Bluetooth Low Energy Template: Release October 22nd, 2022

TEST REPORT

N°: 21806588-799393-B(FILE#8175439) **Version : 01**

Subject	**Radio spectrum matters tests according to standards: 47 CFR Part 15.247 & RSS-247 Issue 3 & RSS-Gen Issue 5**
Issued to	**EWATTCH** 13 Rue Maurice Jeandon 88100 - SAINT-DIE-DES-VOSGES FRANCE
Apparatus under test	
↳ Product	**SQUID PRO LoRaWAN**
↳ Trade mark	**EWATTCH**
↳ Manufacturer	**EWATTCH**
↳ Model under test	**SQUID-PRO**
↳ Serial number	**70B3D5475012134E**
↳ FCC ID	**2BBDC-SQUID-PRO-01**
↳ IC	**31217-SQUIDPRO01**
Conclusion	See Test Program chapter
Test date	April 4, 2024 to April 11, 2024
Test location	Moirans
FCC Test site	FR0008 - 918017 (MOI)
ISED Test site	FR0008 - 6500A
Sample receipt date	April 1, 2024
Composition of document	55 pages
Document issued on	May 22, 2024

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PUBLICATION HISTORY

Version	Date	Author	Modification
01	May 22, 2024	Akram HAKKARI	Creation of the document

Each new edition of this test report replaces and cancels the previous edition. The control of the old editions of report is under responsibility of client.

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1. TEST PROGRAM

References

- **47 CFR Part 15.247**
- **RSS 247 Issue 3**
- **RSS Gen Issue 5**
- **KDB 558074 D01 DTS Meas Guidance v05r02**
- **ANSI C63.10-2013**

Radio requirement:

Clause (47CFR Part 15.247 & RSS-247 Issue 3 & RSS-Gen Issue 5) Test Description	Test result - Comments			
Occupied Bandwidth	☑ PASS	☐ FAIL	☐ NA	☐ NP(1)
20dB Bandwidth	☑ PASS	☐ FAIL	☐ NA	☐ NP(1)
Number of Hopping Frequency	☑ PASS	☐ FAIL	☐ NA	☐ NP(1)
Carrier Frequency Separation	☑ PASS	☐ FAIL	☐ NA	☐ NP(1)
Time of Occupancy	☑ PASS	☐ FAIL	☐ NA	☐ NP(1)
Maximum Conducted Output Power	☑ PASS	☐ FAIL	☐ NA	☐ NP(1)
Conducted Spurious Emission at the Band Edge	☑ PASS	☐ FAIL	☐ NA	☐ NP(1)
Unwanted Emissions into Non-Restricted Frequency Bands	☑ PASS	☐ FAIL	☐ NA()	☐ NP(1)
Unwanted Emissions into Restricted Frequency Bands	☑ PASS	☐ FAIL	☐ NA	☐ NP(1)
Receiver Radiated emissions	☐ PASS	☐ FAIL	☑ NA	☐ NP(1)
This table is a summary of test report, see conclusion of each clause of this test report for detail.				

(1): Limited program
(2): EUT not directly or indirectly connected to the AC Power Public Network

PASS: EUT complies with standard's requirement
FAIL: EUT does not comply with standard's requirement
NA: Not Applicable
NP: Test Not Performed

2. EQUIPMENT UNDER TEST: CONFIGURATION (DECLARED BY PROVIDER)

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):
EWATTCH SQUID-PRO **Serial Number: 70B3D5475012134E**

Equipment Under Test

Power supply:
During all the tests, EUT is supplied by V_{nom}: 24 VDC
For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply1	DC	24 VDC	-	-

Voltage table used (for Power Line Conducted Emissions):

Type	Measurement performed:	
☑ AC	☑ **120VAC/60Hz**	☑ **240VAC/50Hz**
☐ DC	☐ **+12VDC**	☐ **-....VDC**
☐ Battery	☐ **+3.6VDC**	☐ **-....VDC**
☐ USB (Laptop auxiliary)	☐ **120VAC/60Hz (Laptop auxiliary)**	☐ **240VAC/50Hz(Laptop auxiliary)**

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Comments
Supply1	24 VDC	3	No	No	-
Access1	Sensor connector	2	Yes	No	-
Access2	Sensor connector	2	Yes	No	-
Access3	Sensor connector	2	Yes	No	-
Access4	Sensor connector	2	Yes	No	-
Access5	Sensor connector	2	Yes	No	-
Access6	Sensor connector	2	Yes	No	-
Access7	Sensor connector	2	Yes	No	-
Access8	Sensor connector	2	Yes	No	-
Access9	Sensor connector	2	Yes	No	-
Access10	Sensor connector	2	Yes	No	-
Access11	Sensor connector	2	Yes	No	-
Access12	Sensor connector	2	Yes	No	-
Access13	USB	1	Yes	Yes	Accessible only for testing
Access14	Connector (three-phase)	3	Yes	No	-

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Laptop	Lenovo Thinkpad	-	-

Equipment information:

Bluetooth Classic Type:	**LoraWAN**		
Frequency band:	[902-928] MHz		
Spectrum Modulation:	☑ FHSS		
Number of Channel:	64		
Channel bandwidth:	125kHZ		
Antenna Type:	☐ Integral	☑ External	☐ Dedicated
Antenna connector:	☑ Yes	☐ No	☐ Temporary for test
Transmit chains: Antenna Requirements §15.203	1		
	Single antenna		
	Gain: 3dBi		
	The transmitter uses an integral antenna and it permanently connected		
Beam forming gain:	No		
Receiver chains	1		
Type of equipment:	☑ Stand-alone	☐ Plug-in	☐ Combined
Ad-Hoc mode:	☐ Yes	☑ No	
Duty cycle:	☑ Continuous duty	☐ Intermittent duty	☐ 100% duty
Equipment type:	☑ Production model	☐ Pre-production model	
Operating temperature range:	Tmin:	☐ -20°C / ☐ 0°C	☑ 5°C
	Tnom:	20°C	
	Tmax:	☐ 35°C / ☐ 55°C	☑ 65°C
Type of power source:	☐ AC power supply	☐ DC power supply	☐ Battery
Operating voltage range:	Vnom:	☐ 230V/50Hz	☑ 24Vdc

CHANNEL PLAN – 125kHz channels uplink	
Channel	**Frequency (MHz)**
Cmin:	**902.3**
Cmid:	**908.7**
Cmax:	**914.9**

2.2. RUNNING MODE

Test mode	Description of test mode
Test mode 1	Permanent emission with modulation on a fixed channel in the data rate that produced the highest power
Test mode 2	Permanent emission with modulation & hopping in the data rate that produced the highest power
Test mode 3	Permanent reception

All tests are done with OutputPower = 8dBm

Test	Running mode

Occupied Bandwidth	☑ Test mode 1 (1)	☐ Alternative test mode()
20dB Bandwidth	☑ Test mode 1 (1)	☐ Alternative test mode()
Number of Hopping Frequency	☑ Test mode 2 (1)	☐ Alternative test mode()
Carrier Frequency Separation	☑ Test mode 2 (1)	☐ Alternative test mode()
Time of Occupancy	☑ Test mode 2 (1)	☐ Alternative test mode()
Maximum Conducted Output Power	☑ Test mode 1 (1)	☐ Alternative test mode()
Conducted Spurious Emission at the Band Edge	☑ Test mode 1 (1)	☐ Alternative test mode()
Unwanted Emissions into Non-Restricted Frequency Bands	☑ Test mode 1 (1)	☐ Alternative test mode()
Unwanted Emissions into Restricted Frequency Bands	☑ Test mode 1 (1)	☐ Alternative test mode()
Receiver Radiated emissions	☑ Test mode 3 (1)	☐ Alternative test mode()

(1) Following commands with the specific test software "X" are used to set the product:
a. – See document "X"(provided by customer) for the command used during test.

Hardware information		
Software (if applicable):	**V. :**	**EWATTCH Production Tool**

2.3. EQUIPMENT LABELLING

2.4. EQUIPMENT MODIFICATION

☑ None ☐ Modification:

2.5. *FIELD STRENGTH CALCULATION*

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

FS = RA + AF + CF – AG

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

Assume a receiver reading of 52.5dBµV is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dBµV/m.
FS = 52.5 + 7.4 + 1.1 – 29 = 32 dBµV/m
The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
Level in µV/m = Common Antilogarithm [(32dBµV/m)/20] = 39.8 µV/m.

2.6. *TEST DISTANCE EXTRAPOLATION – FCC/ISED*

The field strength is extrapolated to the new measurement distance using formula from FCC Part15.31 (f) and §6.5-6.6 RSS-GEN:

Below 30MHz,

$$FS_{\text{limit}} = FS_{\max} - 40\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right)$$

Above 30MHz,

$$FS_{\text{limit}} = FS_{\max} - 20\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right)$$

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

2.7. *CALIBRATION DATE*

The calibration intervals are extended at 12+2 months. This extended interval is based on the fact that there is sufficient calibration data to statistically establish a trend or based on experience of use of the test equipment to assure good measurement results for a longer period.

3. OCCUPIED BANDWIDTH

3.1. TEST CONDITIONS

Test performed by	: Akram HAKKARI
Date of test	: April 8, 2024
Ambient temperature	: 21 °C
Relative humidity	: 33 %

3.2. TEST SETUP

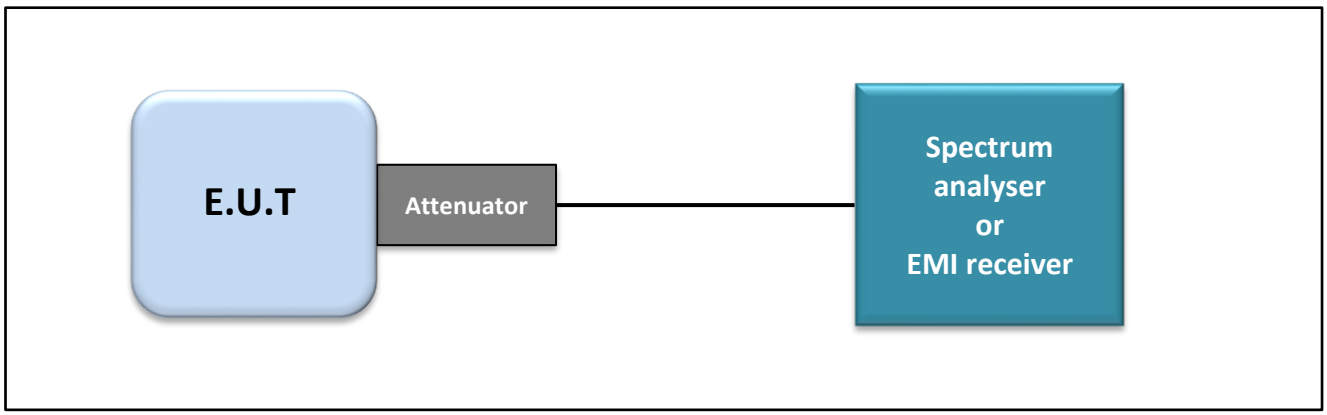
- The Equipment under Test is installed:
☐ On a table
☑ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:
☑ Conducted Method
☐ Radiated Method

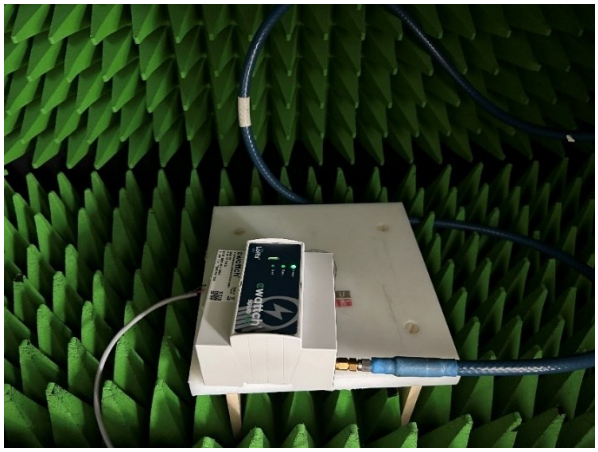
- Test Procedure:
☑ RSS-Gen Issue 5 § 6.7
☑ ANSI C63.10 § 6.9.2

Measurement Procedure:

a) RBW shall be in the range of 1% to 5% of the anticipated occupied bandwidth
b) Set the video bandwidth (VBW) ≥ 3 x RBW
c) SPAN = Capture all products of the modulation process
d) Detector = Peak.
e) Trace mode = max hold.
f) Sweep = auto couple.
g) Allow the trace to stabilize.
h) OBW 99% function of spectrum analyzer used



Test set up of Occupied Bandwidth



Photograph for Occupied bandwidth

3.3. *LIMIT*

None

3.4. TEST EQUIPMENT LIST

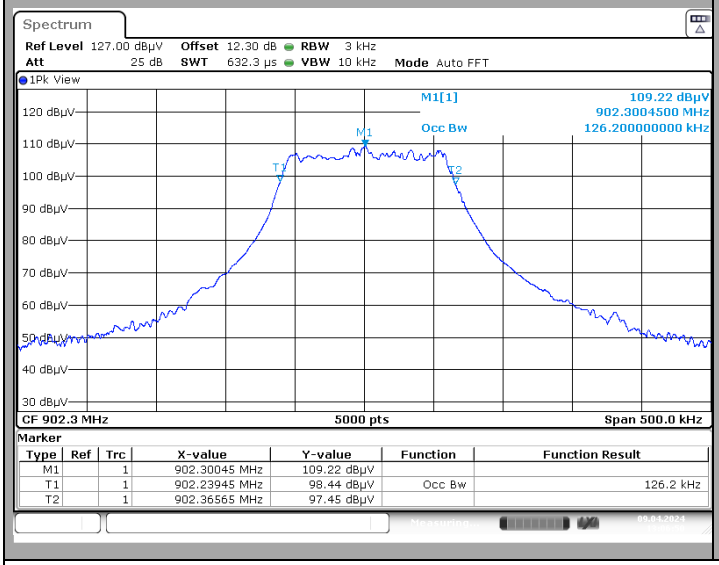
TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
DC Power Supply	RS PRO	RS3005P	A7042314		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Full Anechoic Room	SIEPEL	_	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
SMA 1.5m	SUCOFLEX	18GHz	A5329864	10/23	10/24
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	02/24	02/26

Note: In our quality system, the test equipment calibration due is more & less 2 months

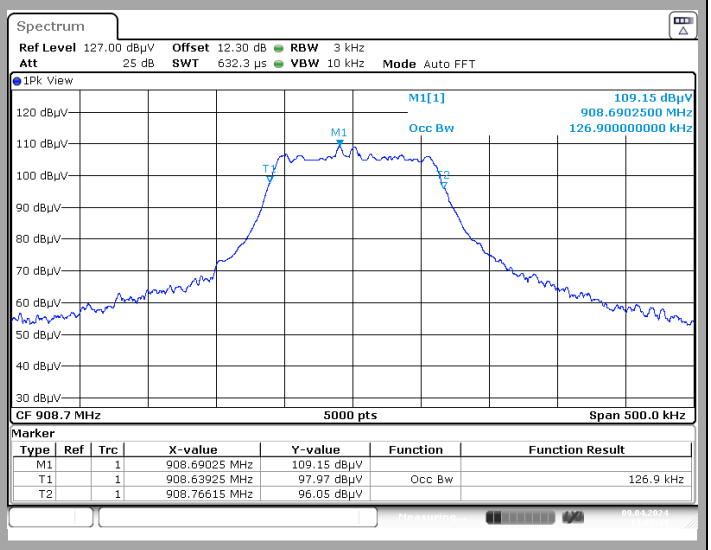
3.5. RESULTS

Occupied Bandwidth

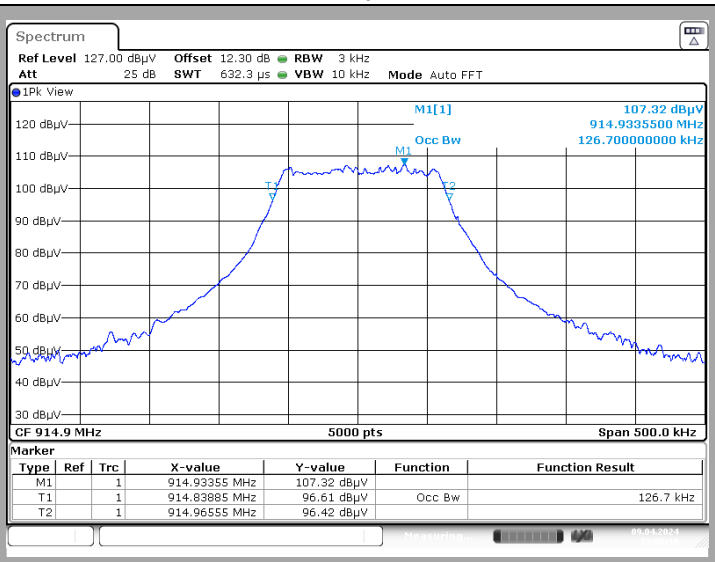
Cmin



Cnom



Cmax



Channel	Occupied Bandwidth (MHz)
Cmin	0.1262
Cnom	0.1269
Cmax	0.1267

3.6. *CONCLUSION*

Occupied Channel Bandwidth measurement performed on the sample of the product **EWATTCH SQUID-PRO**, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS-GEN ISSUE 5** limits.

