


Prüfbericht-Nr.: Test report no.:	CN21JML7 001	Auftrags-Nr.: Order no.:	244312940	Seite 1 von 123 Page 1 of 123
Kunden-Referenz-Nr.: Client reference no.:	1288983	Auftragsdatum: Order date:	2021-02-08	
Auftraggeber: Client:	IKEA of Sweden AB Box 702, SE-343 81, Älmhult, Sweden			
Prüfgegenstand: Test item:	VAPPEBY Lamp BT speaker outdoor			
Bezeichnung / Typ-Nr.: Identification / Type no.:	E2004 FCC ID: FHO-E2004 IC: 10912A-E2004			
Auftrags-Inhalt: Order content:	Complete test			
Prüfgrundlage: Test specification:	FCC CFR47 Part 15, Subpart C Section 15.247 RSS-Gen Issue 5, Amendment 2, February 2021 RSS-247 Issue 2, February 2017 ANSI C63.10: 2013			
Wareneingangsdatum: Date of sample receipt:	2021-06-09			
Prüfmuster-Nr.: Test sample no.:	A003069443-001~002			
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			
geprüft von: tested by:	X <u>Hongfei Wu</u>	genehmigt von: authorized by:	X <u>Elliot Zhang</u>	
Datum: Date:	2021-08-20 <small>Signed by: Hongfei Wu</small>	Ausstellungsdatum: Issue date:	2021-08-20 <small>Signed by: Elliot Zhang</small>	
Stellung / Position:	PE	Stellung / Position:	Reviewer	
Sonstiges / Other:	HVIN: E2004			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet			
* Legend:	P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested			
<p>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugswise 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></p>				

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 modified semi-anechoic chamber	Frankonia	SAC3	G1811378	2022-06-27
Bilog antenna	Teseq	CBL 6112D	G1811425	2023-03-10
EMI test receiver	Rohde & Schwarz	ESCI	G1811402	2021-09-18
Spectrum analyser	Rohde & Schwarz	FSV40	G1822702	2021-11-01
Preamplifier	Taiwan EMCI	EMC184045SE	G1825372	2023-03-06
Log periodic antenna	Rohde & Schwarz	HL050	G1811417	2023-03-10
Broadband Horn Antenna	Schwarzbeck	BBHA 9170	9170-305	2023-07-09
Preamplifier	Taiwan EMCI	EMC051845SE	G1825371	2023-03-06
Spectrum Analyzer	Keysight	N9020A	MY54500180	2021-09-08
Thermohygrometer	Testo	608-H1	1241320614	2021-10-13
EMI test receiver	R&S	ESIB26	G1811380	2023-03-06
Artificial main network	R&S	ENV432	G1830003	2022-11-01
EMC measurement software	R&S	EMC32 (Ver 10.20.01)	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 basis 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 a Bluetooth speaker.

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:	VAPPEBY Lamp BT speaker outdoor
Model No.:	E2004
Operating Voltage:	DC 7.2V (Li-ion Battery)
Technical Specification of Bluetooth Classic	
Frequency Range:	2402 to 2480MHz
Modulation Type:	GFSK, $\pi/4$ DQPSK, 8DPSK
Data Rate:	1Mbps(GFSK), 2Mbps($\pi/4$ DQPSK), 3Mbps(8DPSK)
Antenna Type:	PCB Antenna
Antenna Gain:	-3.07 dBi (Provided by the Client)

3.3 Independent Operation Modes

Table 4: Independent Operation Modes

Test Mode	Data Rate	Channel
TM1	1-DH5	00
TM2	1-DH5	39
TM3	1-DH5	78
TM4	2-DH5	00
TM5	2-DH5	39
TM6	2-DH5	78
TM7	3-DH5	00
TM8	3-DH5	39
TM9	3-DH5	78
TM10	1-DH1	Hopping
TM11	1-DH3	Hopping
TM12	1-DH5	Hopping
TM13	2-DH1	Hopping
TM14	2-DH3	Hopping
TM15	2-DH5	Hopping
TM16	3-DH1	Hopping
TM17	3-DH3	Hopping
TM18	3-DH5	Hopping
TM19	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 to measure its maximum power level. 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 used: BT FCC tool, V2.21

Table 5: Power parameter value

Channel Frequency [MHz]	Power Parameter Value
2402	3
2441	3
2480	3

4.3 Special Accessories and Auxiliary Equipment

Null.

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 PCB antenna, the directional gain of antenna is -3.07 dBi 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 6: 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: PCB 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 PCB antenna can be used
Verdict:	Pass

RSS-Gen 6.4 – External Control	
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 transmitter external controls accessible to the user that can be adjusted and operated in violation of the limits of this standard.
Verdict:	PASS

RSS-Gen 6.8 – Antenna Requirement

Requirement: When measurements at the antenna port are used to determine the 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:	PCB Antenna
b) Manufacture:	N/A
c) Model No.:	N/A
d) Gain with reference to an isotropic radiator:	-3.07 dBi

