

Prüfbericht-Nr.: Test report no.:	60362194 001	Auftrags-Nr.: Order no.:	238135118	Seite 1 von 33 Page 1 of 33
Kunden-Referenz-Nr.: Client reference no.:	N/A	Auftragsdatum: Order date:	2020.02.25	
Auftraggeber: Client:	Eve Systems LLC 100 Pine St., Suite 1250, San Francisco CA 94111 USA			
Prüfgegenstand: Test item:	Eve Aqua			
Bezeichnung / Typ-Nr.: Identification / Type no.:	20EBM8101			
Auftrags-Inhalt: Order content:	FCC Part 15C / ISED RSS-247 Test report (Thread)			
Prüfgrundlage: Test specification:	FCC 47CFR Part 15: Subpart C Section 15.247 ISED RSS-247 (02-2017)			
Wareneingangsdatum: Date of sample receipt:	2020.03.25			
Prüfmuster-Nr.: Test sample no.:	A002797212-001, A001077419-002			
Prüfzeitraum: Testing period:	2020.03.25 - 2020.04.17			
Ort der Prüfung: Place of testing:	EMC/RF Laboratory Taipei			
Prüflaboratorium: Testing laboratory:	TUV Rheinland Taiwan Ltd.			
Prüfergebnis*: Test result*:	Pass			
überprüft von: reviewed by:	 Mars Y.J. Lin		genehmigt von: authorized by:	 Ryan W.T. Chen
Datum: 2020.04.22 Date:			Datum: 2020.04.22 Date:	
Stellung / Position:	Project Engineer		Stellung / Position:	Project Manager
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend N/A = nicht anwendbar	4 = ausreichend N/T = nicht getestet
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory N/A = not applicable	4 = sufficient N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: Passed

5.1.2 MAXIMUM CONDUCTED PEAK OUTPUT POWER

RESULT: Passed

5.1.3 6dB BANDWIDTH AND 99% BANDWIDTH

RESULT: Passed

5.1.4 POWER DENSITY

RESULT: Passed

5.1.5 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100kHz BANDWIDTH

RESULT: Passed

5.1.6 SPURIOUS EMISSION

RESULT: Passed

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: Passed

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1. General Remarks

1.1 Complementary Materials

The following attachments are integral parts of this test report:

Appendix P: Photo Documentation internal view
(File Name: 60362193 001, 60362194 001 APPENDIX P)

Appendix D: Test Result of Radiated Emissions
(File Name: 60362194 001 APPENDIX D)

Test Specifications

The following standards were applied.

Table 1: Applied Standard and Test Levels

Radio
FCC 47CFR Part 15: Subpart C Section 15.247 FCC 47CFR Part 2: Subpart J Section 2.1091 ISED RSS-247 Issue 2, Feb 2017 ISED RSS-102 Issue 5, March 2015 ISED RSS-Gen, Issue 5, March 2019 ANSI C63.10:2013 KDB558074 D01 DTS Meas Guidance v05r02 KDB447498 D01 General RF Exposure Guidance v06

1.2 Decision Rule of conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

2.2 Test Facility

TUV Rheinland Taiwan Ltd.

No. 458-18, Sec 2, Fenliao., Linkou Dist.
New Taipei City 244
Taiwan (R.O.C.)

FCC Registration No.: 226631
IC Canada Registration No.: 25563
TAF Accredited NCC Test Lab. No.:3567
TAF ISO17025 Certification effective period: 6th-May-2019 to 05th-May-2022



Testing Laboratory
3567

2.3 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due Date
EMI Test Receiver	R&S	ESR7	102109	2019/4/17	2020/4/16
				2020/3/30	2021/3/29
Spectrum Analyzer	R&S	FSV40	101508	2020/3/16	2021/3/15
Pre-Amplifier	Agilent	8447D	2727A05146	2020/2/17	2021/2/16
Pre-Amplifier	EMCI	EMC051845SE	980635	2020/2/11	2021/2/10
Pre-Amplifier	EMCI	EMC184045SE	980656	2020/2/11	2021/2/10
Bilog Antenna	SCHWARZBECK	VULB-9168	00950	2020/1/20	2021/1/19
Horn Antenna	ETS-Lindgren	3117	00218929	2019/11/27	2020/11/26
Horn Antenna	SCHWARZBECK	BBHA 9170	00896	2020/1/17	2021/1/16
Loop Antenna	EMCI	LPA600	287	2019/12/20	2020/12/19
Test Software	Audix	e3	Ver. 9	N/A	N/A
Test Cable	HUBER+SUHNER	SUCOFLEX 104EA	800057/4EA	2020/3/25	2021/3/24
Test Cable	HUBER+SUHNER	SUCOFLEX 104	802244/4	2020/3/25	2021/3/24
Test Cable	HUBER+SUHNER	SUCOFLEX 104	MY37203/4	2020/3/25	2021/3/24
Test Cable	HUBER+SUHNER	SUCOFLEX 102EA	800897/2EA	2020/3/25	2021/3/24
Test Cable	HUBER+SUHNER	SUCOFLEX 102EA	800902/2EA	2020/3/25	2021/3/24
Test Cable	HUBER+SUHNER	SUCOFLEX 102EA	801026/2EA	2020/3/25	2021/3/24
Thermo Chamber	Giant Force	GHT-150-40-CP-SD	MAA1902-010	2020/2/1	2021/2/1
Signal Generator	R&S	SMB100A03	181335	2020/1/23	2021/1/23
Power Meter	Anritsu	ML2495A	1901008	2019/4/29	2020/4/28
Power Sensor	Anritsu	MA2411B	1725269	2019/4/29	2020/4/28

2.4 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.5 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular schedule using in house standards or comparisons.

2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements .

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	± 1.5 dB
RF power density, conducted	± 3 dB
spurious emissions, conducted	± 3 dB
all emissions, radiated	± 6 dB
Temperature	± 1 °C
Humidity	± 5 %

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a flowmeter. It contains a thread compatible module enabling the user to communicate data through a Wireless interface.

For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Eve Aqua
Type Designation	20EBM8101
FCC ID	SNE-WHV-2
IC	11192A-WHV002
HVIN	SA-7716

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequencies	2405~2480MHz
Channel Spacing	5M
Channel number	16
Operation Voltage	3Vdc
Modulation	OQPSK
Antenna gain	3.8dBi

3.3 Independent Operation Modes

Basic operation modes are:

- A. Transmitting
- B. Receiving
- C. Normal

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Circuit Diagram
- Block Diagram
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The test modes were adapted accordingly in reference to the instructions for use.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Table 6: Table for Parameters of Test Software Setting

Mode	Channel Frequency		
	2405 MHz	2440 MHz	2480 MHz
THREAD	8	8	3

4.2 Test Operation and Test Software

Setup for testing: Test samples are provided with a USB interface which makes it possible to control them through a test software installed on a notebook computer.

This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed in section 3.3 as appropriate. After finishing the setup command, the setup computer can be removed.

The samples were used as follows:
Conducted sample: A001077419-002
Radiation sample: A002797212-001

Full test was applied on all test modes, but only worst case was shown

Test Software	Putty.exe
---------------	-----------

4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

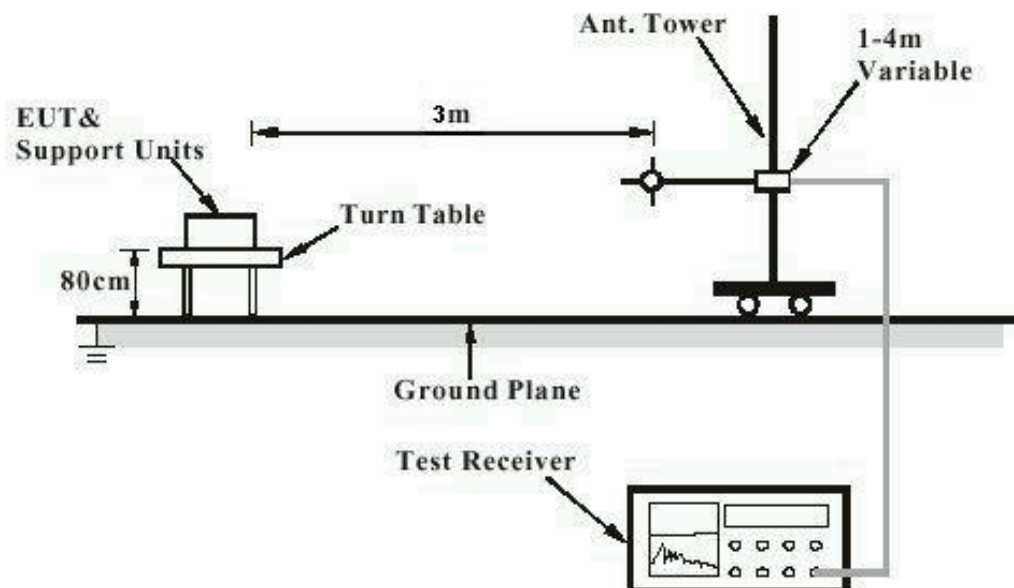
Kind of Equipment	Manufacturer	Model Name	S/N
HP Laptop	HP	15-da1046TX	CND9111RJ2