4. 20dB Emission Bandwidth

4.1. TEST CONDITIONS

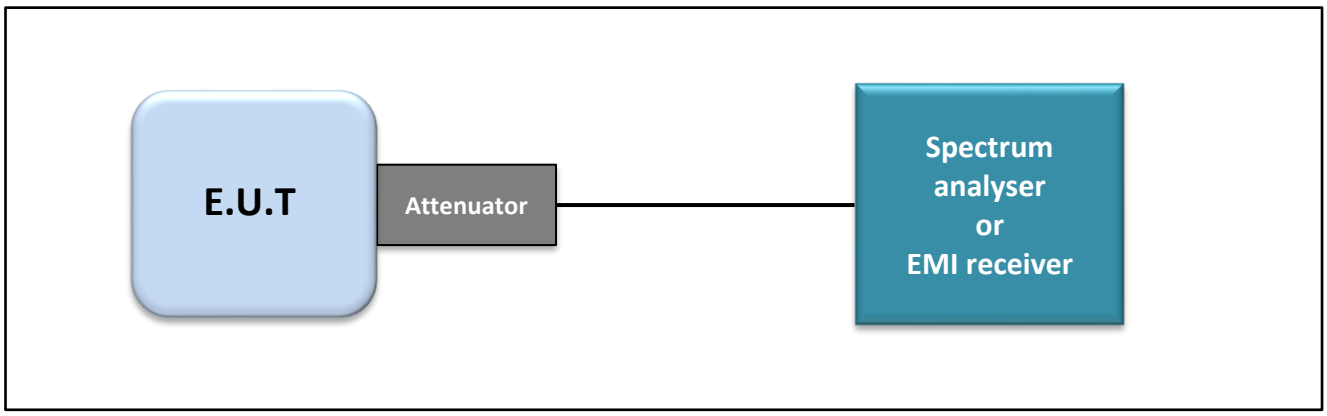
Test performed by	: Akram HAKKARI
Date of test	: April 8, 2024
Ambient temperature	: 21 °C
Relative humidity	: 33 %

4.2. TEST SETUP

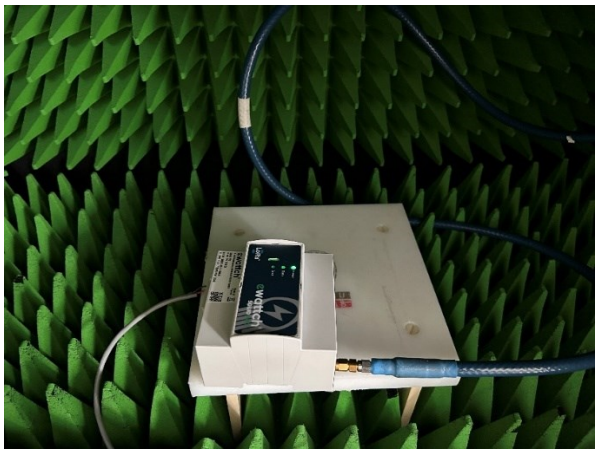
- The Equipment Under Test is installed:
☐ On a table
☑ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:
☑ Conducted Method
☐ Radiated Method

- Test Procedure:
☑ ANSI C63.10 § 6.9.2:
The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with the Peak Output Power measured. The EUT is turn ON and using the MaxHold function, the frequency separation of two frequencies that were attenuated 20dB from the Peak Output Power level. A delta marker is used to measure the frequency difference as the emission bandwidth.



Test set up of 20dB Emission Bandwidth



Photograph for 20dB emission bandwidth

4.3. LIMIT

The maximum allowed 20dB bandwidth of hopping channel is 500kHz.

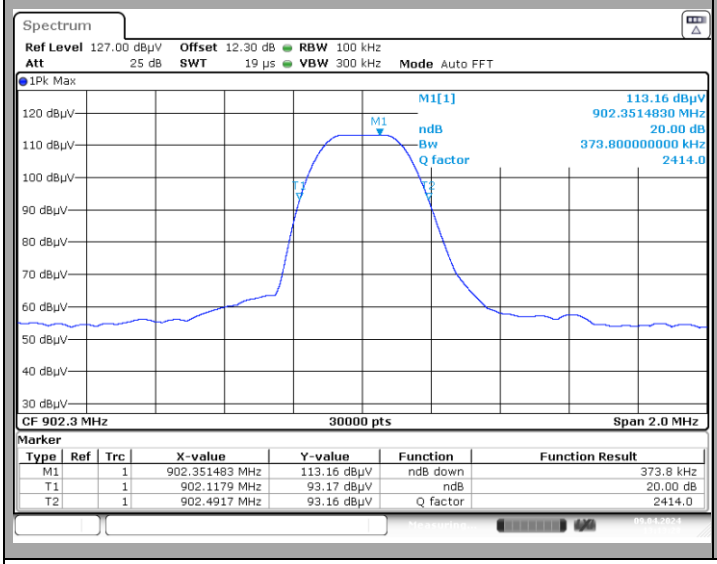
4.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
DC Power Supply	RS PRO	RS3005P	A7042314		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Full Anechoic Room	SIEPEL	_	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
SMA 1.5m	SUCOFLEX	18GHz	A5329864	10/23	10/24
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	02/24	02/26

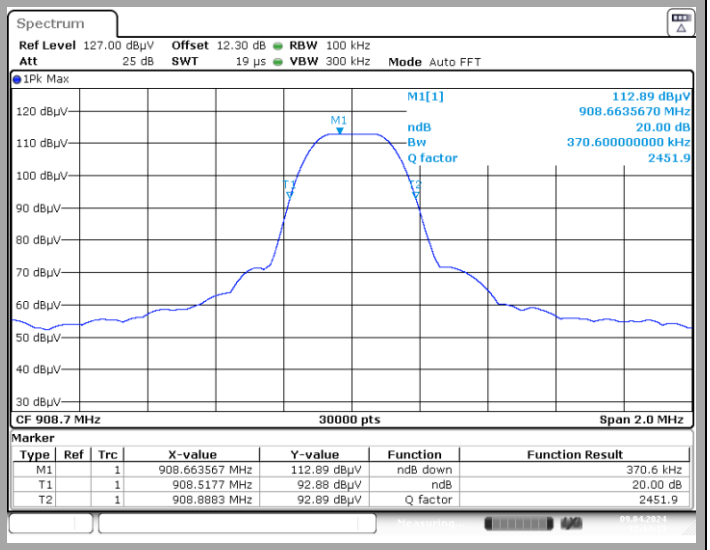
Note: In our quality system, the test equipment calibration due is more & less 2 months

4.5. RESULTS

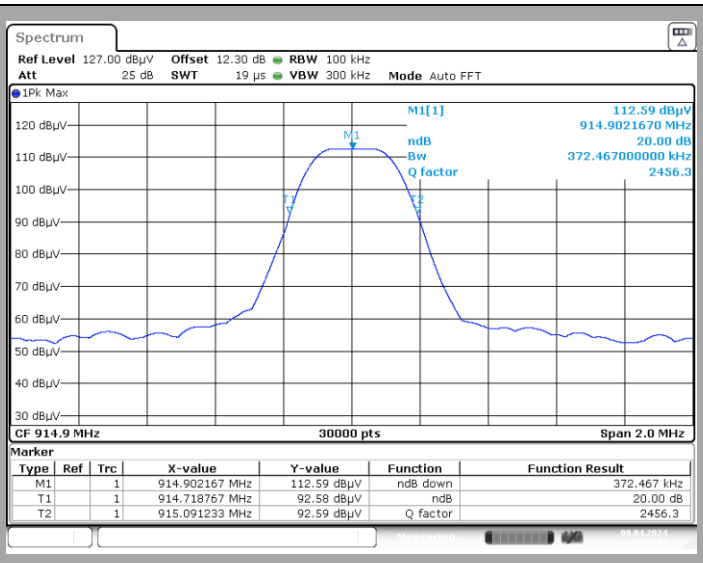
Cmin



Cnom



Cmax



Channel	20dB Bandwidth (kHz)
Cmin	373.8
Cnom	370.6
Cmax	372.46

4.6. CONCLUSION

20dB Emission Bandwidth measurement performed on the sample of the product **EWATTCH** SQUID-PRO, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 3** limits.

5. CARRIER FREQUENCY SEPARATION

5.1. TEST CONDITIONS

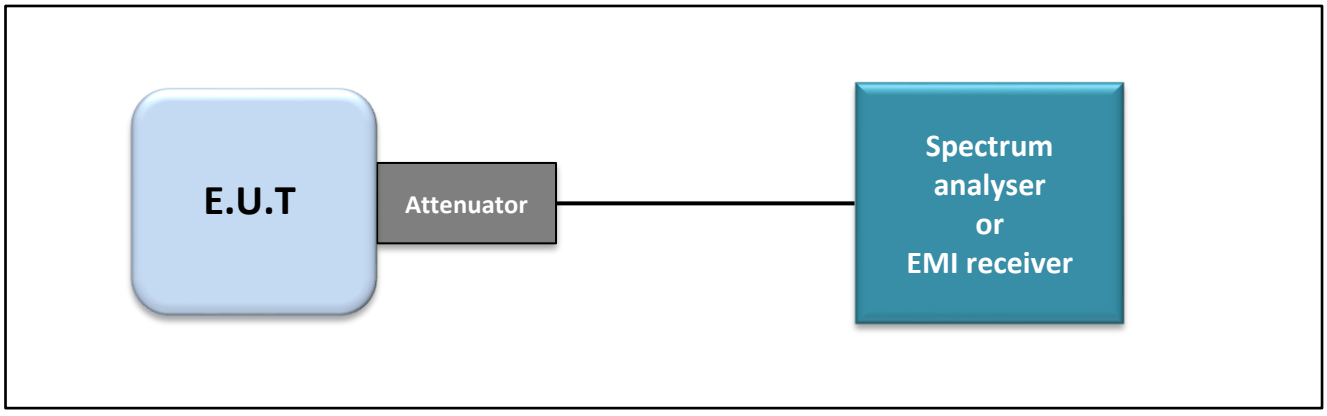
Test performed by	: Akram HAKKARI
Date of test	: April 9, 2024
Ambient temperature	: 22 °C
Relative humidity	: 33 %

5.2. TEST SETUP

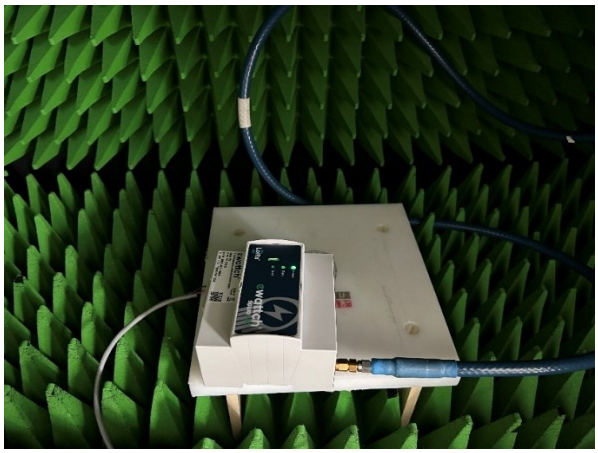
- The Equipment Under Test is installed:
☐ On a table
☑ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:
☑ Conducted Method
☐ Radiated Method

- Test Procedure:
☑ ANSI C63.10 § 7.8.2:
The EUT is placed in an anechoic chamber; levels have been corrected to be in compliant with the Peak Output Power measured. The EUT is turn ON and using the MaxHold function, the separation of two adjacent channels is recorded. A delta marker is used to measure the frequency difference.



