

Prüfbericht-Nr.: Test report no.:	50348468 001	Auftrags-Nr.: Order no.:	238112162	Seite 1 von 36 Page 1 of 36
Kunden-Referenz-Nr.: Client reference no.:	N/A	Auftragsdatum: Order date:	6-Feb-2020	
Auftraggeber: Client:	STMicroelectronics SAS 190 Avenue Celestin Coq, Rousset, France			
Prüfgegenstand: Test item:	STM32WB5MMG			
Bezeichnung / Typ-Nr.: Identification / Type no.:	32WB5M			
Auftrags-Inhalt: Order content:	FCC Part 15C/ISED RSS-247/ Test report (Zigbee)			
Prüfgrundlage: Test specification:	FCC 47CFR Part 15: Subpart C Section 15.247(DTS) ISED RSS-247 ISSUE 2 FEB 2017			
Wareneingangsdatum: Date of sample receipt:	19-Feb-2020			
Prüfmuster-Nr.: Test sample no.:	A001065433-003, A001065433-004			
Prüfzeitraum: Testing period:	22-Feb-2020 - 3-Mar-2020			
Ort der Prüfung: Place of testing:	EMC/RF Laboratory Taipei			
Prüflaboratorium: Testing laboratory:	Taipei Testing laboratories			
Prüfergebnis*: Test result*:	Pass			
überprüft von: reviewed by:			genehmigt von: authorized by:	
Datum: 02-Jul-2020 Date:	Mars Y.J. Lin		Datum: 02-Jul-2020 Date:	Ryan W.T. Chen
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>				

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TEST SUMMARY

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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: 50348468 001 Appendix P)

Appendix D: Test Result of Radiated Emissions
(File Name: 50348468 001 Appendix D)

Test Specifications

The following standards were applied.

Table 1: Applied Standard and Test Levels

Radio
FCC CFR47 Part 15: Subpart C Section 15.247 ISED RSS-247 Issue 2 Feb 2017 ISED RSS-Gen, Issue 5, April 2018 ANSI C63.10:2013 KDB558074 D01 DTS Meas Guidance v05

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

Taipei Testing Laboratories

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

2.2 Test Facility

AC Mains Conduction:
11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)
FCC Registration No.: 180491
IC Canada Registration No.: 9465A

Conducted Test / Radiated Test:
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	102108	2019/4/17	2020/4/16
Spectrum Analyzer	R&S	FSV40	101508	2019/10/15	2020/10/15
Pre-Amplifier	Agilent	8447D	2944A10772	2020/2/14	2021/2/13
Pre-Amplifier	EMCI	EMC051845SE	980633	2020/2/07	2021/2/06
Pre-Amplifier	EMCI	EMC184045SE	980657	2020/2/07	2021/2/06
Bilog Antenna	SCHWARZBECK	VULB-9168	00951	2020/1/14	2021/1/13
Horn Antenna	ETS-Lindgren	3117	00218930	2020/12/27	2021/12/26
Horn Antenna	SCHWARZBECK	BBHA 9170	00887	2019/4/12	2020/4/11
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_9k~18G	800056/4EA	2019/4/18	2020/4/17
Test Cable	HUBER+SUHNER	SUCOFLEX 104_9k~18G	804680/4	2019/4/18	2020/4/17
Test Cable	HUBER+SUHNER	SUCOFLEX 104_9k~18G	MY37202/4	2019/4/18	2020/4/17
Test Cable	HUBER+SUHNER	SUCOFLEX 102EA_1G~40G	800898/2EA	2019/4/18	2020/4/17
Test Cable	HUBER+SUHNER	SUCOFLEX 102EA_1G~40G	800901/2EA	2019/4/18	2020/4/17
Test Cable	HUBER+SUHNER	SUCOFLEX 102EA_1G~40G	801027/2EA	2019/4/18	2020/4/17
Power Meter	Anritsu	ML2495A	1901008	2019/4/29	2020/4/28
Power Sensor	Anritsu	MA2411B	1725269	2019/4/29	2020/4/28
EMI Test Receiver	Rohde & Schwarz	ESR 7	101062	2019/10/15	2020/10/15
Two-Line V-Network (for EUT)	Rohde & Schwarz	ENV216	101243	2019/06/23	2020/06/23
Two-Line V-Network	Rohde & Schwarz	ENV216	101262	2019/07/16	2020/07/16
Telecom ISN 4 Line	Fischer Custom Communications	FFCC-TLISN- T4-02-09	101168	2020/02/03	2021/02/03
Impedance Stabilization Network	TESEQ	ISN T800	51949	2020/02/25	2021/02/25
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	0357.8810.54- 102102-HN	2019/07/25	2020/07/25
Test Software	Audix	e3	Ver. 9	N/A	N/A

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	± 0.1 ppm
RF power/RF Exposure(MPE), 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 %
DC and low frequency voltages	± 3 %

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a STM32WB5MMG. It contains a Zigbee compatible chip 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	STM32WB5MMG
Type Identification	32WB5M
Brand Name	STMicroelectronics SAS
FCC ID	YCP-STM32WB5M001
Canada ID	8976A-STM32WB5M01
HVIN	STM32WB5M01

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequencies	2405- 2480 MHz
Channel Spacing	5 MHz
Channel number	16
Operation Voltage	3.3Vdc
Modulation	QPSK
Antenna gain	2.0dBi

3.3 Independent Operation Modes

Basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving
- C. Standby
- D. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Circuit Diagram
- Instruction Manual
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

Table 6: Table for Parameters of Test Software Setting

Mode	Channel Frequency		
	2405 MHz	2440 MHz	2480 MHz
OQPSK	6	6	6

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.

The samples were used as follows:

A001065433-003

A001065433-004

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

Test Software	STM32CubeMonitor-RF
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4.3 Special Accessories and Auxiliary Equipment

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

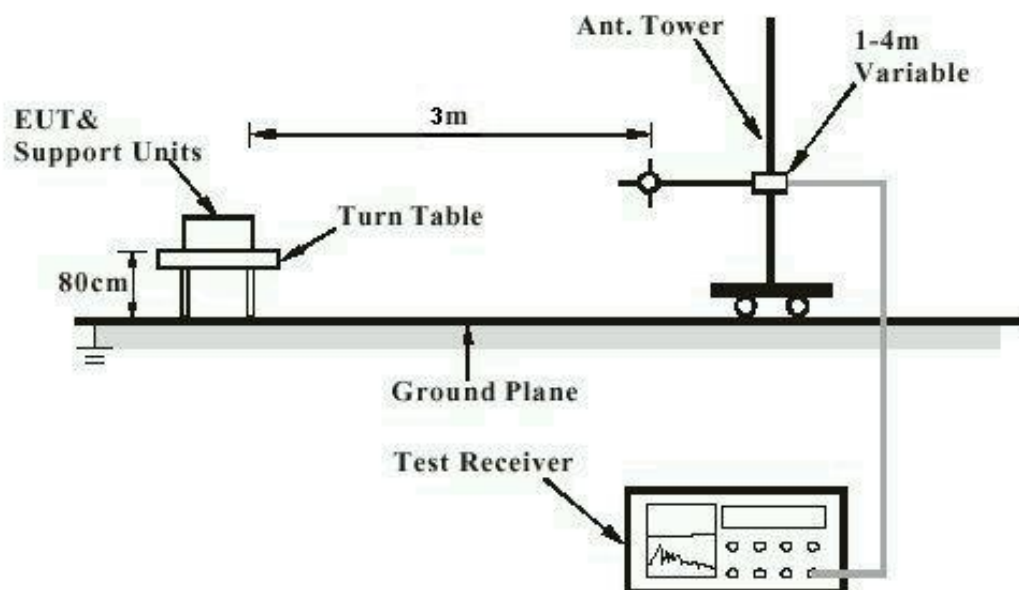
Description	Manufacturer	Model No.	Serial No.
Notebook(EMC-06)	Lenovo	TP00048A	PB-0F8B2