4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m

Diagram of Measurement Equipment Configuration for Mains Conduction Measurement (if applicable)

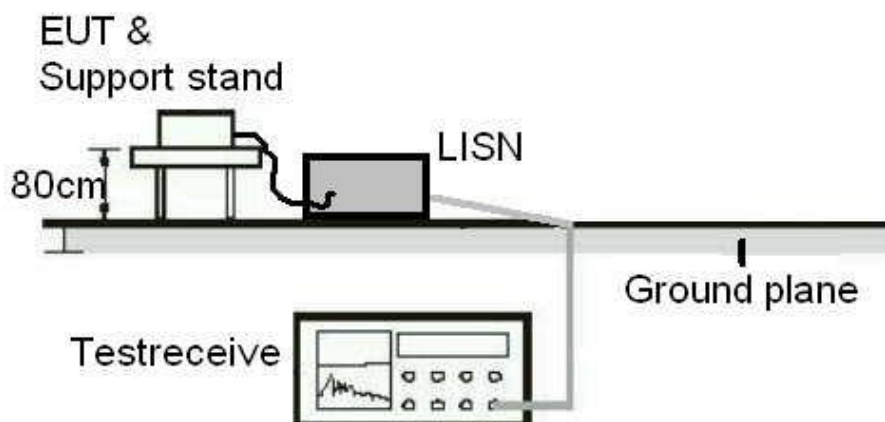
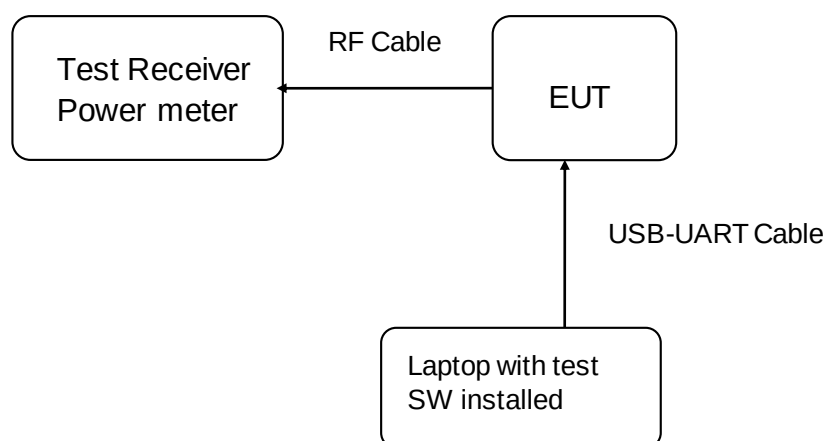


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



Note: The output power is measured by power meter according to 8.3.1.3 KDB558074 D01 Meas Guidance v05r02 8.3.1.3.

5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

Test standard : FCC Part 15.247(b)(4), Part 15.203 and ISSED
RSS-Gen 6.8

Requirement : The maximum conducted output power shall be reduced
in equal quantity according to the total dBi of the antenna
directional gain over 6 dBi.

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 3.8 dBi.
The antenna is a printed PCB trace antenna with no possibility of replacement with a non-approved
antenna by the end-user.

The directional gain of this antenna does not exceed 6dBi, so the limit does not reduce.

Refer to EUT photo for details.

5.1.2 Maximum conducted Peak output power

RESULT:

Passed

Test standard : FCC Part 15.247(b)(3), ISSED RSS-247 5.4(b)
 Basic standard : ANSI C63.10:2013, KDB558074(8.3.1.3)
 Limit : 1 Watt
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A

 Ambient temperature : 20-24 °C
 Relative humidity : 50-65 %
 Atmospheric pressure : 100-103 kPa

Table 7: Test result of Maximum conducted Peak output power

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2405	7.30	0.00537	1
Middle Channel	2440	7.20	0.00525	1
High Channel	2480	4.17	0.00261	1

Pmax: 5.3703 mW

5.1.3 6dB Bandwidth and 99% Bandwidth

RESULT:
Passed

Test standard : FCC Part 15.247(a)(2), ISED RSS-247 5.2(a)
 ISED RSS-Gen (Issue 5) 6.7
 Basic standard : ANSI C63.10:2013, KDB558074
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A
 Ambient temperature : 20-24°C
 Relative humidity : 50-65%
 Atmospheric pressure : 100-103 kPa

Table 8: Test result of 6dB Bandwidth

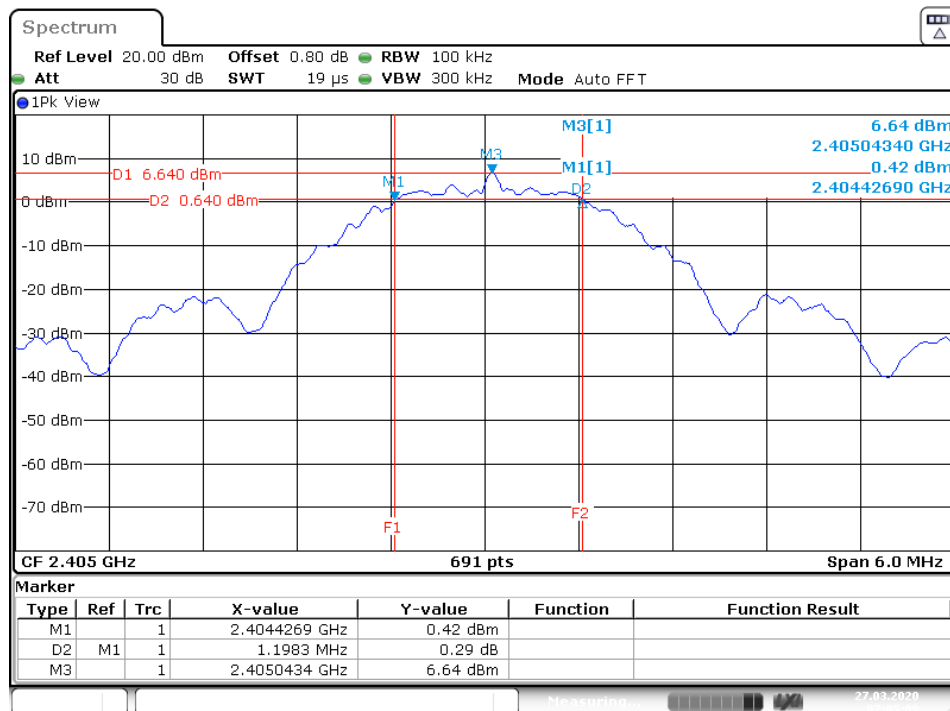
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low Channel	2405	1.198	>500	Pass
Mid Channel	2440	1.198	>500	Pass
High Channel	2480	1.233	>500	Pass

Table 9: Test result of 99% Bandwidth

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Low Channel	2405	2.240
Mid Channel	2440	2.240
High Channel	2480	2.257

