - 6/26/2025

5.3 Decision Rule:

Cetecom Inc. follows ILAC G8:09/2019 chapter 4.2.1 (Simple Acceptance Rule).

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3. The measurement uncertainty is mentioned in this test report, See chapter 9, but is not taken into account – neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong.

6 Measurement Procedures

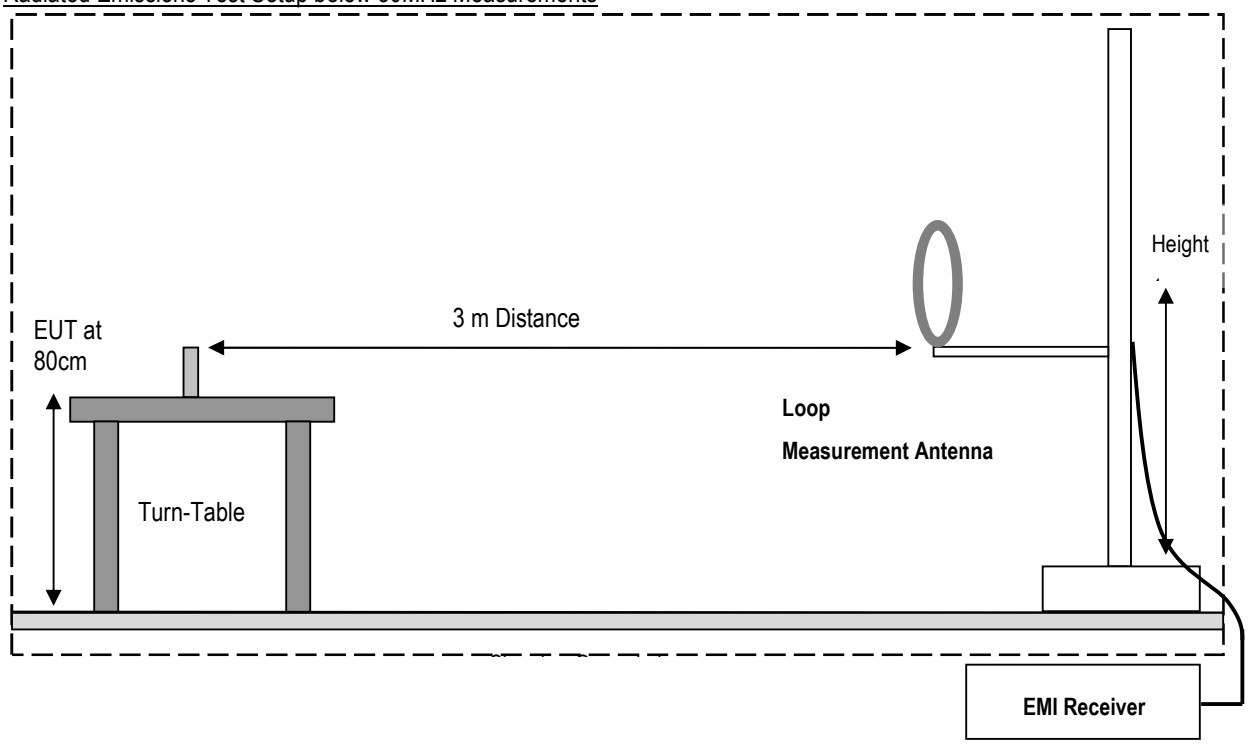
Testing is performed according to the guidelines provided in ANSI C63.10 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

6.1 Radiated Measurement

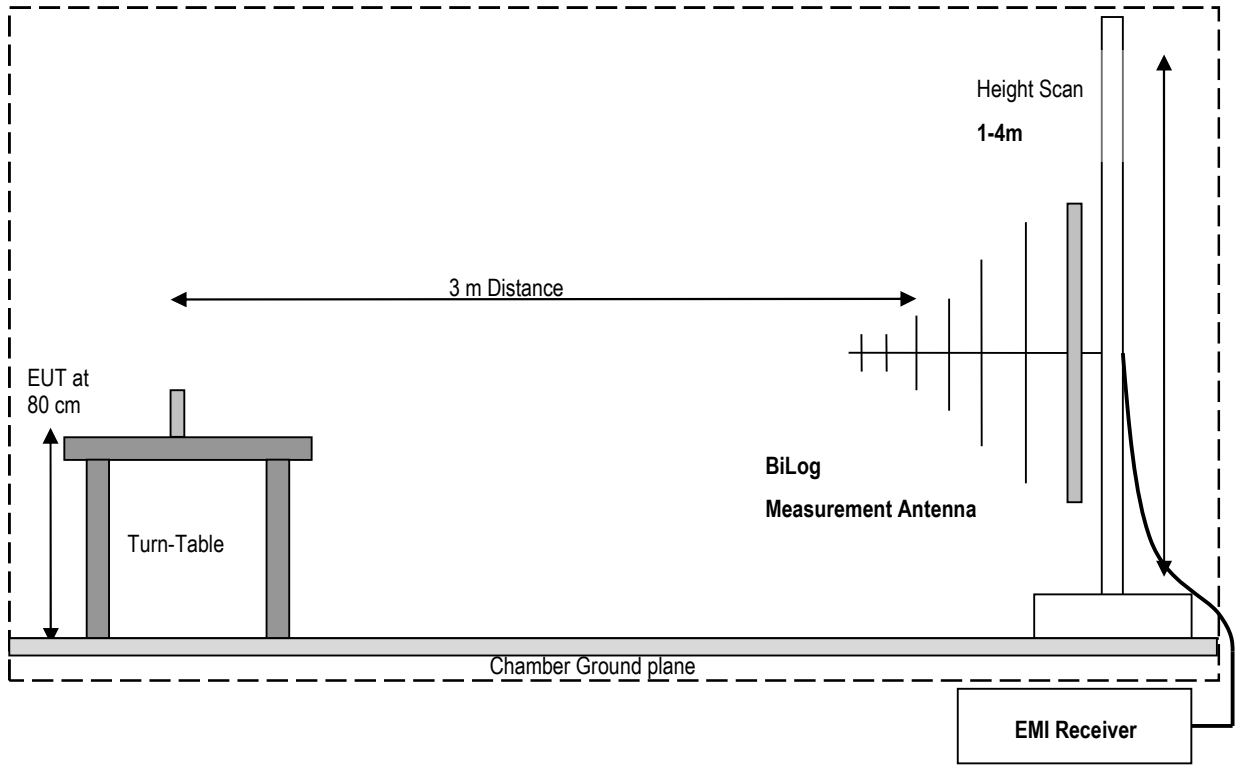
- The exploratory measurement is accomplished by running a matrix of sweeps over the required frequency range with R&S Test-SW EMC32 and continuous turntable movements during preview (360°), and both antenna polarizations (Horizontal/Vertical) at three antenna heights (1, 1.5, 2 meters). This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axes of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 6 highest emissions (emission level 6 dB higher than the noise floor and margin to the limit < 20 dB) 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 maximum are then put through the final measurement and again maximized in a 90° range of the turntable, fine search in the frequency domain, and height scan between 1m and 4m.
- 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 2 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, and a Biconilog antenna is used from 30 MHz to 1 GHz

6.2 Radiated Measurement Diagrams

Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



6.3 Sample Calculations for Field Strength Measurements

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

- Measured reading in dBµV
- Cable Loss between the receiving antenna and SA in dB and
- 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 (dBµV/m) = Measured Value on SA (dBµV) + Cable Loss (dB) + 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

6.4 Field Strength Correction Based on Distance

To correct for distance when measuring at a distance other than the specification distance;

- For measurements below 30 MHz: $FS_{limit} = FS_{max} – 40\log (d_{limit}/d_{measure})$
- For measurements above 30 MHz: $FS_{limit} = FS_{max} – 20\log (d_{limit}/d_{measure})$

where
FS_{limit} is the calculation of field strength at the limit distance, expressed in dBµV/m
FS_{max} is the measured field strength, expressed in dBµV/m
$d_{measure}$ is the distance of the measurement point from the EUT
d_{limit} is the reference limit distance – 40log(SpecDistance/TestDistance) = Distance Factor

Example:

Frequency (MHz)	Field Strength Limit @30m (µV/m)	Field Strength Limit @30m (dBµV/m)	Field Strength limit @3m (dBµV/m)
10	30	29.54	69.54
100	30	29.54	49.54

6.5 RF Antenna port measurement

- 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.

7 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
FCC §15.209; FCC §15.225(d);	Radiated Emissions	Nominal	Op.1 Op.4	☑	☐	☐	Complies
FCC §15.207	AC Conducted Emissions	Nominal	Op.2	☑	☐	☐	Complies
FCC §15.225(e);	Frequency Stability	Nominal and Extreme Temperature	Op.3	☑	☐	☐	Complies Note 2
FCC §15.225(a), (b), (c);	Field strength in the band mask	Nominal	Op.3	☑	☐	☐	Complies
FCC §15.215(c);	20 dB Bandwidth	Nominal	Op.3	☑	☐	☐	Complies

Note 1: NA = Not Applicable; NP = Not Performed.