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)

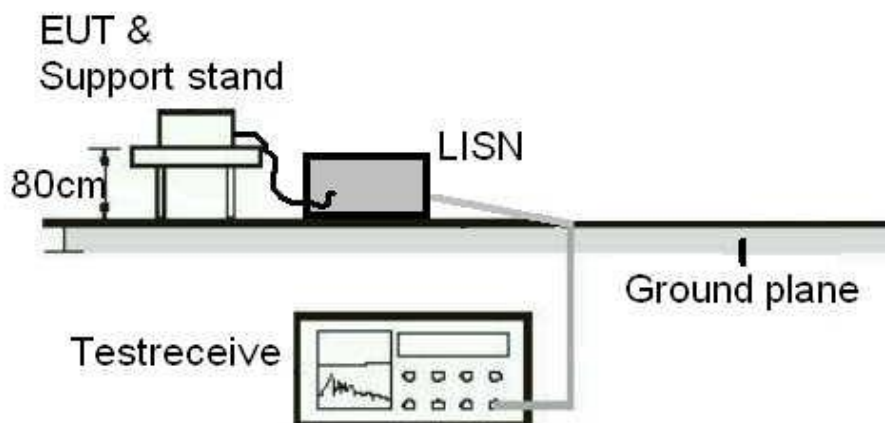
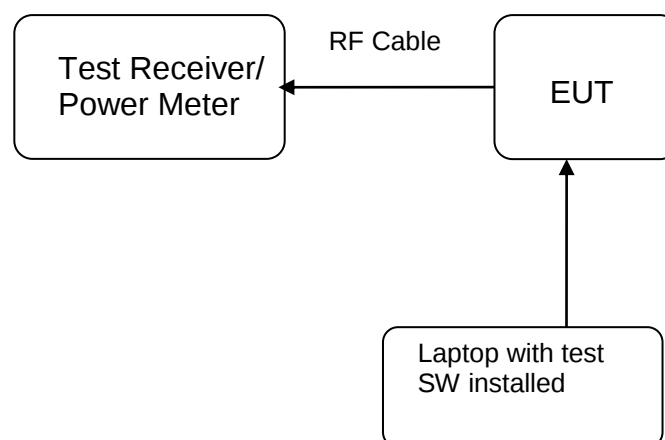


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



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

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 2.0dBi. The antenna is a chip antenna with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.

5.1.2 Peak Output Power

RESULT:

Passed

Test standard : FCC Part 15.247(b)(3), ISSED RSS-247 5.4(d)
 Basic standard : ANSI C63.10:2013, KDB558074
 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 Peak Output Power

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2405	4.95	0.00313	1
Middle Channel	2435	4.87	0.00307	1
High Channel	2480	4.86	0.00306	1

Pmax: 3.1261 mW
 Maximum EIRP: 6.95 dBm

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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)
 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

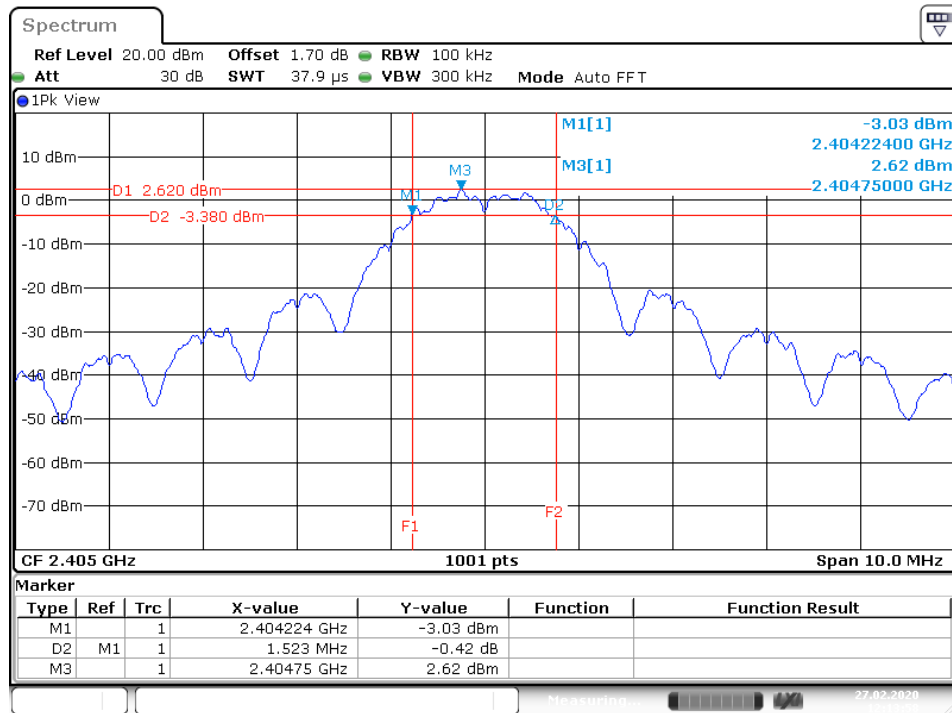
Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low Channel	2405	1.523	>500	Pass
Mid Channel	2435	1.548	>500	Pass
High Channel	2480	1.558	>500	Pass

Table 9: Test result of 99% Bandwidth,

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Low Channel	2405	2.4076
Mid Channel	2435	2.4276
High Channel	2480	2.4575