Verdict: PASS

Figure 1: 20dB & 99% Bandwidth

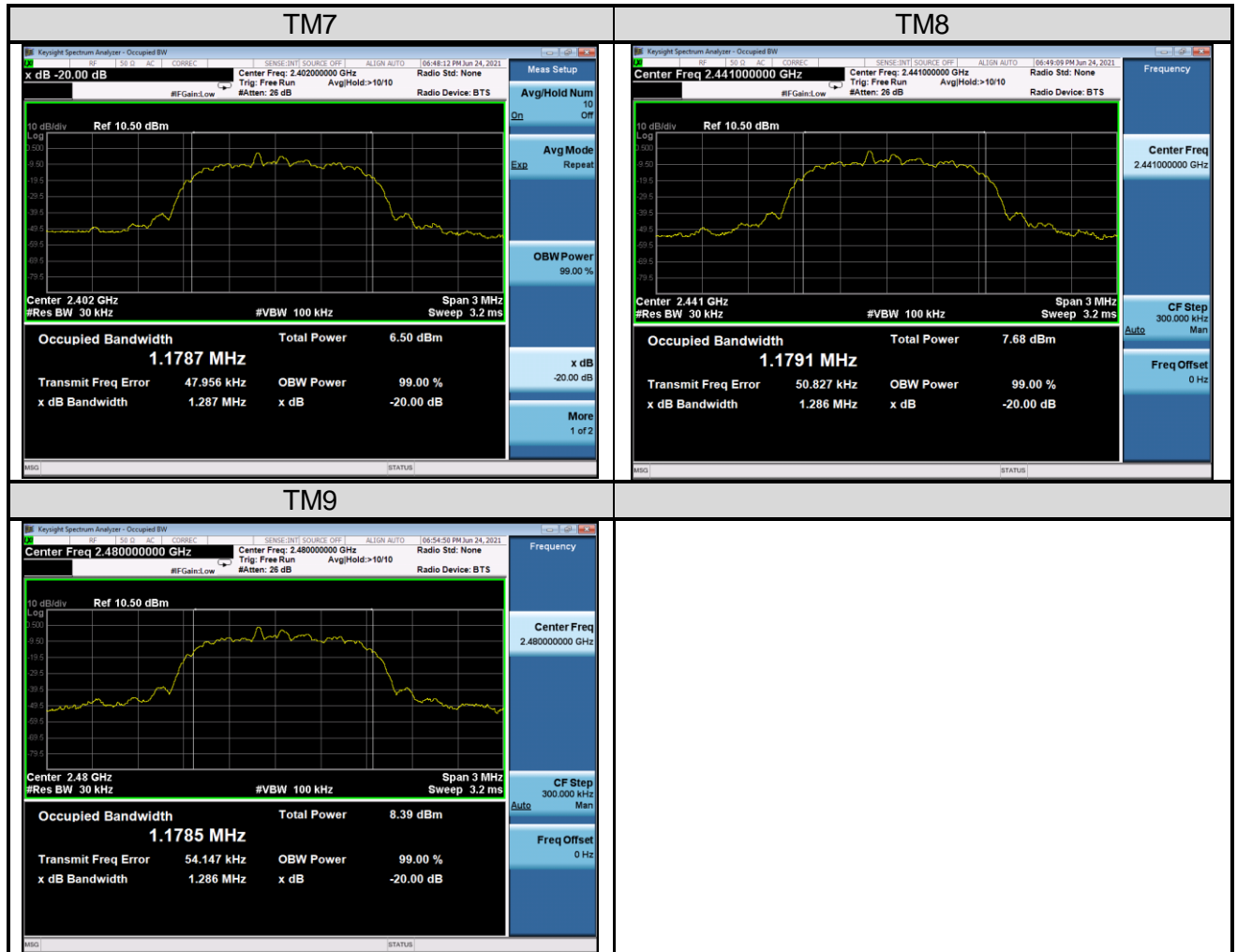
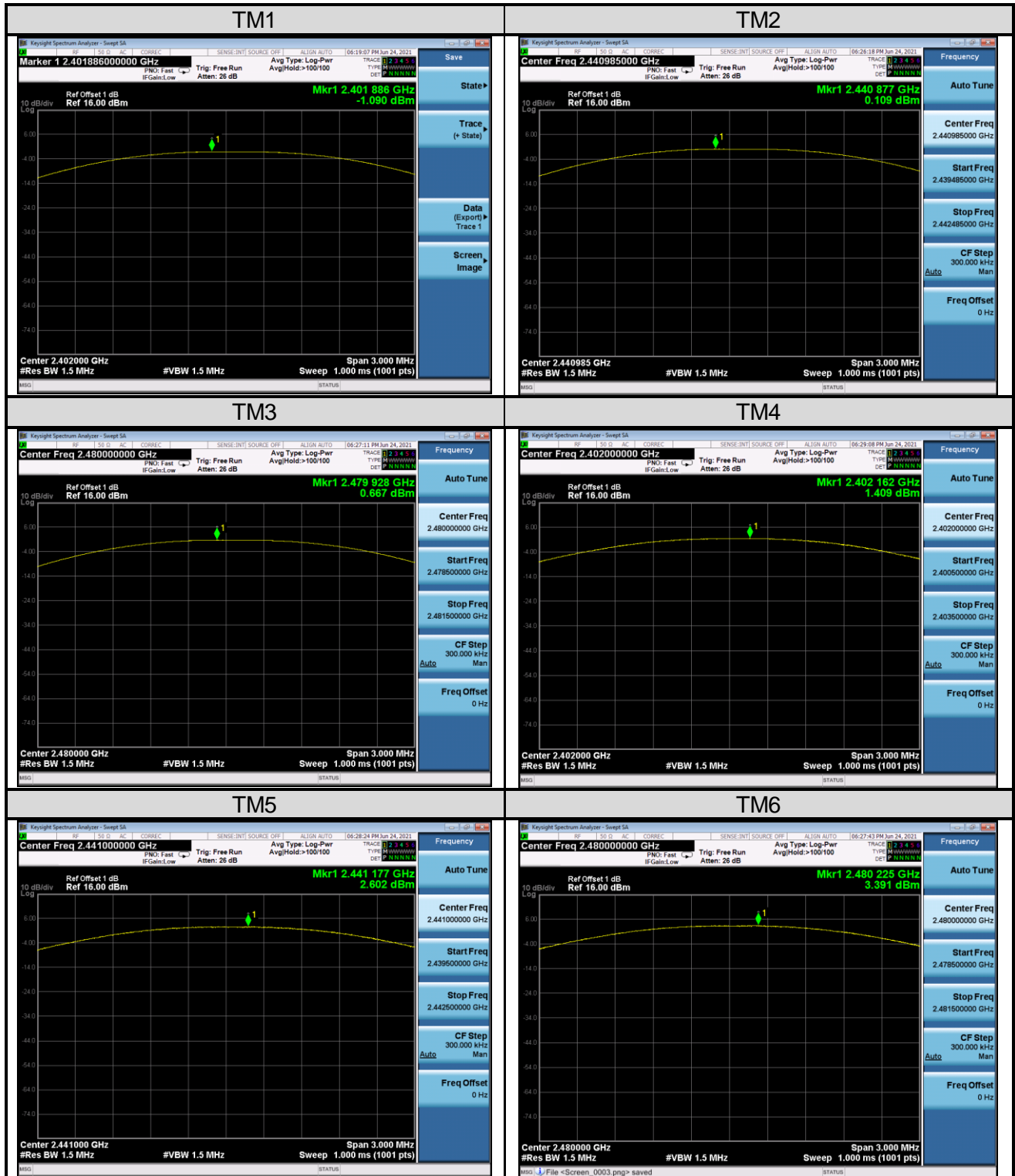