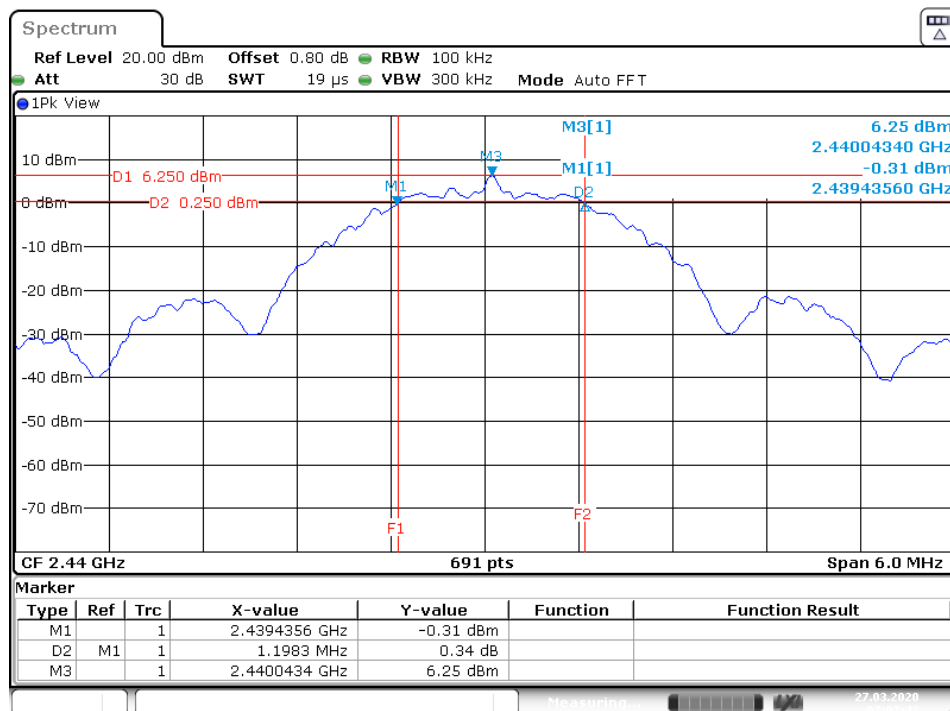
Test Plot of 6dB Bandwidth

Low Channel



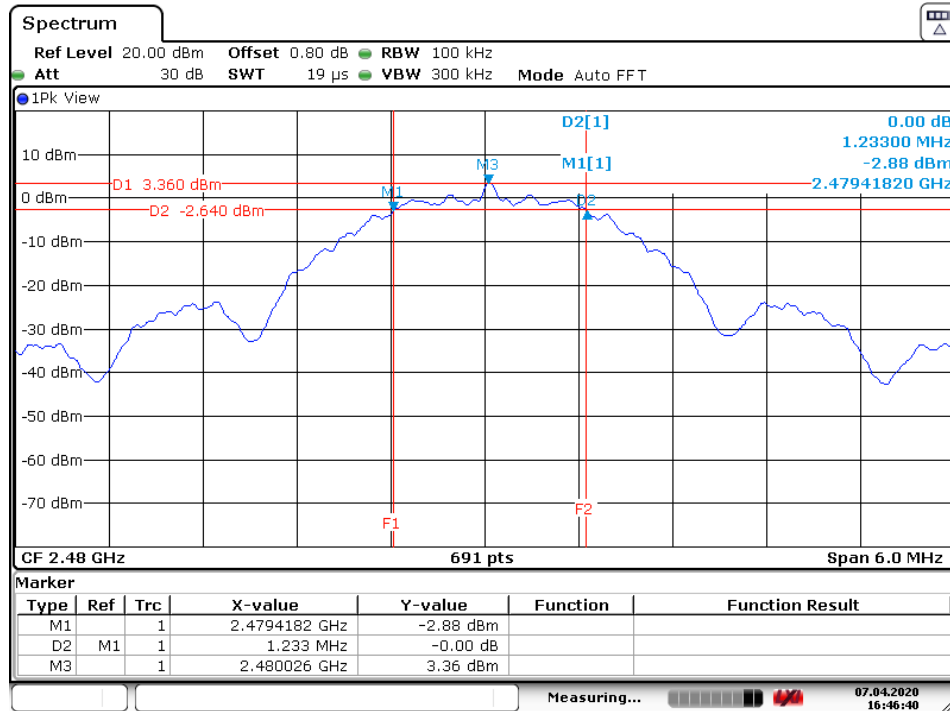
Date: 27.MAR.2020 07:05:09

Middle Channel



Date: 27.MAR.2020 07:07:42

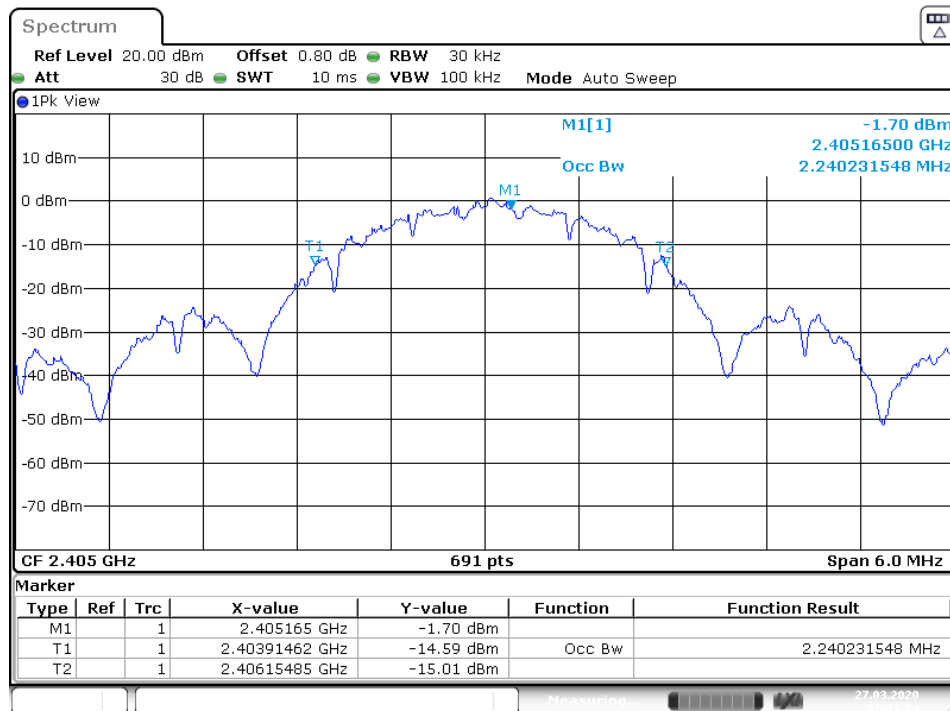
High Channel



Date: 7.APR.2020 16:46:40

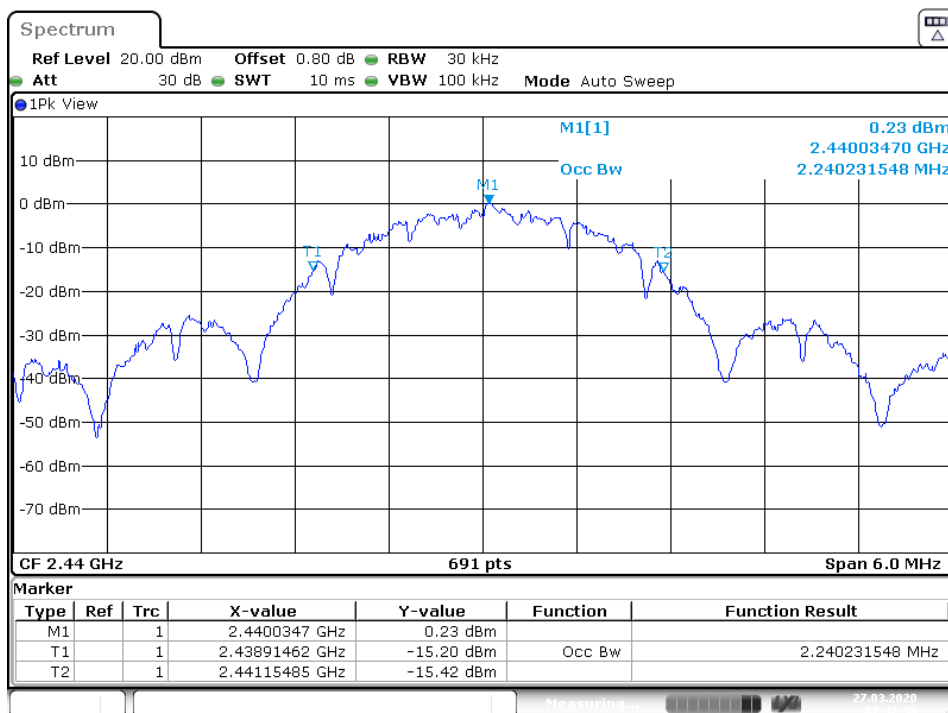
Test Plot of 99% Bandwidth

Low Channel



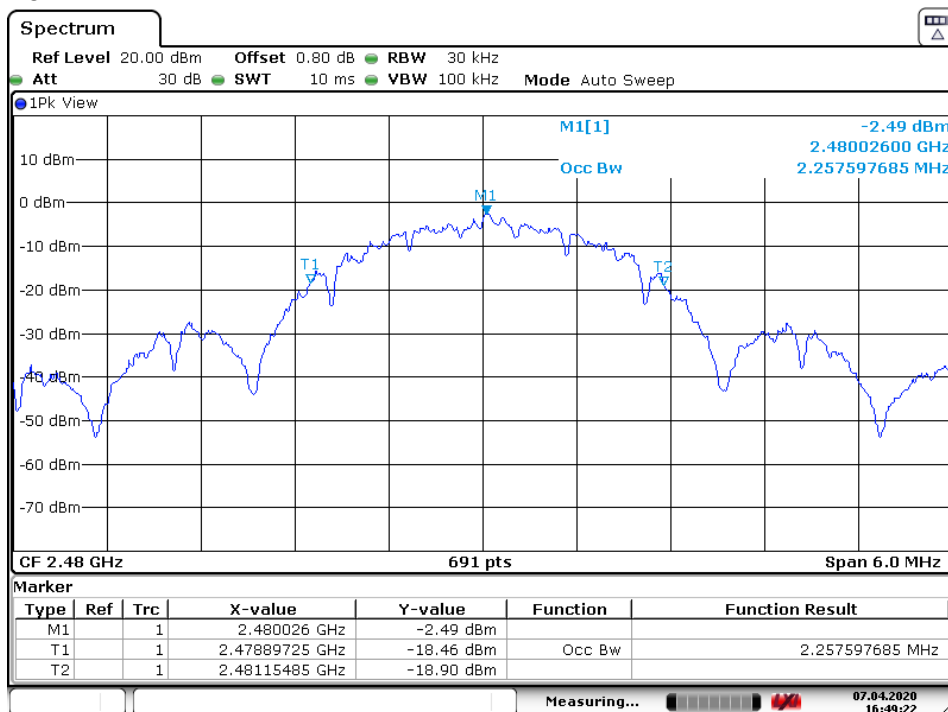
Date: 27.MAR.2020 07:31:55

Middle Channel



Date: 27.MAR.2020 07:32:56

High Channel



Date: 7.APR.2020 16:49:22

5.1.4 PowerDensity

RESULT:**Passed**

Test standard : FCC Part 15.247(e) , ISSED RSS-247 5.2(b)
Basic standard : ANSI C63.10:2013, KDB558074
Kind of test site : Shielded room

Test setup

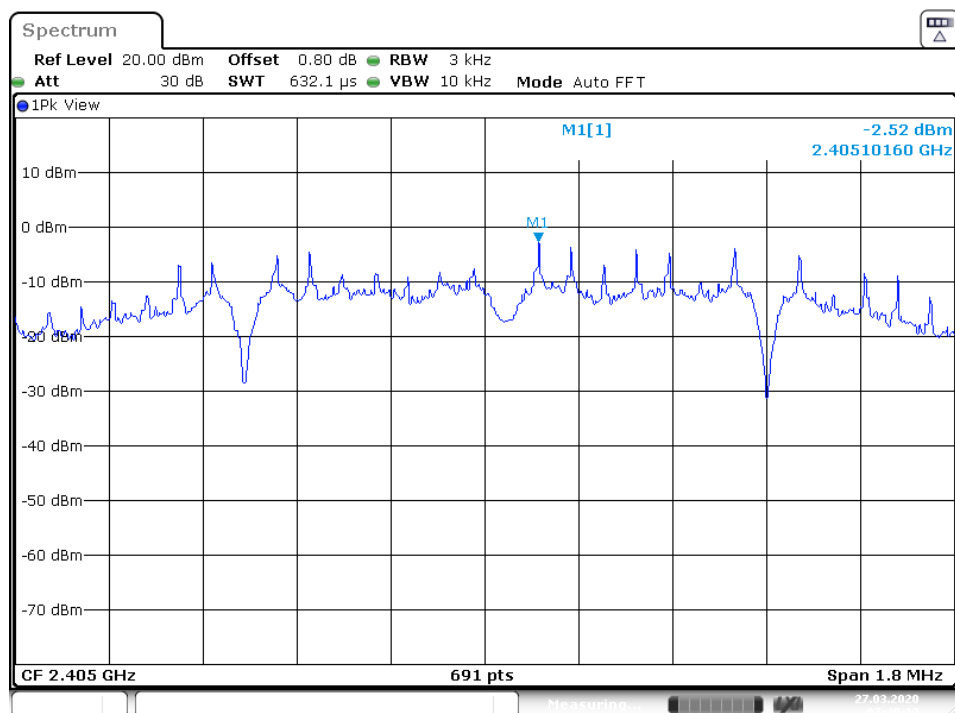
Test Channel : Low/ Middle/ High