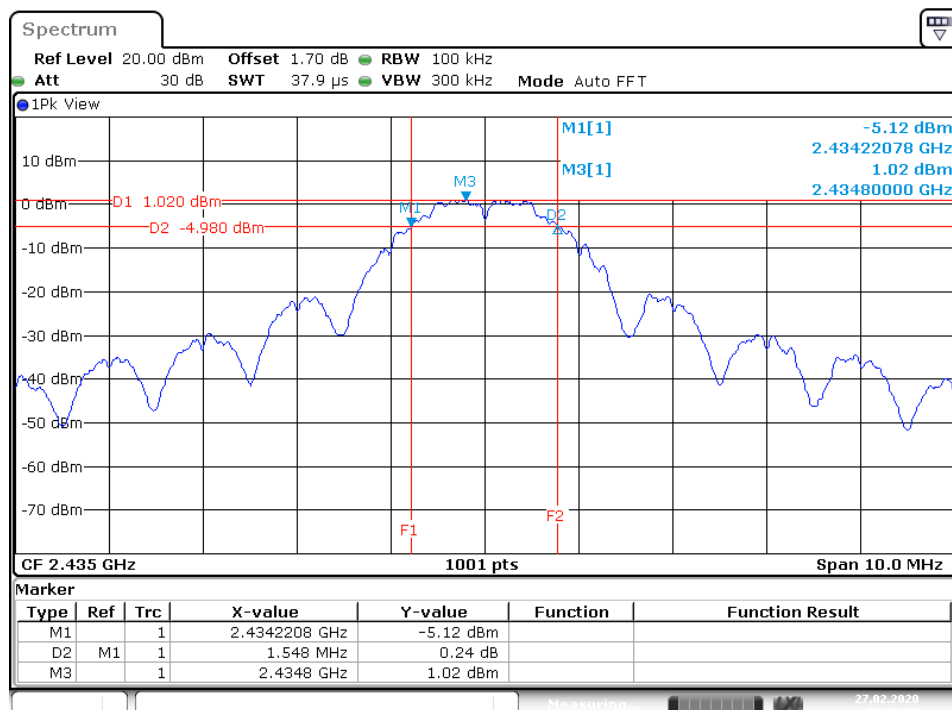
Test Plot of 6dB Bandwidth

Low Channel



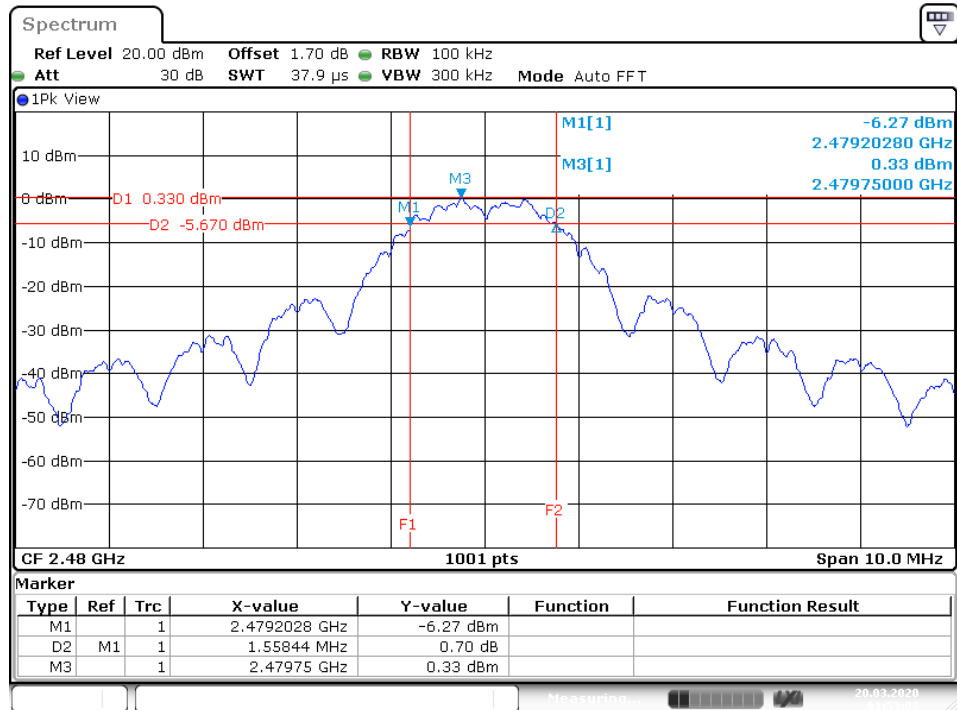
Date: 27.FEB.2020 12:13:58

Middle Channel



Date: 27.FEB.2020 12:58:08

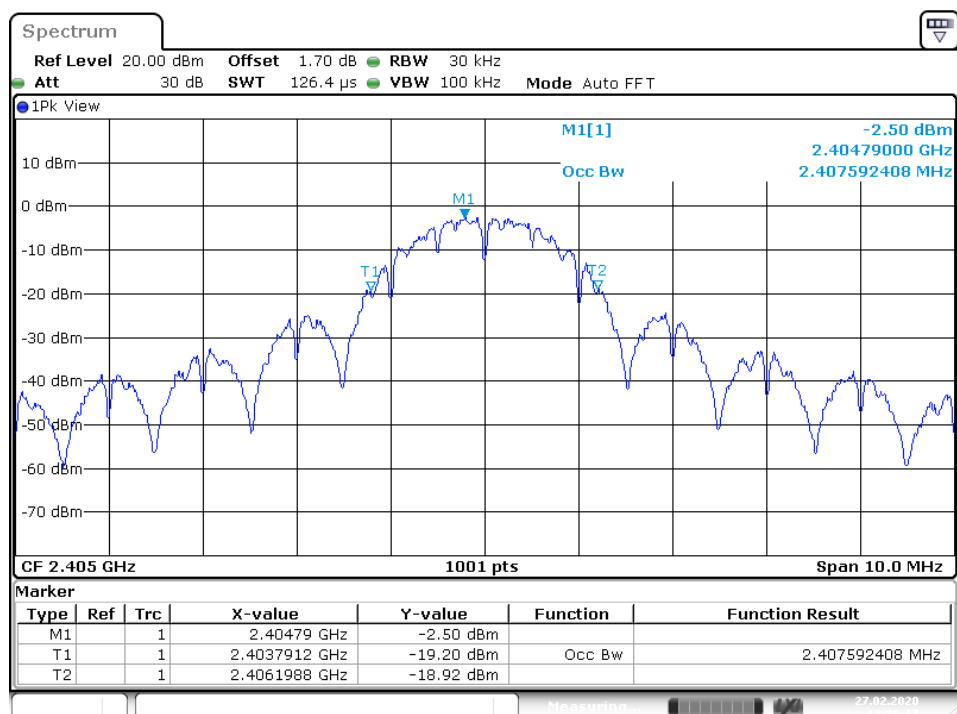
High Channel



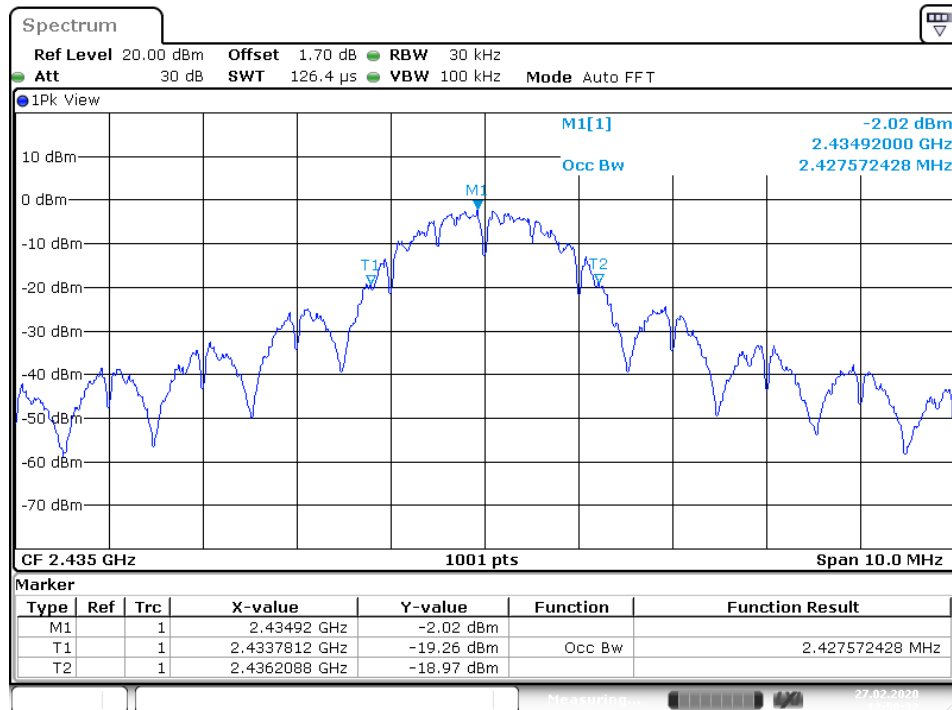
Date: 20.MAR.2020 01:53:02

Test Plot of 99% Bandwidth

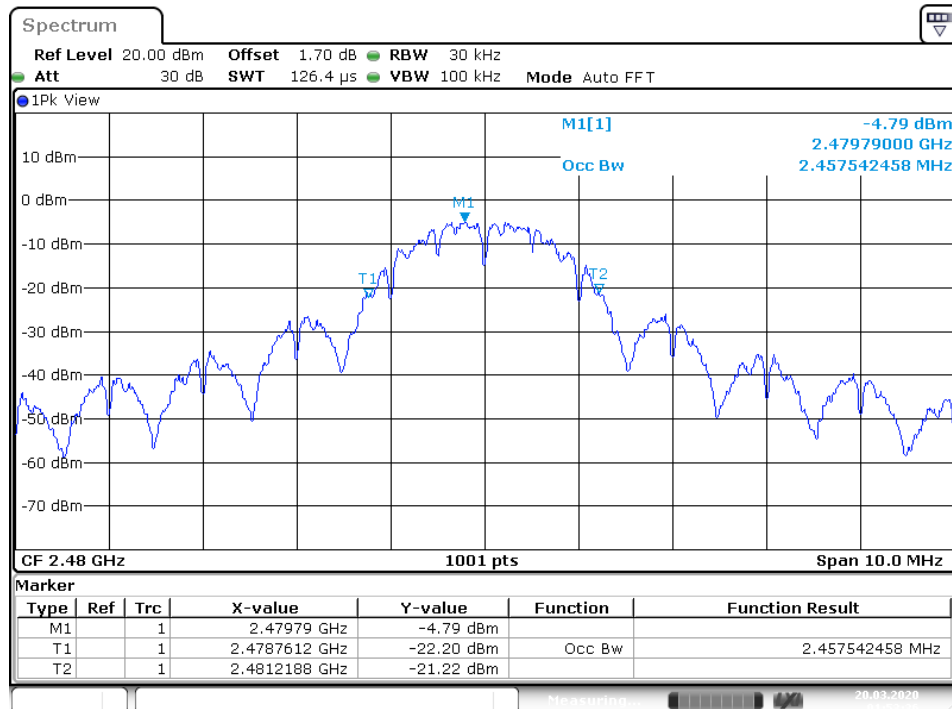
Low Channel



Date: 27.FEB.2020 13:38:16

Middle Channel


Date: 27.FEB.2020 12:58:32