Test set up of Carrier Frequency Separation



Photograph for Carrier Frequency Separation

5.3. LIMIT

Carrier Frequency Separation shall be at least two-thirds of the 20dB Bandwidth

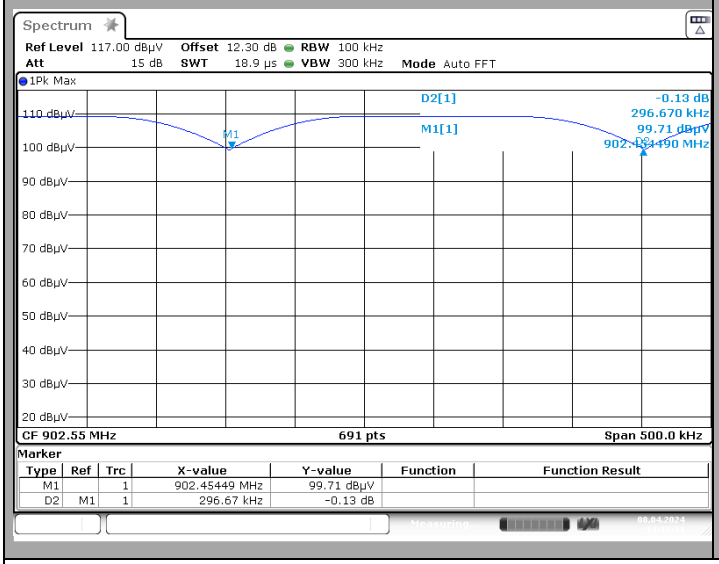
5.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
DC Power Supply	RS PRO	RS3005P	A7042314		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Full Anechoic Room	SIEPEL	_	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
SMA 1.5m	SUCOFLEX	18GHz	A5329864	10/23	10/24
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	02/24	02/26

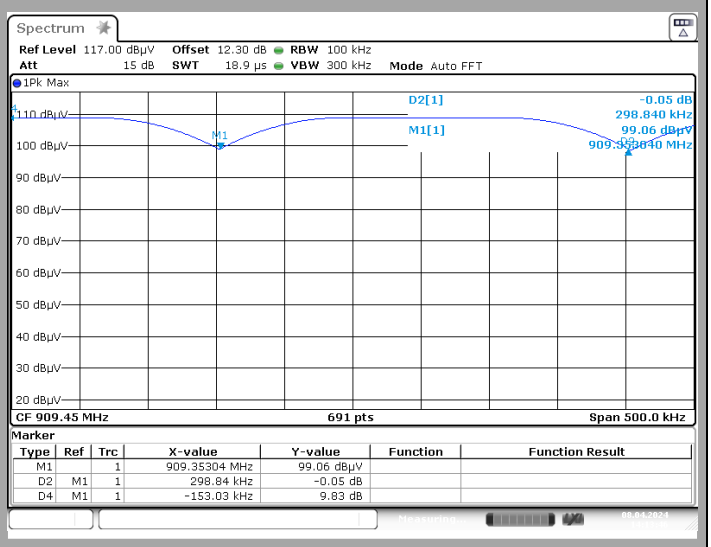
Note: In our quality system, the test equipment calibration due is more & less 2 months

5.5. RESULTS

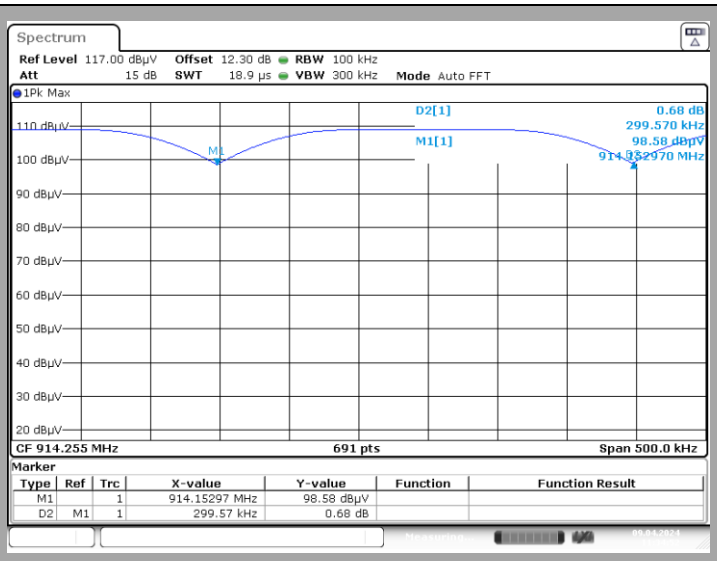
Cmin



Cnom



Cmax



Channel	Carrier Frequency Separation (kHz)	Limit (kHz)
Cmin	296.6	Minimum 2/3 of 20dB Emission Bandwidth
Cnom	298.8	Minimum 2/3 of 20dB Emission Bandwidth
Cmax	299.5	Minimum 2/3 of 20dB Emission Bandwidth

5.6. CONCLUSION

Carrier Frequency Separation measurement performed on the sample of the product **EWATTCH** SQUID-PRO, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS-GEN ISSUE 5** limits.

6. NUMBER OF HOPPING FREQUENCY

6.1. TEST CONDITIONS

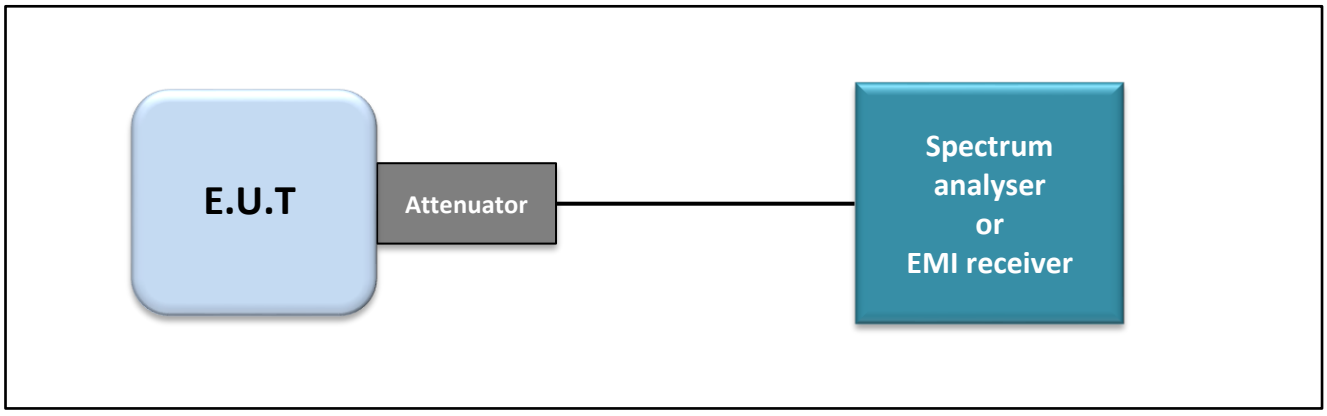
Test performed by	: Akram HAKKARI
Date of test	: April 9, 2024
Ambient temperature	: 22 °C
Relative humidity	: 33 %

6.2. TEST SETUP

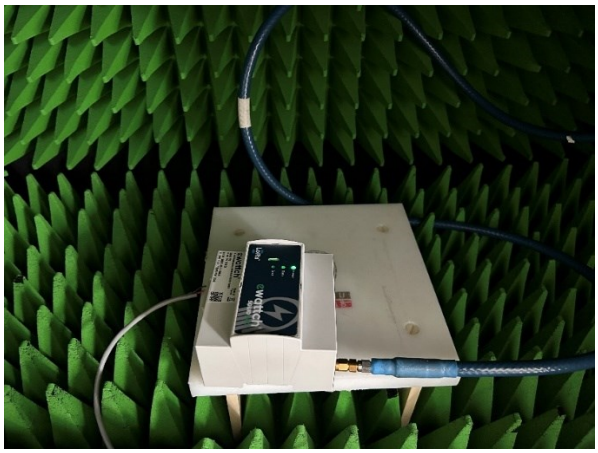
- The Equipment Under Test is installed:
☐ On a table
☑ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:
☑ Conducted Method
☐ Radiated Method

- Test Procedure:
☑ ANSI C63.10 § 7.8.3:
The EUT is placed in an anechoic chamber. The EUT is turn ON and using the MaxHold function and a delta marker the number of frequencies used for this FHSS system is recorded, see following graphs.



Test set up of Number of Hopping Frequency



Photograph for Number of Frequency Hopping

6.3. LIMIT

Number of Hopping Frequencies shall be at least 15 channels

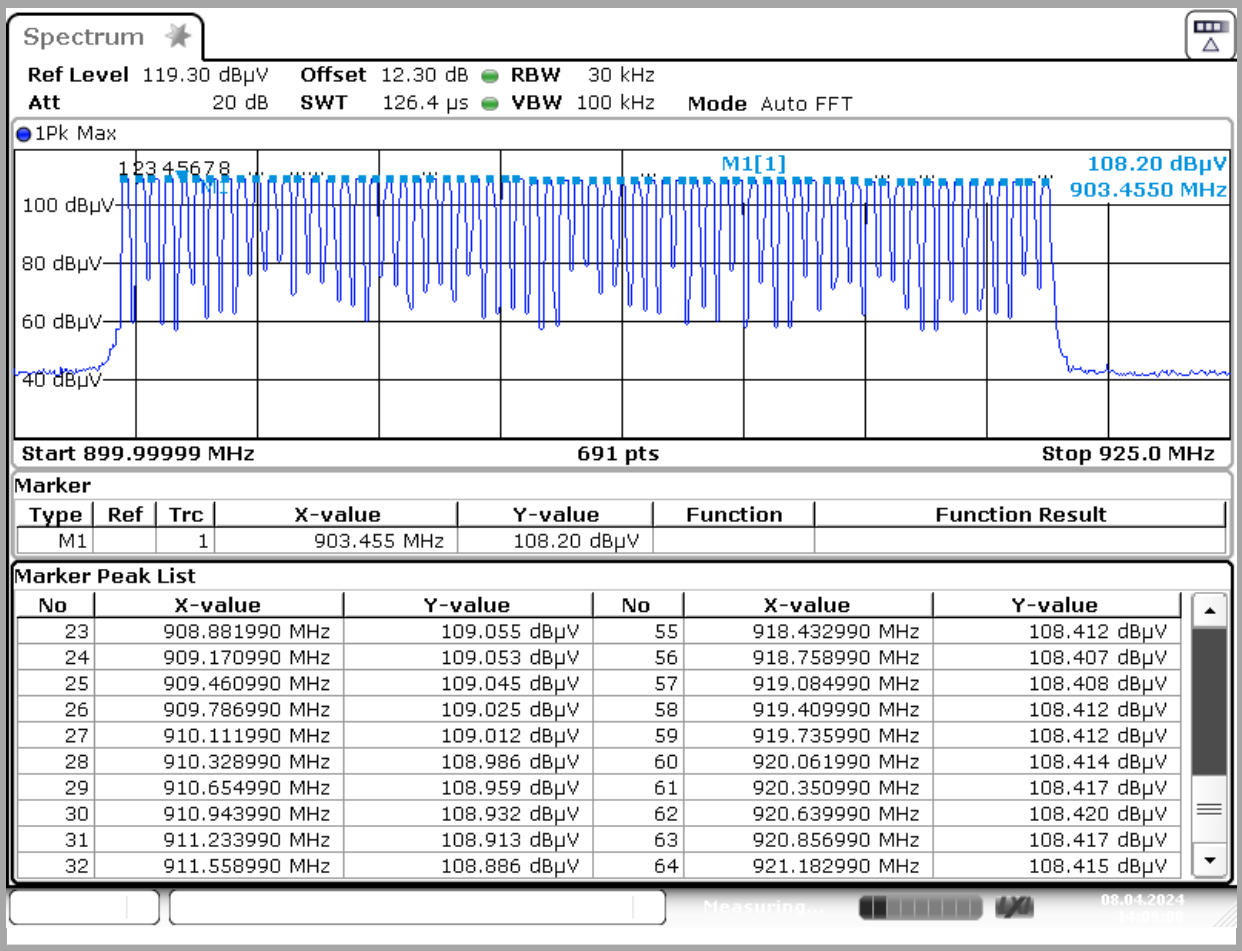
6.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
DC Power Supply	RS PRO	RS3005P	A7042314		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Full Anechoic Room	SIEPEL	_	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
SMA 1.5m	SUCOFLEX	18GHz	A5329864	10/23	10/24
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	02/24	02/26

Note: In our quality system, the test equipment calibration due is more & less 2 months

6.5. RESULTS

GFSK (DH5)
Call



Channel	Number of Hopping Frequencies	Limit
Call	64	Minimum 15

6.6. CONCLUSION

Number of Frequency Hopping measurement performed on the sample of the product **EWATTCH** SQUID-PRO, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **Select Result** to the **47 CFR PART 15.247 & RSS-GEN ISSUE 5** limits.

7. TIME OF OCCUPANCY

7.1. TEST CONDITIONS

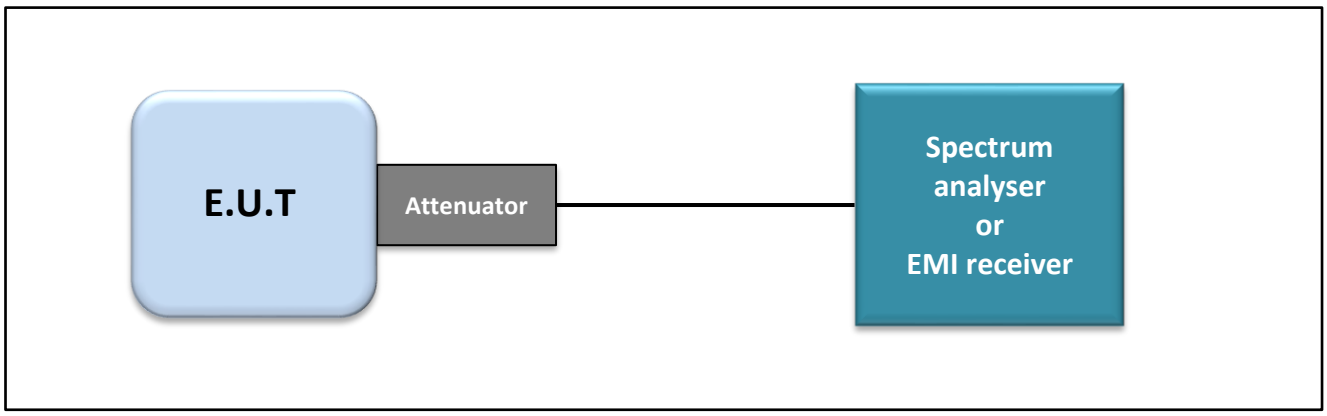
Test performed by	: Akram HAKKARI
Date of test	: April 8, 2024
Ambient temperature	: 22 °C
Relative humidity	: 33 %

7.2. TEST SETUP

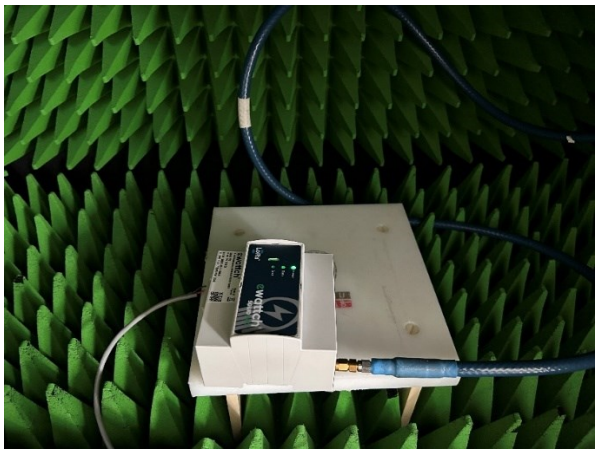
- The Equipment Under Test is installed:
☐ On a table
☑ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:
☑ Conducted Method
☐ Radiated Method

- Test Procedure:
☑ ANSI C63.10 § 7.8.4
Dwell Time is measured and calculated using the zero SPAN mode on a channel frequency and a SWEEP with an adapter value to measure the number of transmission within a period and the time of transmission