Note 2: The equipment under test is battery-operated and was tested with a fully charged battery. Variation in the primary supply voltage is not applicable.

8 Test Result Data

8.1 Radiated Emissions Measurement

8.1.1 Measurement according to ANSI C63.10

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 3 KHz
- Detector: Peak

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

8.1.2 Limits:

FCC §15.225

- The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

FCC §15.209

- 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)*1
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
88–216	150	3	43.5
216–960	200	3	46
Above 960	500	3	54

*1: Refer to section 6.4 of this document for the correction based on distance.

8.1.3 Test Summary:

Environmental Conditions	
Ambient Temperature:	23° C
Relative Humidity:	42%
Atmospheric Pressure:	1010 mbar

Test Results					
Plot #	**EUT Set-Up #**	**EUT operating mode**	**Scan Frequency**	**Power Supply Input**	**Result**
1	1	Op. 1	9 kHz – 30 MHz	3.2 V LiFePO4 battery	Pass
2	1	Op. 1	30 MHz – 1 GHz	3.2 V LiFePO4 battery	Pass
3	1	Op.4	30 MHz – 1 GHz	3.2 V LiFePO4 battery	Not applicable*1

*1: This test was performed to determine whether the emission observed at approximately 390 MHz originates from the intentional radiator or the digital device, in order to assess compliance with FCC §§15.209/15.225. The measurement was taken with the radios disabled (Plot 3) and compared to the measurement with the radios enabled (Plot 2) to evaluate any variation in emission levels. The objective was to verify whether the ~390 MHz emission is attributable solely to the digital device, which is subject to the requirements of FCC §15.109 Class A (Refer to test report '*25-3-0001501T001-TR-QWAKE-003-25001-FCC15B*' section 4.2). The observed difference in the emission level is a negligible variation, which confirms that the ~390 MHz emission is associated with the digital device alone.

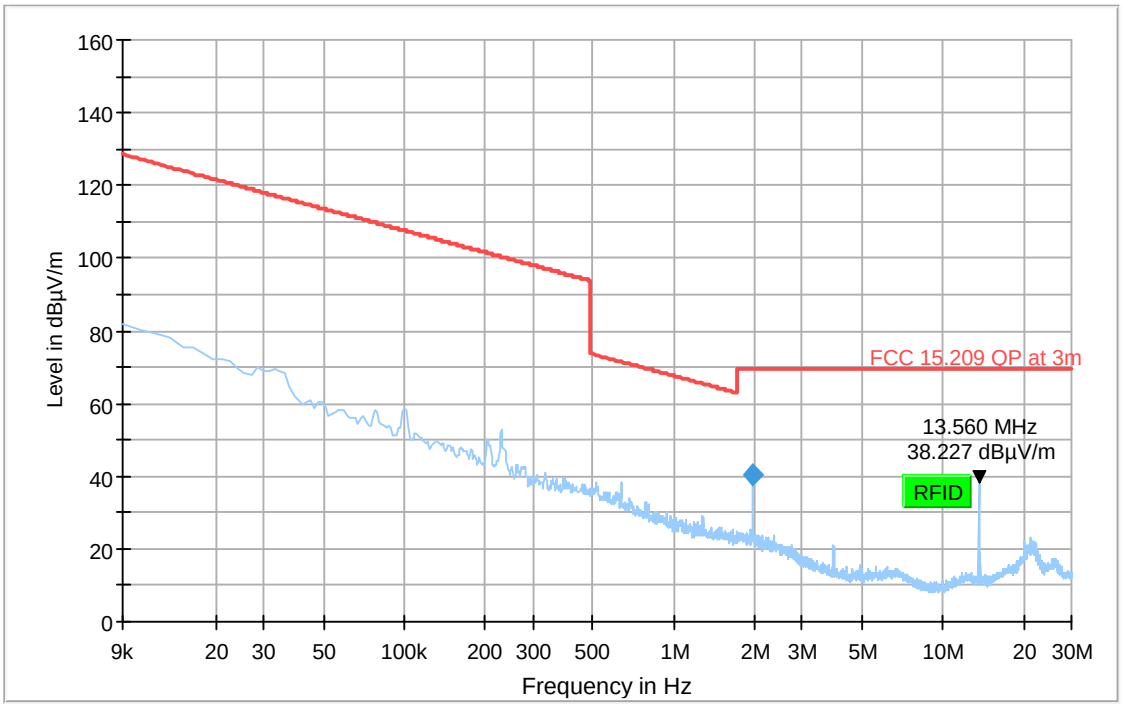
8.1.4 Measurement Plots:

Plot # 1 Radiated Emissions: 9 kHz – 30 MHz

Tx Frequency: 13.56 MHz	ASK

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)
1.968	40.452	69.50	29.05	1000.0	3.0	100.0	V	310.0	13.5	0.3	-28.7	41.9	27.0



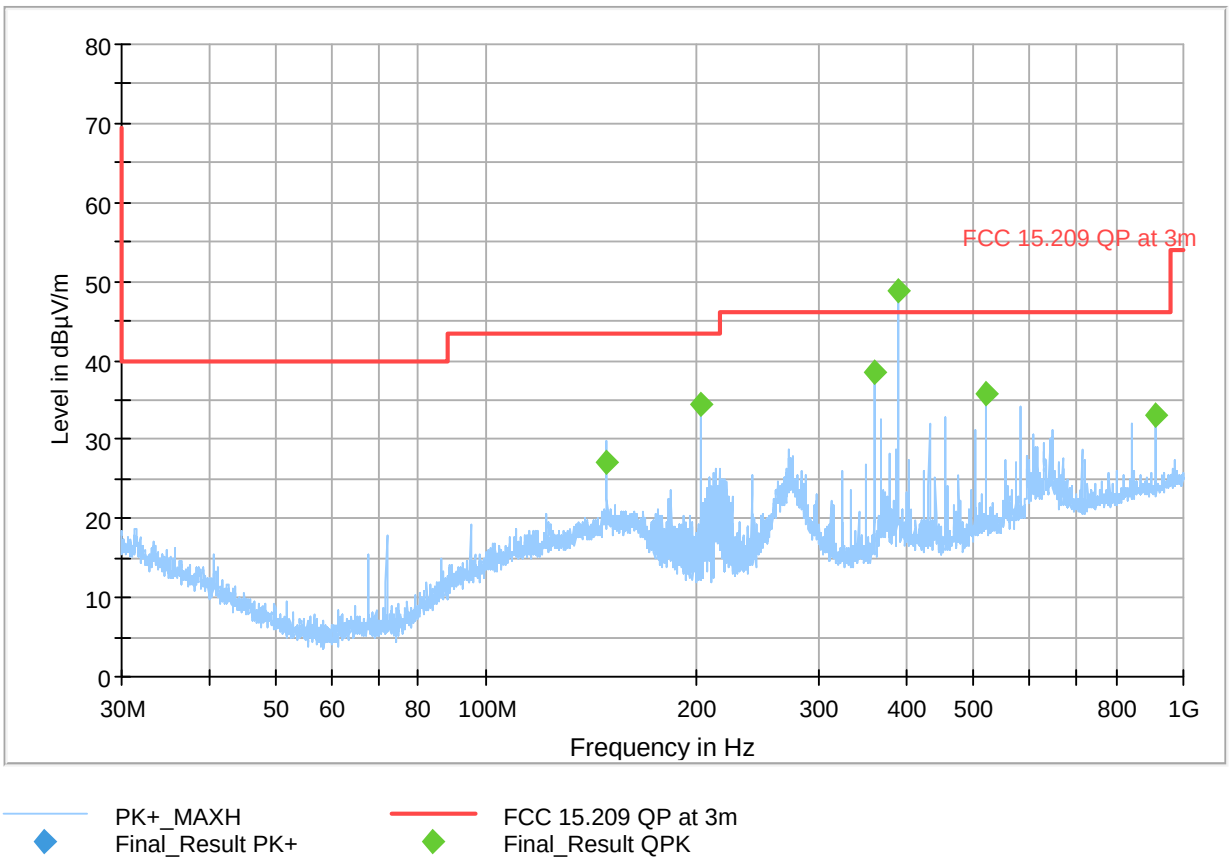
Plot # 2 Radiated Emissions: 30 MHz – 1 GHz

See section 8.1.3 of this document *1 statement

Tx Frequency: 13.56 MHz	ASK

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)
149.140	27.169	43.50	16.33	500.0	120.0	100.0	V	244.0	-10.0	-34.4	0.0	24.4	37.2
203.388	34.358	43.50	9.14	500.0	120.0	100.0	V	230.0	-15.9	-34.2	0.0	18.2	50.3
359.970	38.392	46.02	7.63	500.0	120.0	151.0	V	46.0	-13.0	-33.6	0.0	20.6	51.4
389.967	48.841	46.02	-2.82	500.0	120.0	100.0	H	73.0	-11.2	-33.4	0.0	22.3	60.0
519.971	35.832	46.02	10.19	500.0	120.0	100.0	V	101.0	-8.7	-33.1	0.0	24.4	44.5
909.984	32.955	46.02	13.07	500.0	120.0	135.0	H	108.0	-3.1	-32.0	0.0	28.9	36.1



