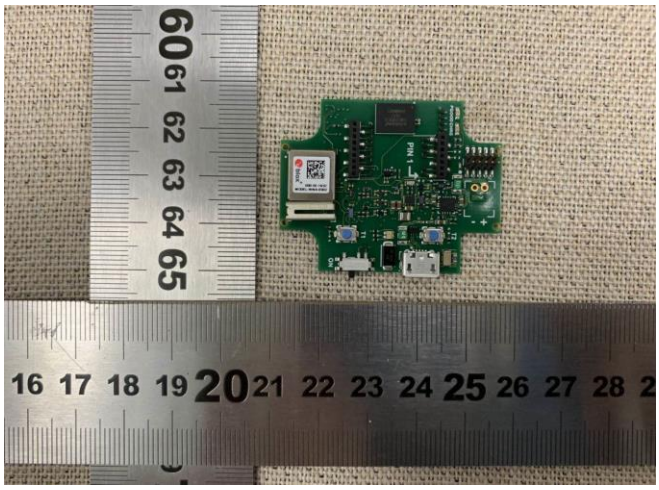
Prüfbericht - Produkte
Test Report - Products

TÜVRheinland®

Prüfbericht-Nr.: *Test report no.:*	**60408756 001**	**Auftrags-Nr.:** *Order no.:*	**244242523**	Seite 1 von 87 *Page 1 of 87*
Kunden-Referenz-Nr.: *Client reference no.:*	**244061385**	**Auftragsdatum:** *Order date:*	**2020-06-02**	
Auftraggeber: *Client:*	**Bosch Sensortec GmbH** Gerhard-Kindler-Strasse 9, 72770 Reutlingen, Germany			
Prüfgegenstand: *Test item:*	Application Board 3.0			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	APP 3.0 FCC ID: 2AO4I-APP30 IC: 26413-APP30			
Auftrags-Inhalt: *Order content:*	Complete test			
Prüfgrundlage: *Test specification:*	FCC CFR47 Part 15, Subpart C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02 RSS-Gen Issue 5, Amendment 1, March 2019 RSS-247 Issue 2, February 2017 ANSI C63.10: 2013			
Wareneingangsdatum: *Date of sample receipt:*	2020-06-05			
Prüfmuster-Nr.: *Test sample no:*	A002888420-001			
Prüfzeitraum: *Testing period:*	Refer to test report			
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: *Test result*:*	Pass			



überprüft von: reviewed by:	X Hongfei Wu	**genehmigt von:** authorized by:	X Elliot Zhang
Datum: 2021-03-03 *Date:*	Signed by: Hongfei Wu	**Datum: 2021-03-03** *Date:*	Signed by: Elliot Zhang
Stellung / *Position:*	**Hongfei Wu / PE**	**Stellung** / *Position:*	**Elliot Zhang / Reviewer**

Sonstiges / *Other:*	HVIN: APP 3.0
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	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*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.
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.
V05

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT
RESULT: *Pass*

5.1.2 6DB & 99% BANDWIDTH
RESULT: *Pass*

5.1.3 PEAK OUTPUT POWER
RESULT: *Pass*

5.1.4 POWER SPECTRAL DENSITY
RESULT: *Pass*

5.1.5 CONDUCTED BAND EDGE AND OUT-OF BAND EMISSIONS
RESULT: *Pass*

5.2.1 CONDUCTED EMISSION
RESULT: *Pass*

5.3.1 RADIATED BAND-EDGE
RESULT: *Pass*

5.3.2 RADIATED SPURIOUS EMISSION
RESULT: *Pass*

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1. General Remarks

1.1 Complementary Materials

Null.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland (Shanghai) Co., Ltd.
Shanghai TUV Rheinland Building No. 177, 178 Lane 777, West Guangzhong Rd, Jing'an District, Shanghai, China
The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 958801.

The Innovation, Science and Economic Development Canada has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance. The description of the test facility is listed under chambers filing number 2932F.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Due Date
3m Anechoic Chamber	Frankonia	SAC3	FJ129002	2022-05-13
EMI Test Receiver	R&S	ESCI	100280	2020-10-31
Spectrum Analyzer	R&S	FSV40	101258	2021-10-31
BiLog Antenna	Teseq	CBL 6112D	40530	2021-02-13
Log-periodic Antenna	R&S	HL050	100692	2021-02-16
Preamplifier	Taiwan EMC Instruments Corporation	EMC051845SE	980612	2021-03-05
Broadband Horn Antenna	Schwarzbeck	BBHA 9170	9170-305	2021-07-09
Preamplifier	Taiwan EMC Instruments Corporation	EMC184045SE	980596	2021-03-05
Spectrum Analyzer	Keysight	N9020A	MY54500180	2021-05-09
DC Power Supply	ALLPOWER	ADC50-20	99223	2020-10-12
Thermohygrometer	Testo	608-H1	1241320614	2020-10-13
EMI test receiver	R&S	ESIB26	G1811380	2021-03-06
Artificial main network	R&S	ENV432	G1830003	2020-11-01
EMC measurement software	R&S	EMC32	G1824845	N/A

2.3 Traceability

All measurement equipment calibrations are traceable to NIST or where calibration is performed outside the United States, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer’s specifications. Additionally all equipment is verified for proper performance on a regular basics using in house standards or comparisons.

2.5 Measurement Uncertainty

Table 2: Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Antenna Port Conducted Emission	< 1GHz	±0.39dB
	> 1GHz	±0.68dB
Radiated Emission	9kHz – 30MHz	±2.93dB
	30MHz - 1GHz	±5.34dB
	> 1GHz	±5.40dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT (Equipment Under Test) is an application board which contains Bluetooth module.

For details refer to the User Manual and Circuit Diagram.

3.2 Ratings and System Details

Table 3: Technical Specification of EUT

General Description of EUT	
Product Name:	Application Board 3.0
Model No.:	APP 3.0
Operation Voltage:	DC 5V (USB)
Technical Specification of Bluetooth LE 5.0	
Frequency Range:	2402 – 2480MHz
Modulation Type:	GFSK
Data Rate:	1Mb/s, 2Mb/s, 500kb/s, 125kb/s
Antenna Type:	PIFA Antenna
Antenna Gain:	2 dBi

3.3 Independent Operation Modes

Table 4: Independent Operation Modes

Test Mode	Channel	Frequency	Data Rate	Power Setting
TM1	00	2402	1 MB/s	0
TM2	19	2440	1 MB/s	0
TM3	39	2480	1 MB/s	0
TM4	00	2402	2 MB/s	0
TM5	19	2440	2 MB/s	0
TM6	39	2480	2 MB/s	0
TM7	00	2402	500 kB/s	0
TM8	19	2440	500 kB/s	0
TM9	39	2480	500 kB/s	0
TM10	00	2402	125 kB/s	0
TM11	19	2440	125 kB/s	0
TM12	39	2480	125 kB/s	0
TM13	Normal Operating Mode			

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Bill of Material
- PCB Layout
- Photo Document
- Circuit Diagram
- Instruction Manual
- Rating Label

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured at its power output according to Clause 4.2. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All testing were performed according to the procedures in ANSI C63.10: 2013.
Test software: SecureCRT

Table 5: Power parameter value

Data Rate	Channel Frequency [MHz]	Power Parameter Value	Data Rate	Channel Frequency [MHz]	Power Parameter Value
1 MB/s	2402	0	500 kB/s	2402	0
	2440	0		2440	0
	2480	0		2480	0
2 MB/s	2402	0	125 kB/s	2402	0
	2440	0		2440	0
	2480	0		2480	0

4.3 Special Accessories and Auxiliary Equipment

Table 6: Auxiliary Equipment

Product Name	Model Name	Manufactory
Shuttle Board	BMI088	BOSCH
Laptop	T450	Thinkpad

Note: Above auxiliary equipment was used for Conducted Emission test.