Test set up of Time of Occupancy



Photograph for Time of Occupancy

7.3. LIMIT

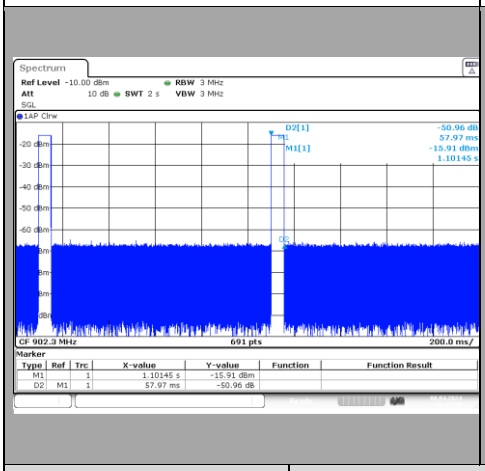
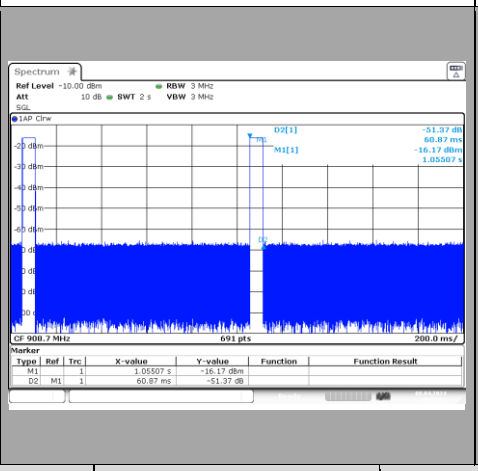
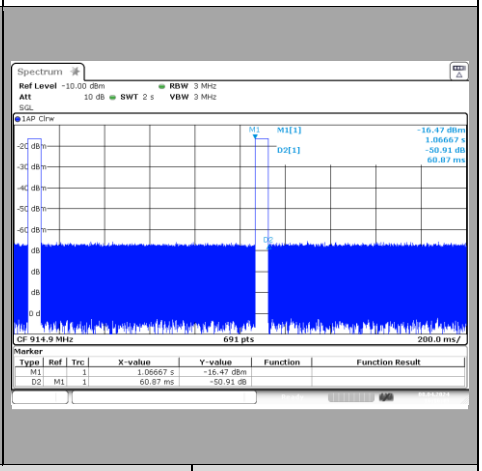
The Time of Occupancy shall not exceed 0.4s within any period of 0.4s multiplied by the number of hopping channels employed

7.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
DC Power Supply	RS PRO	RS3005P	A7042314		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Full Anechoic Room	SIEPEL	_	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
SMA 1.5m	SUCOFLEX	18GHz	A5329864	10/23	10/24
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	02/24	02/26

Note: In our quality system, the test equipment calibration due is more & less 2 months

7.5. RESULTS

Time of Occupancy		
Cmin	**Cmid**	**Cmax**
		

Channel	Burst Length (ms)	Number of Hopping during Time of Occupancy	Time of Occupancy (ms)	Limit of Time of Occupancy (ms)
Cmin	57.97	4	231.88	400
Cmid	60.87	4	243,48	400
Cmax	60.87	4	243,48	400

7.6. CONCLUSION

Time of Occupancy measurement performed on the sample of the product **EWATTCH** SQUID-PRO, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS-GEN ISSUE 5** limits.

8. MAXIMUM CONDUCTED OUTPUT POWER

8.1. TEST CONDITIONS

Test performed by	: Akram HAKKARI
Date of test	: April 8, 2024
Ambient temperature	: 22 °C
Relative humidity	: 33 %

8.2. TEST SETUP

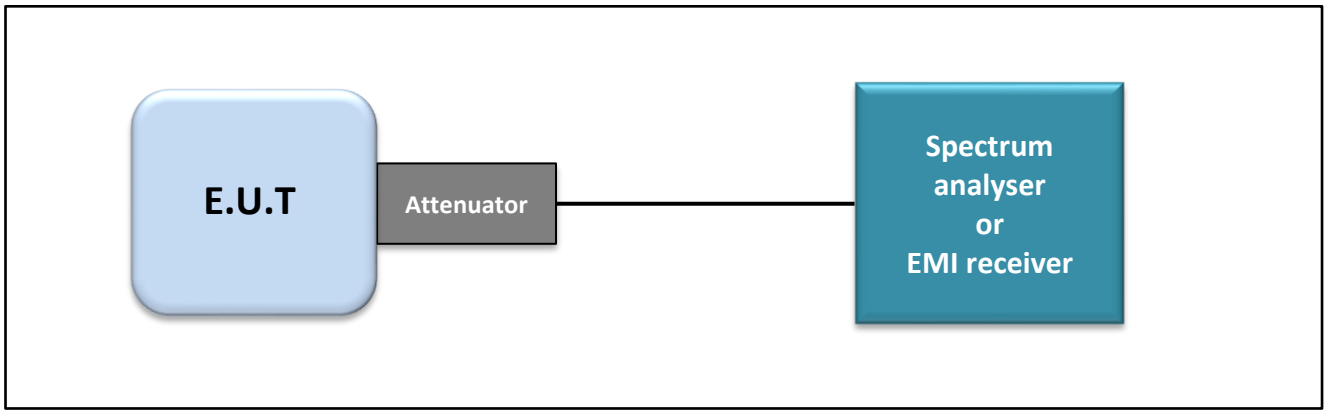
- The Equipment Under Test is installed:
☐ On a table
☐ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:
☑ Conducted Method
☐ Radiated Method

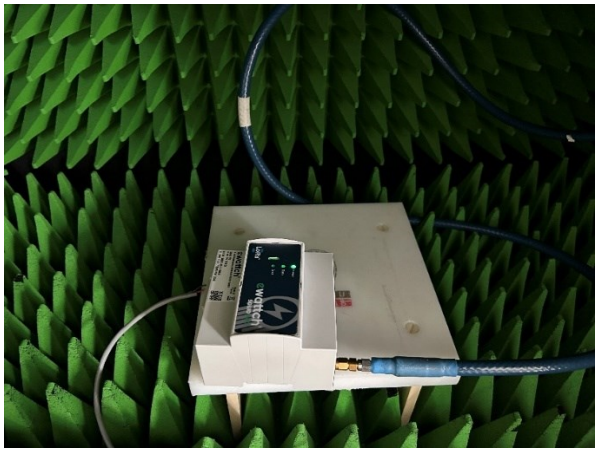
- Test Procedure:
☑ ANSI C63.10 § 7.8.5

Measurement Procedure:

a) 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
b) 2) RBW > 20 dB bandwidth of the emission being measured.
c) 3) VBW ≥ RBW.
d) 4) Sweep: Auto.
e) 5) Detector function: Peak.
f) 6) Trace: Max hold.



Test set up of Maximum Conducted Output Power



Photograph for Maximum Conducted Output Power

8.3. LIMIT

Maximum Conducted Output power:
Shall not exceed 21dBm
Limits are reduced by G-6dBi if Antenna Gain above 6dBi

8.4. TEST EQUIPMENT LIST

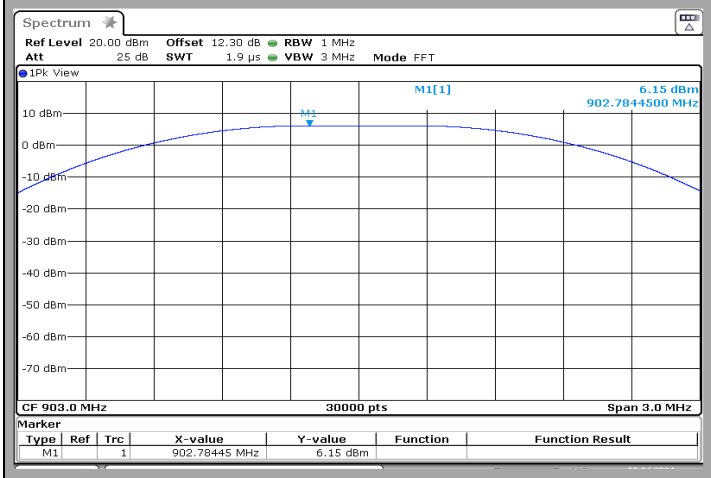
TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
DC Power Supply	RS PRO	RS3005P	A7042314		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Full Anechoic Room	SIEPEL	_	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
SMA 1.5m	SUCOFLEX	18GHz	A5329864	10/23	10/24
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	02/24	02/26

Note: In our quality system, the test equipment calibration due is more & less 2 months

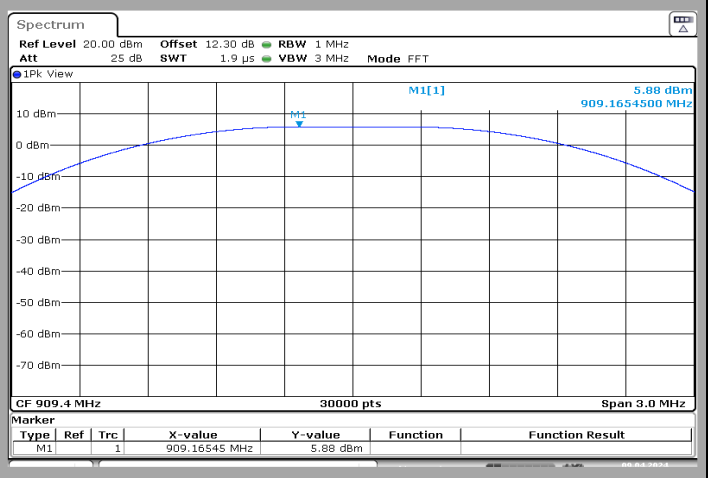
8.5. RESULTS

LoraWAN

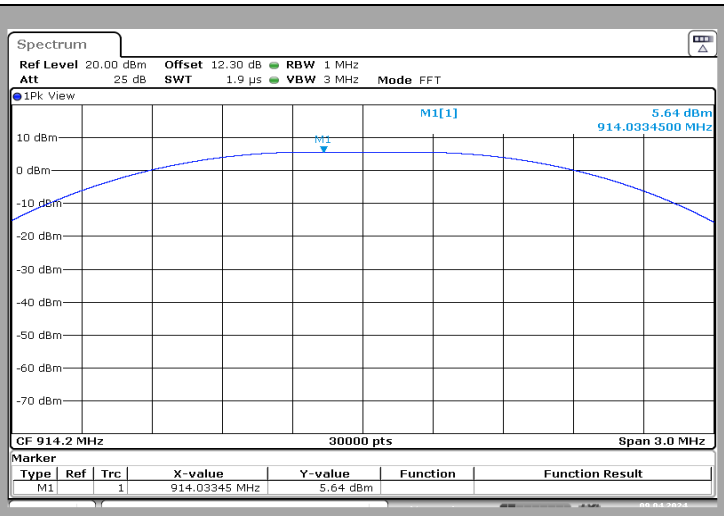
Cmin



Cnom



Cmax



Channel	Offset Cable + Att (dB)	Antenna Gain (dBi)	Maximum Conducted Power (dBm)	Limit (dBm)
Cmin	**12.3**	3	6.15	21dBm. Reduced by G-6dBi if Antenna Gain above 6dBi
Cnom	**12.3**	3	5.88	21dBm. Reduced by G-6dBi if Antenna Gain above 6dBi
Cmax	**12.3**	3	5.64	21dBm. Reduced by G-6dBi if Antenna Gain above 6dBi

8.6. CONCLUSION

Maximum Conducted Output Power measurement performed on the sample of the product **EWATTCH SQUID-PRO**, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 3** limits.

9. UNWANTED EMISSIONS INTO NON-RESTRICTED FREQUENCY BANDS AT THE BAND EDGE

9.1. TEST CONDITIONS

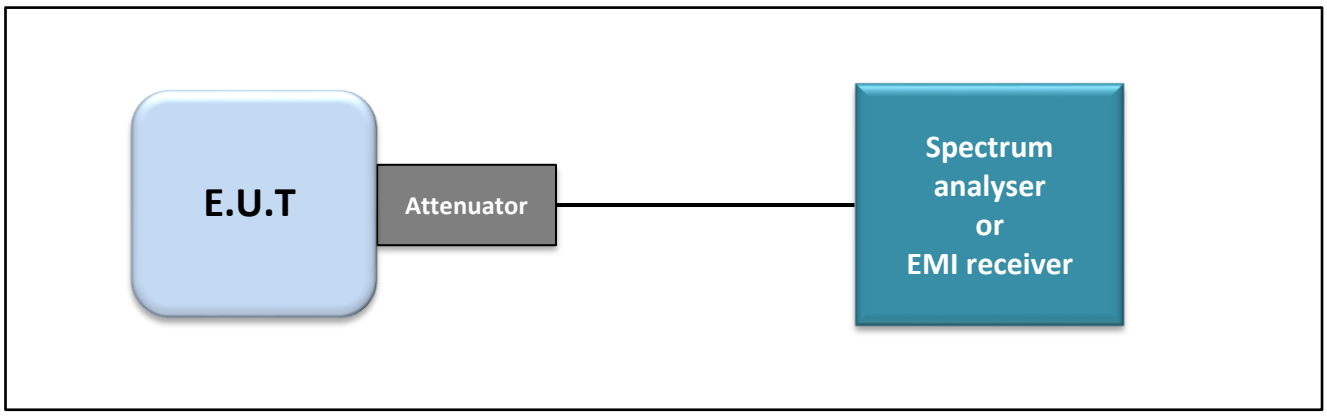
Test performed by	: Akram HAKKARI
Date of test	: April 10, 2024
Ambient temperature	: 22 °C
Relative humidity	: 32 %

9.2. TEST SETUP

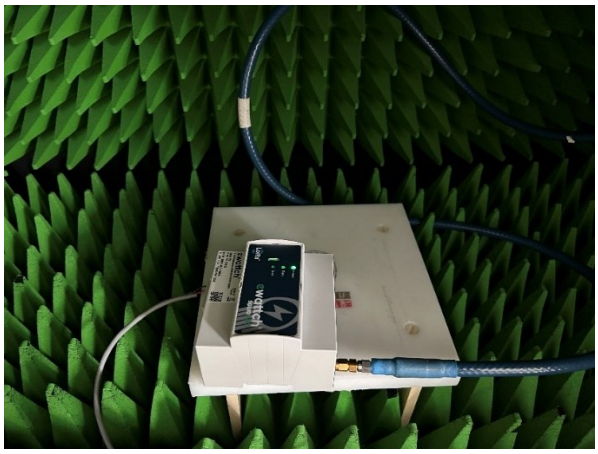
- The Equipment Under Test is installed:
☐ On a table
☑ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:
☑ Conducted Method
☐ Radiated Method

- Test Procedure:
☑ ANSI C63.10 § 7.8.6



Test set up of Unwanted Emissions into Non-Restricted Frequency Bands at the Band Edge



Photograph for Unwanted Emission into non-restricted frequency bands at the band edge

9.3. LIMIT

All Spurious Emissions must be at least 20dB below the Fundamental Radiator Level at the Band Edge Edge