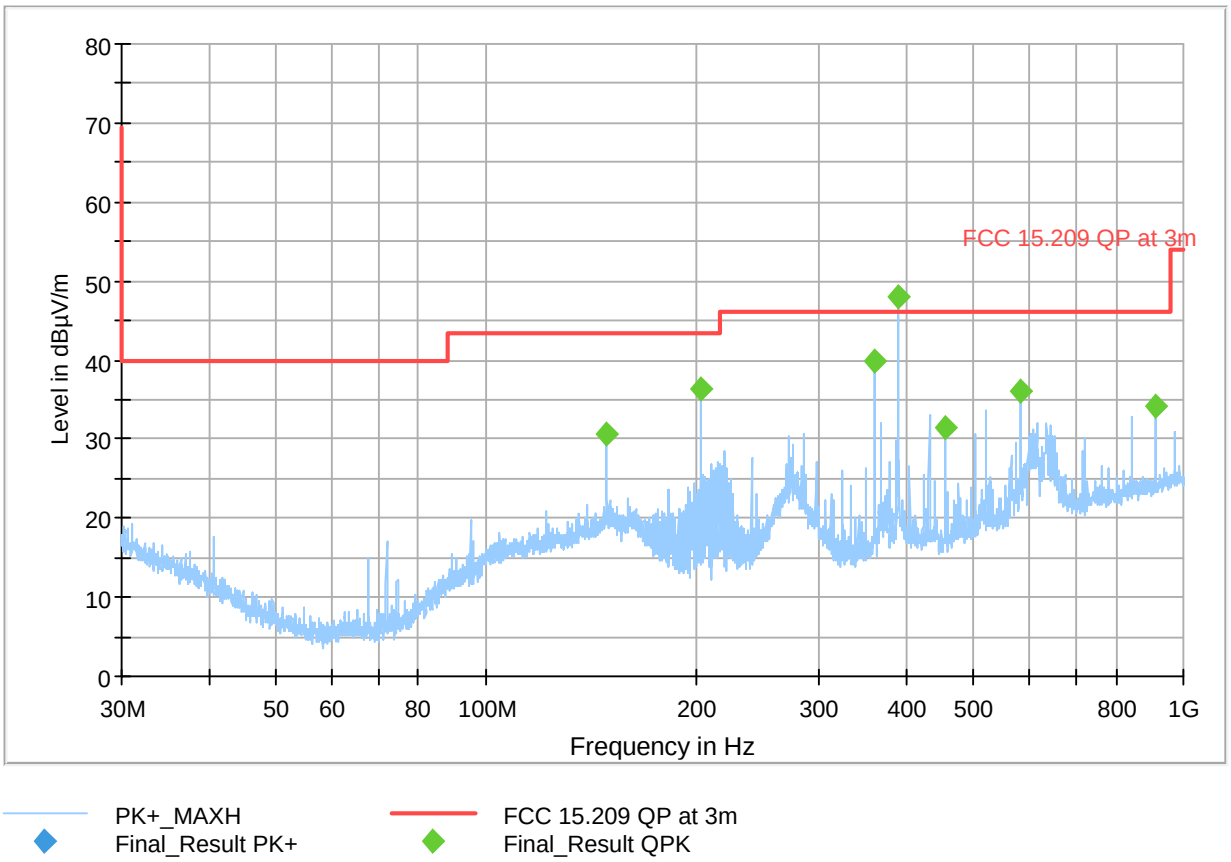
Plot # 3 Radiated Emissions: 30 MHz – 1 GHz

See section 8.1.3 of this document *1 statement

Tx Frequency: 13.56 MHz	ASK

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)
149.163	30.689	43.50	12.81	500.0	120.0	160.0	H	69.0	-9.3	-34.4	0.0	25.1	40.0
203.405	36.262	43.50	7.24	500.0	120.0	107.0	H	281.0	-16.2	-34.2	0.0	17.9	52.5
359.988	39.991	46.02	6.03	500.0	120.0	100.0	H	123.0	-12.6	-33.6	0.0	21.0	52.6
389.992	48.077	46.02	-2.06	500.0	120.0	193.0	H	286.0	-11.2	-33.4	0.0	22.3	59.2
455.000	31.360	46.02	14.66	500.0	120.0	134.0	V	232.0	-10.4	-33.3	0.0	22.9	41.7
585.000	35.969	46.02	10.05	500.0	120.0	135.0	H	95.0	-8.2	-32.9	0.0	24.7	44.2
909.999	34.226	46.02	11.79	500.0	120.0	100.0	H	190.0	-3.1	-32.0	0.0	28.9	37.3



8.2 AC Power line Conducted Emissions according to CFR 47 Part 15.207

Exploratory Measurements Spectrum Analyzer Setting	
Frequency band	150 kHz – 30 MHz
Resolution Bandwidth	9 kHz
Detector	Peak, Average
Trace Mode	Max Hold
Step Size	4 kHz
Measurement Time	coupled

8.2.1 Measurement Procedure:

- The EUT and accessories are placed on a non-conducting table 80 cm above the horizontal ground plane and 40 cm from the vertical ground plane.
- Cables that hang closer than 40 cm to the ground plane are gathered into a 30 cm to 40 cm long bundle.
- The power cable of the EUT is connected to the LISN.
- The 6 highest emissions within 20 dB of the limit are noted.

8.2.2 Limits:

FCC §15.207

- (a)Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

8.2.3 Test Summary:

Environmental Conditions	
Ambient Temperature:	22° C
Relative Humidity:	42.4%
Atmospheric Pressure:	1011 mbar

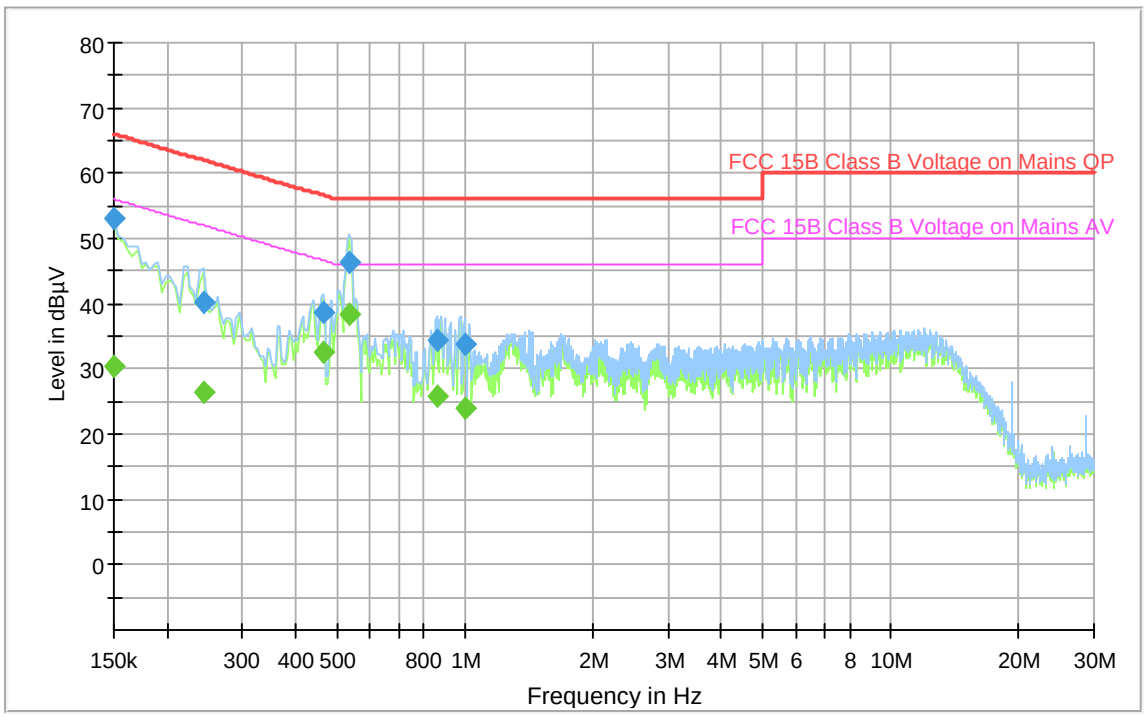
Test Results							
Plot #	**EUT Set-Up #**	**EUT operating mode**	**Detector (Peak / AVG / QP)**	**Line Under Test**	**Power Supply Input**	**Comments**	**Result**
4	2	Op. 2	QP & AVG	Line & Neutral	120 V AC	Final measurement	Pass