Operation Mode : A
Ambient temperature : 20-24°C
Relative humidity : 50-65%
Atmospheric pressure : 100-103 kPa

Table 10: Test result of Power Density

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2405	-2.52	8
Middle Channel	2440	-7.09	8
High Channel	2480	-6.11	8

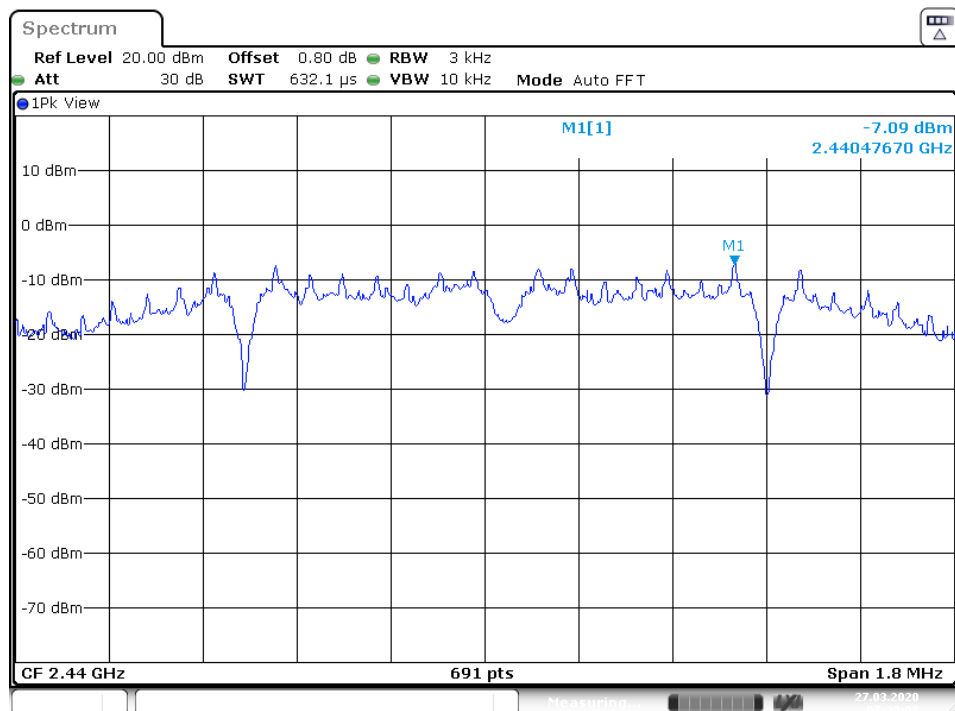
Test Plot of Power Density

Low Channel

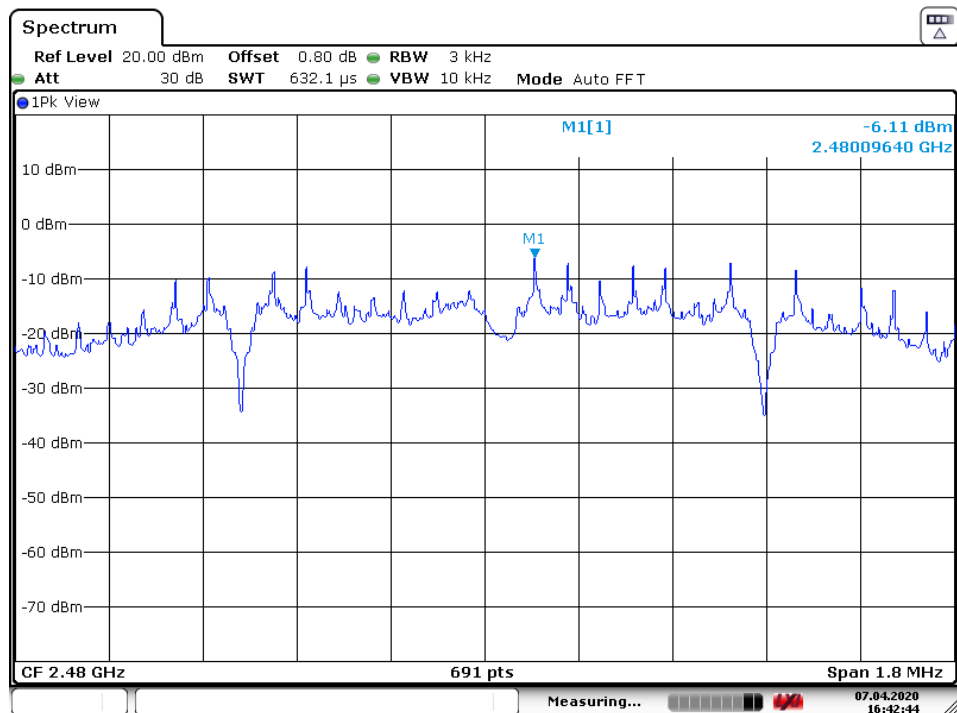


Date: 27.MAR.2020 07:40:13

Middle Channel



Date: 27.MAR.2020 07:39:09

High Channel


Date: 7.APR.2020 16:42:45

5.1.5 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth

RESULT:**Passed**

Test standard	:	FCC part 15.247(d), RSS-247 5.5
Basic standard	:	ANSI C63.10:2013, KDB558074
Limit	:	20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power)
Kind of test site	:	Shielded room