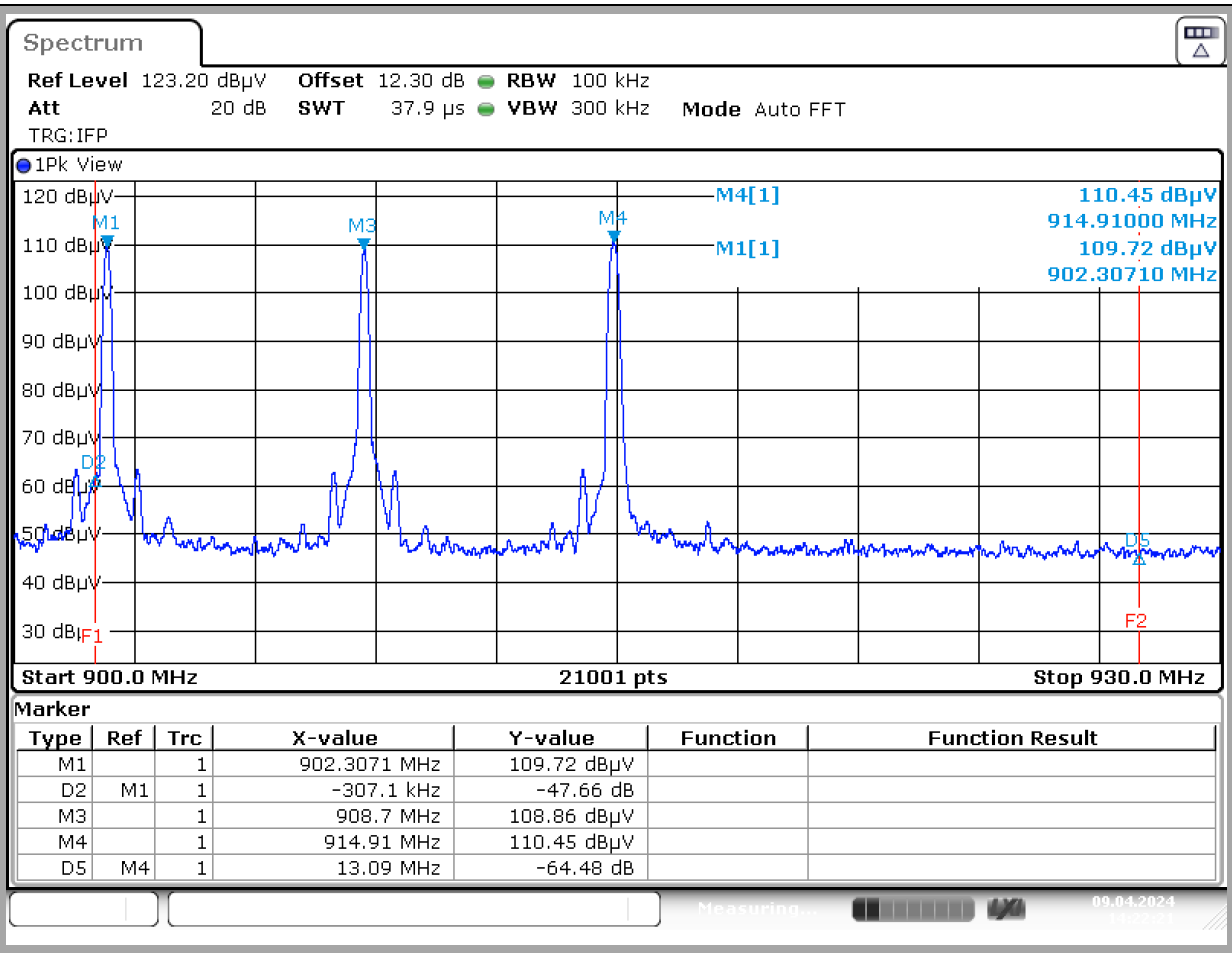
9.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
DC Power Supply	RS PRO	RS3005P	A7042314		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Full Anechoic Room	SIEPEL	_	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
SMA 1.5m	SUCOFLEX	18GHz	A5329864	10/23	10/24
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	02/24	02/26

Note: In our quality system, the test equipment calibration due is more & less 2 months

9.5. RESULTS

Cmin/Cnom/Cmax



Frequency (MHz)	Level (dBc)	Limit (dBc)
902	-47.66	20
928	-64.48	20

9.6. CONCLUSION

Unwanted Emission into non-restricted frequency bands at the band edge measurement performed on the sample of the product **EWATTCH SQUID-PRO**, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 3** limits.

10. UNWANTED EMISSIONS INTO NON-RESTRICTED FREQUENCY BANDS

10.1. TEST CONDITIONS

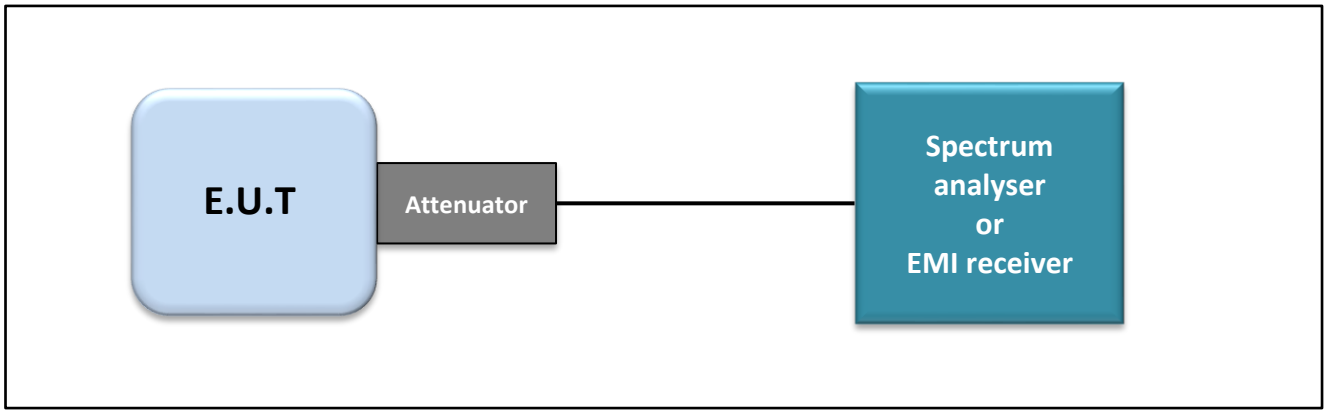
Test performed by	: Akram HAKKARI
Date of test	: April 10, 2024
Ambient temperature	: 22 °C
Relative humidity	: 32 %

10.2. TEST SETUP

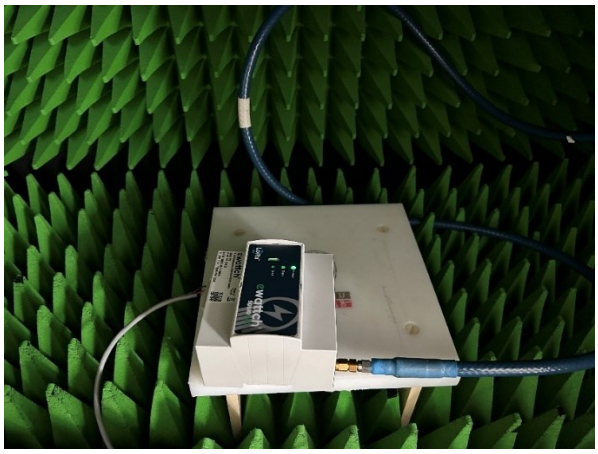
- The Equipment under Test is installed:
☐ On a table
☑ In an anechoic chamber

- Measurement is performed with a spectrum analyzer in:
☑ Conducted Method
☐ Radiated Method

- Test Procedure:
☑ ANSI C63.10 § 7.8.8



Test set up of Unwanted Emissions into Non-Restricted Frequency Bands



Photograph for Unwanted Emission into non-restricted frequency bands

10.3. LIMIT

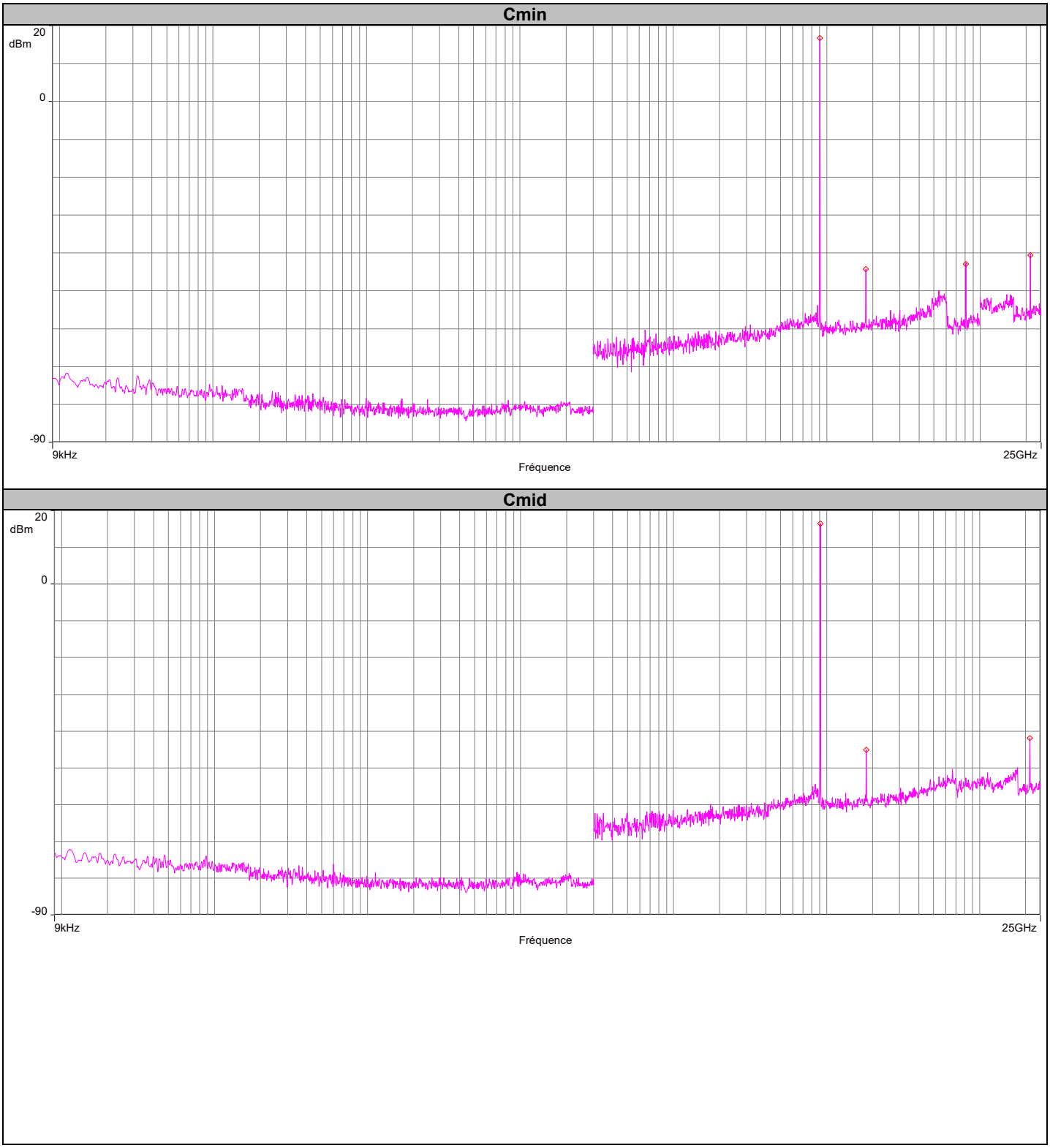
All Spurious Emissions must be at least 20 below the Fundamental Radiator Level

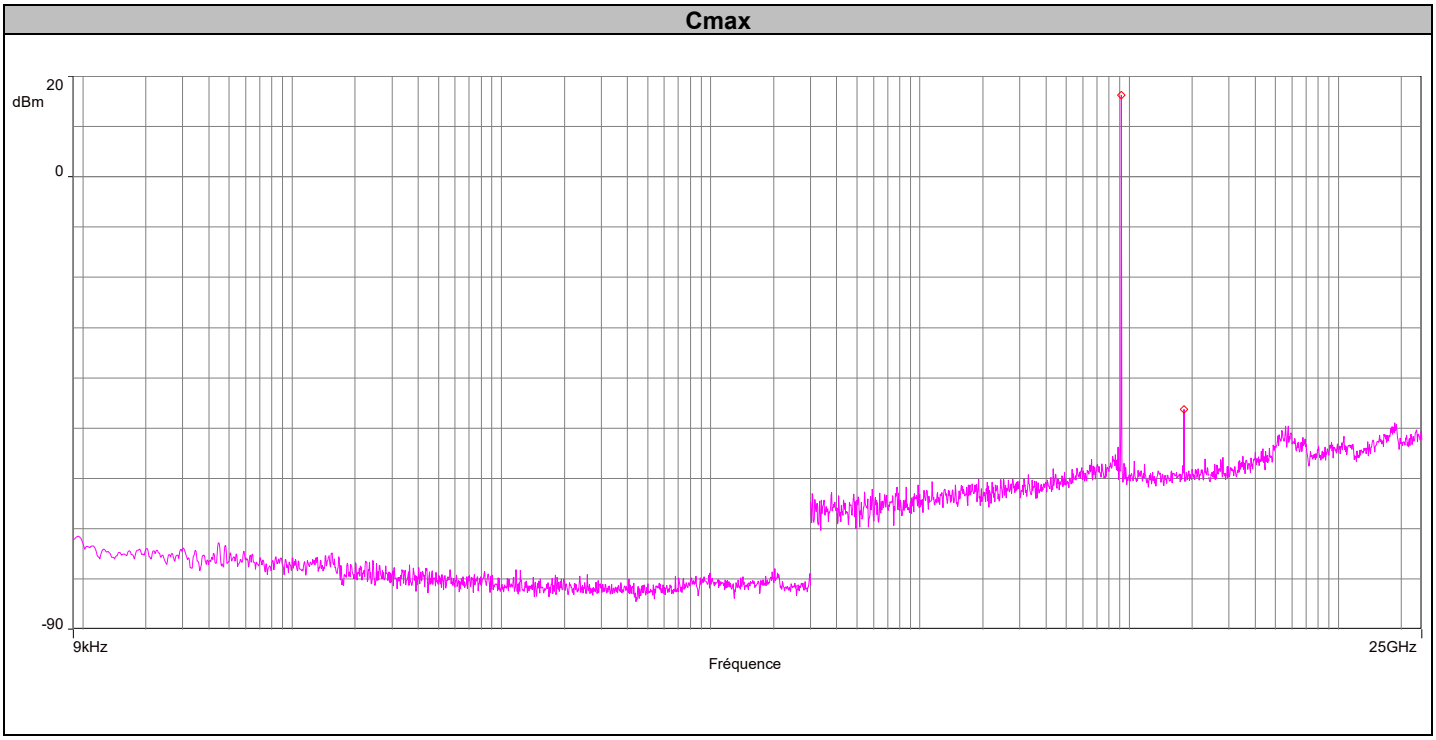
10.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Attenuator 10dB	AEROFLEX	_	A7122267	10/23	10/25
DC Power Supply	RS PRO	RS3005P	A7042314		
Emission Cable (SMA 1m)	TELEDYNE	26GHz	A5329874	08/22	08/25
Full Anechoic Room	SIEPEL	_	D3044024		
Multimeter - CEM	FLUKE	87	A1240251	10/23	10/25
SMA 1.5m	SUCOFLEX	18GHz	A5329864	10/23	10/24
Thermo-hygrometer	TESTO	608-H1	B4204120	03/23	03/25
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	02/24	02/26

Note: In our quality system, the test equipment calibration due is more & less 2 months

10.5. RESULTS


Cmin
20
dBm
0
-90
9kHz
25GHz
Fréquence
Cmid
20
dBm
0
-90
9kHz
25GHz
Fréquence



All spurious emissions are lower than 20 dB below the fundamental radiator level.

10.6. CONCLUSION

Unwanted Emission into non-restricted frequency bands measurement performed on the sample of the product **EWATTCH SQUID-PRO**, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **compliant** to the **47 CFR PART 15.247 & RSS 247 ISSUE 3** limits.