8.2.4 Measurement Plots:

Plot # 4

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150	---	30.26	56.00	25.74	1000.0	9.0	L1	GND	10.1
0.150	53.18	---	66.00	12.82	1000.0	9.0	L1	GND	10.1
0.243	---	26.55	52.00	25.45	1000.0	9.0	L1	GND	10.0
0.243	40.32	---	62.00	21.68	1000.0	9.0	L1	GND	10.0
0.465	---	32.49	46.61	14.12	1000.0	9.0	L1	GND	9.9
0.465	38.80	---	56.61	17.81	1000.0	9.0	L1	GND	9.9
0.533	46.38	---	56.00	9.62	1000.0	9.0	L1	GND	9.9
0.533	---	38.28	46.00	7.72	1000.0	9.0	L1	GND	9.9
0.860	34.27	---	56.00	21.73	1000.0	9.0	L1	GND	9.9
0.860	---	25.67	46.00	20.33	1000.0	9.0	L1	GND	9.9
0.997	---	24.03	46.00	21.97	1000.0	9.0	L1	GND	9.9
0.997	33.84	---	56.00	22.16	1000.0	9.0	L1	GND	9.9



8.3 Field strength in band mask

Exploratory Measurements Spectrum Analyzer Setting	
Frequency band	13.110 – 14.010 MHz
Resolution Bandwidth	3 kHz
Detector	Peak
Trace Mode	Max Hold
Step Size	1.5 kHz
Measurement Time	coupled

8.3.1 Limits:

FCC §15.225

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters
- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

The limits above are converted to dBµV/m using the formula: 20log(microvolts/meter)

The limits above are converted to dBµV/m @ 3 meters distance according to ANSI C63.10:2020 clause 6.4.4.2 Equation (4):

$FS_{limit} = FS_{max} - 40\log (d_{limit}/d_{measure})$

where
FS_{limit} is the calculation of field strength at the limit distance, expressed in dBµV/m
FS_{max} is the measured field strength, expressed in dBµV/m
$d_{measure}$ is the distance of the measurement point from the EUT
d_{limit} is the reference limit distance

- Within the band 13.553-13.567 MHz
  - 15.848 microvolts/meter = 84 dBµV/m = 124 dBµV/m @ 3 Meters
- Within the band 13.410-13.553 MHz and 13.567-13.710 MHz
  - 334 microvolts/meter = 50.475 dBµV/m = 90.475 dBµV/m @ 3 Meters
- Within the band 13.110-13.410 MHz and 13.710-14.010
  - 106 microvolts/meter = 40.506 dBµV/m = 80.506 dBµV/m @ 3 Meters

8.3.2 Test Summary:

Environmental Conditions	
Ambient Temperature:	23° C
Relative Humidity:	42%
Atmospheric Pressure:	1010 mbar

Test Results					
Plot #	**EUT Set-Up #**	**EUT operating mode**	**Scan Frequency**	**Power Supply Input**	**Result**
4	4	Op. 1	13.110 – 14.010 MHz	3.2 V LiFePO4 battery	Pass

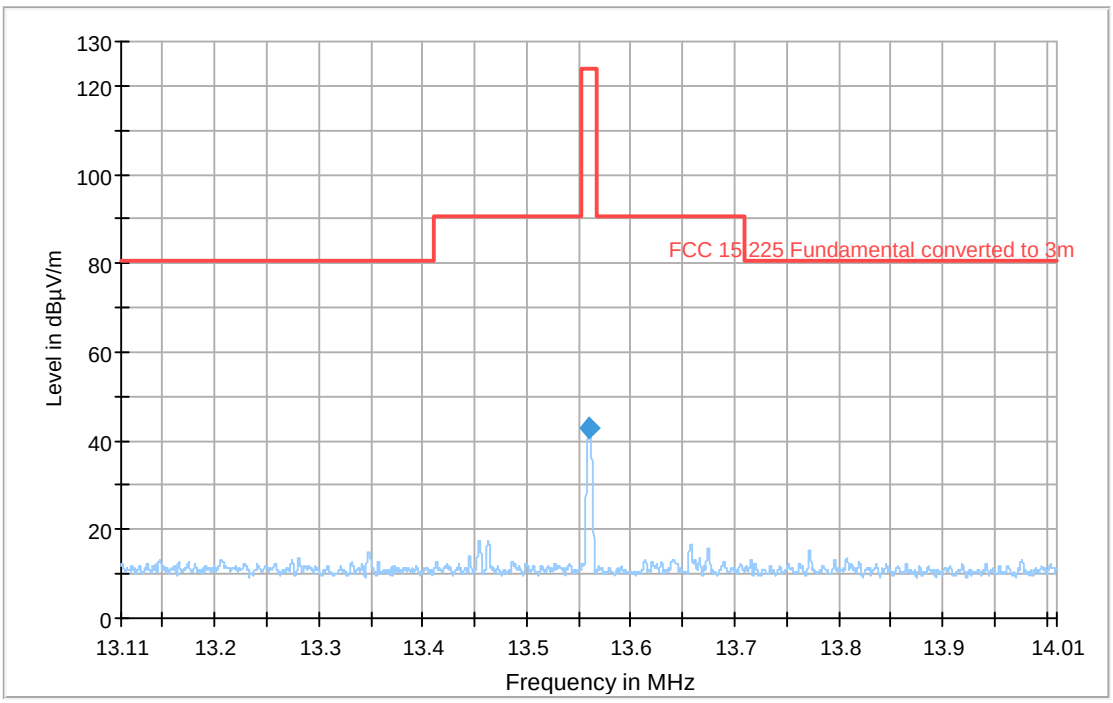
8.3.1 Measurement Plots:

Plot # 5 Radiated Emissions: 13.110 – 14.010 MHz

Tx Frequency: 13.56 MHz	ASK

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)	Preamp (dB)	Trd Corr. (dB/m)	Raw Rec (dBµV)
13.560	43.041	124.00	80.96	1000.0	9.0	100.0	H	14.0	6.1	0.4	-28.9	34.6	36.9



8.4 Frequency Stability

8.4.1 Measurement according to ANSI C63.10:2020 clause 6.8.1 Frequency stability with respect to ambient temperature

a) Supply the EUT with a nominal AC voltage or install a new or fully charged battery in the EUT.

If possible, a dummy load shall be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, then the EUT shall be placed in the center of the chamber with the antenna adjusted to the shortest length possible.

Turn ON the EUT and tune it to one of the number of frequencies shown in 5.6.

b) Couple the unlicensed wireless device output to the measuring instrument by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away), or by connecting a dummy load to the measuring instrument, through an attenuator if necessary.

NOTE – An instrument that has an adequate level of accuracy as specified by the procuring or regulatory agency is the recommended measuring instrument.

c) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).

d) Turn the EUT OFF and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.

e) Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.

f) While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

g) Measure the frequency at each of the frequencies specified in 5.6.

h) Switch OFF the EUT but do not switch OFF the oscillator heater.

i) Lower the chamber temperature by not more than 10 °C, and allow the temperature inside the chamber to stabilize.

j) Repeat step f) through step i) down to the lowest specified temperature.

Spectrum Analyzer settings

- RBW =300 Hz
- VBW = 1 kHz
- Set span = 8 kHz
- Sweep time = auto couple
- Detector = Peak
- Trace mode = MaxHold

8.4.2 Limits

FCC §15.225(e); The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to + 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery

8.4.3 Test Summary:

Test Results				
Plot #	**EUT Set-Up #**	**EUT operating mode**	**Power Supply Input**	**Result**
5 – 12	3	Op. 3	3.2 V LiFePO4 battery	Pass