Figure 2: Peak Output Power, TM1 to TM9


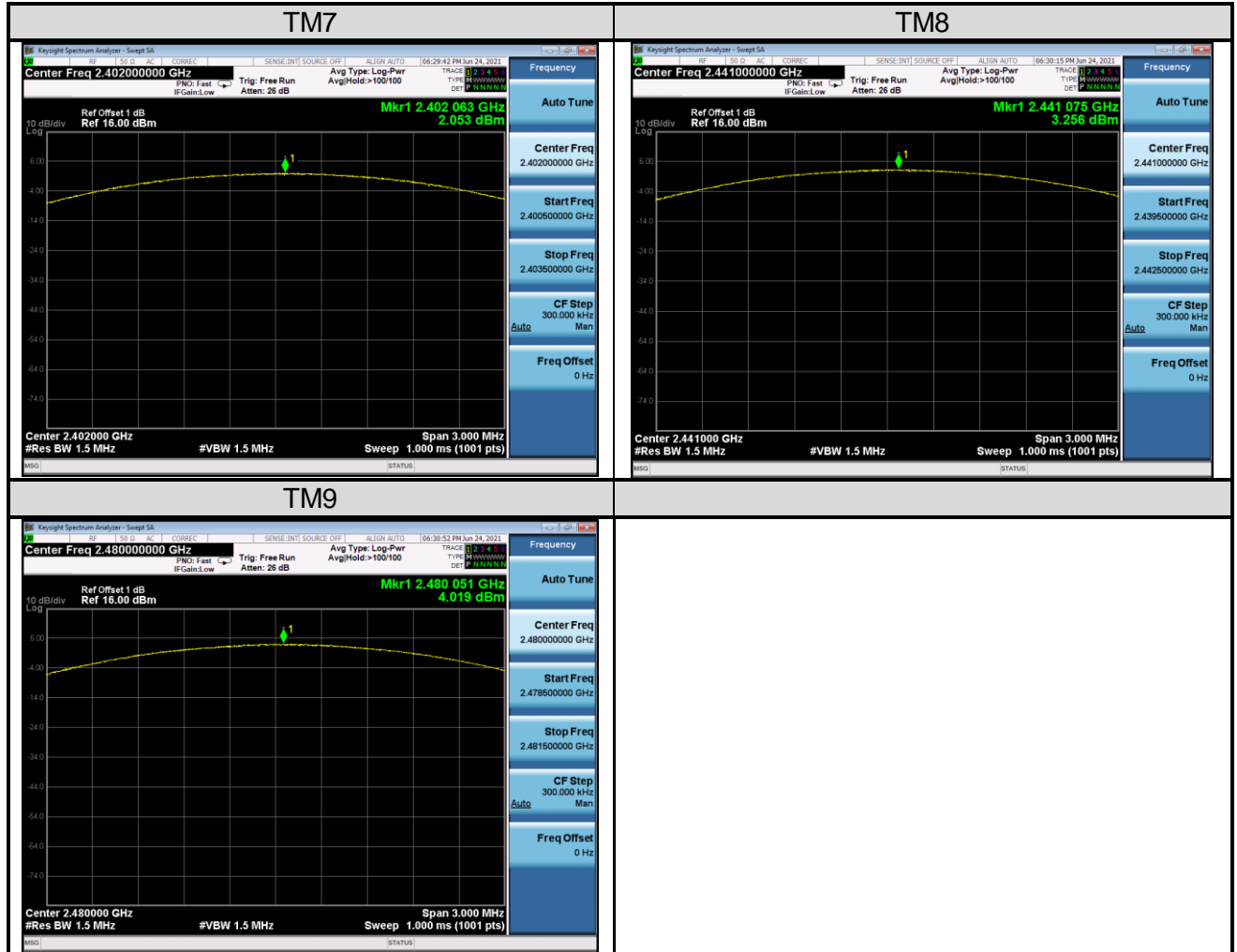
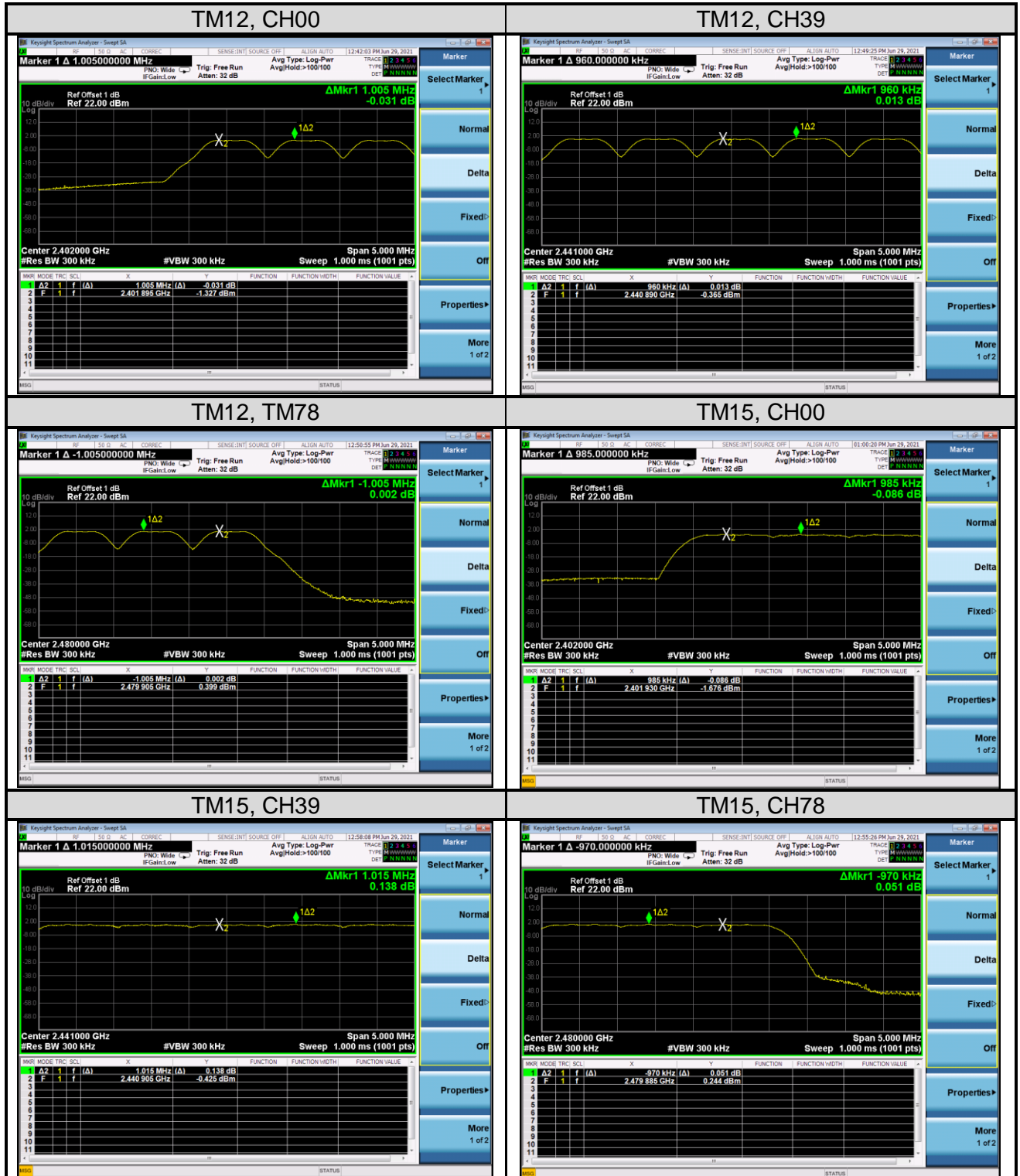