High Channel


Date: 20.MAR.2020 01:53:36

5.1.4 Power Density

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

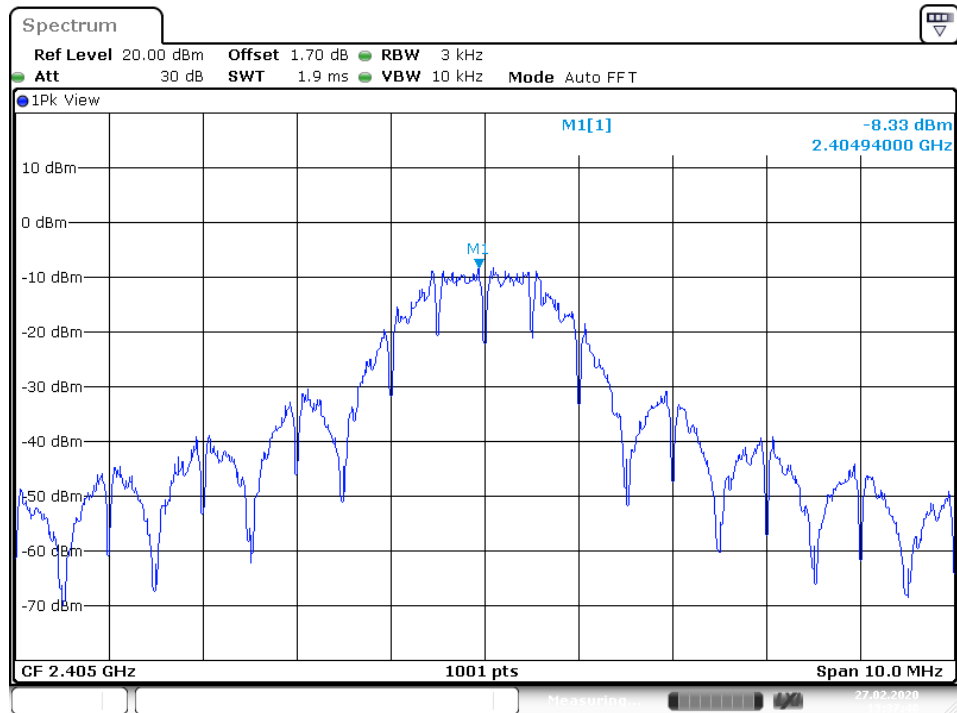
Test Channel : Low/ Middle/ High
Operation Mode : A
Ambient temperature : 20-24°C
Relative humidity : 50-65%
Atmospheric pressure : 100-103 kPa

Table 10: Test result of Power Density

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2405	-8.33	8
Middle Channel	2435	-8.45	8
High Channel	2480	-11.24	8