8.4.1 Measurement result:

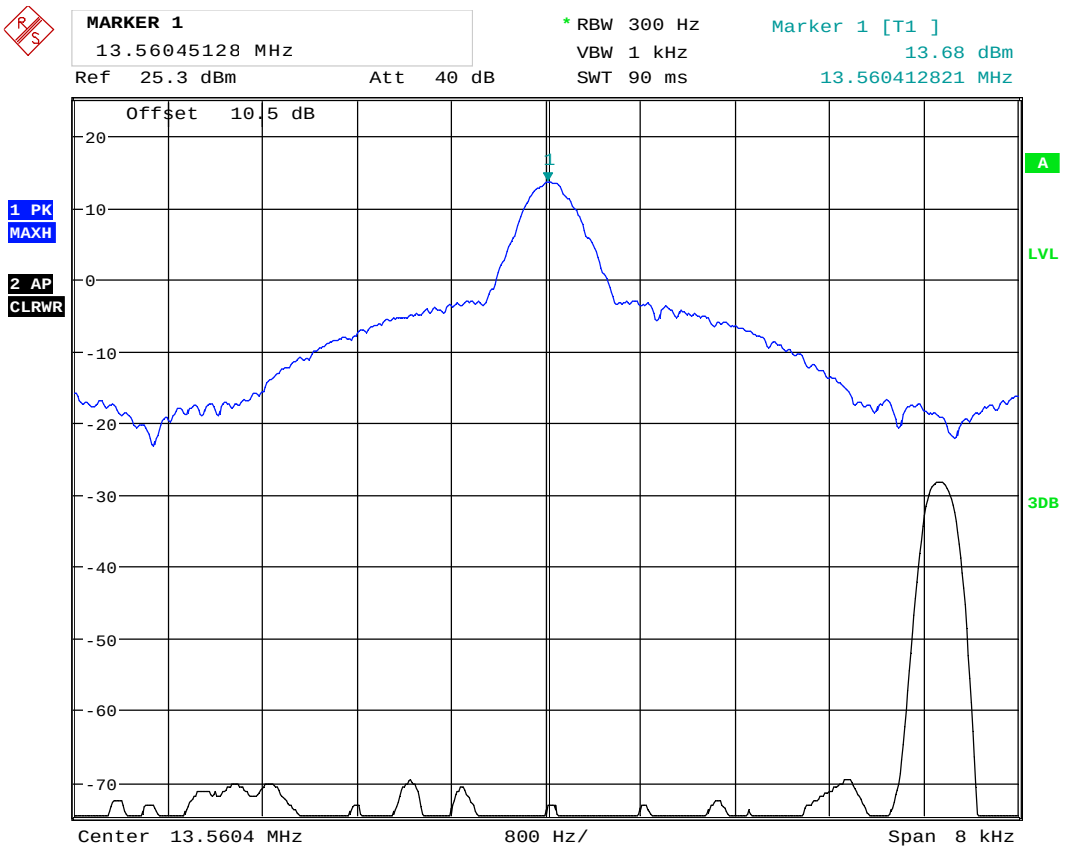
Test Results						
Plot #	**Temperature (°C)**	**Measurement Time (Minutes)**	**Measured Peak (dBm)**	**Tolerance*1 (%)**	**Limit (%)**	**Result**
6	20	Reference	13.560413	-	-	-
7	+50	0	13.560387	0.0002	0.01	Pass
		2	13.560426	0.0001	0.01	Pass
		5	13.560426	0.0001	0.01	Pass
		10	13.560374	0.0003	0.01	Pass
8	+40	0	13.560400	0.0001	0.01	Pass
		2	13.560400	0.0001	0.01	Pass
		5	13.560374	0.0003	0.01	Pass
		10	13.560400	0.0001	0.01	Pass
9	+30	0	13.560426	0.0001	0.01	Pass
		2	13.560362	0.0004	0.01	Pass
		5	13.560387	0.0002	0.01	Pass
		10	13.560464	0.0004	0.01	Pass
10	+10	0	13.560451	0.0003	0.01	Pass
		2	13.560515	0.0008	0.01	Pass
		5	13.560464	0.0004	0.01	Pass
		10	13.560451	0.0003	0.01	Pass
11	0	0	13.560400	0.0001	0.01	Pass
		2	13.560464	0.0004	0.01	Pass
		5	13.560464	0.0004	0.01	Pass
		10	13.560451	0.0003	0.01	Pass

12	-10	0	13.560451	0.0003	0.01	Pass
		2	13.560413	0.0000	0.01	Pass
		5	13.560451	0.0003	0.01	Pass
		10	13.560528	0.0009	0.01	Pass
13	-20	0	13.560400	0.0001	0.01	Pass
		2	13.560400	0.0001	0.01	Pass
		5	13.560362	0.0004	0.01	Pass
		10	13.560413	0.0000	0.01	Pass

*1 Tolerance = |(Measured Peak/Reference peak)-1| *100

8.4.1 Measurement plots:

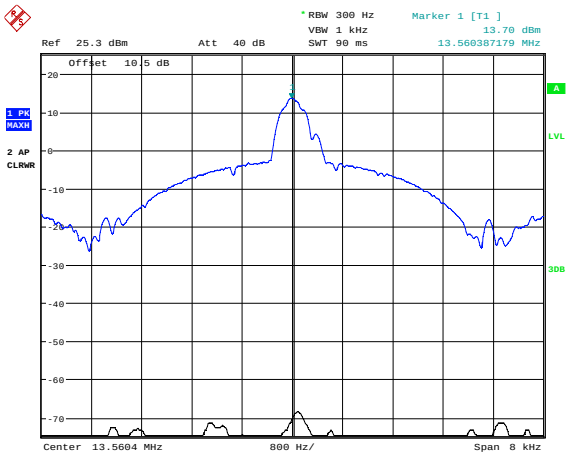
Plot #6		
13.56 MHz	Reference Measurement	Temperature: 20°C

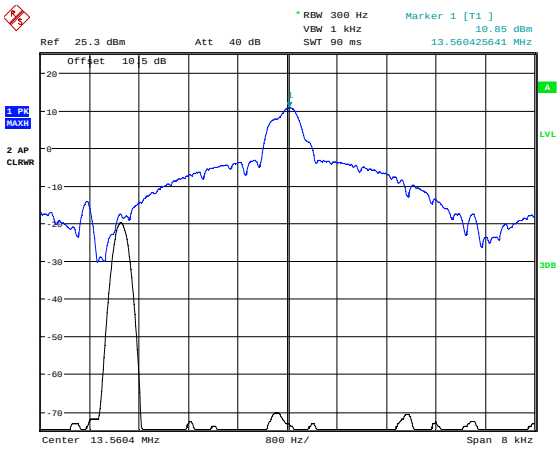


Date: 27.MAY.2025 12:53:16

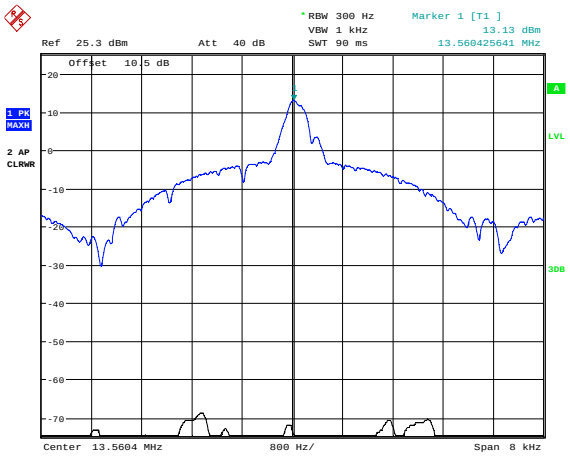
Plot #7

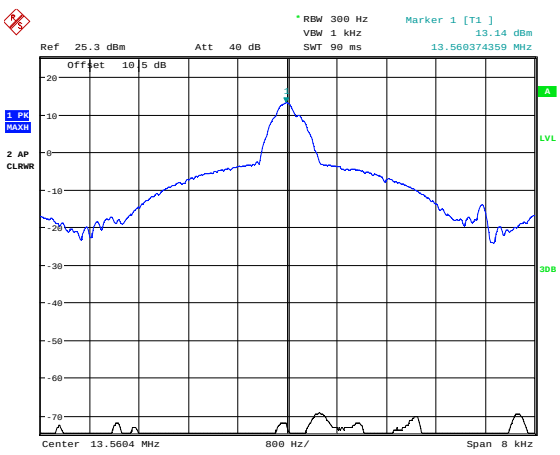
13.56 MHz	Measurement time: 0 min	Temperature: 50°C	13.56 MHz	Measurement time: 2 min	Temperature: 50°C





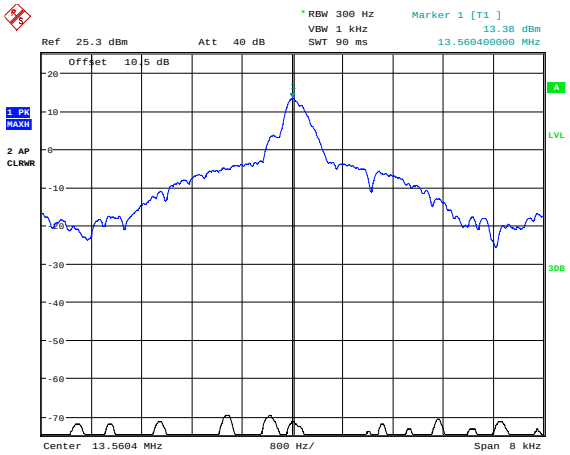
13.56 MHz	Measurement time: 5 min	Temperature: 50°C	13.56 MHz	Measurement time: 10 min	Temperature: 50°C