Test setup

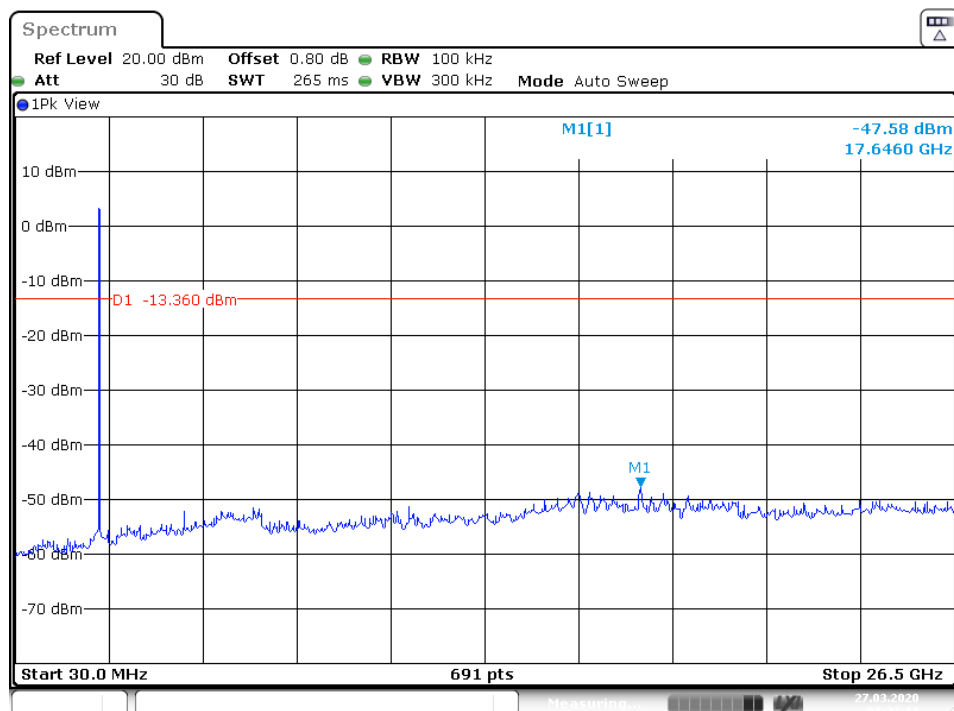
Test Channel	:	Low/ Mid/ High for spurious, Low/ High for Band Edge
Operation mode	:	A
Ambient temperature	:	20-24°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103 kPa

All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achieved as well.

Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.