11. UNWANTED EMISSIONS IN RESTRICTED FREQUENCY BANDS

11.1. TEST CONDITIONS

Test performed by : Akram HAKKARI
Date of test : April 4, 2024
Ambient temperature : 22 °C
Relative humidity : 33 %

11.2. TEST SETUP

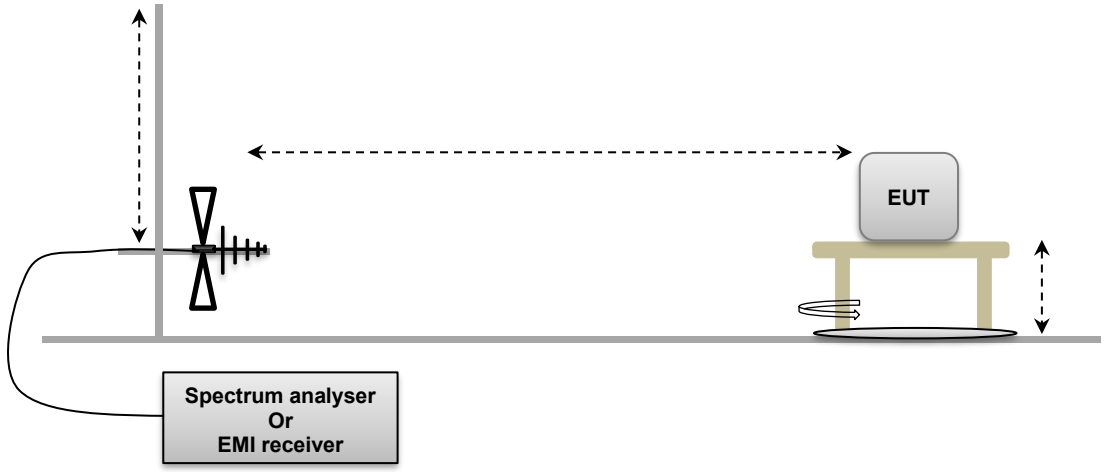
Test procedure:
ANSI C63.10 & FCC Part 15 subpart C

Following frequency ranges, test setup parameters are different and specified in this table:

Frequency range:	**9kHz to 30MHz**	
Test:	**Pre-Characterization**	**Qualification**
Antenna Polarization:	Parallel, Perpendicular and Ground parallel	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	1m
Antenna Type:	Loop	
RBW Filter:	200Hz below 150kHz / 9kHz above 150kHz	
Maximization:	Turntable rotation of 360 degrees range and all axis of EUT used in normal configuration	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Open Aera Test Site
Distance EUT - Antenna:	3m	10m
Detector:	Peak	QPeak

Frequency range:	**30MHz to 1GHz**	
Test:	**Pre-Characterization**	**Qualification**
Antenna Polarization:	Horizontal and Vertical	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	Varied from 1m to 4m
Antenna Type:	Bi-Log	
RBW Filter:	120kHz	
Maximization:	Turntable rotation of 360 degrees range and all axis of EUT used in normal configuration	
EUT height:	1.5m	0.8m
Test site:	Full Anechoic Chamber	Open Aera Test Site
Distance EUT - Antenna:	3m	3m
Detector:	Peak	QPeak

Frequency range:	1GHz to 9.5GHz	
Test:	**Pre-Characterization**	**Qualification**
Antenna Polarization:	Horizontal and Vertical	
Antenna Height:	Centered on EUT (§6.6.5 ANSI C63-10)	Centered on EUT (§6.6.5 ANSI C63-10)
Antenna Type:	Horn	
RBW Filter:	1MHz	
Maximization:	Turntable rotation of 360 degrees range and all axis of EUT used in normal configuration	
EUT height:	1.5m	1.5m
Test site:	Full Anechoic Chamber	Full Anechoic Chamber
Distance EUT - Antenna:	3m	3m
Detector:	Peak & Average	Peak & Average



Test setup of Unwanted Emissions in Restricted Frequency Bands

Photograph for Unwanted Emission in restricted frequency bands

11.3. LIMIT

Measure at 300m		
Frequency range	**Level**	**Detector**
9kHz-490kHz	67.6dBµV/m /F(kHz)	QPeak
Measure at 30m		
Frequency range	**Level**	**Detector**
490kHz-1.705MHz	87.6dBµV/m /F(kHz)	QPeak
1.705MHz-30MHz	29.5dBµV/m	QPeak
Measure at 10m		
Frequency range	**Level**	**Detector**
30MHz to 88MHz	29.5dBµV/m	QPeak
88MHz to 216MHz	33dBµV/m	QPeak
216MHz to 960MHz	35.5BµV/m	QPeak
960MHz to 1000MHz	43.5dBµV/m	QPeak
Above 1000MHz	63.5dBµV/m	Peak
	43.5dBµV/m	Average

Measure at 3m		
Frequency range	**Level**	**Detector**
30MHz to 88MHz	40dBµV/m	QPeak
88MHz to 216MHz	43.5dBµV/m	QPeak
216MHz to 960MHz	46BµV/m	QPeak
960MHz to 1000MHz	54dBµV/m	QPeak
Above 1000MHz	74dBµV/m	Peak
	54dBµV/m	Average

11.4. TEST EQUIPMENT LIST

TEST EQUIPMENT USED					
Description	**Manufacturer**	**Model**	**Identifier**	**Cal_Date**	**Cal_Due**
Amplifier 10MHz - 18GHz	LCIE SUD EST	_	A7102082	05/22	05/24
Antenna Bi-log	AH System	SAS-521-7	C2040180	05/23	05/25
Antenna horn 18GHz	EMCO	3115	C2042029	03/22	03/25
BAT EMC	NEXIO	v3.21.0.32	L1000115		
Cable 0.75m	-	18GHz	A5329900	08/22	08/24
Comb EMR HF	YORK	CGE01	A3169114		
CONTROLLER	INNCO	CO3000	D3044034		
Filter Matrice	LCIE SUD EST	Combined filters	A7484078	03/23	03/25
Rehausse Table C3	LCIE	_	F2000511		
Rehausse Table C3	LCIE	_	F2000507		
Semi-Anechoic chamber #3 (BF)	SIEPEL	_	D3044017_BF	04/22	04/25
Semi-Anechoic chamber #3 (VSWR)	SIEPEL	_	D3044017_VSWR	04/22	04/25
SMA Cable 18GHz 0.5m	TELEDYNE	18GHz	A5330059	02/23	02/24
SMA Cable 18GHz 0.5m	TELEDYNE	18GHz	A5330060	02/23	02/24
SMA Cable 18GHz 0.6m	TELEDYNE	18GHz	A5330055	02/23	02/24
SMA Cable 18GHz 3.5m	TELEDYNE	18GHz	A5330058	02/23	02/24
SMA Cable 18GHz 6m	TELEDYNE	18GHz	A5330057	02/23	02/24
Spectrum analyzer	ROHDE & SCHWARZ	FSU 26	A4060058	09/23	09/25
Table C3	LCIE	_	F2000461		
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	05/23	05/25
TILT	INNCO	TILT	D3044033		
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371		
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444		
Antenna loop	ELECTRO-METRICS	EM-6879	C2040294	08/22	08/24
Antenna Mat (OATS)	ETS Lingren	2071-2	F2000392		
Biconic Antenna	EATON	94455-1	C2040234	05/23	05/25
Cable (OATS)	_	1GHz	A5329623	09/23	09/24
Emission Cable	MICRO-COAX	1GHz	A5329656	09/23	09/24

Emission Cable	RADIALEX		A5329061	07/23	07/24
Emission Cable	CABELTEL	6GHz	A5329069	02/24	02/25
OATS	_	_	F2000409	08/23	08/24
Rehausse Table C1/OATS	LCIE	_	F2000512		
Table C1/OATS	LCIE	_	F2000445		
Turntable (OATS)	ETS Lingren	Model 2187	F2000403		
Turntable / Mast controller (OATS)	ETS Lingren	Model 2066	F2000372		

Note: In our quality system, the test equipment calibration due is more & less 2 months

11.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

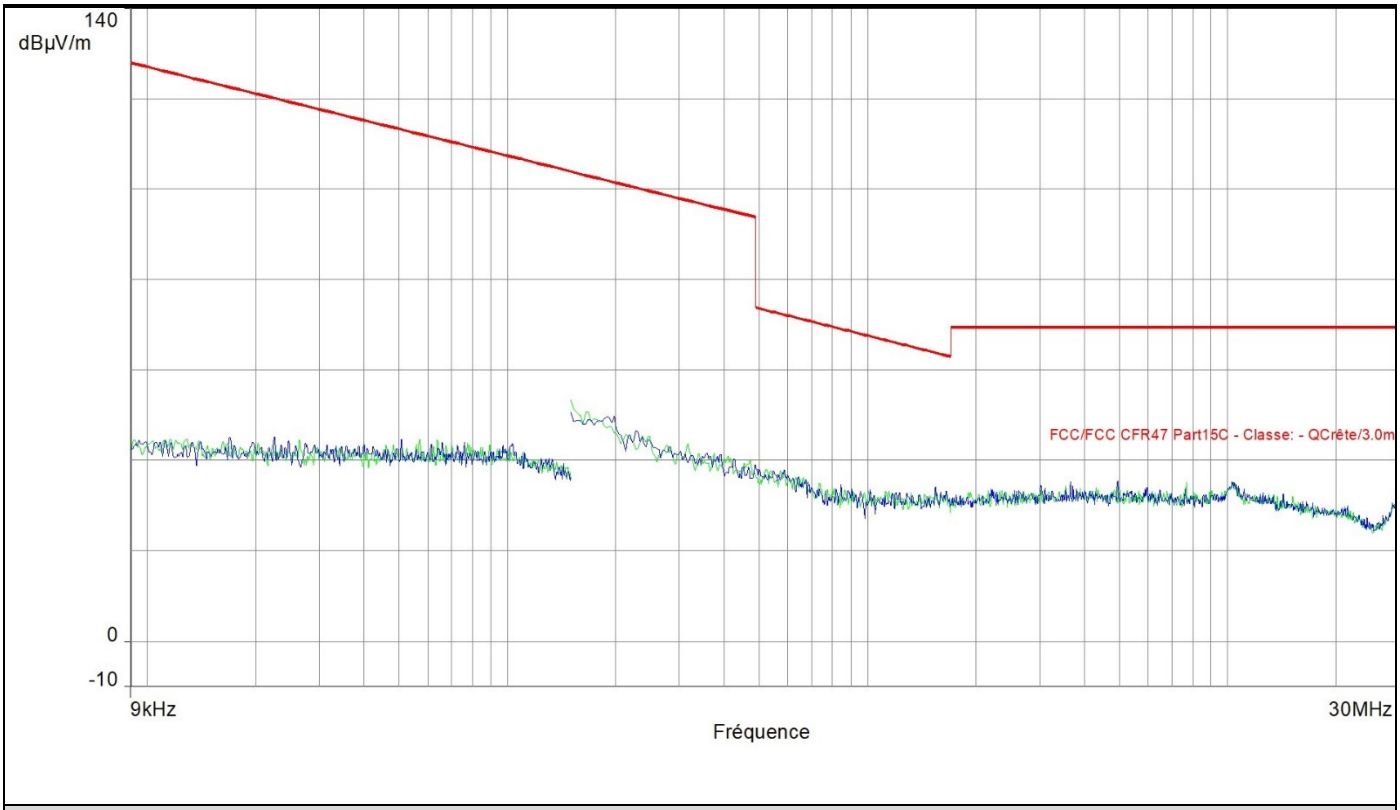
11.6. 9RESULTS

11.6.1. 9kHz to 30MHz

Graphs – Pre characterization:

Graph identifier		Polarization	Mode	Channel	EUT position	Comments
Emr#	1	0°/90°	TX	Cmin	Axis XY/Z	See the following results
Emr#	2	180°	TX	Cmin	Axis XY/Z	See the following results
Emr#	3	0°/90°	TX	Cmid	Axis XY/Z	See the following results
Emr#	4	180°	TX	Cmid	Axis XY/Z	See the following results
Emr#	5	0°/90°	TX	Cmax	Axis XY/Z	See the following results
Emr#	6	180°	TX	Cmax	Axis XY/Z	See the following results

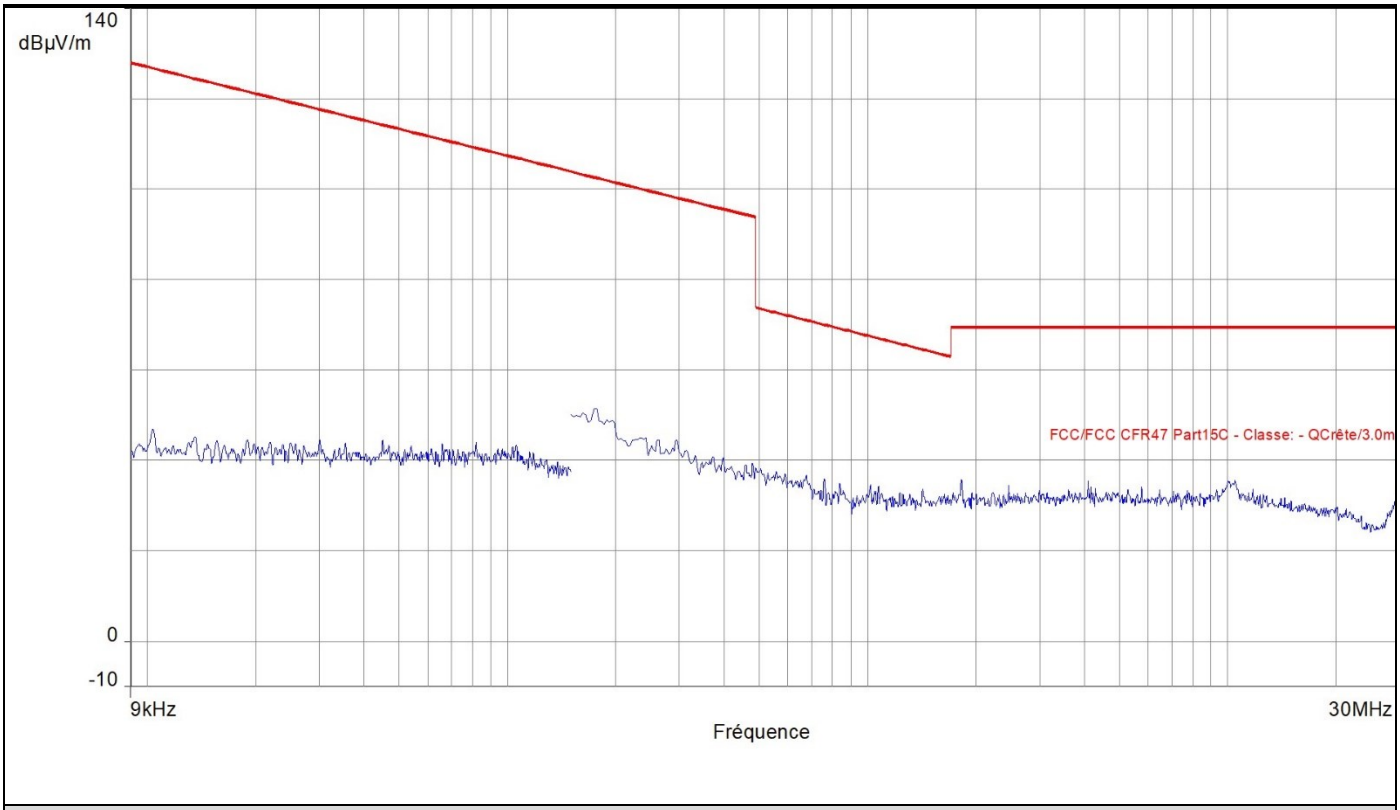
RADIATED EMISSIONS			
Graph name:	Emr#1	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(0°/90°) - TX mode - Axis 0° (Worst case presented) 902.3MHz	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:		**RBW :**	200Hz to 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz to 30kHz