4.4 Countermeasures to achieve EMC Compliance

Null.

5. Test Results

5.1 Conducted Testing at Antenna Port

5.1.1 Antenna Requirement

RESULT: **Pass**

According to the manufacturer declared, the EUT has one PIFA antenna, the directional gain of antenna is 2dBi and the antenna is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

Table 7: Antenna Requirement

FCC 15.203 – Antenna Requirement 1		
Requirement:	No antenna other than that furnished by the responsible party shall be used with the device	
Results:	Antenna type:	PIFA antenna
Verdict:	Pass	

FCC 15.204 – Antenna Requirement 2	
Requirement:	An intentional radiator may be operated only with the antenna with which it is authorized. If an antenna is marketed with the intentional radiator, it shall be of a type which is authorized with the intentional radiator.
Results:	Only one integral antenna can be used
Verdict:	Pass

RSS-Gen 6.4 – External Controls	
Requirement:	The device shall not have any external controls accessible to the user that enable it to be adjusted, selected or programmed to operate in violation of the regulatory requirements, including RSS-Gen and the applicable RSSs.
Results:	The device does not have any external controls accessible to the user that enable it to be adjusted, selected or programmed to operate in violation of the regulatory requirements, including RSS-Gen and the applicable RSSs.
Verdict:	Pass

RSS-Gen 6.8 – Antenna Requirement		
Requirement:	When measurements at the antenna port are used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.	
Results:	a) Antenna type:	PIFA
	b) Manufacture:	N/A
	c) Model No.:	N/A
	d) Gain with reference to an isotropic radiator:	2dBi
Verdict:	Pass	

5.1.2 6dB & 99% Bandwidth

RESULT: **Pass**

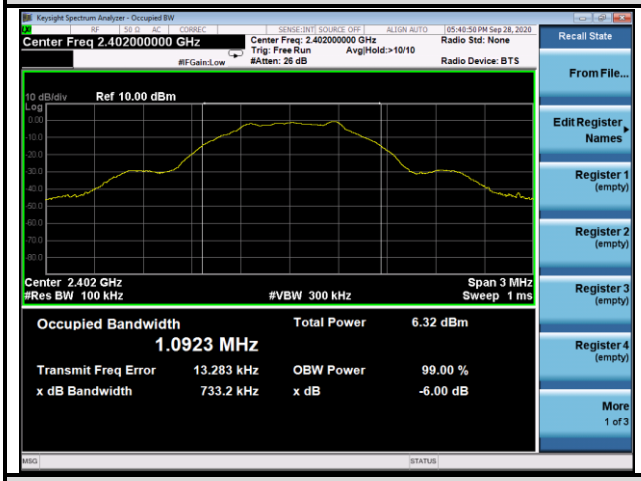
Date of testing	:	2020-09-28
Ambient temperature	:	20.6°C
Relative humidity	:	58.6%
Atmospheric pressure	:	101kPa
Test requirement	:	FCC Part 15.247(a)(2) RSS-247 Issue 2, February 2017, Clause 5.2(a)
Test procedure	:	KDB 558074 D01v05r02 ANSI C63.10: 2013
Test voltage	:	DC 5V
Test modes applied	:	TM1 to TM12

Table 8: 6dB & 99% Bandwidth

Test Mode	CH.	Freq. [MHz]	6dB Bandwidth [kHz]	6dB Bandwidth Limit [kHz]	99% Bandwidth [MHz]
TM1	00	2402	733.2	≥ 500	1.0745
TM2	19	2440	741.7	≥ 500	1.0769
TM3	39	2480	720.2	≥ 500	1.0862
TM4	00	2402	1360.0	≥ 500	2.0903
TM5	19	2440	1310.0	≥ 500	2.1061
TM6	39	2480	1320.0	≥ 500	2.1039
TM7	00	2402	748.1	≥ 500	1.0572
TM8	19	2440	723.1	≥ 500	1.0586
TM9	39	2480	735.1	≥ 500	1.0758
TM10	00	2402	697.6	≥ 500	1.0875
TM11	19	2440	654.1	≥ 500	1.0897
TM12	39	2480	699.5	≥ 500	1.0948