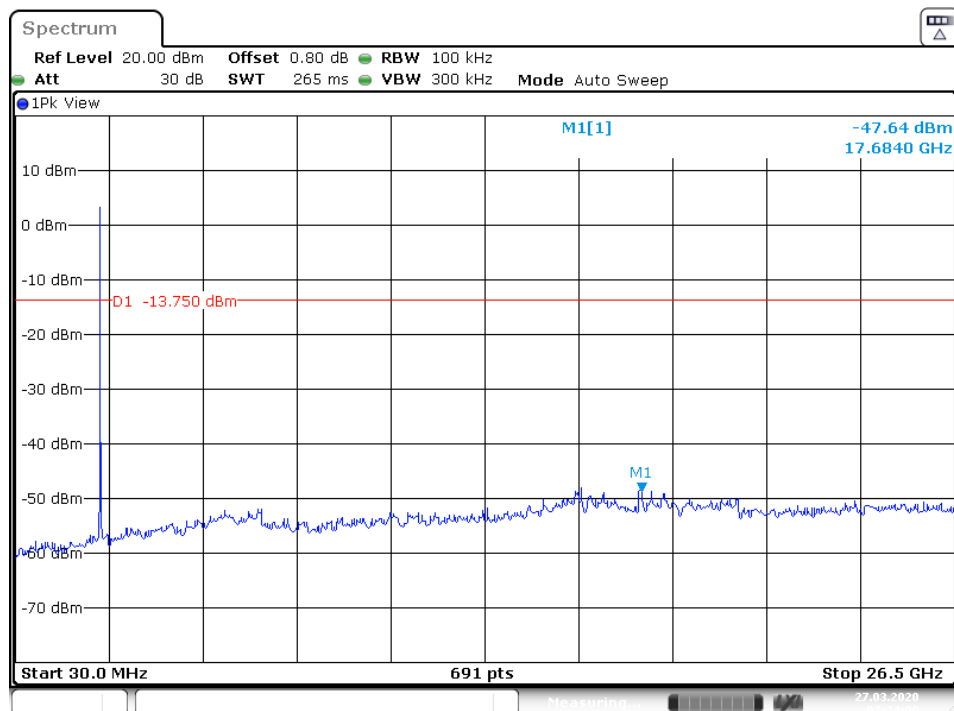
Test Plot 100kHz Conducted Emissions

Low Channel



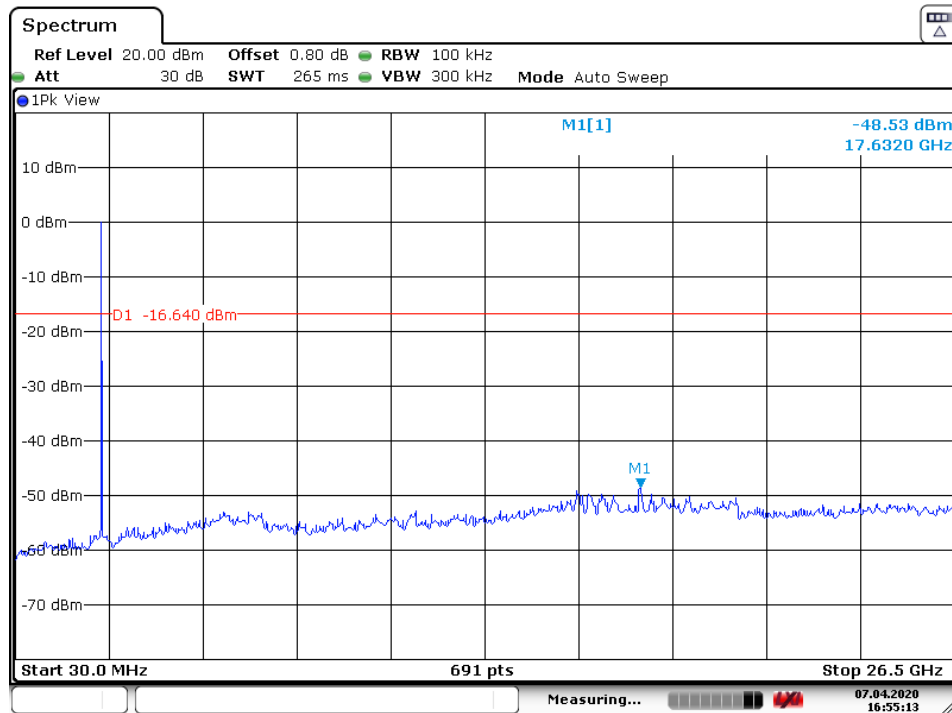
Date: 27.MAR.2020 07:22:14

Middle Channel



Date: 27.MAR.2020 07:24:01

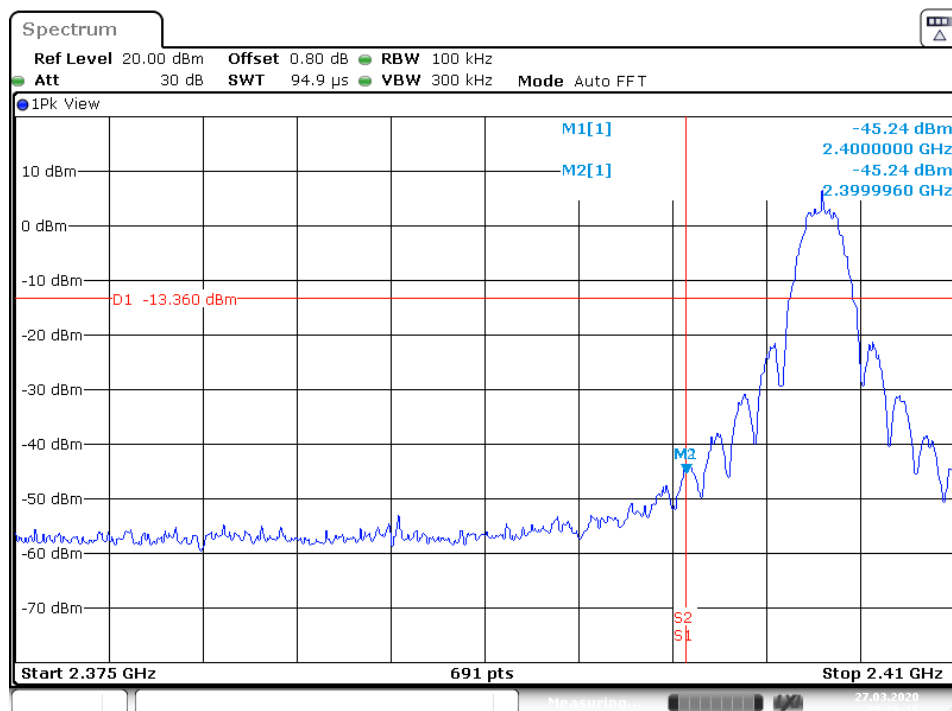
High Channel



Date: 7.APR.2020 16:55:13

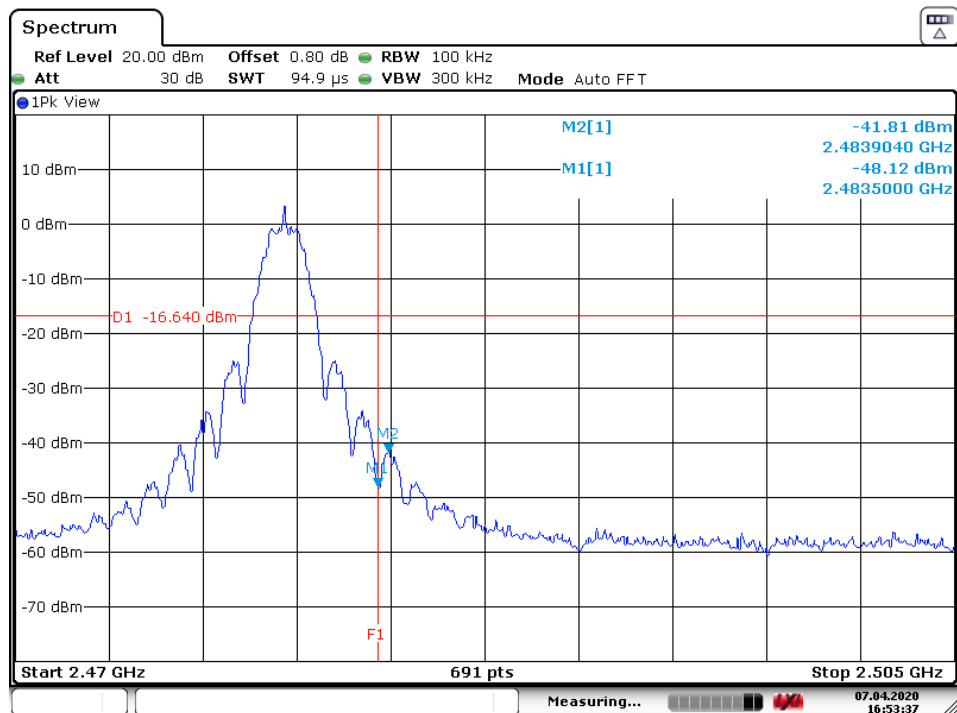
Test Plot 100kHz RBW of Band Edge

Low Channel



Date: 27.MAR.2020 07:19:16

High Channel



Date: 7.APR.2020 16:53:37

5.1.6 Spurious Emission

RESULT:**Passed**

Test standard : FCC part 15.247(d), FCC 15.205, FCC 15.209, ISED
RSS-247 5.5 and ISED RSS-Gen issue 5
Basic standard : ANSI C63.10: 2013
Limits : Radiated emissions which fall in the restricted bands, as
defined in FCC 15.205(a) and RSS-Gen i5, 8.10 (Table 7),
must comply with the radiated emission limits specified in
FCC 15.209(a) and ISED RSS-Gen i5, 8.9 (Table 5 and
6).
Emission radiated outside the restricted and authorized
frequency bands must either comply with the radiated
emission limits specified for the restricted bands or in
FCC15.247(d) and ISED RSS-247 i2, 5.5

Kind of test site : 3m Semi-Anechoic Chamber

Test setup

Test Channel : Low/ Middle/ High
Operation mode : A

For details refer to Appendix D.

The Radiated Emissions testing was performed in the X, Y and Z axis orientation. The worst-case Axis orientation is recorded in this test report.

Factor (dB/m)=Antenna Factor(dB/m)+Cable loss (dB)
Level(dBuV/m)=Reading(dBuV)+ Factor(dB/m)

6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:
Passed

Test standard : FCC KDB Publication 447498 D01 v06
 FCC CFR 47 Part 2 Subpart J Section 2.1091
 ISED RSS-102 issue 5, 2.5.2

Separation distance is more than 20 cm, thus mobile device exposure limits can be applied.

FCC Maximum Exposure:

Mode	Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Maximum Output Power (dBm)	Output Power (mW)	Power Density (S)(mW/cm ²)	Test Result
Thread	2405	3.80	2.3988	7.3000	5.3703	0.002564	Pass

Limit FCC: 1500-100,000 MHz 1.0 mW/cm²

ISED:
Exemption Limits for Routine Evaluation – RF Exposure Evaluation

At or above 300MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W, where f is in MHz;

f= 2405MHz

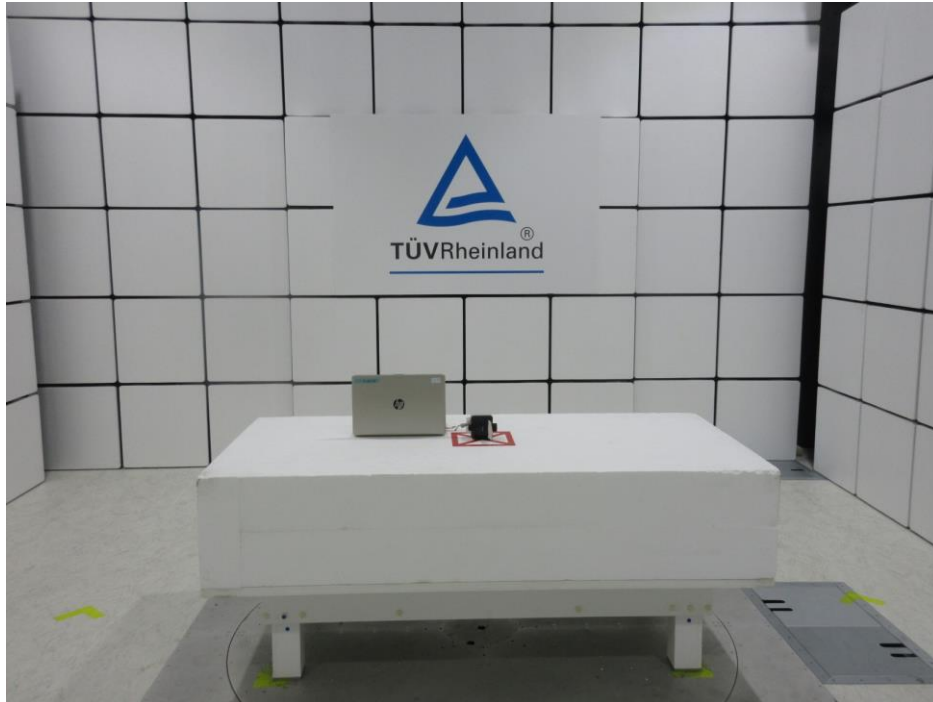
$$1.31 \times 10^{-2} \times 2405^{0.6834} = 2.67W$$

After evaluation the 2405MHz e.i.r.p 11.10dBm calculated result is closer to its limit.