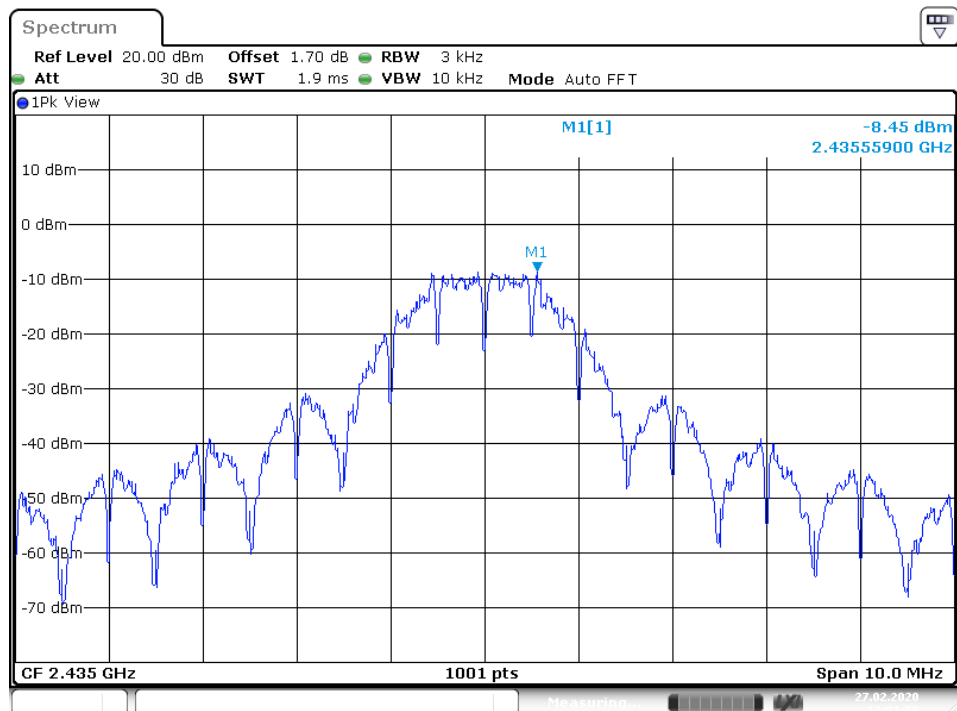
Test Plot of Power Density

Low Channel

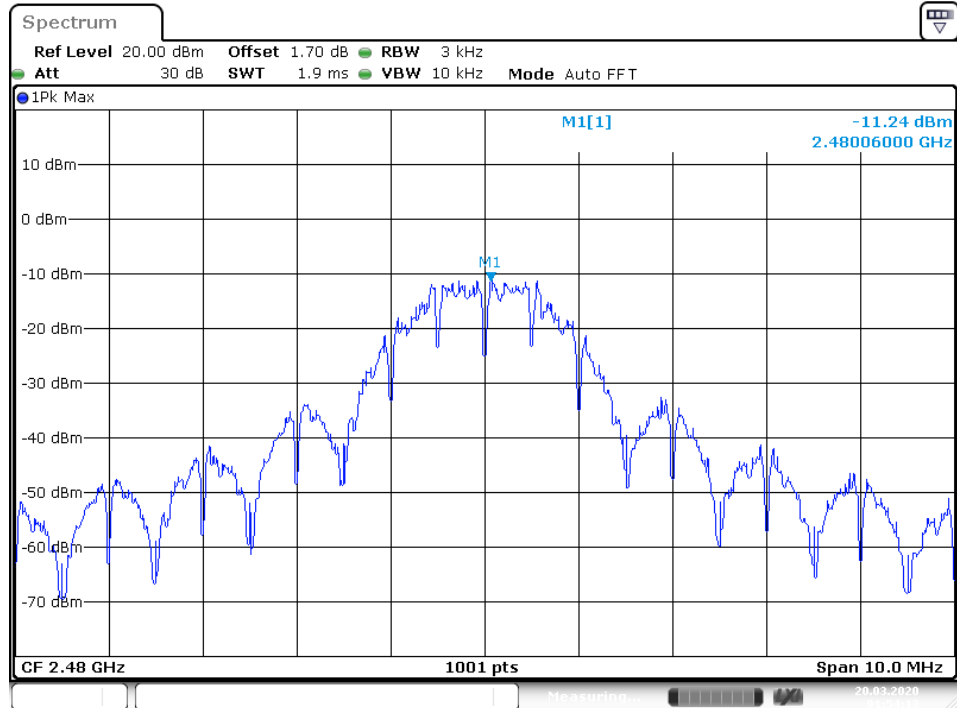


Date: 27.FEB.2020 13:37:48

Middle Channel



Date: 27.FEB.2020 13:01:50

High Channel


Date: 20.MAR.2020 01:54:13

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

RESULT:**Passed**

Test standard	:	FCC part 15.247(d), ISED 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

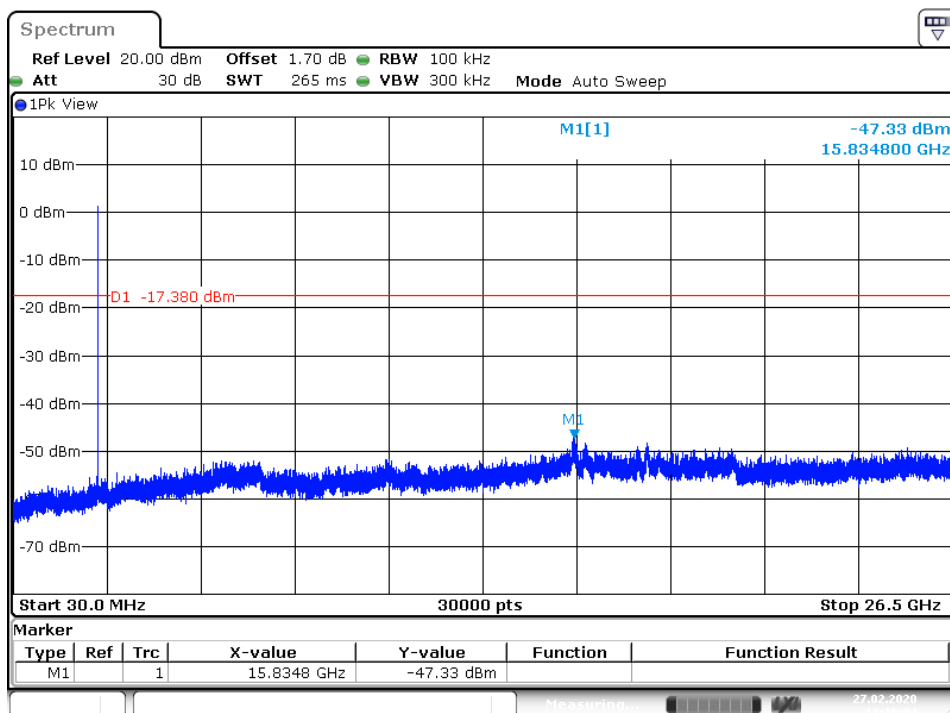
Test Channel	:	Low/ Middle/ High for Conducted Spurious Emissions Low/ High for Frequency Band Edge
Operation Mode	:	A
Ambient temperature	:	20-24°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103 kPa

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 RF circuit and that there are no inductive components of significant size connected to the antenna port, 9kHz to 30MHz frequency range is not tested based on technical judgment.