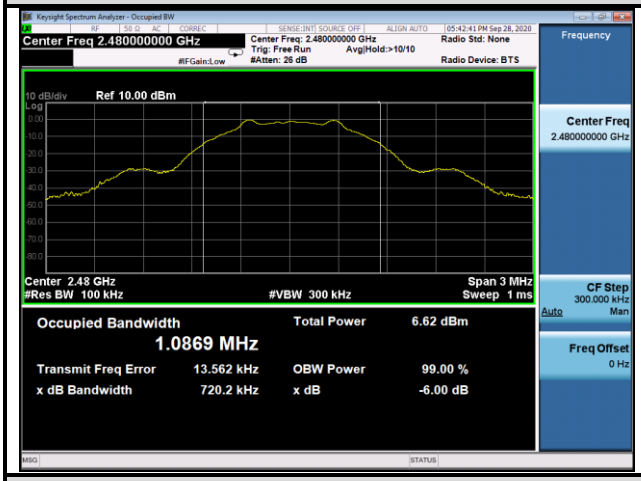
Figure 1: 6dB Bandwidth

TM1

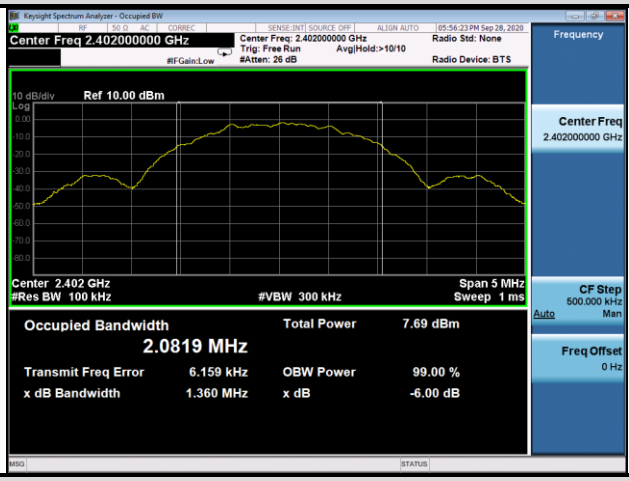


TM2

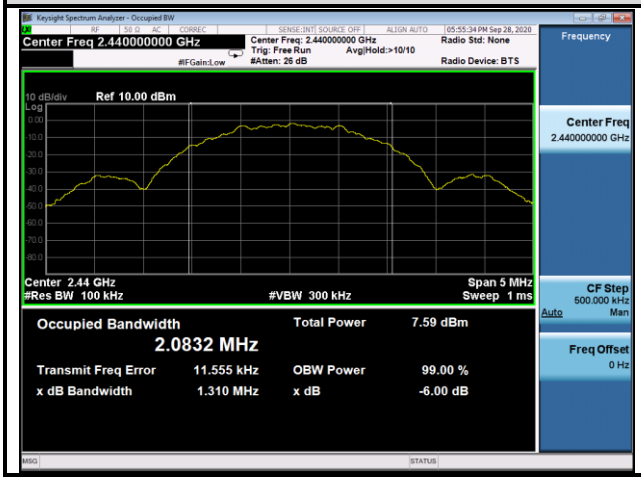
TM3



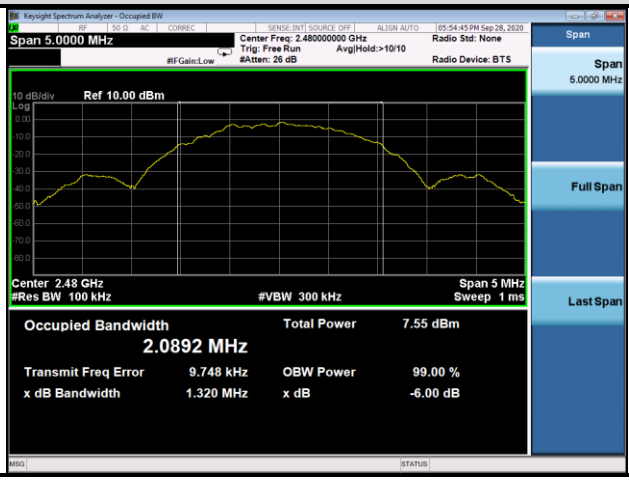
TM4



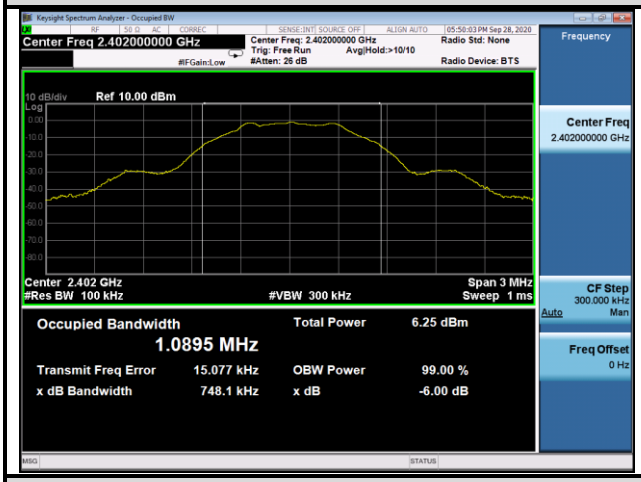
TM5



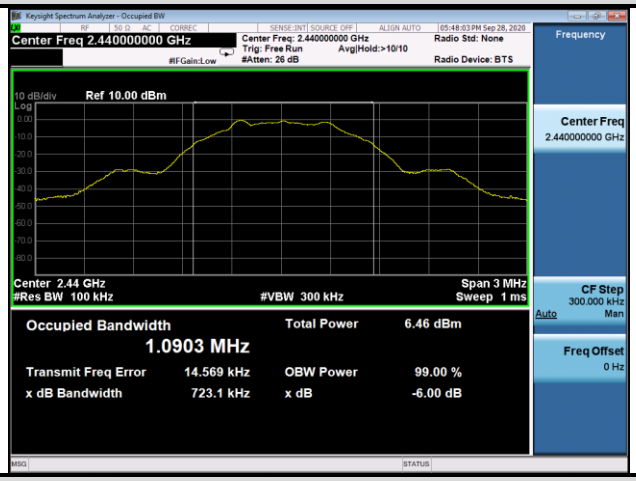
TM6



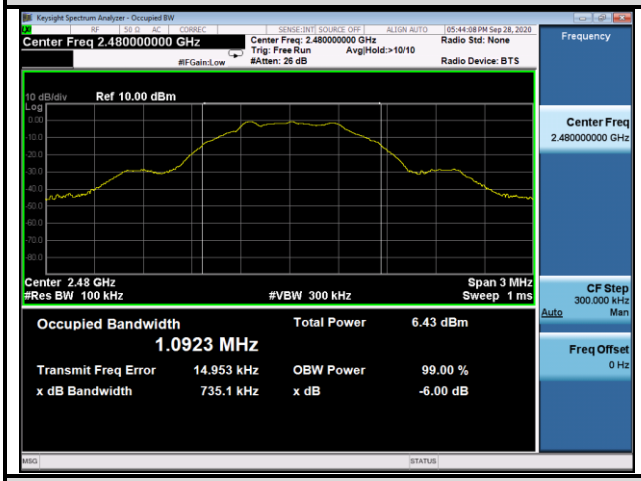
TM7



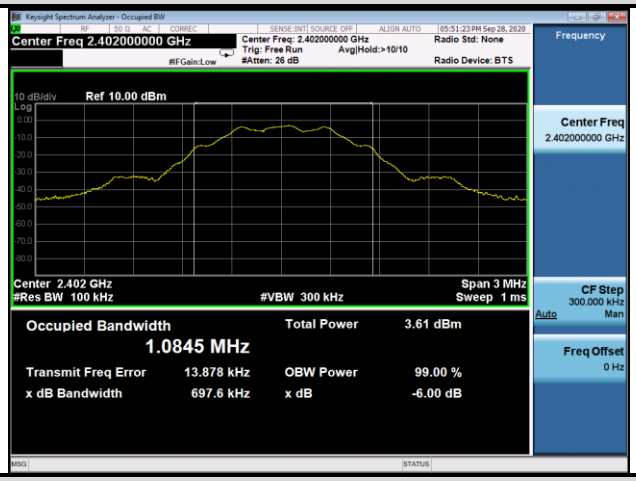
TM8



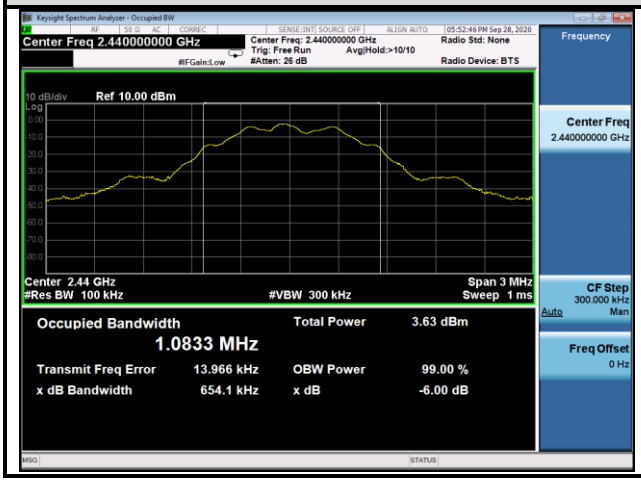
TM9



TM10



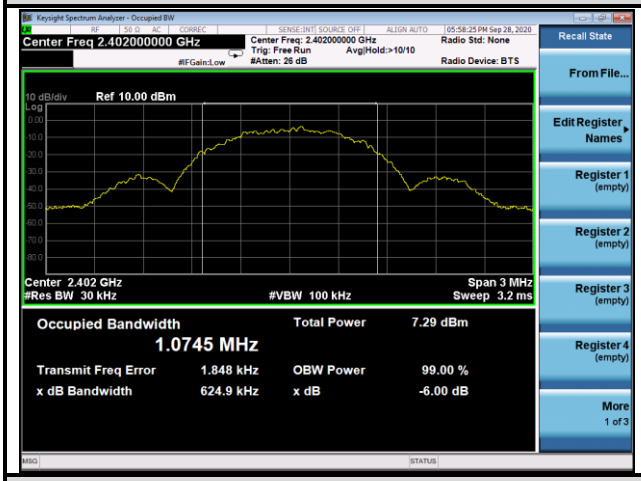
TM11



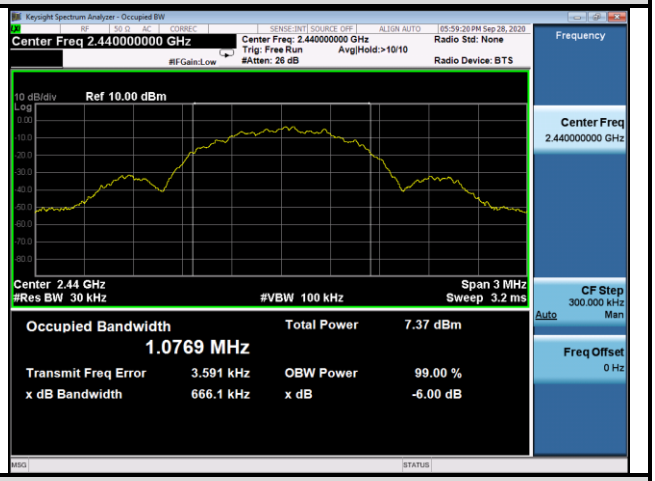
TM12

Figure 2: 99% Bandwidth

TM1



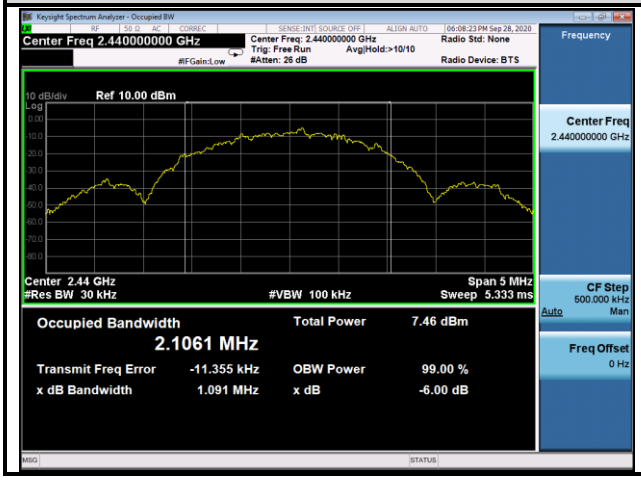
TM2



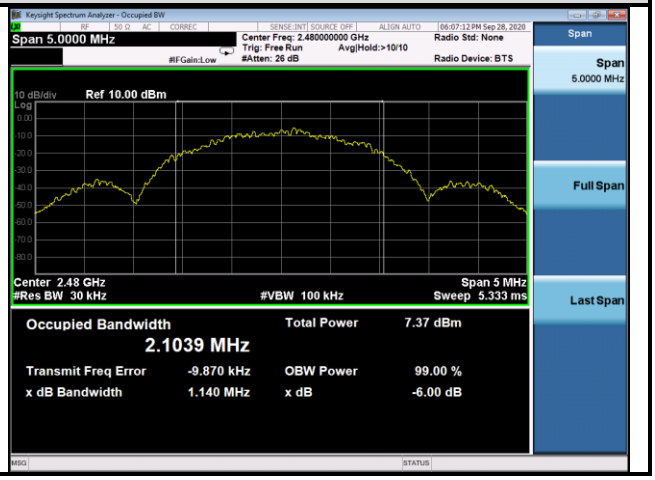
TM3

TM4

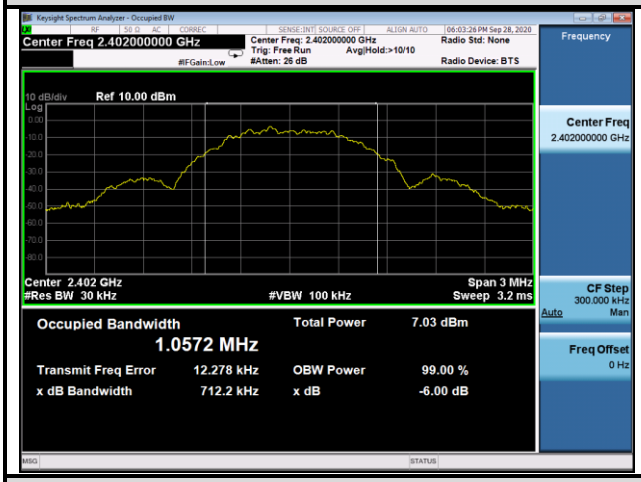
TM5



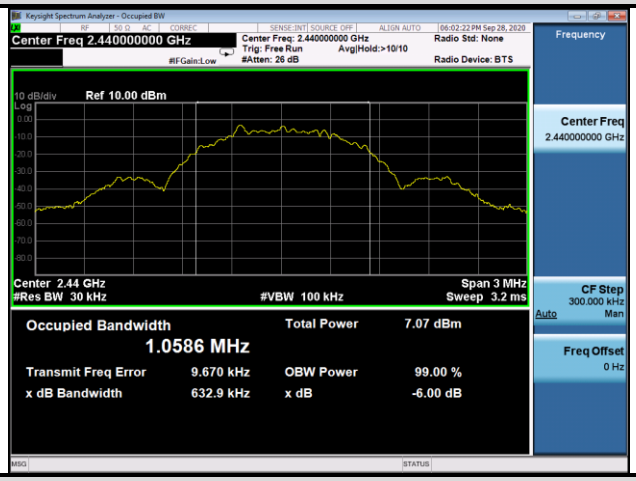
TM6