Figure 3: Frequency Separation




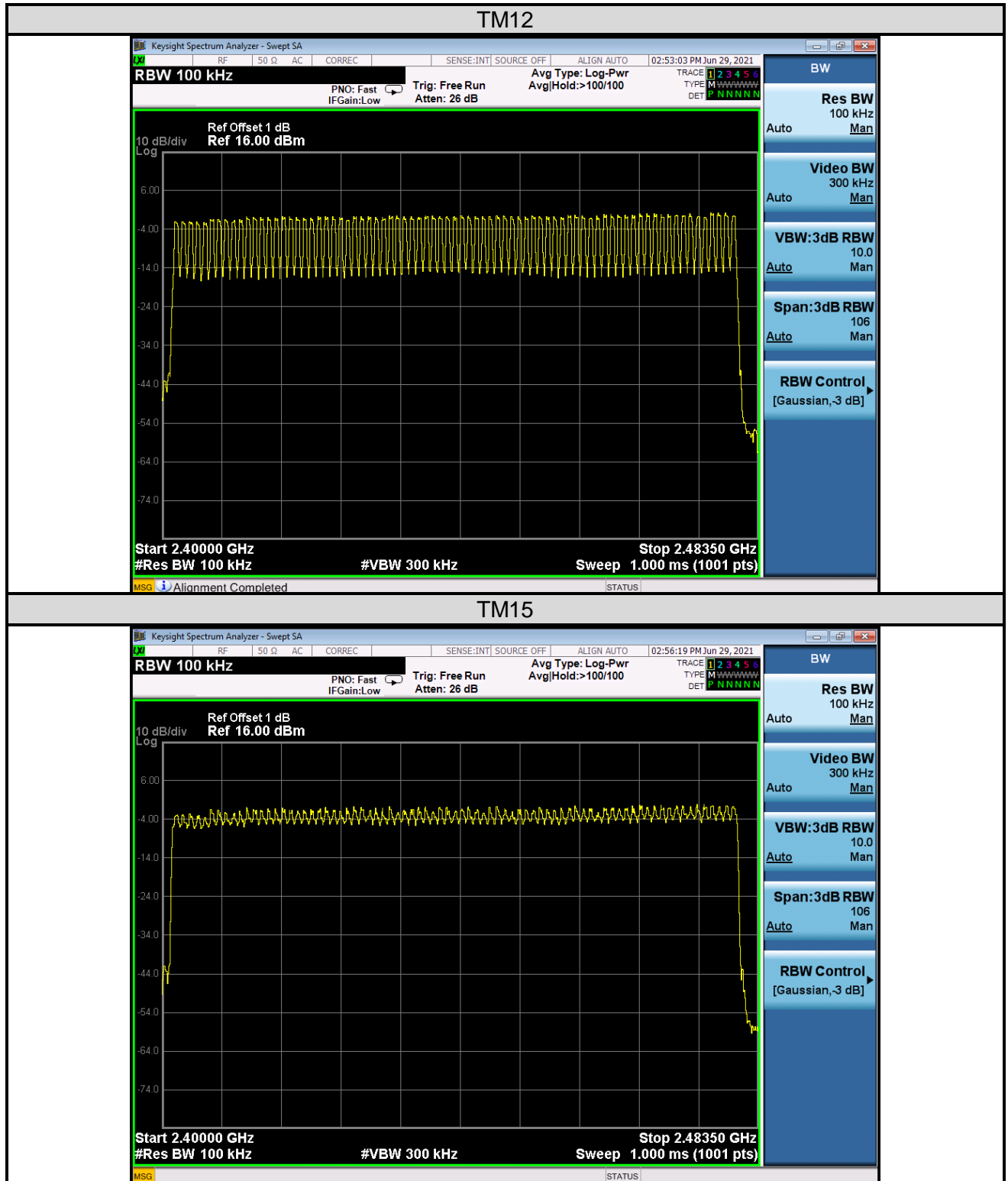
5.1.5 Number of Hopping Frequency

RESULT:**Pass**

Date of testing : 2021-06-29
Ambient temperature : 21.5°C
Relative humidity : 57.4%
Atmospheric pressure : 101kPa
Test requirement : FCC 15.247(a)(1)(iii)
RSS-247 Issue 2, February 2017, Clause 5.1(d)
Test procedure : ANSI C63.10: 2013
Test voltage : DC 7.2V
Test modes applied : TM12, TM15, TM18