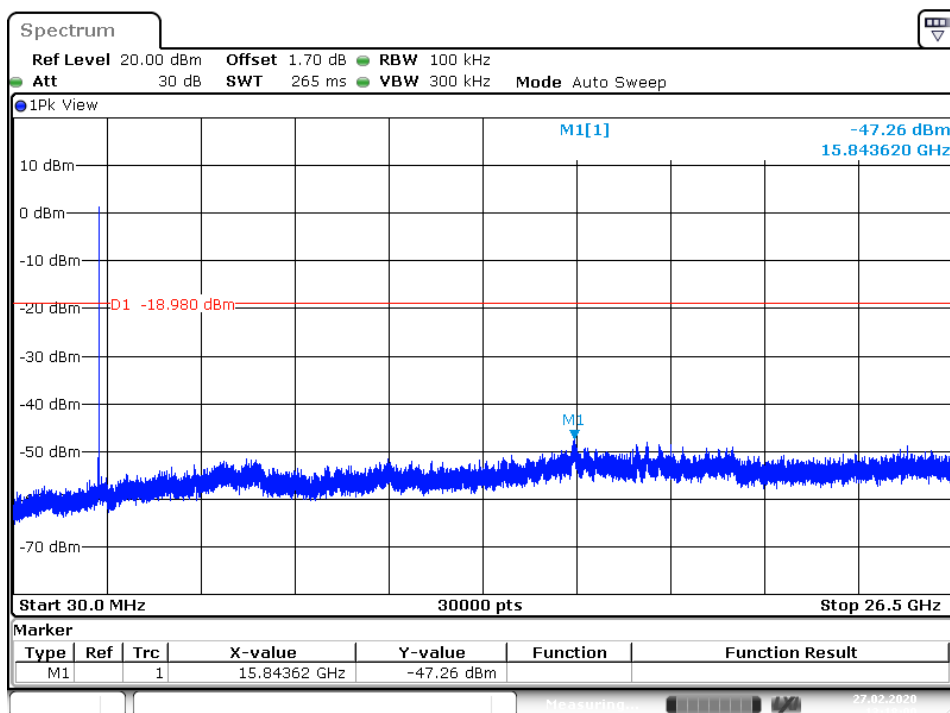
Test Plot 100kHz Conducted Emissions

Low Channel

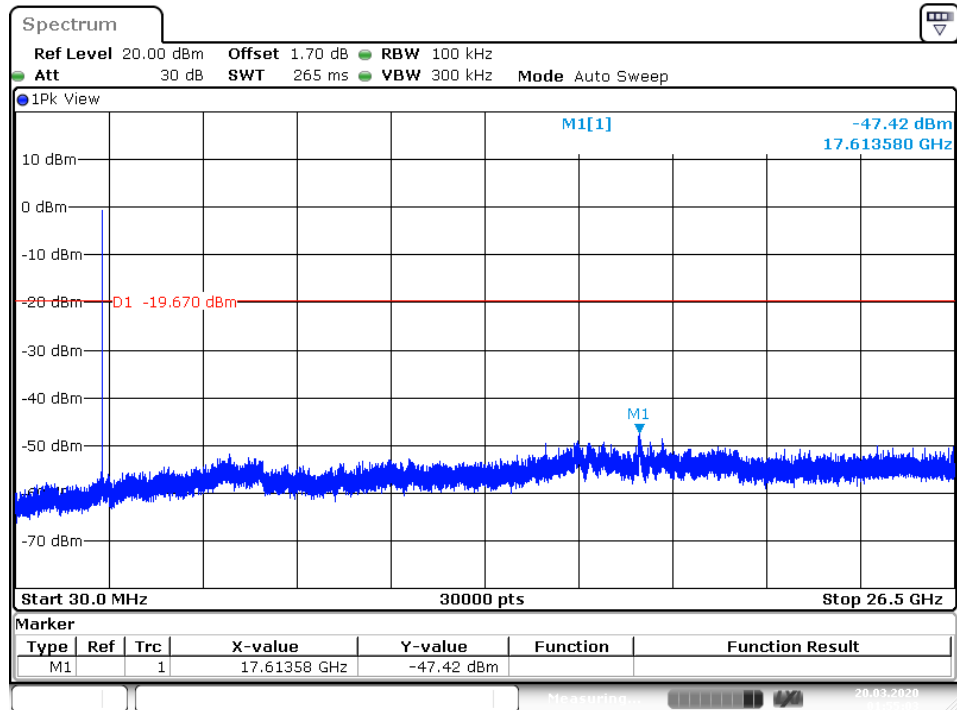


Date: 27.FEB.2020 12:19:04

Middle Channel



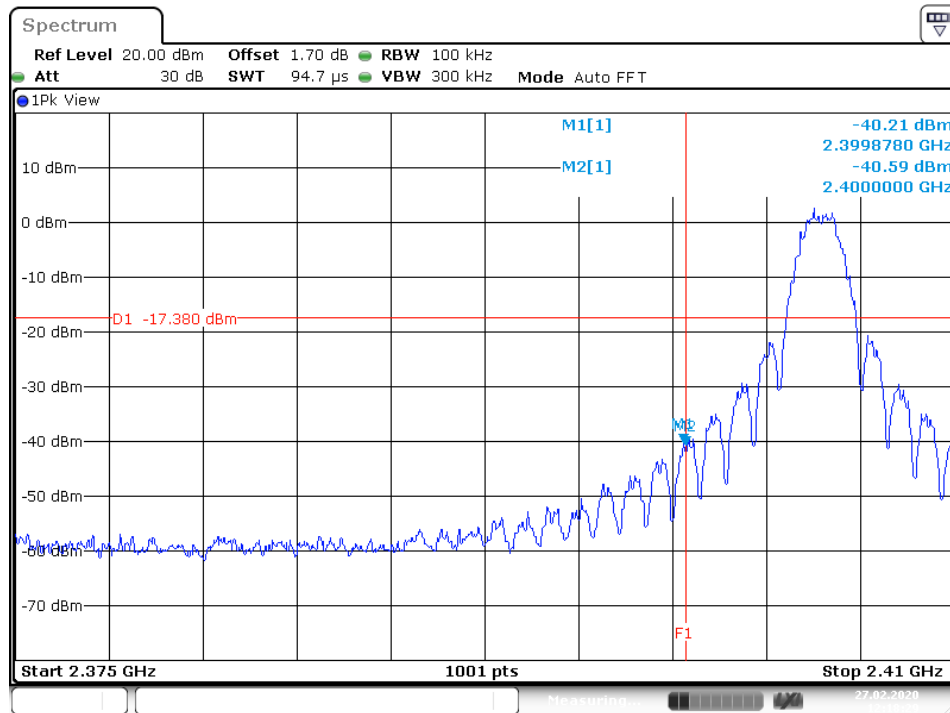
Date: 27.FEB.2020 13:18:00

High Channel


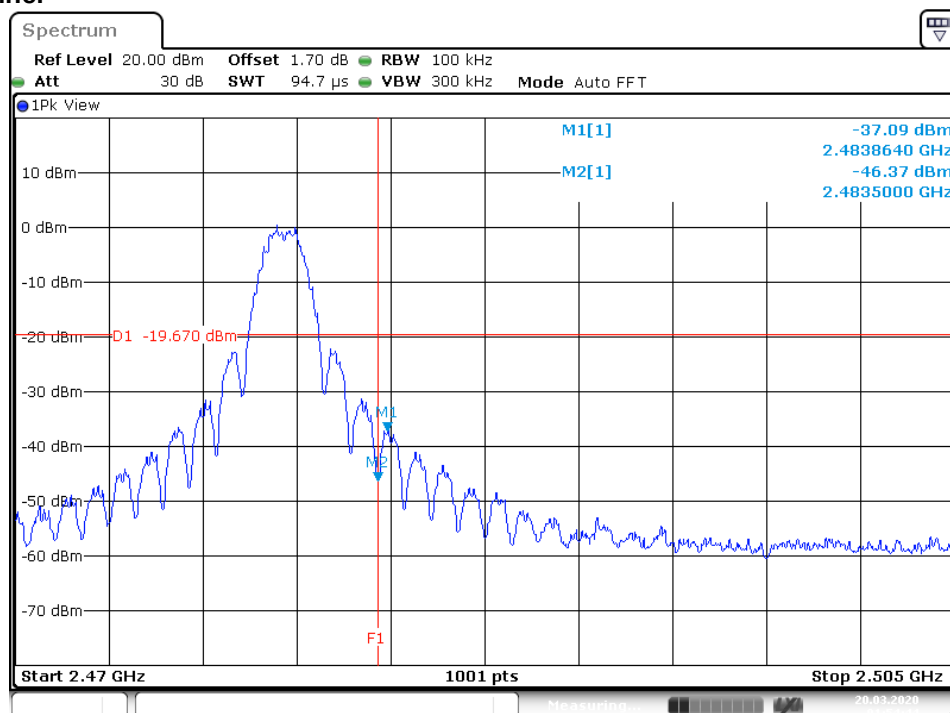
Date: 20.MAR.2020 01:55:03

Test Plot 100kHz RBW of Band Edge

Low Channel



High Channel



5.1.6 Spurious Emission

RESULT:

Passed

Test standard : FCC part 15.247(d), FCC 15.205, FCC 15.209 and ISED RSS-Gen 8.9 and ISED RSS-Gen 8.10

Basic standard : ANSI C63.10: 2013
 Limits : Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and ISED RSS-Gen i5, 8.10 (Table 7), must comply with the radiated emission limits specified in FCC 15.209(a) and ISED RSS-Gen 5, 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, B

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

Factor (dB/m)=Antenna Factor(dB/m)+Cable loss (dB)

Level(dBuV/m)=Reading(dBuV)+ Factor(dB/m)

For details refer to Appendix D.

Testing was carried out within frequency range 9kHz to the tenth harmonic. 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.

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5.2 Mains Emissions

5.2.1 Mains Conducted Emissions

RESULT:**Passed**

Test standard	:	FCC Part 15.207 FCC Part 15.107 ISED RSS-Gen 8.8
Limits	:	Mains Conducted emissions as defined in above test standards must comply with the mains conducted emission limits specified
Kind of test site	:	Shielded Room

Test setup

Test Channel	:	2405MHz
Operation mode	:	A
Ambient temperature	:	20-24 °C
Relative humidity	:	50-65 %
Atmospheric pressure	:	100-103 kPa

Remark: For details refer to Appendix D.

6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:**Passed****Test Specification**

Test standard

: CFR47 FCC Part 2: Section 2.1091
CFR47 FCC Part 1: Section 1.1310
FCC KDB Publication 447498 v06, section 7
ISED RSS-102 Issue 5 March 2015, section 2.5.1

➤ **FCC requirements**