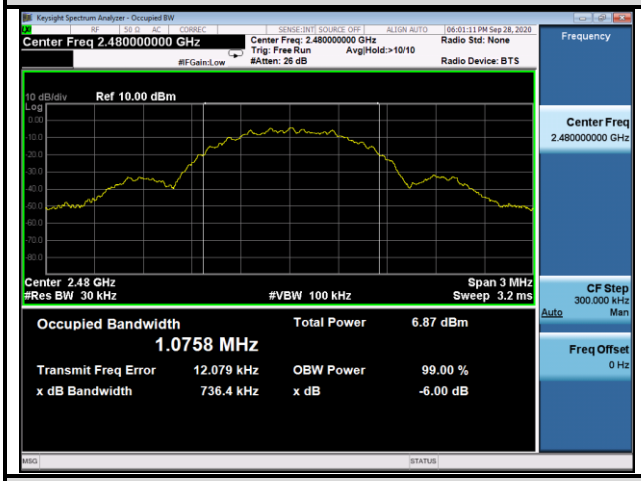
TM7



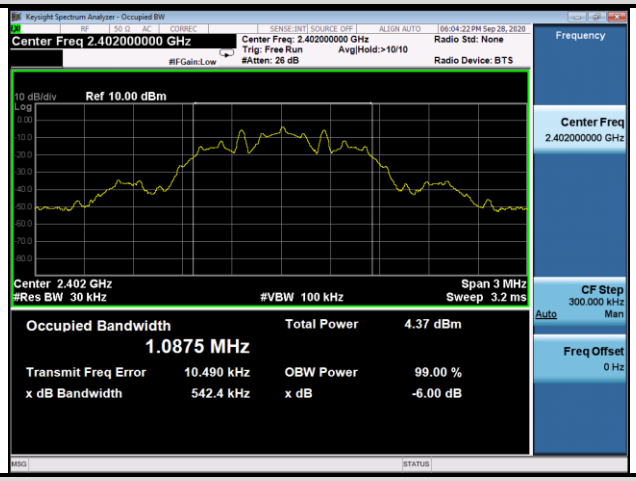
TM8



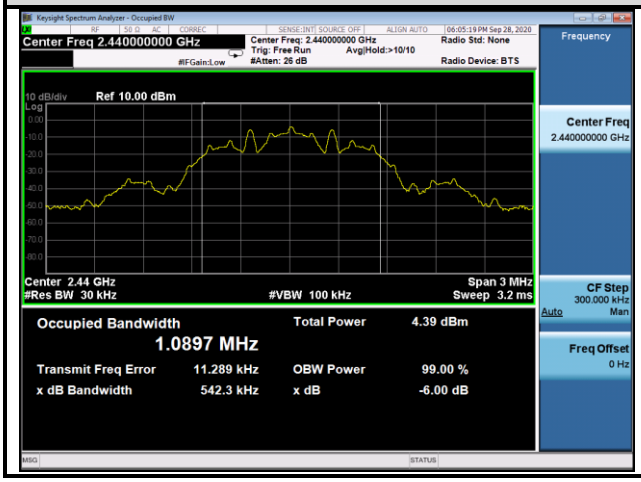
TM9



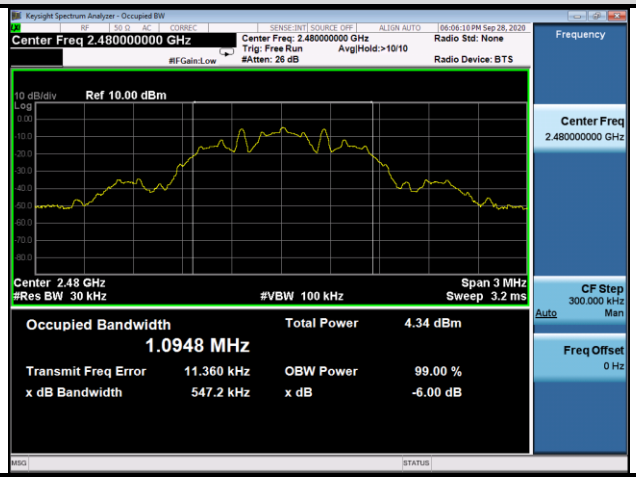
TM10



TM11



TM12



5.1.3 Peak Output Power

RESULT: **Pass**

Date of testing	:	2020-09-28
Ambient temperature	:	23.1°C
Relative humidity	:	48.5%
Atmospheric pressure	:	101kPa
Test requirement	:	FCC Part 15.247(b)(3) RSS-247 Issue 2, February 2017, Clause 5.4(d)
Test procedure	:	KDB 558074 D01v05r02 ANSI C63.10: 2013
Test voltage	:	DC 5V
Test modes applied	:	TM1 to TM12

Table 9: Peak Output Power

Mode	Antenna Gain [dBi]	CH.	Freq. [MHz]	Maximum Peak Conducted Output Power [dBm]	Peak Conducted Output Power Limit [dBm]	Maximum EIRP [dBm]	EIRP Limit [dBm]
TM1	2	00	2402	-0.331	30	1.669	36
TM2		19	2440	-0.326	30	1.674	36