Spurious emissions

No significative frequency observed

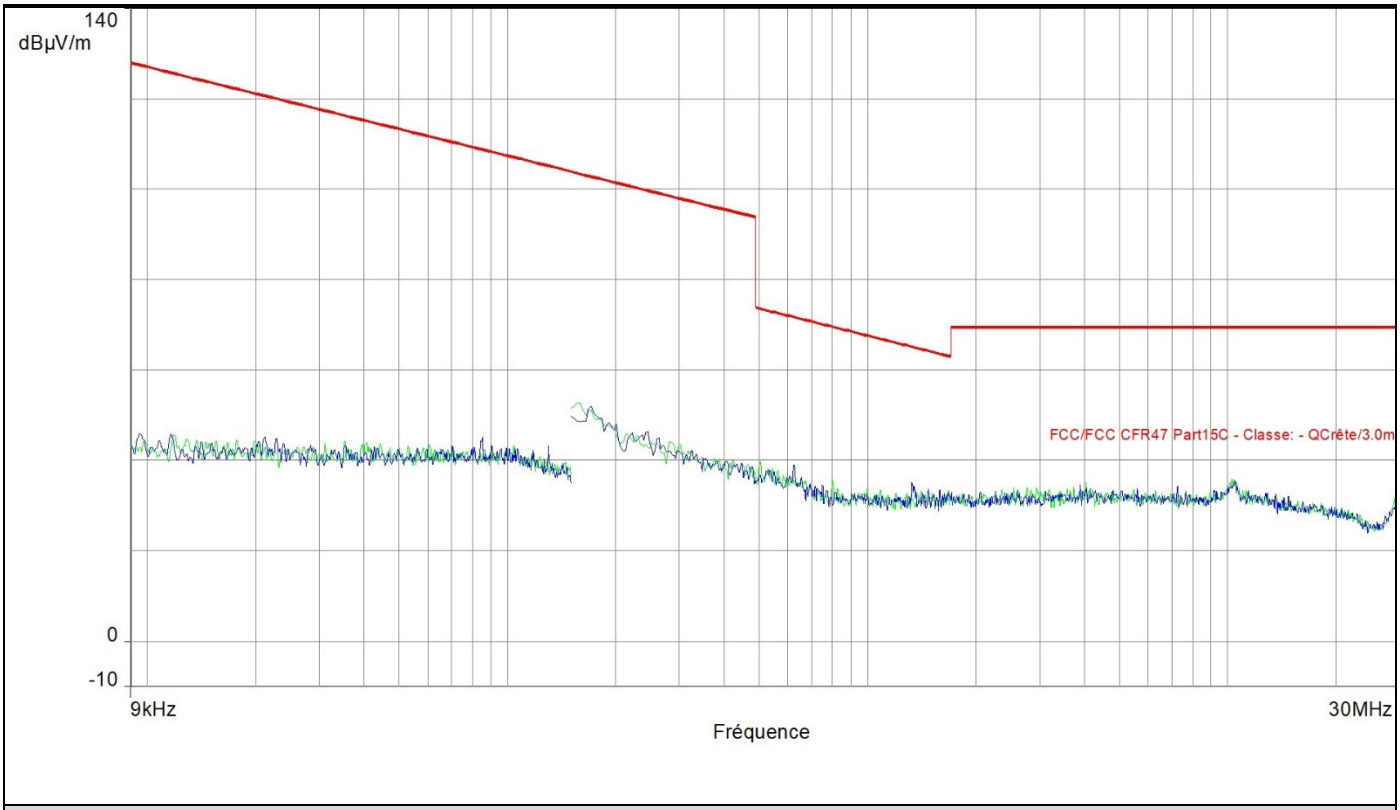
RADIATED EMISSIONS			
Graph name:	Emr#2	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(180°) - TX mode - Axis 0° (Worst case presented) 902.3MHz	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:		**RBW :**	200Hz to 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz to 30kHz



Spurious emissions

No significative frequency observed

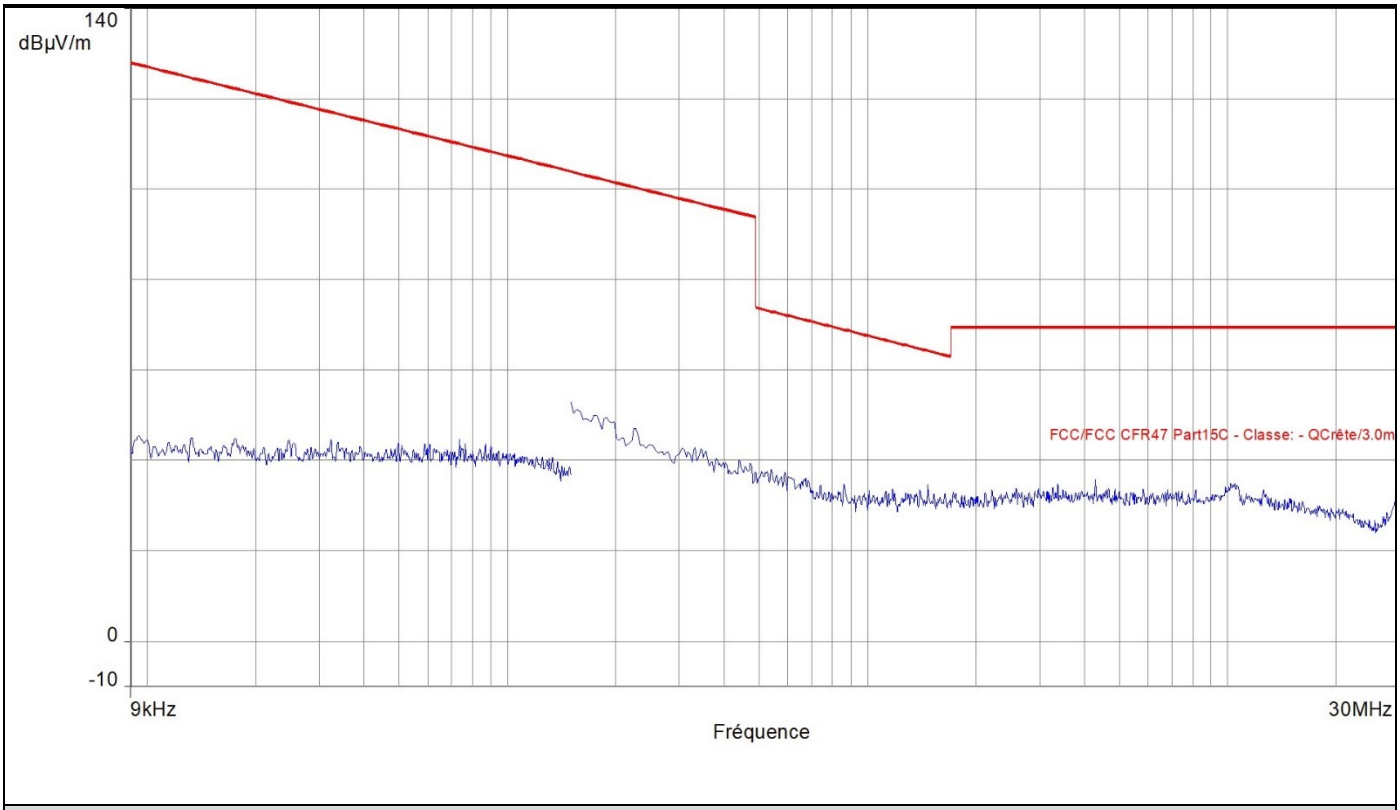
RADIATED EMISSIONS			
Graph name:	Emr#3	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(0°/90°) - TX mode - Axis 0° (Worst case presented) 908.7MHz	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:		**RBW :**	200Hz to 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz to 30kHz



Spurious emissions

No significative frequency observed

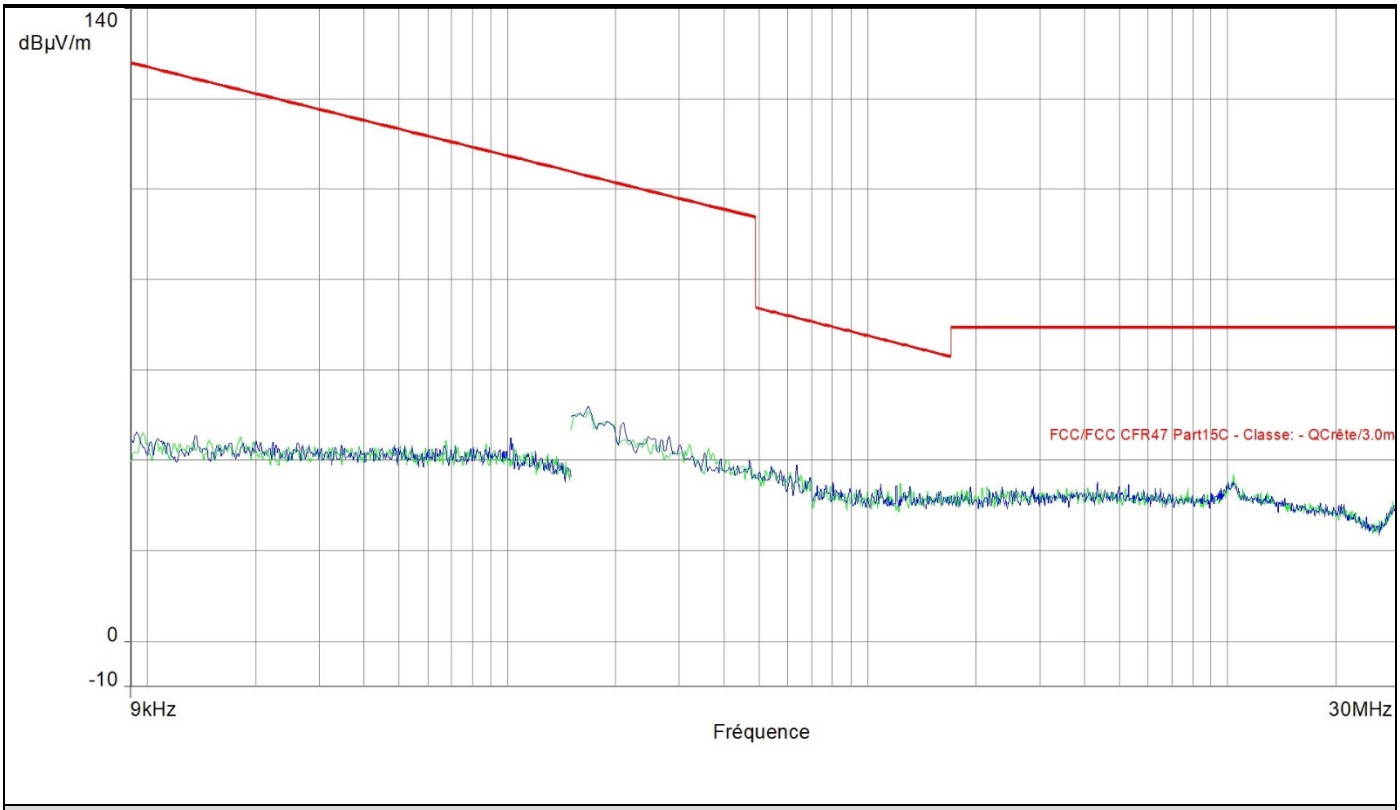
RADIATED EMISSIONS			
Graph name:	Emr#4	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(180°) - TX mode - Axis 0° (Worst case presented) 908.7MHz	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:		**RBW :**	200Hz to 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz to 30kHz



Spurious emissions

No significative frequency observed

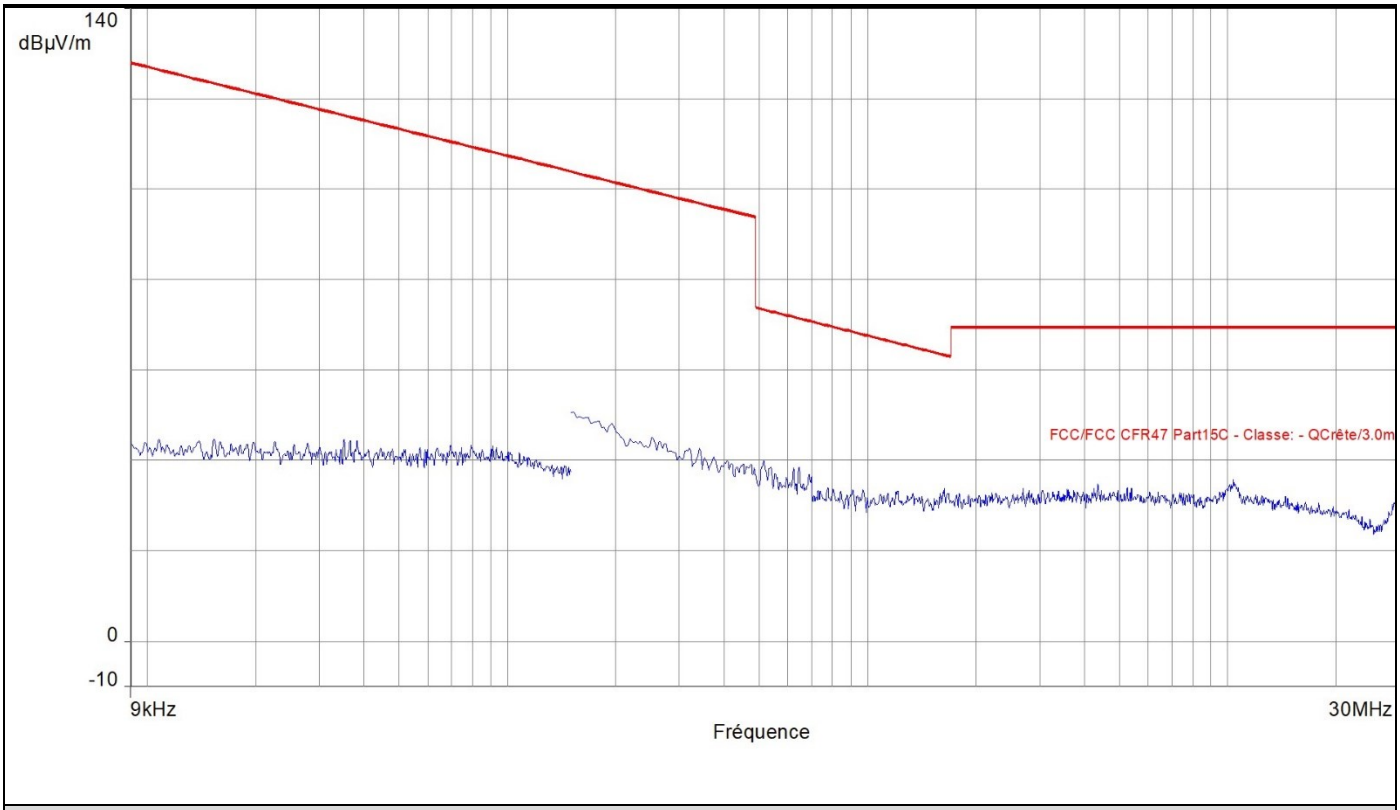
RADIATED EMISSIONS			
Graph name:	Emr#5	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(0°/90°) - TX mode - Axis 0° (Worst case presented)	
Class:		914.9MHz	
Frequency range: [9kHz - 30MHz]			
Antenna polarization:		**RBW :**	200Hz to 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz to 30kHz