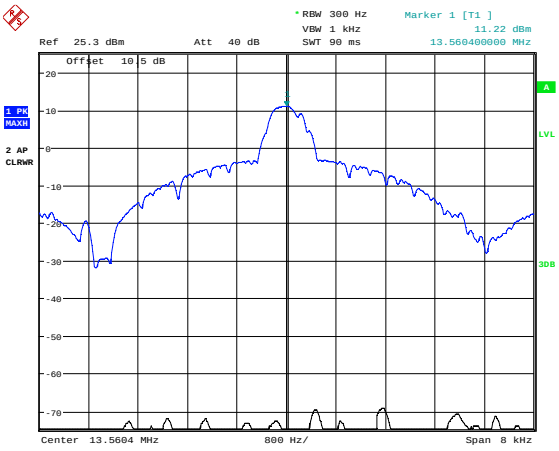




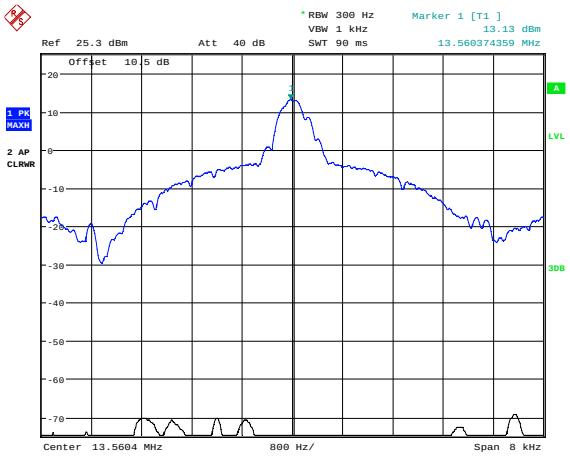
Plot #8

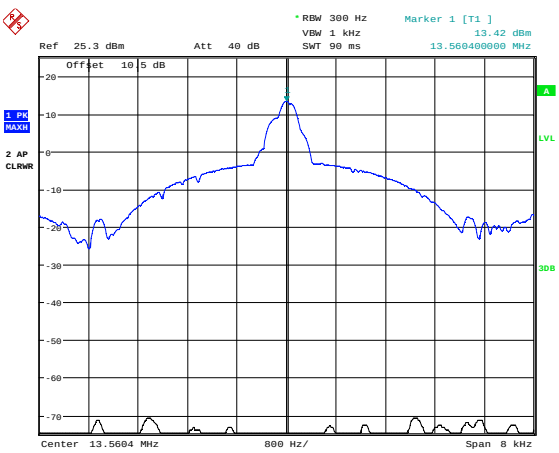
13.56 MHz	Measurement time: 0 min	Temperature: 40°C	13.56 MHz	Measurement time: 2 min	Temperature: 40°C





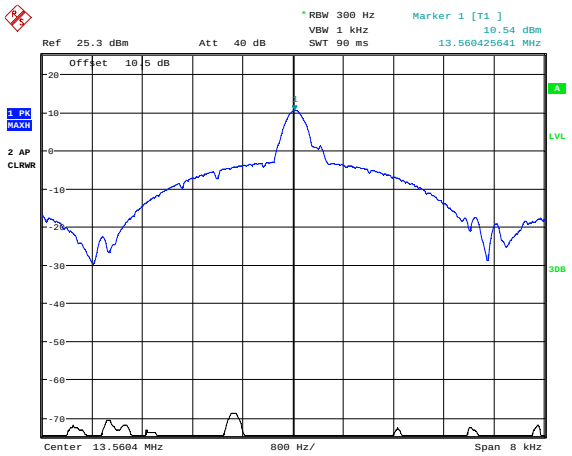
13.56 MHz	Measurement time: 5 min	Temperature: 40°C	13.56 MHz	Measurement time: 10 min	Temperature: 40°C