TM3		39	2480	-0.298	30	1.702	36
TM4		00	2402	-0.339	30	1.661	36
TM5		19	2440	-0.307	30	1.693	36
TM6		39	2480	-0.279	30	1.721	36
TM7		00	2402	-0.360	30	1.640	36
TM8		19	2440	-0.324	30	1.676	36
TM9		39	2480	-0.296	30	1.704	36
TM10		00	2402	-0.352	30	1.648	36
TM11		19	2440	-0.312	30	1.688	36
TM12		39	2480	-0.287	30	1.713	36

Note:
EIRP=Peak Conducted Output Power + Antenna Gain

5.1.4 Power Spectral Density

RESULT: **Pass**

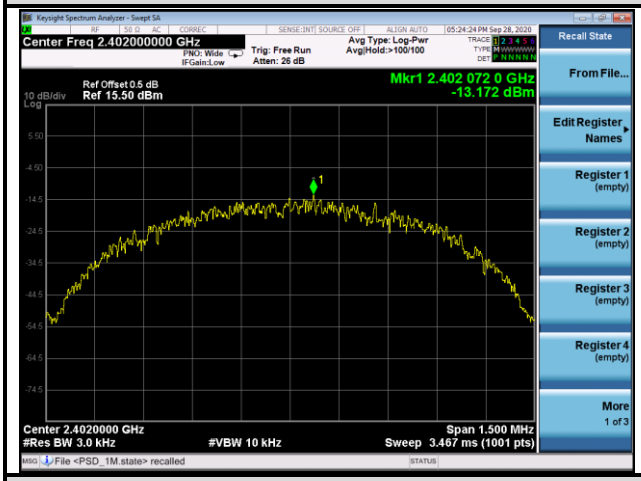
Date of testing	:	2020-09-28
Ambient temperature	:	21.4°C
Relative humidity	:	56.1%
Atmospheric pressure	:	101kPa
Test requirement	:	FCC Part 15.247(e) RSS-247 Issue 2, February 2017, Clause 5.2(b)
Test procedure	:	KDB 558074 D01v05r02 ANSI C63.10: 2013
Test voltage	:	DC 5V
Test modes applied	:	TM1 to TM12