Table 10: Number of Hopping Frequency

Frequency Range	Measured Quantity of Hopping Channel	Limit
2402 to 2480	79	≥15

Figure 4: Number of Hopping Frequency

TM15

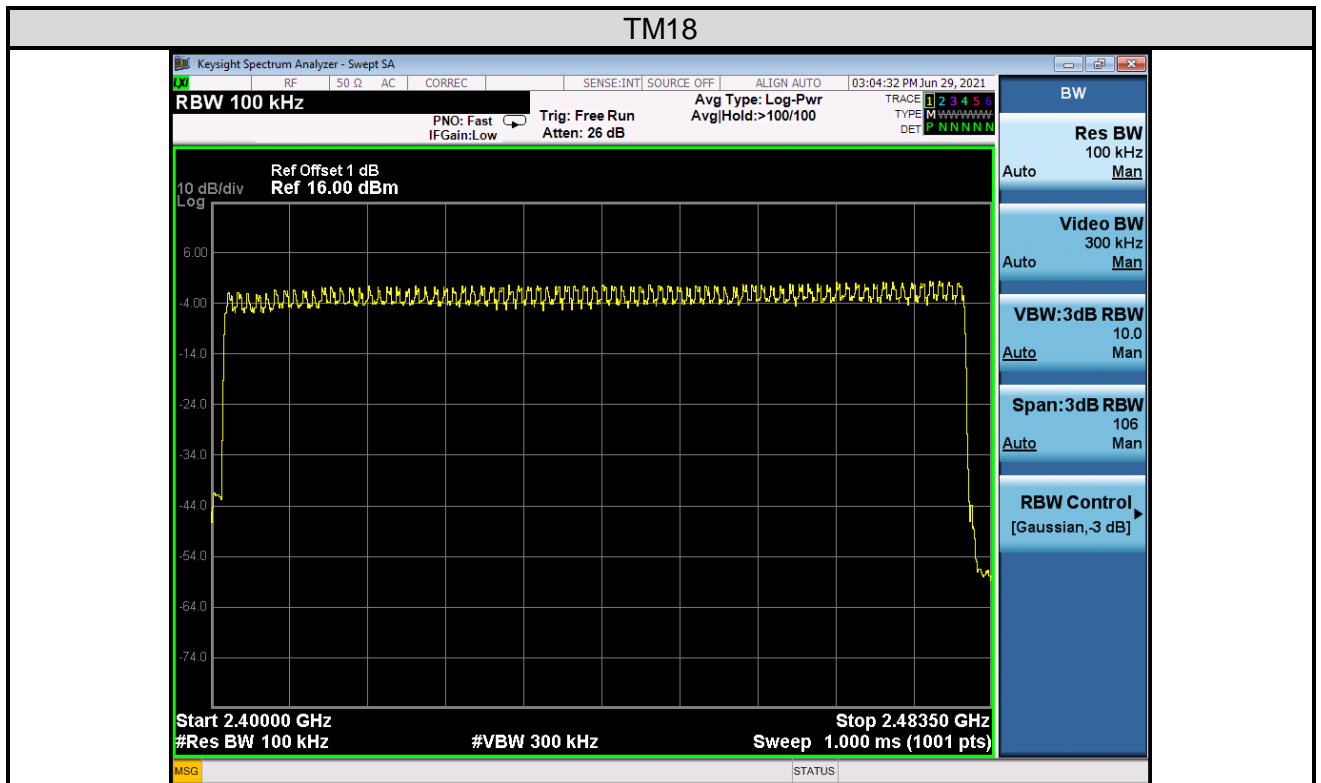
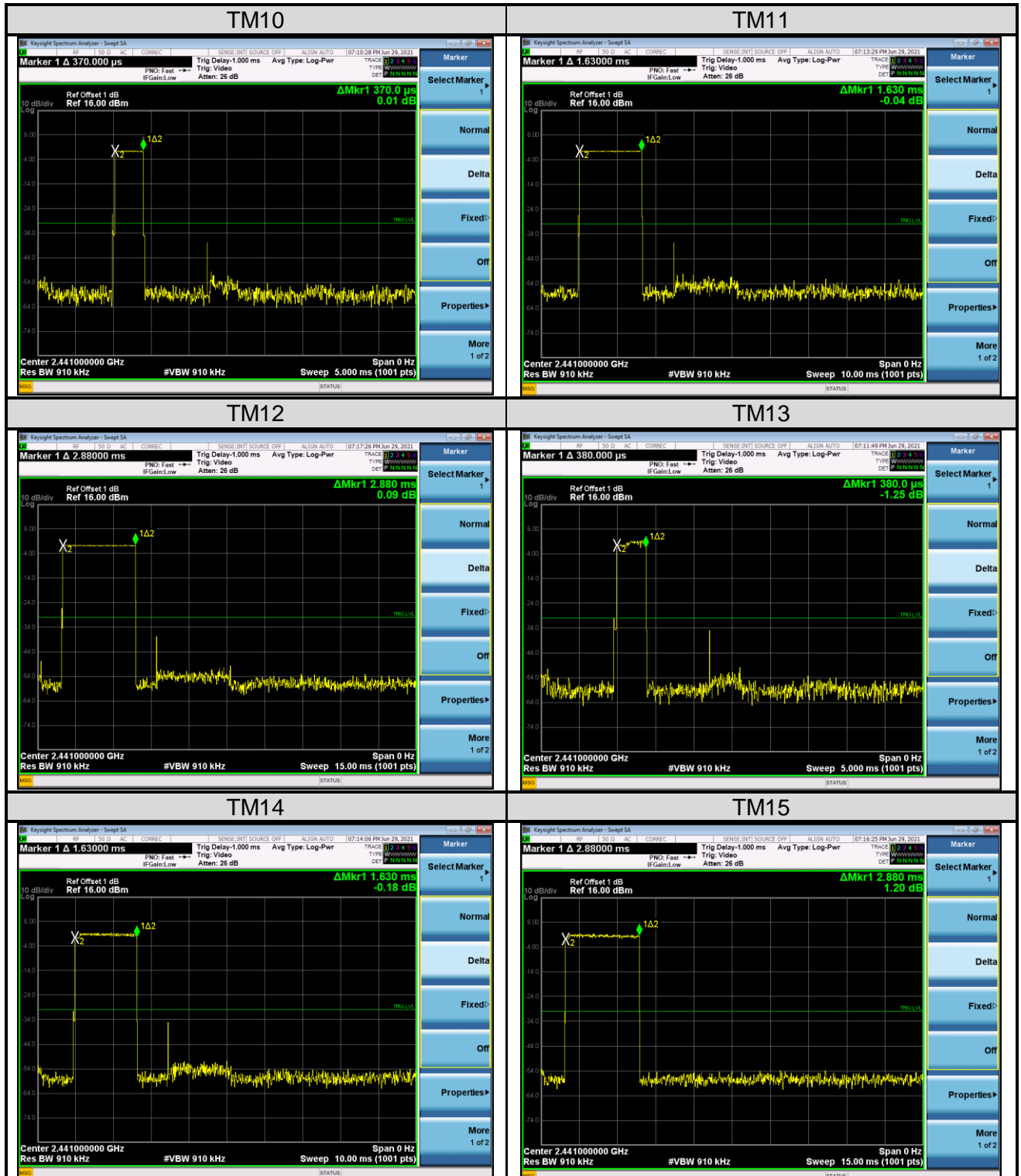
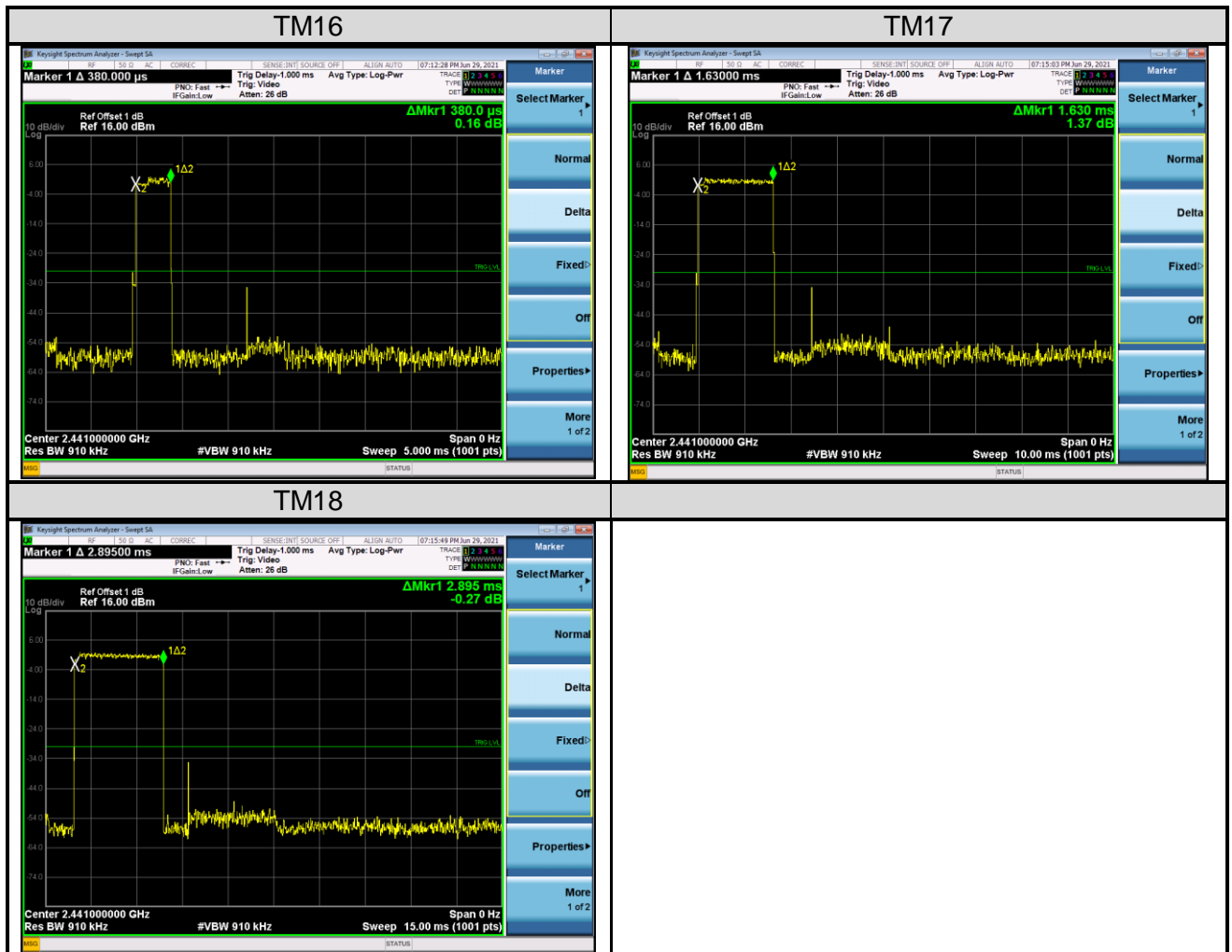