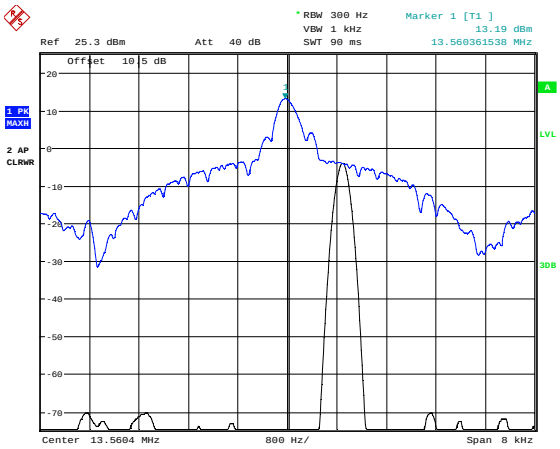


Plot #9

13.56 MHz	Measurement time: 0 min	Temperature: 30°C	13.56 MHz	Measurement time: 2 min	Temperature: 30°C

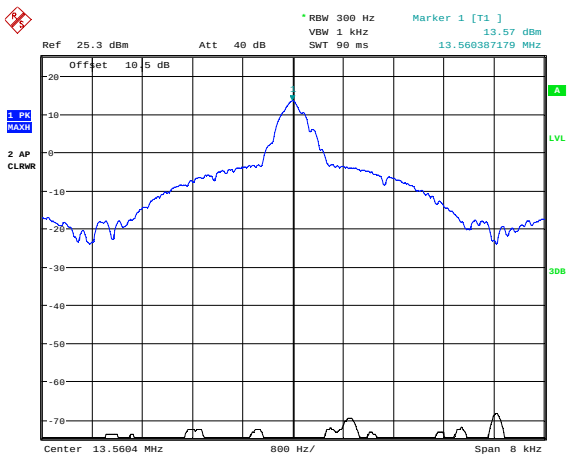


Date: 27.MAY.2025 14:24:06

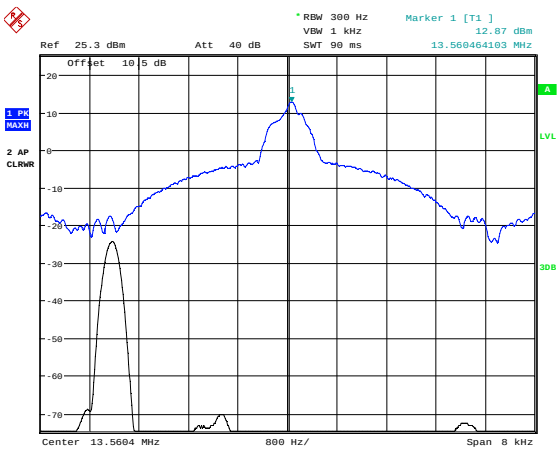


Date: 27.MAY.2025 14:26:33

13.56 MHz	Measurement time: 5 min	Temperature: 30°C	13.56 MHz	Measurement time: 10 min	Temperature: 30°C



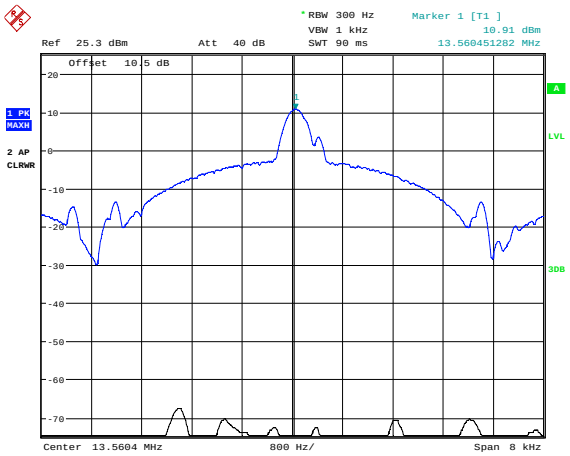
Date: 27.MAY.2025 14:30:24



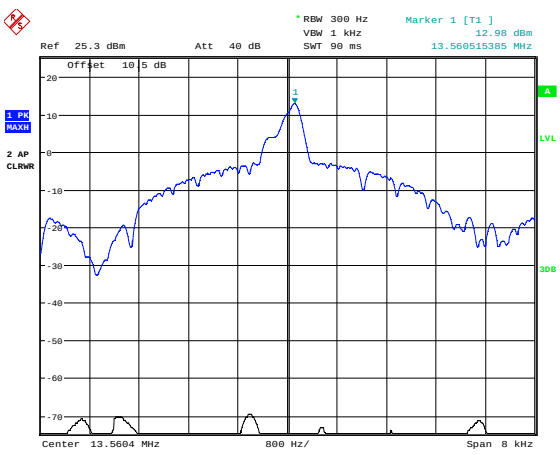
Date: 27.MAY.2025 14:35:37

Plot #10

13.56 MHz	Measurement time: 0 min	Temperature: 10°C	13.56 MHz	Measurement time: 2 min	Temperature: 10°C

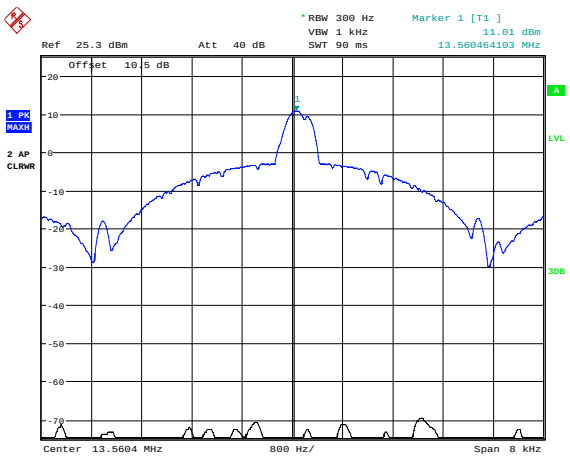


Date: 27.MAY.2025 15:19:49

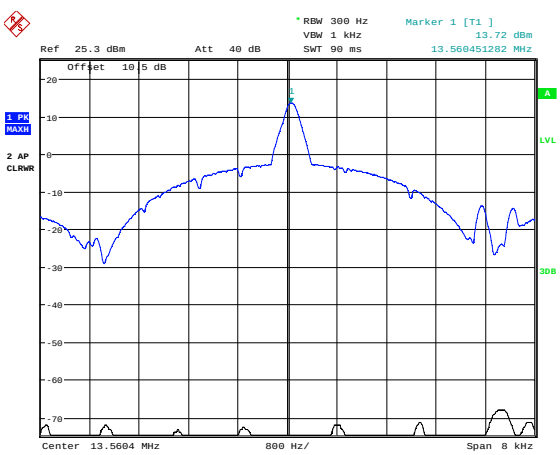


Date: 27.MAY.2025 15:22:07

13.56 MHz	Measurement time: 5 min	Temperature: 10°C	13.56 MHz	Measurement time: 10 min	Temperature: 10°C



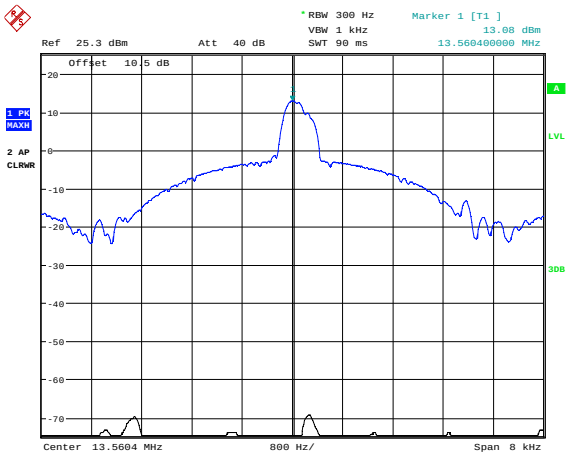
Date: 27.MAY.2025 15:25:28



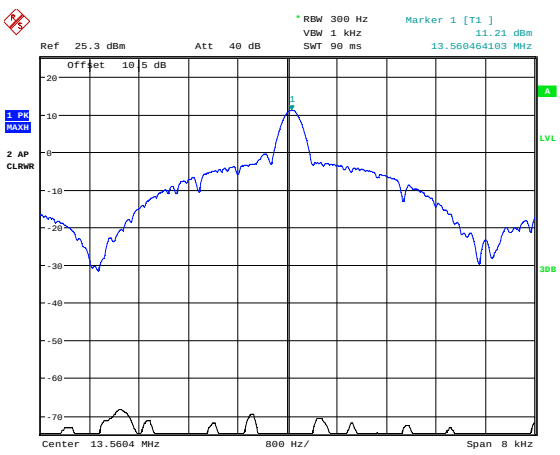
Date: 27.MAY.2025 15:30:28

Plot #11

13.56 MHz	Measurement time: 0 min	Temperature: 0°C	13.56 MHz	Measurement time: 2 min	Temperature: 0°C

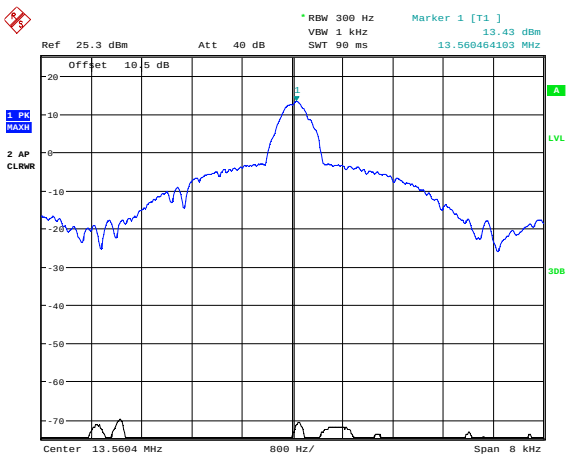


Date: 27.MAY.2025 15:47:21

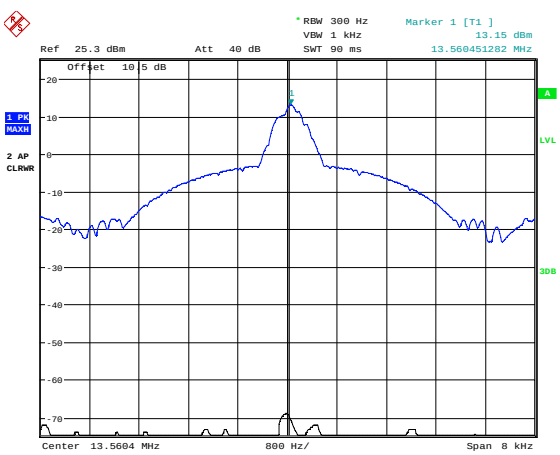


Date: 27.MAY.2025 15:49:28

13.56 MHz	Measurement time: 5 min	Temperature: 0°C	13.56 MHz	Measurement time: 10 min	Temperature: 0°C



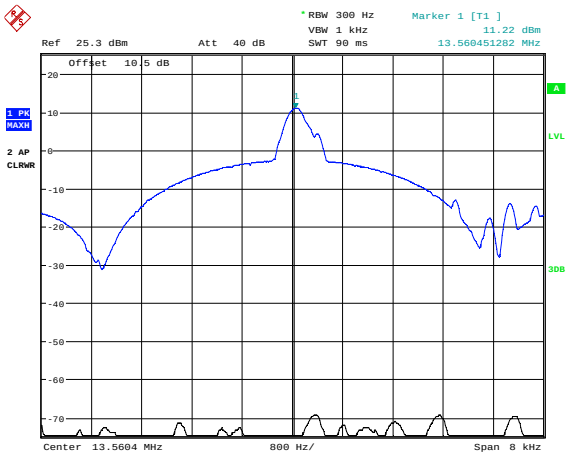
Date: 27.MAY.2025 15:52:39



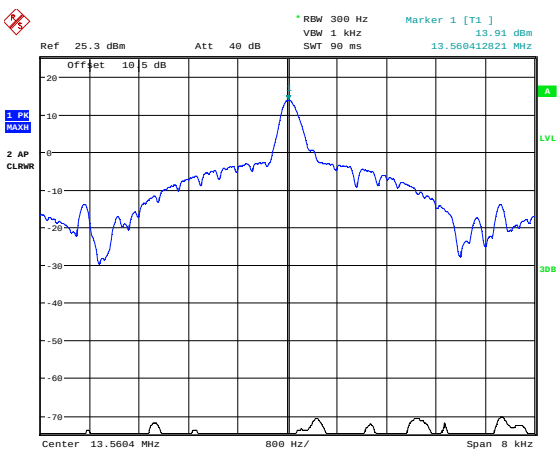
Date: 27.MAY.2025 15:57:57

Plot #12

13.56 MHz	Measurement time: 0 min	Temperature: -10°C	13.56 MHz	Measurement time: 2 min	Temperature: -10°C

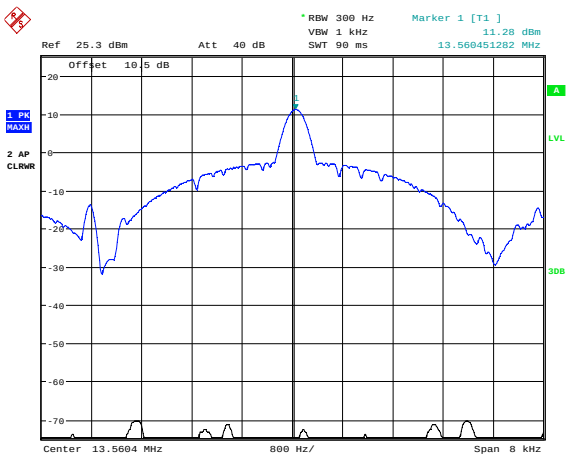


Date: 27.MAY.2025 16:36:07

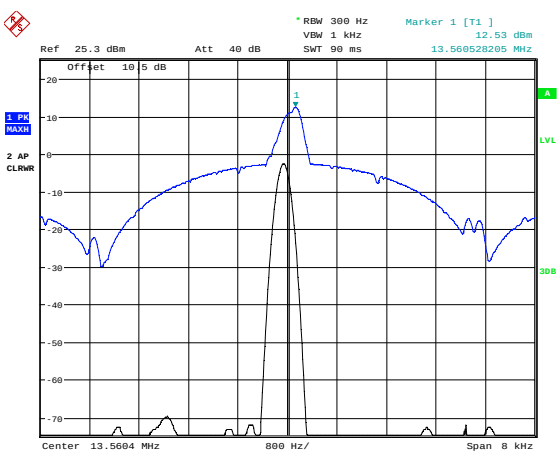


Date: 27.MAY.2025 16:38:17

13.56 MHz	Measurement time: 5 min	Temperature: -10°C	13.56 MHz	Measurement time: 10 min	Temperature: -10°C



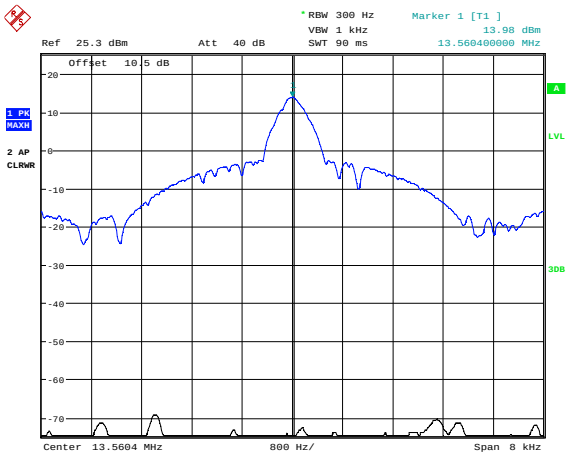
Date: 27.MAY.2025 16:41:27



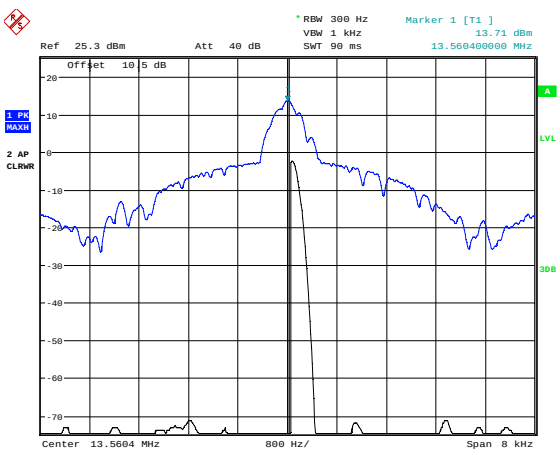
Date: 27.MAY.2025 16:46:38

Plot #13

13.56 MHz	Measurement time: 0 min	Temperature: -20°C	13.56 MHz	Measurement time: 2 min	Temperature: -20°C

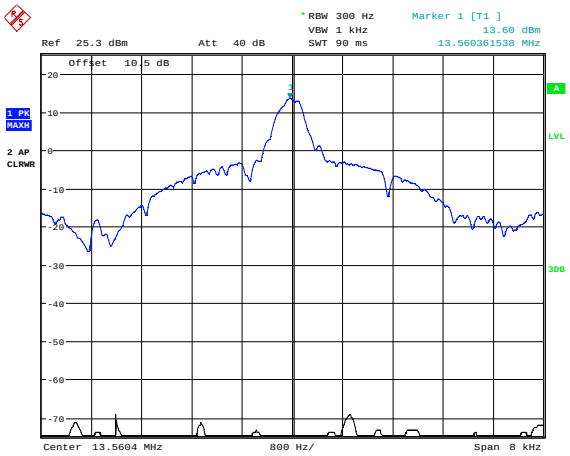


Date: 28.MAY.2025 10:20:30

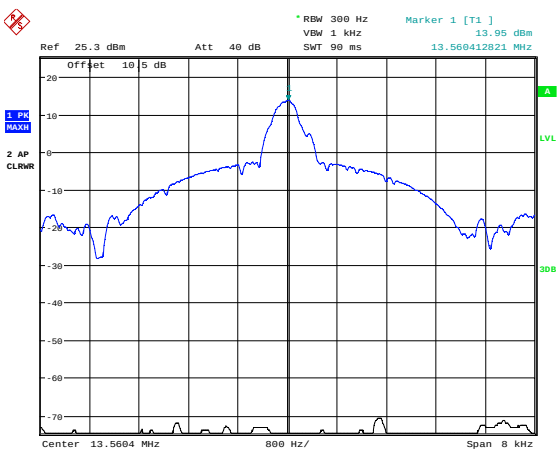


Date: 28.MAY.2025 10:22:42