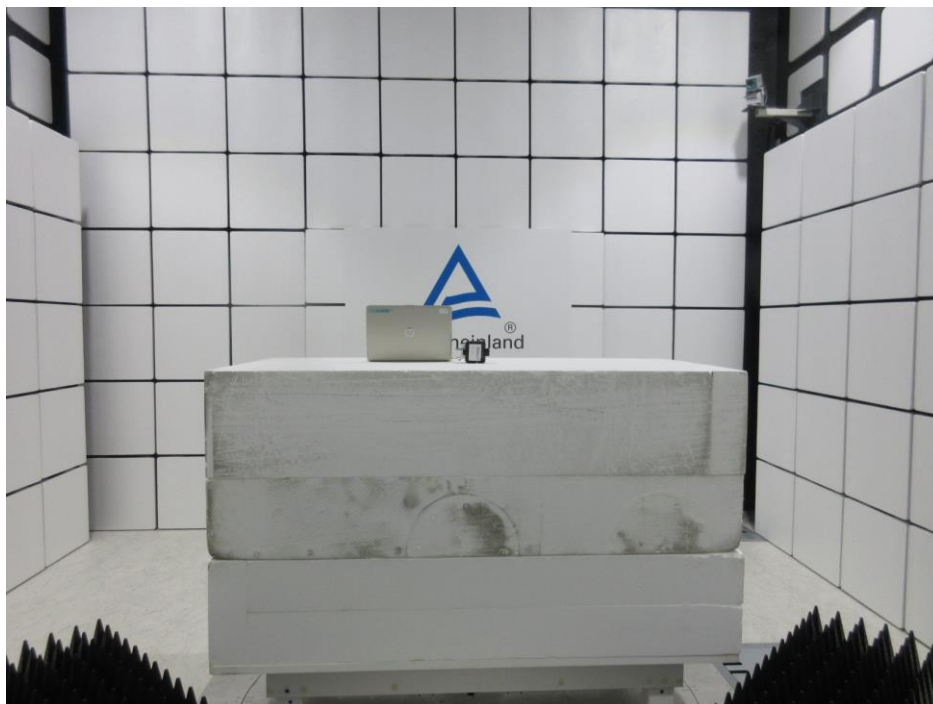
11.10dBm = 0.01289W, it is well below the limit of Exemption Limits for Routine Evaluation, so RF exposure assessment meets its standards.

7. Photographs of the Test Set-Up

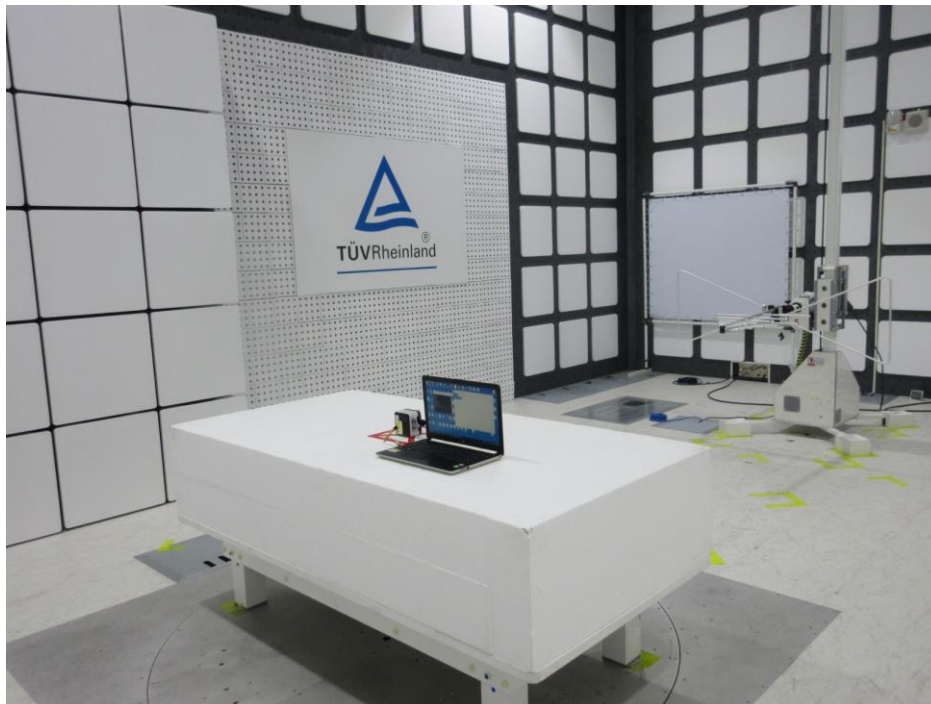
Photograph 1: Set-up for Spurious Emissions (Front View 1)



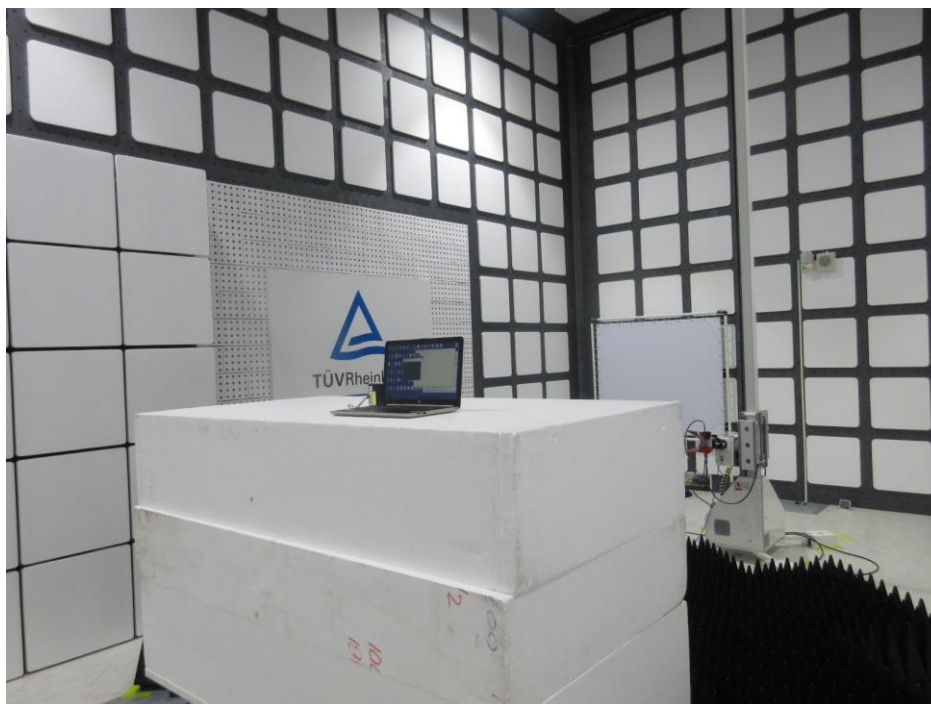
Photograph 2: Set-up for Spurious Emissions (Front View 2)



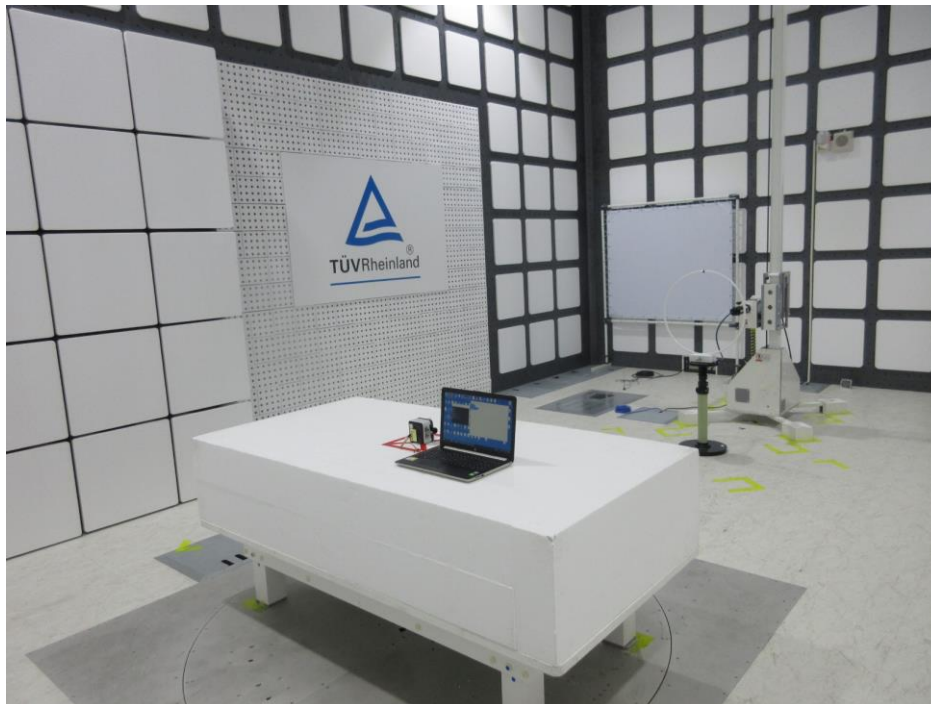
Photograph 3: Set-up for Spurious Emissions (Back View 1)