FCC requirement: Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 20cm normally can be maintained between the user and the device.

MPE Calculation Method according to KDB 447498 v06Power Density: $S_{(mW/cm^2)} = PG/4\pi R^2$ or $EIRP/4\pi R^2$

Where:

S = power density (mW/cm²)

P = power input to the antenna (mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (cm)

From the peak RF output power, the minimum mobile separation distance, d=20 cm, as well as the antenna gain (Max. 2.0 dBi), the RF power density can be calculated as below:

$$S_{(mW/cm^2)} = PG/4\pi R^2$$

a) EUT RF Exposure Evaluation standalone operations

Test Mode	Measured Conducted Power		Antenna Gain (dBi)	Measured e.i.r.p (mW)		$S_{(mW/cm^2)} = \frac{PG}{4\pi R^2}$	Limit (mW/cm ²)
	(dBm)	(mW)		(dBm)	(mW)		
Zigbee	4.95	3.13	2	6.95	4.95	0.001	1.0

b) EUT RF Exposure Evaluation simultaneous transmission operations

Simultaneous transmission mode	The sum of the ratios	Result
Not supported	N/A	N/A

➤ **IC requirements:** The EUT shall comply with the requirement of RSS-102 section 2.5.2.

Exemption from Routine Evaluation Limits – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

at or above 300 MHz 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 (adjusted for tune-up tolerance), where f is in MHz;

- RF exposure evaluation exempted power for BLE: 2.670 W
- RF exposure evaluation exempted power for ZigBee: 2.671 W

a) EUT RF Exposure Evaluation standalone operations:

Test Mode	Measured Peak Power		Antenna Gain (dBi)	Measured e.i.r.p (mW)	
	(dBm)	(W)		(dBm)	(W)
Zigbee	4.95	3.13	2	6.95	4.95

b) EUT RF Exposure Evaluation simultaneous transmission operations

Simultaneous transmission mode	The sum of the ratios	Result
Not supported	N/A	N/A

“RF Radiation Exposure Statement Caution: This Transmitter must be installed to provide a separation distance of at least 20 cm from all persons.”

7. Photographs of the Test Set-Up

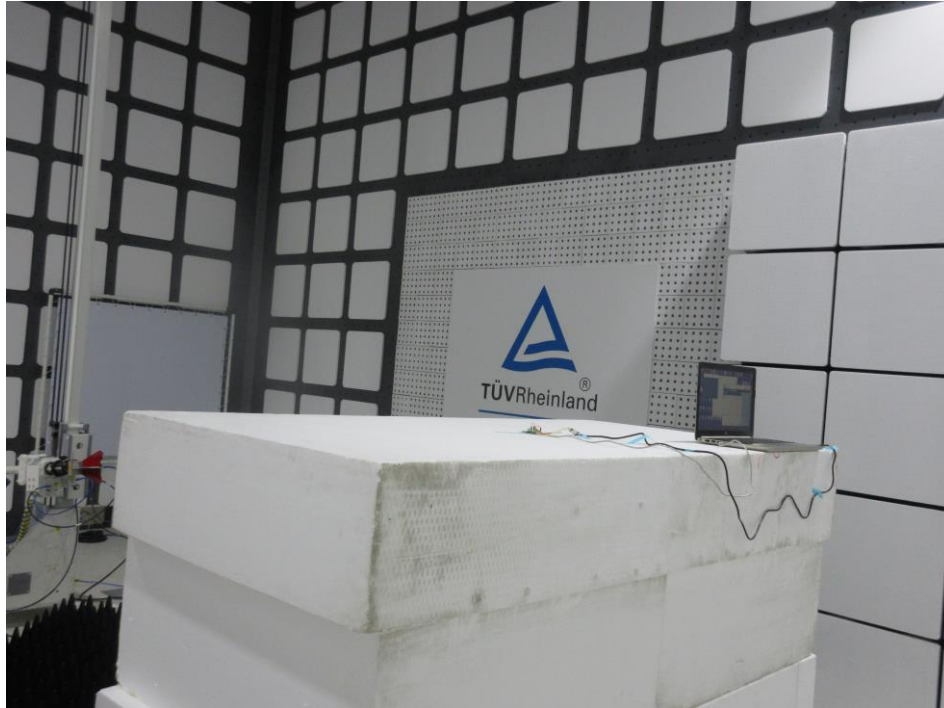
Photograph 1: Set-up for Spurious Emissions (Front View 1)