Table 10: Power Spectral Density

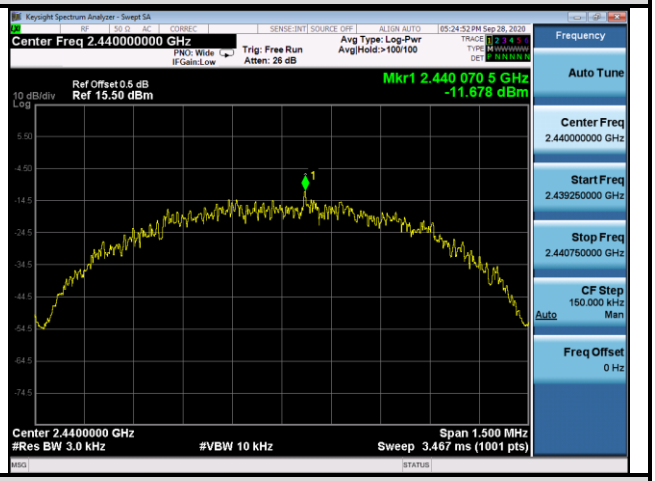
Mode	CH.	Frequency [MHz]	Result [dBm/3kHz]	Limit [dBm/3kHz]
TM1	00	2402	-13.172	8
TM2	19	2440	-11.678	8
TM3	39	2480	-12.675	8
TM4	00	2402	-16.050	8
TM5	19	2440	-15.339	8
TM6	39	2480	-15.221	8
TM7	00	2402	-6.509	8
TM8	19	2440	-6.445	8
TM9	39	2480	-6.431	8
TM10	00	2402	-6.410	8
TM11	19	2440	-6.336	8
TM12	39	2480	-6.285	8