13.56 MHz	Measurement time: 5 min	Temperature: -20°C	13.56 MHz	Measurement time: 10 min	Temperature: -20°C



Date: 28.MAY.2025 10:25:52



Date: 28.MAY.2025 10:31:06

8.5 20 dB Bandwidth

8.5.1 Measurement according to ANSI C63.10:2020 clause 6.9.2

Spectrum Analyzer Settings (20 dB Bandwidth):

- Frequency set to the nominal EUT Channel center frequency
- RBW = 1% to 5% of the 20 dB bandwidth
- VBW = 3 x RBW
- Sweep Time = Auto couple
- Trace = Max-Hold
- Detector: Peak

8.5.2 Limits:

FCC §15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

8.5.3 Test Summary:

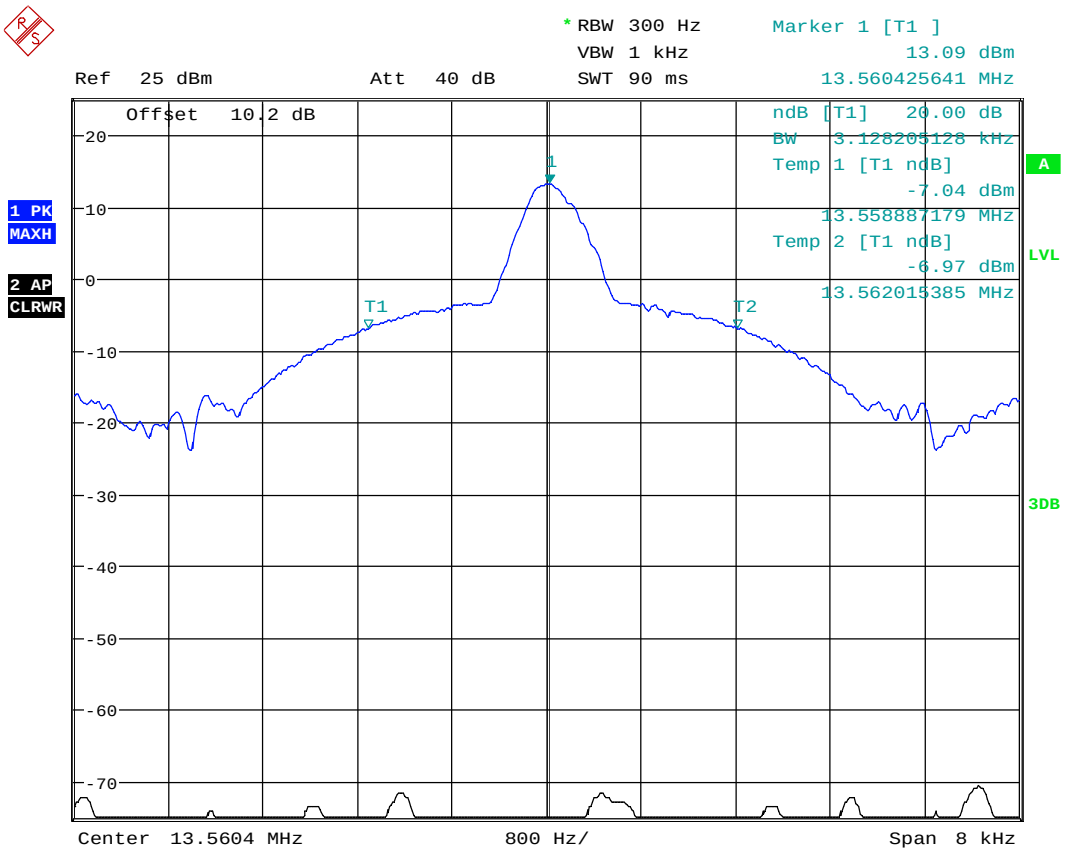
Environmental Conditions	
Ambient Temperature:	22° C
Relative Humidity:	43%
Atmospheric Pressure:	1011 mbar

Test Results							
Plot #	**EUT Set-Up #**	**EUT operating mode**	**Frequency band (MHz)**	**-20 dB (MHz)**	**+20 dB (MHz)**	**20 dB Bandwidth (MHz)**	**Result**
14	3	Op. 3	13.11 – 14.01	13.559	13.562	0.003	Pass

8.5.4 Measurement Plots:

Plot # 14 Radiated Emissions: 13.110 – 14.010 MHz

Tx Frequency: 13.56 MHz	ASK



Date: 27.MAY.2025 12:48:04

9 Test Setup Photos

Setup photos are included in the supporting file name: "EMC_QWAKE_003_25001_FCC_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Item Name	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Passive Loop Antenna	ETS LINDGREN	6512	164698	2 YEARS	9/6/2023
Biconilog Antenna	A.H. Systems	BiLA2G SAS-521-2	569	2 YEARS	10/30/2023
EMI Receiver	ROHDE & SCHWARZ	ESW44	100715	2 YEARS	4/17/2024
EMI Receiver	ROHDE & SCHWARZ	ESW44	103143	2 YEARS	9/12/2024
Digital Thermometer	CONTROL COMPANY	4410,90080-03	230712972	3 YEARS	10/18/2023
Digital Thermometer	CONTROL COMPANY	4410,90080-03	230713059	3 YEARS	10/18/2023
Line Impedance Stabilization Network	FCC	FCC-LISN-50-25-2-08	08014	2 YEARS	10/6/2023
Pulse Limiter	ROHDE & SCHWARZ	ESH3-Z2	102473	3 YEARS	11/2/2023
Multimeter	FLUKE	115	56090717MV	3 YEARS	9/26/2023
Miliohmeter	PCE Americas Inc.	PCE-MO 2001	H371277	3 YEARS	11/10/2023
Test Software	ROHDE & SCHWARZ	EMC32 V11.40.00	-	-	-
Test Software	ROHDE & SCHWARZ	EMC32 V10.50.40	-	-	-

The 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 calibration status either do not specifically require calibration or is internally characterized before use.

11 Revision History

Date	Report Name	Changes to report	Report prepared by
7/21/2025	EMC_QWAKE_003_25001_FCC_15_225	Initial version	Ghanma, Issa

<<The End>>