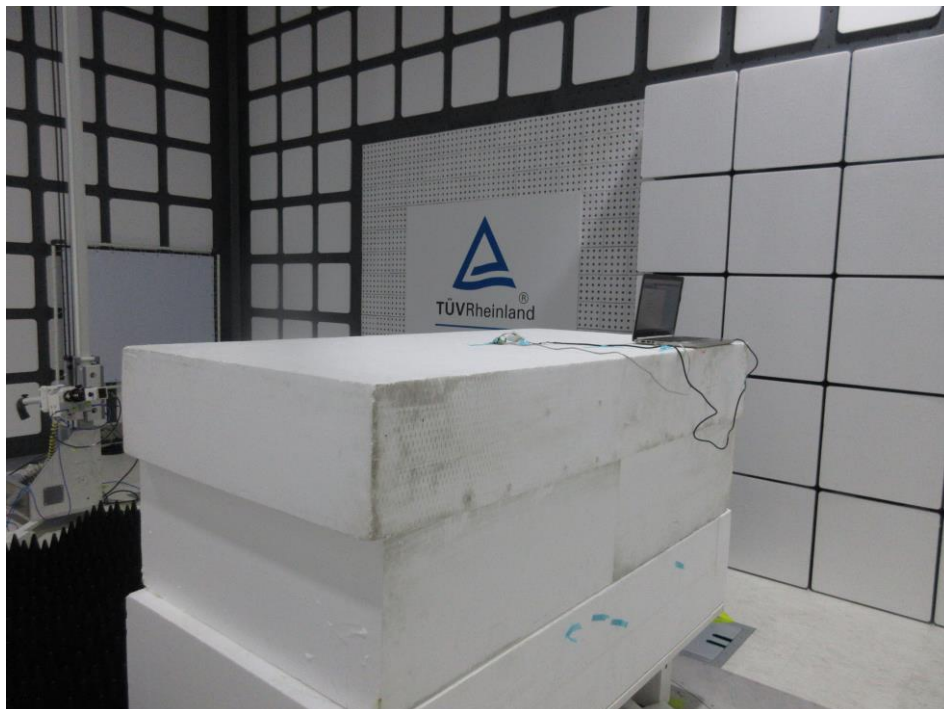
Photograph 2: Set-up for Spurious Emissions (Front View 2)



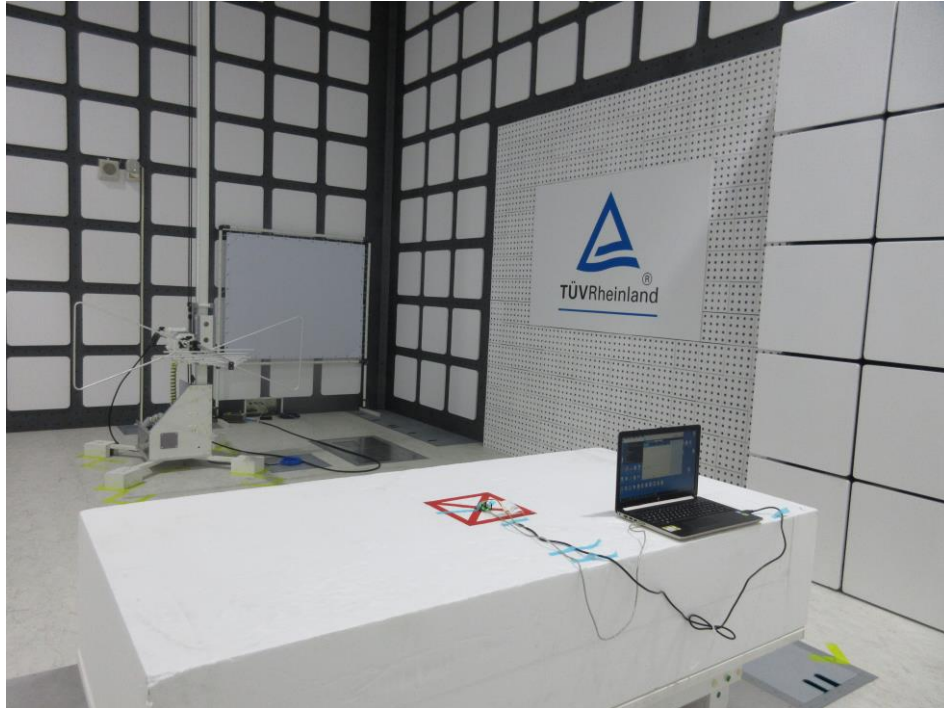
Photograph 3: Set-up for Spurious Emissions (Back View 1)



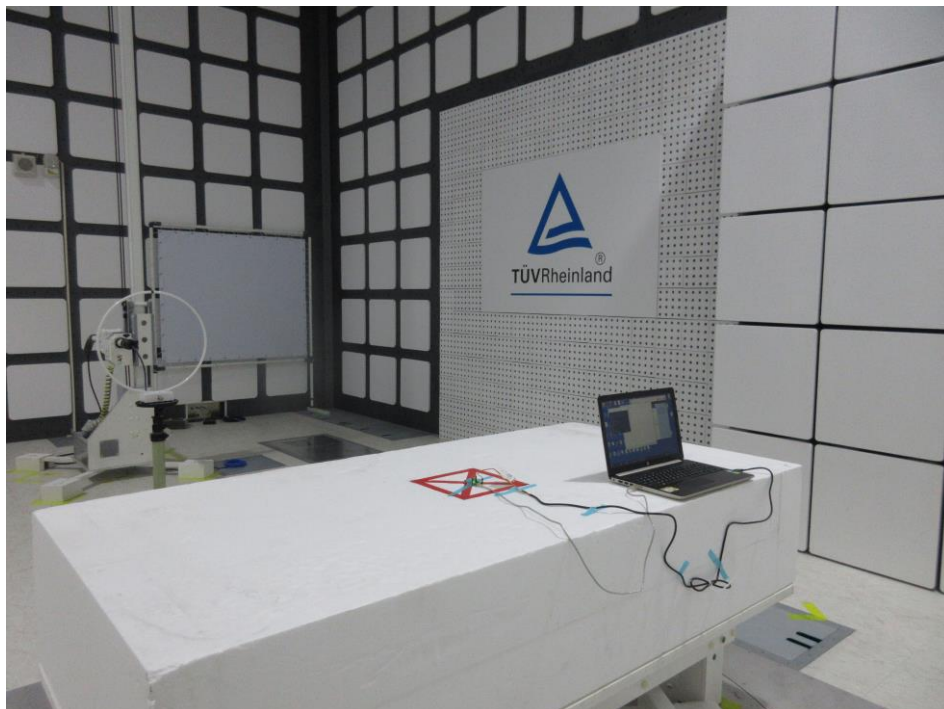
Photograph 4: Set-up for Spurious Emissions (Back View 2)



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 AC Mains Conducted testing (Front View)



Photograph 8: Set-up for AC Mains Conducted testing (Back View)



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