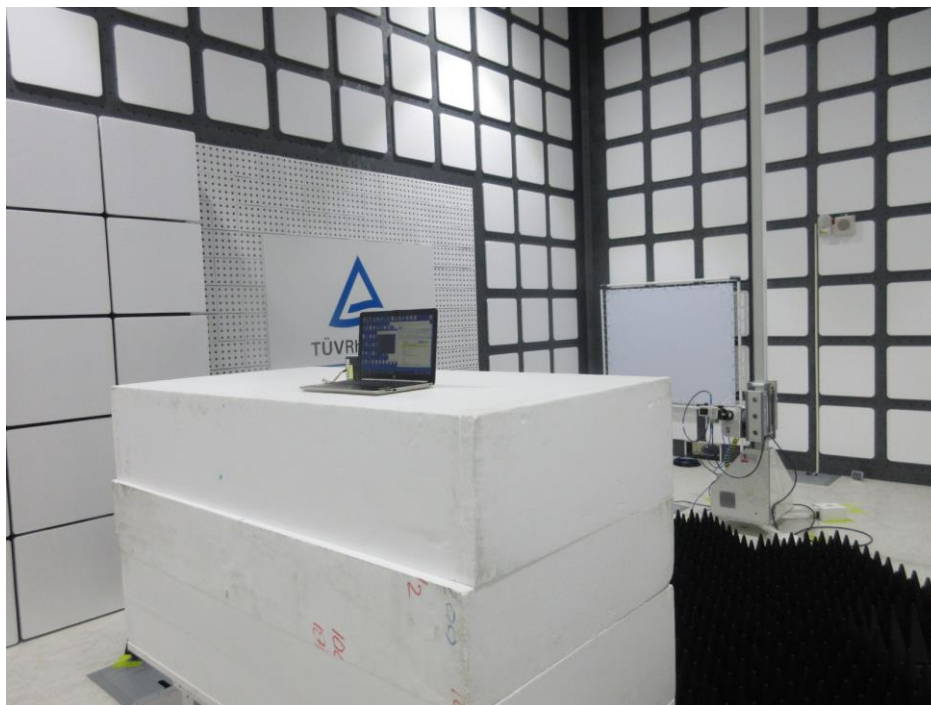
Photograph 4: Set-up for Spurious Emissions (Back View 2)



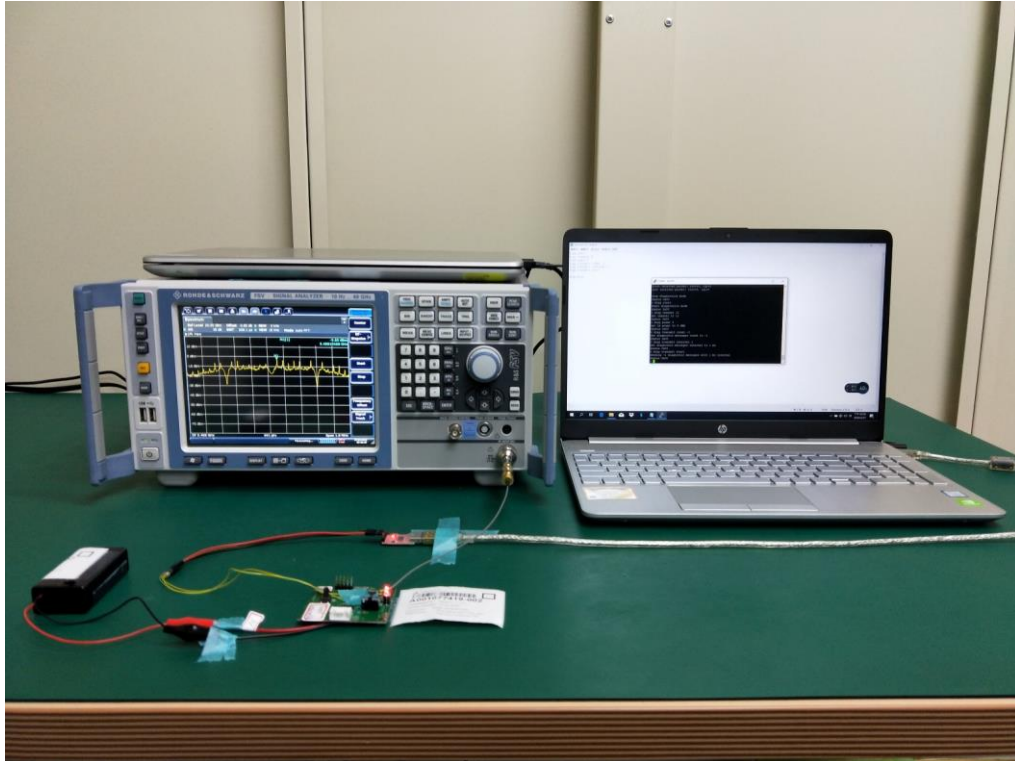
Photograph 5: Set-up for Spurious Emissions (Back View 3)



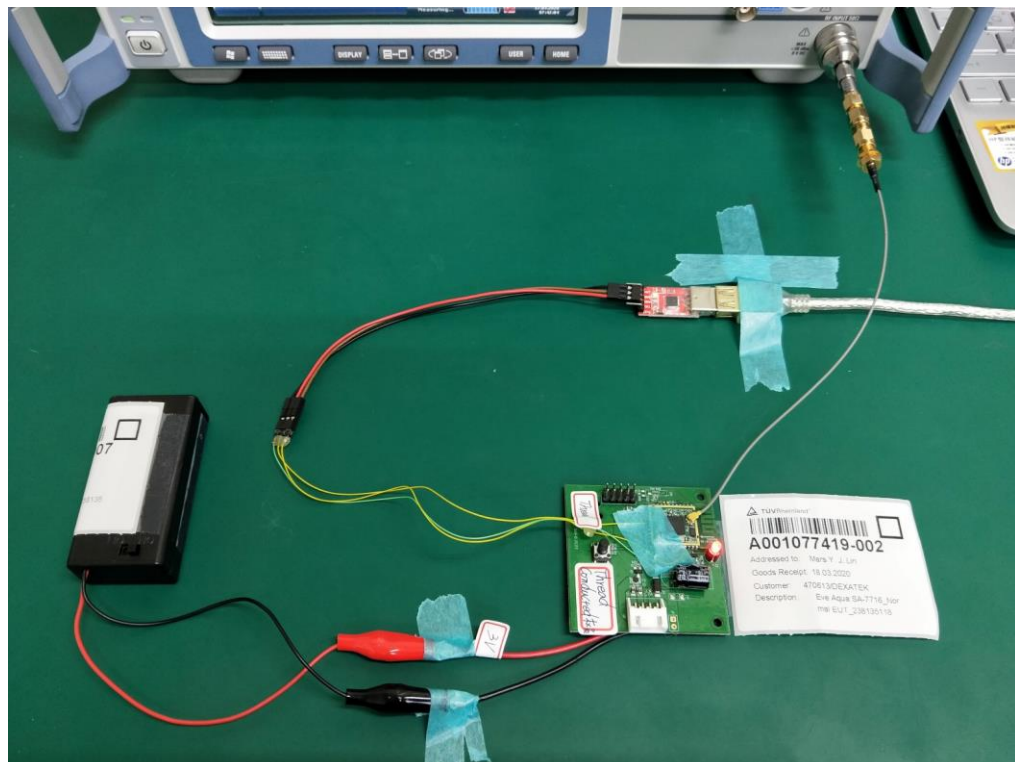
Photograph 6: Set-up for Spurious Emissions (Back View 4)



Photograph 7: Set-up for Conducted Testing (View 1)



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