Spurious emissions

No significative frequency observed

RADIATED EMISSIONS			
Graph name:	Emr#6	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(180°) - TX mode - Axis 0° (Worst case presented) 914.9MHz	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:		**RBW :**	200Hz to 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz to 30kHz



Spurious emissions

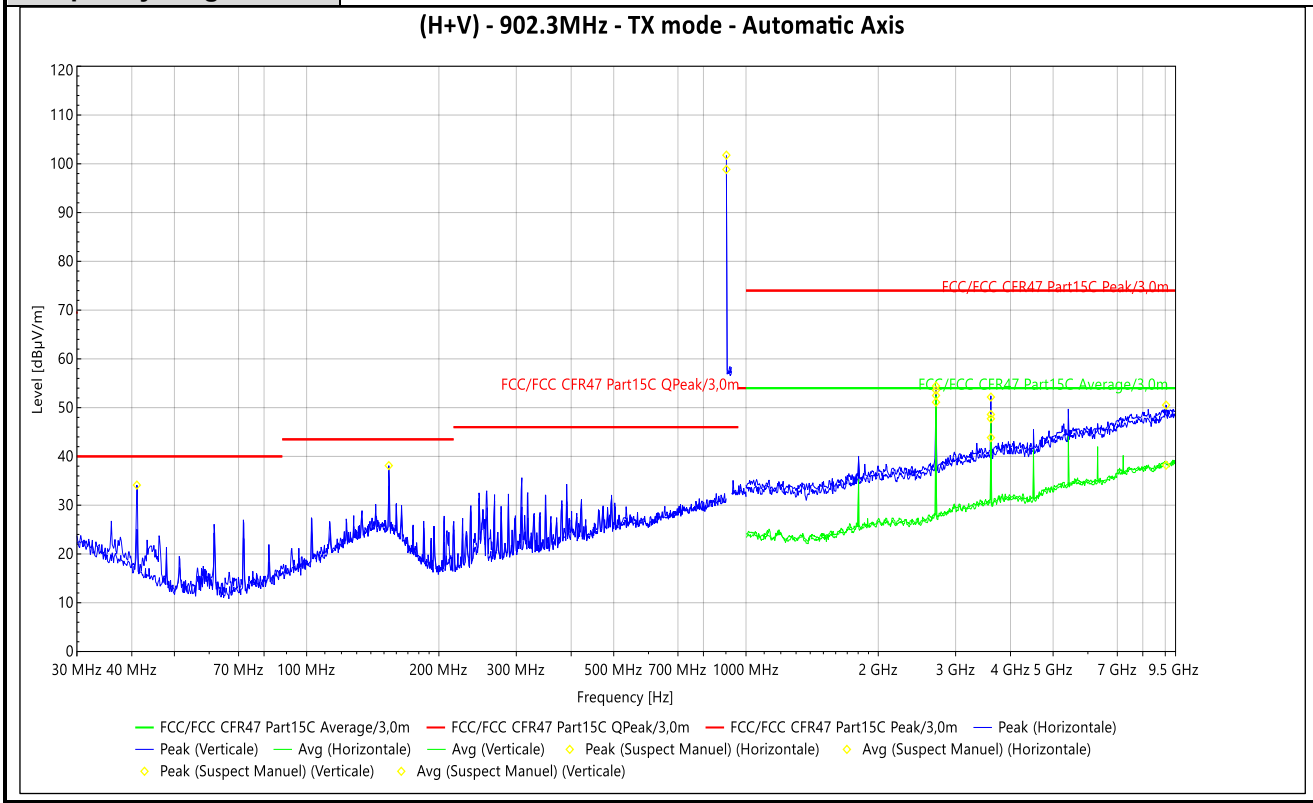
No significative frequency observed

11.6.1. 30MHz to 9.5GHz

Graphs – Pre characterization:

Graph identifier		Polarization	Mode	Channel	EUT position	Comments
Emr#	1	H/V	TX	Cmin	Axis XY/Z	See the following results
Emr#	2	H/V	TX	Cmid	Axis XY/Z	See the following results
Emr#	3	H/V	TX	Cmax	Axis XY/Z	See the following results

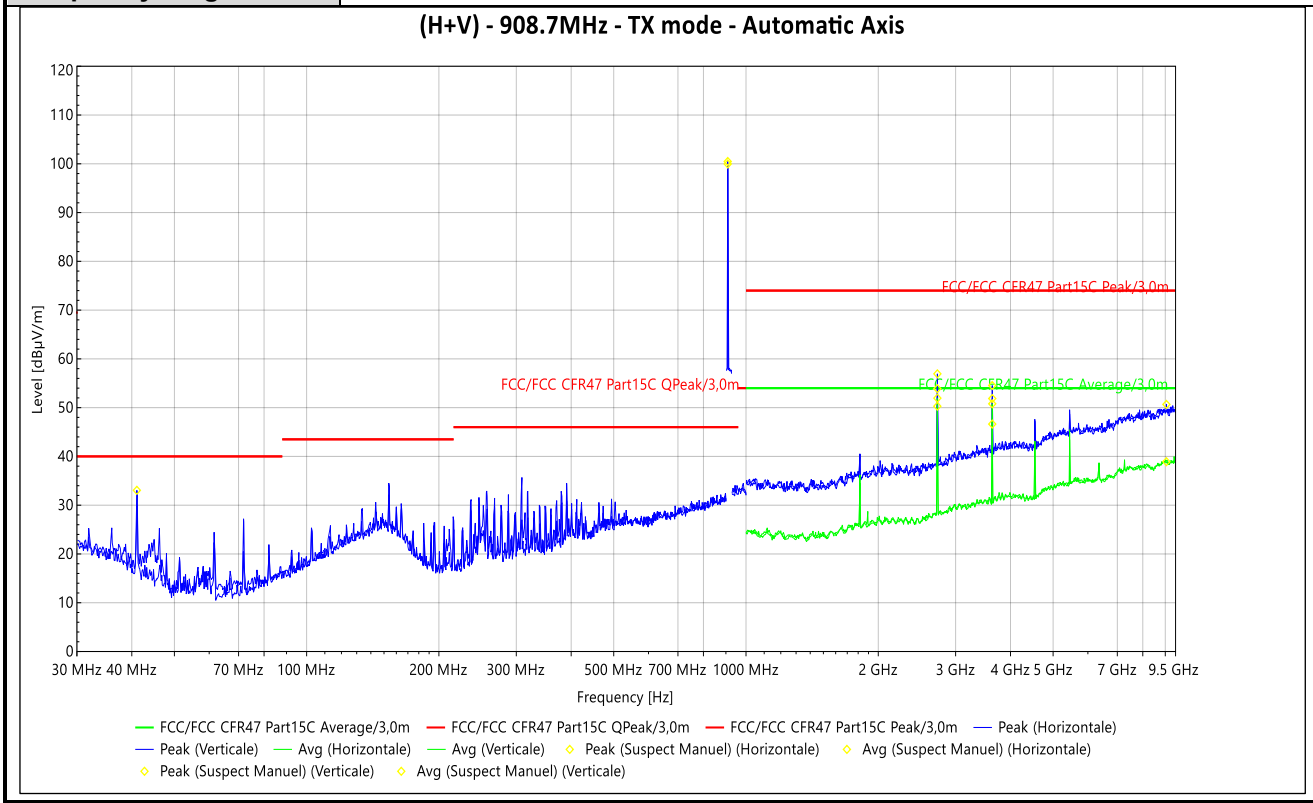
Radiated Emissions	
Graph name:	Emr#1
Frequency range:	30 MHz to 9,5 GHz



Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Lim.QP (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
2.7068 GHz	53.59	74.00	51.13	54.00		292	H	-26.36
3,6095 GHz	52.17	74.00	47.73	54.00		245	H	-22.90
9.03845 GHz	50.52	74.00	38.20	54.00		187	H	-12.98
2.7068 GHz	54.43	74.00	52.49	54.00		7	V	-26.36
3.6095 GHz	48.60	74.00	43.85	54.00		37	V	-22.90
902.312 MHz*	98.84				46.00	113	H	27.90
902.312 MHz*	101.77				46.00	122	V	27.90
153.824 MHz	38.12				43.50	66	H	23.74
41.0744 MHz	34.12				40.00	226	V	15.96

*Carrier frequency
Significant frequency observed

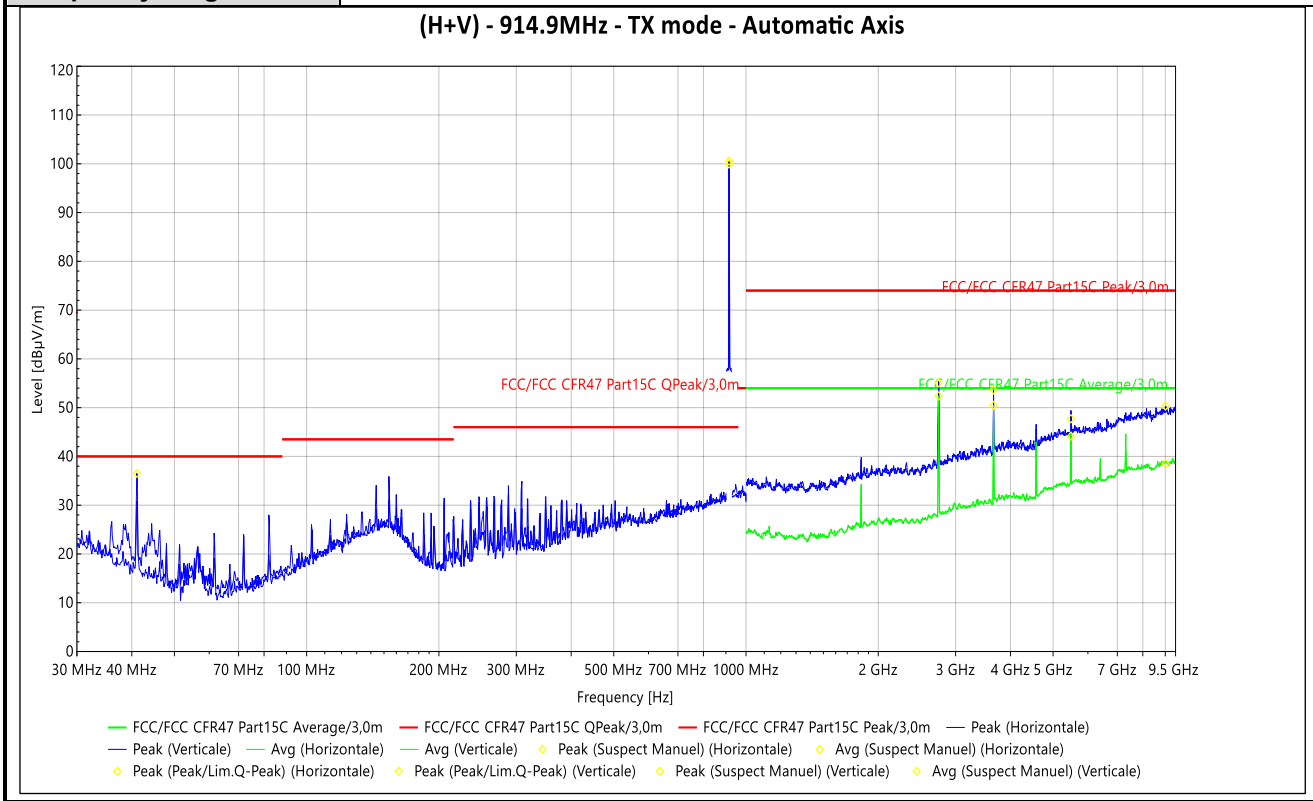
Radiated Emissions	
Graph name:	Emr#2
Frequency range:	30 MHz to 9,5 GHz



Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Lim.QP (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
908.682 MHz*	99.96				46.00	307	H	28.04
908.734 MHz*	100.47				46.00	145	V	28.04
2.72635 GHz	56.92	74.00	51.95	54.00		275	H	-26.28
3.63415 GHz	54.54	74.00	50.79	54.00		221	H	-22.72
9.05375 GHz	50.66	74.00	38.92	54.00		198	H	-13.00
2.7255 GHz	53.89	74.00	50.30	54.00		29	V	-26.28
3.63415 GHz	51.87	74.00	46.63	54.00		272	V	-22.72
41.0744 MHz	33.05				40.00	220	V	15.96

*Carrier frequency
Significant frequency observed

Radiated Emissions	
Graph name:	Emr#3
Frequency range:	30 MHz to 9,5 GHz



Frequency	PK Level (dBµV/m)	Lim.PK (dBµV/m)	Avg (dBµV/m)	Lim.Avg (dBµV/m)	Lim.QP (dBµV/m)	Angle (°)	Polar.	Correct. (dB)
2.7442 GHz	55.06	74.00	52.43	54.00		175	H	-26.25
3.65965 GHz	53.63	74.00	50.48	54.00		231	H	-22.57
5.4897 GHz	47.72	74.00	44.17	54.00		253	H	-17.89
9.0087 GHz	50.32	74.00	38.46	54.00		48	H	-12.93
914.922 MHz*	100.55						H	28.02
914.87 MHz*	99.96						V	28.02
41.0744 MHz	36.53				40.00	234	V	15.96

*Carrier frequency
Significant frequency observed

Final measurement:

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
153.8240	21.2	QP	19.1	40.3	43.5	**-3.2**
41.0744	25.6	QP	13.8	39.4	40.0	**-0.6**

11.7. CONCLUSION

Unwanted Emission in restricted frequency bands measurement performed on the sample of the product **EWATTCH SQUID-PRO**, SN: **70B3D5475012134E**, in configuration and description presented in this test report, show levels **compliant** to the 47 CFR PART 15.247 & RSS 247 ISSUE 3 limits.

12. UNCERTAINTIES CHART

Type de mesure / *Kind of measurement*	**Incertitude élargie laboratoire / *Wide uncertainty laboratory* (k=2) ± x**	**Incertitude limite du CISPR / *CISPR uncertainty limit* ± y**
Measurement of conducted disturbances in voltage on the power port	3.29dB	3.4 dB
Measurement of conducted disturbances in voltage on the telecommunication port.	3.26 dB	5dB
Measurement of discontinuous conducted disturbances in voltage	3.33 dB	3.4 dB
Measurement of conducted disturbances in current	2.67 dB	2.9dB
Spurious emission, radiated (Semi anechoic chamber & open test site)	*5.60 dB*	*6 dB*
Spurious emission, radiated (Full anechoic chamber above 1GHz)	*±3.8 dB*	*±6 dB*
Occupied Channel Bandwidth	*±2.8 %*	*±5 %*
RF power, conducted	*±1.2 dB*	*±1.5 dB*
Power Spectral Density, Conducted	*±1.7 dB*	*±3 dB*
Spurious emission, conducted	*±2.3 dB*	*±3 dB*
Temperature	*±0.75 °C*	*±3 °C*
Supply Voltages	*±1.7 %*	*±3 %*
Time	*±2.3 %*	*±5 %*

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par la norme, la conformité de l'échantillon est établie directement par les niveaux limites applicables. / *The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the standard. The conformity of the sample is directly established by the applicable limits values.*