Figure 3: Power Spectral Density

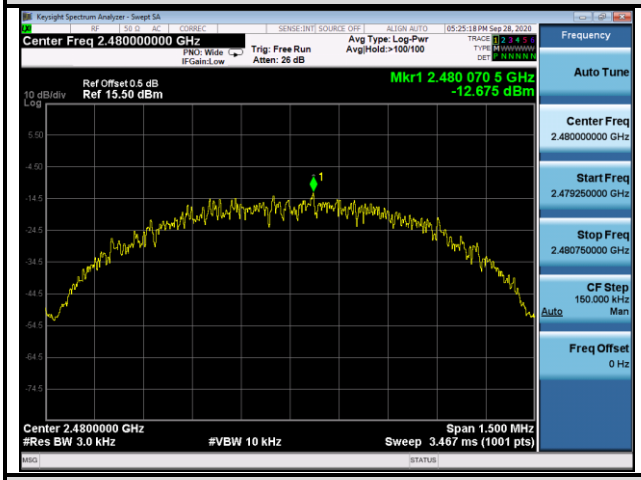
TM1



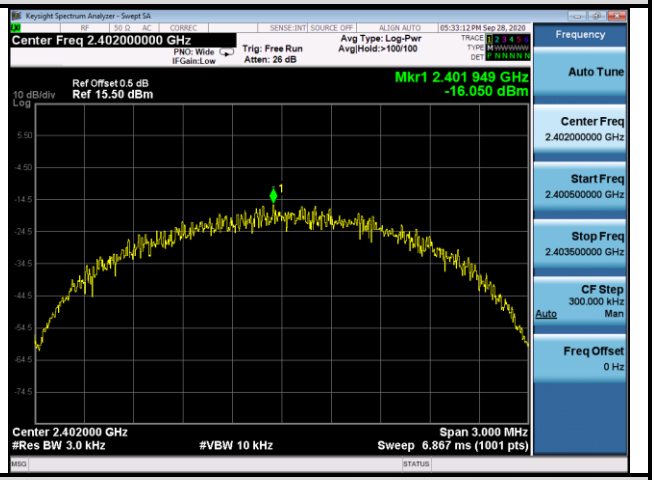
TM2



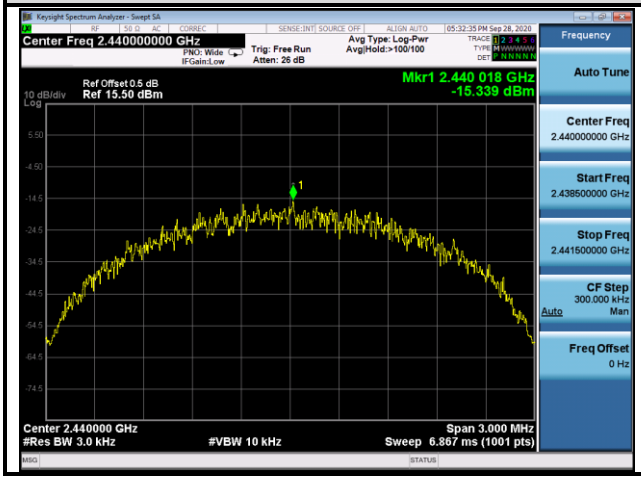
TM3



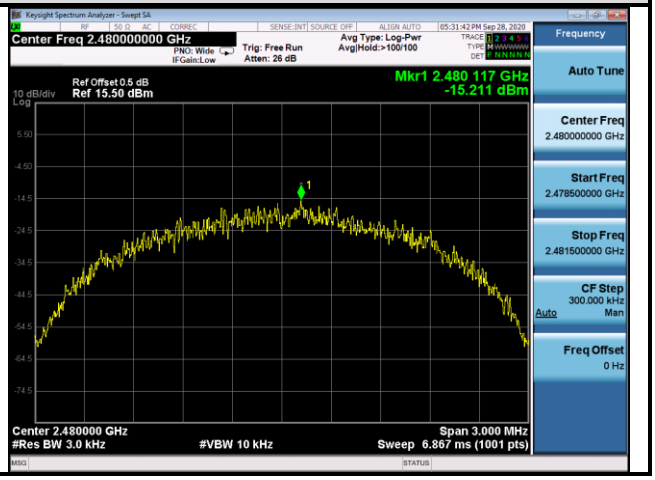
TM4



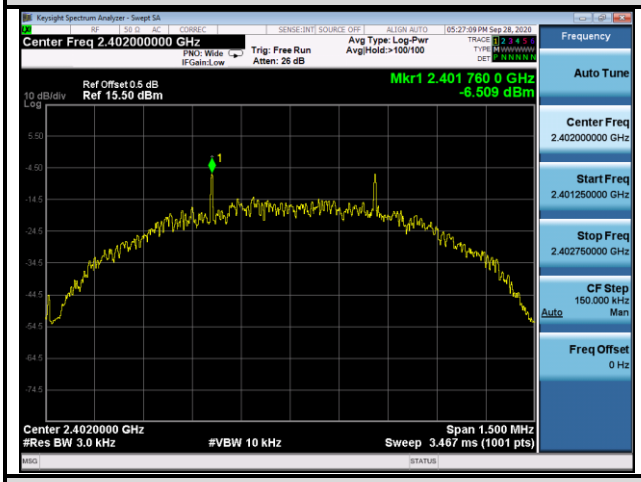
TM5



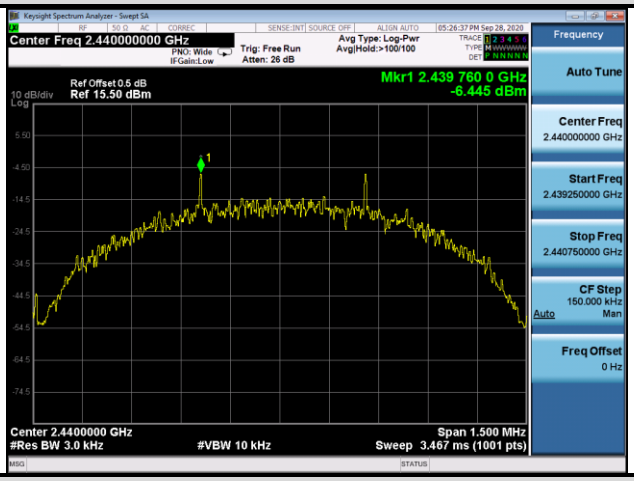
TM6



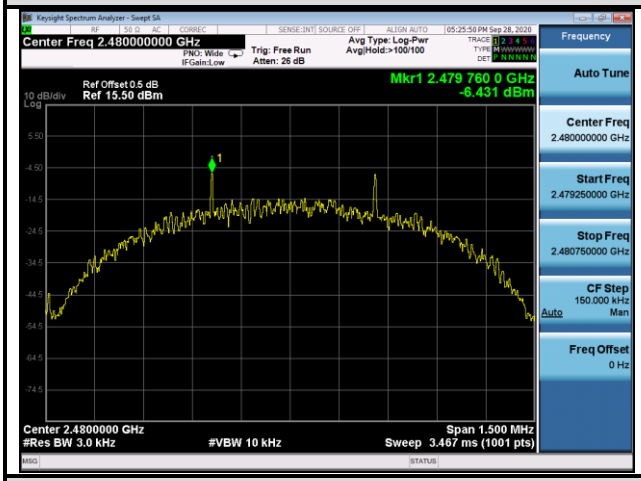
TM7



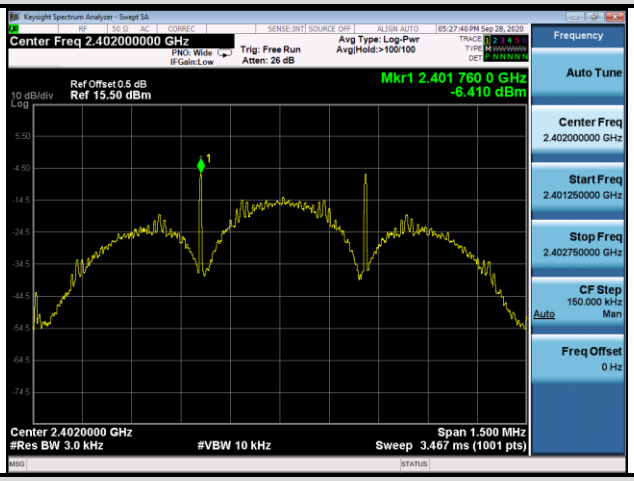
TM8



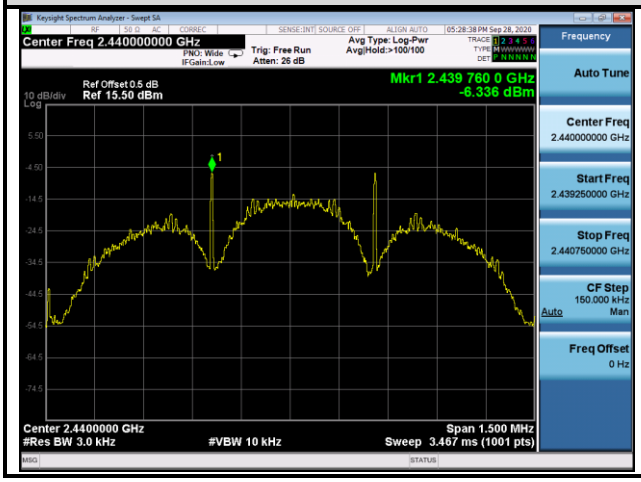
TM9



TM10



TM11



TM12

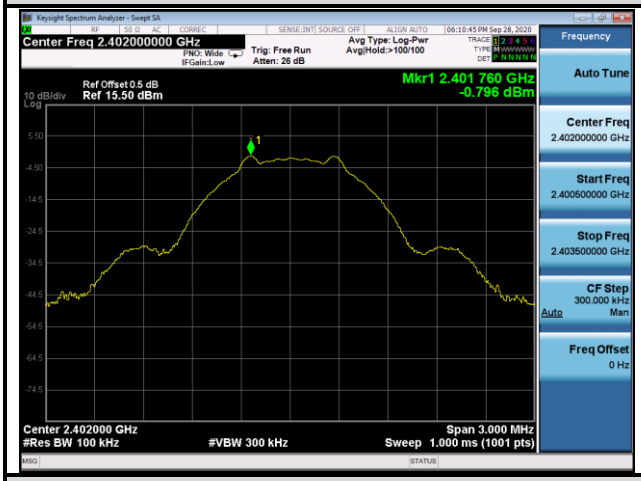
5.1.5 Conducted Band Edge and out-of Band Emissions

RESULT: **Pass**

Date of testing	:	2020-09-28
Ambient temperature	:	21.4°C
Relative humidity	:	56.1%
Atmospheric pressure	:	101kPa
Test requirement	:	FCC Part 15.247(d) RSS-247 Issue 2, February 2017, Clause 5.5
Test procedure	:	KDB 558074 D01v05r02 ANSI C63.10: 2013
Test voltage	:	DC 5V
Test modes applied	:	TM1 to TM12

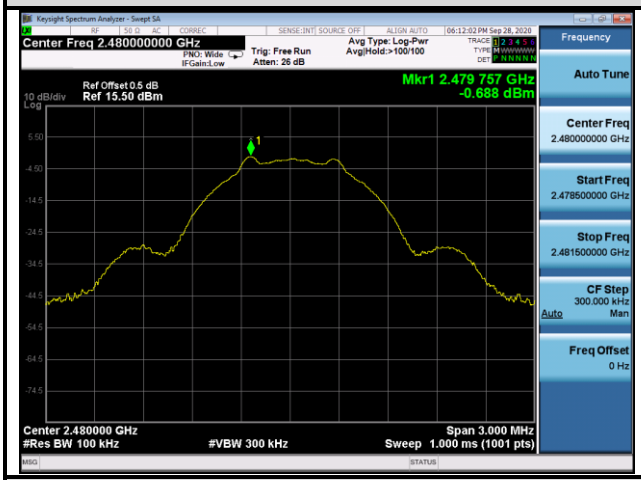
Figure 4: Reference level

TM1



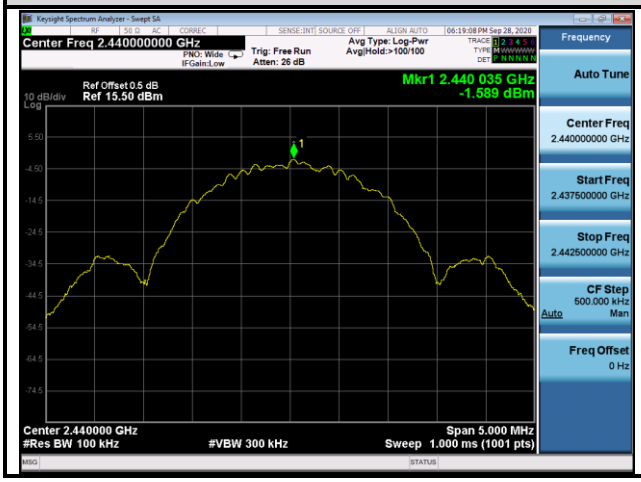
TM2

TM3



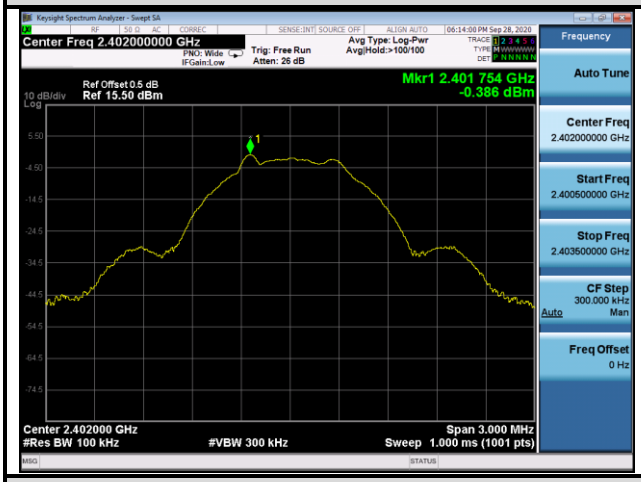
TM4

TM5



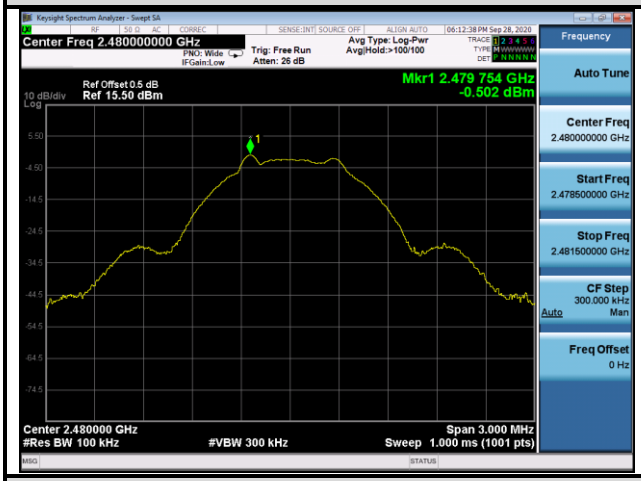
TM6

TM7



TM8

TM9



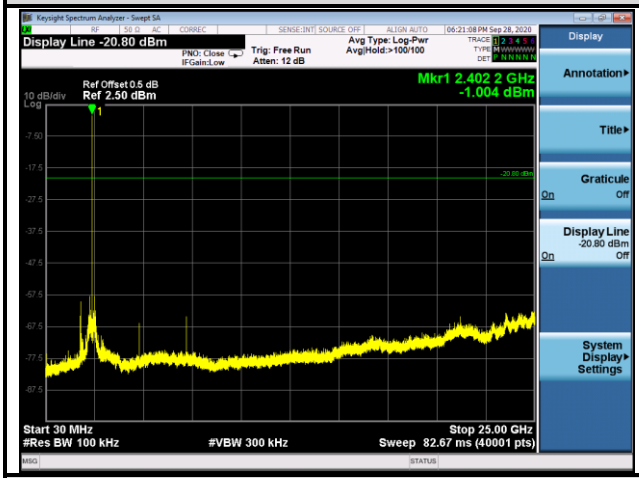
TM10

TM11

TM12

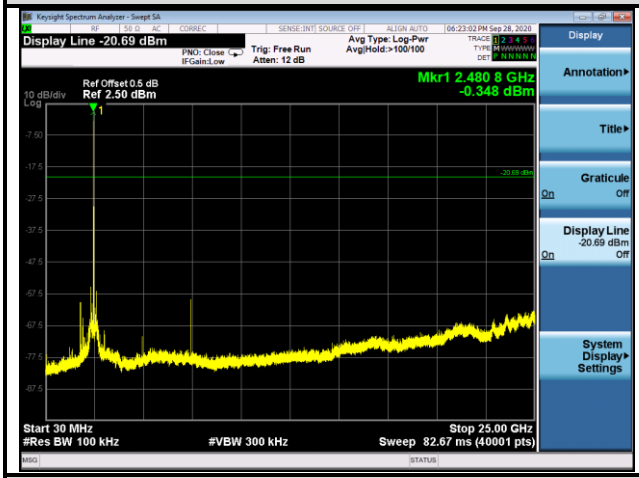
Figure 5: Conducted Spurious Emission

TM1



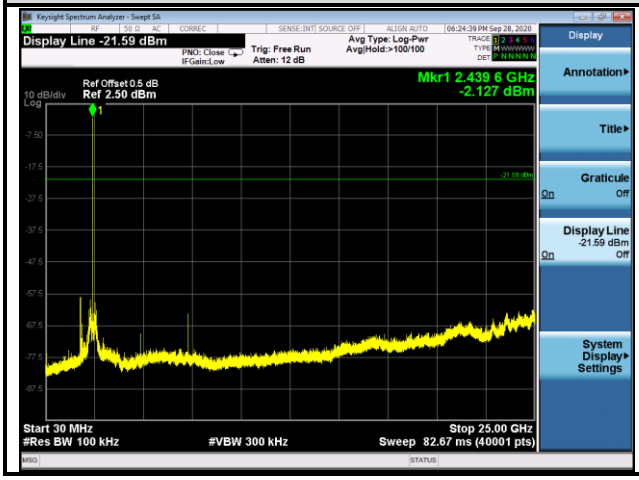
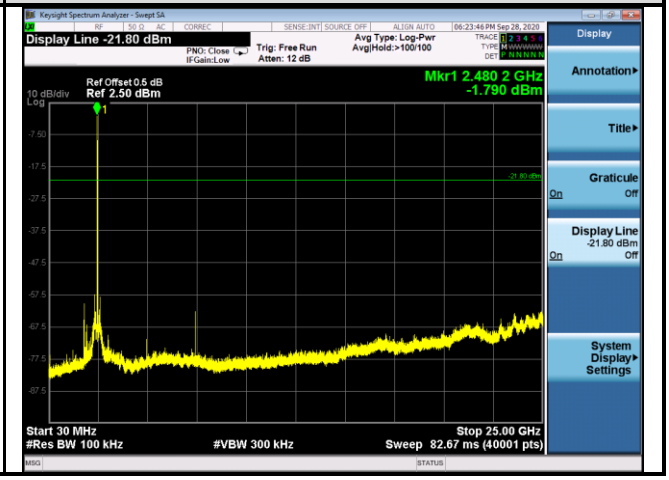
TM2

TM3



TM4

TM5



TM6