Figure 5: Time of Occupancy, TM10 to TM18




5.1.7 Conducted Band Edge and out-of Band Emissions

RESULT:**Pass**

Date of testing : 2021-06-29
Ambient temperature : 21.5°C
Relative humidity : 57.4%
Atmospheric pressure : 101kPa
Test requirement : FCC Part 15.247(d)
RSS-247 Issue 2, February 2017, Clause 5.5
Test procedure : ANSI C63.10: 2013
Test voltage : DC 7.2V
Test modes applied : TM1 to TM9, TM12, TM15, TM18

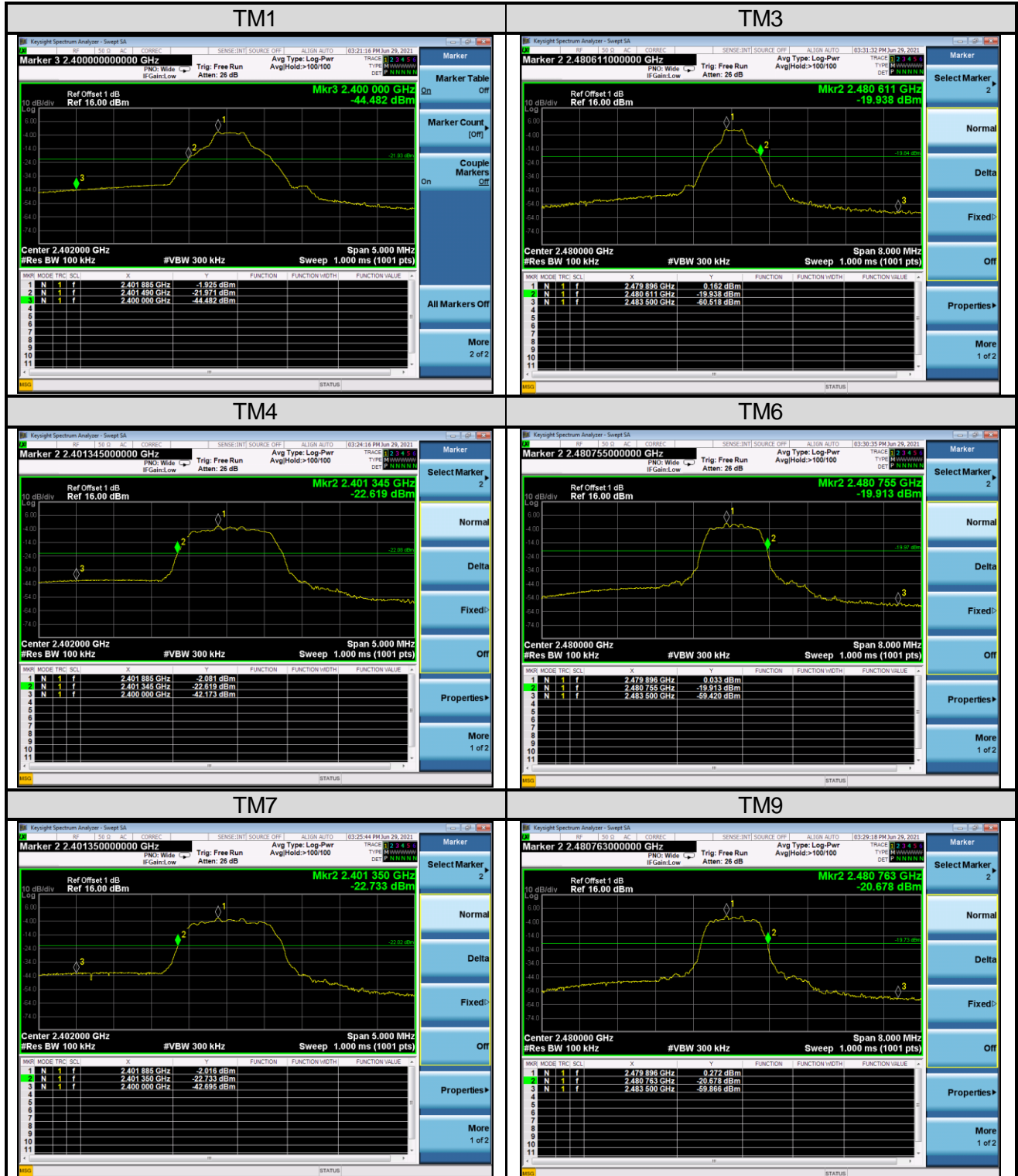
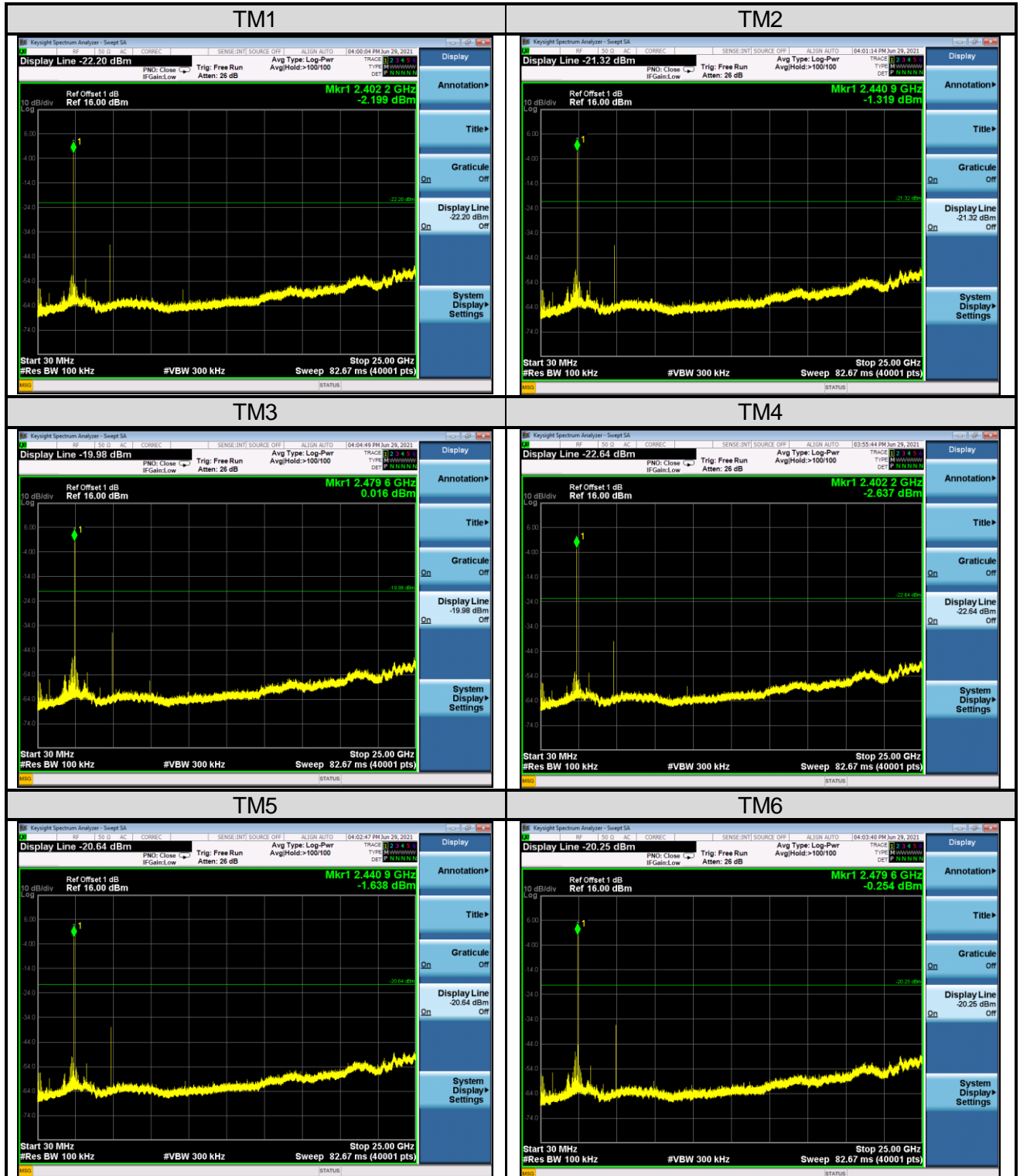
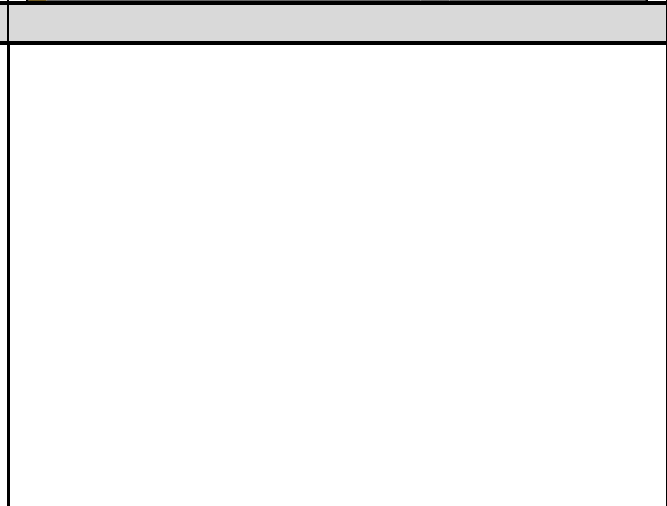
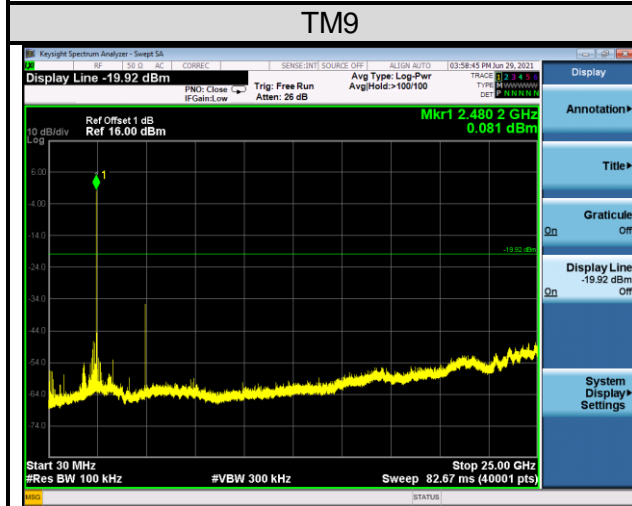
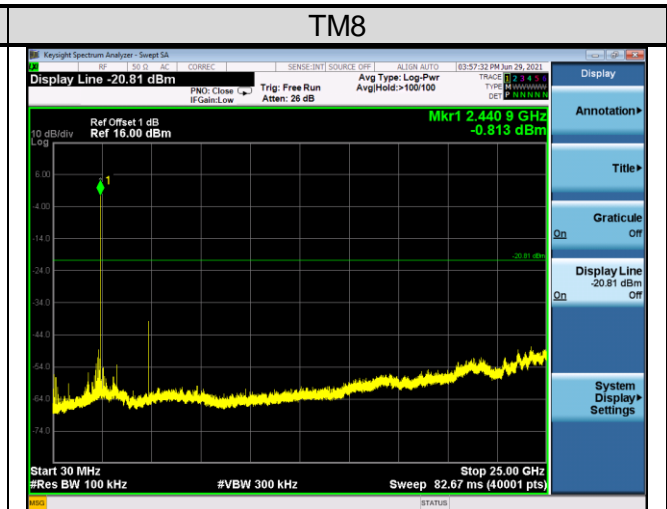
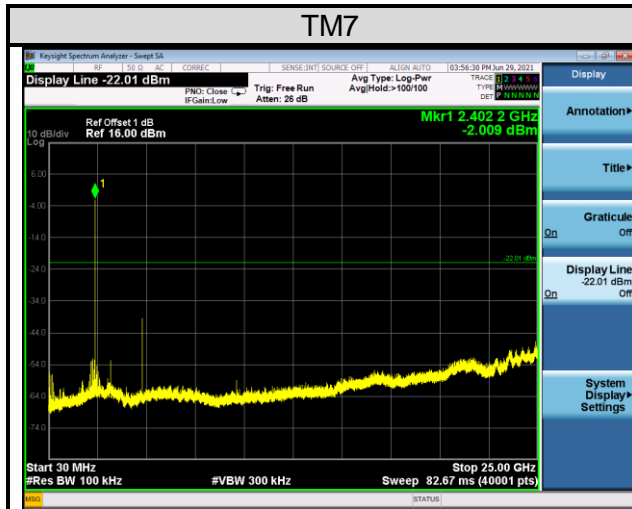
Figure 6: Conducted Band Edge




Figure 7: Conducted Spurious Emission


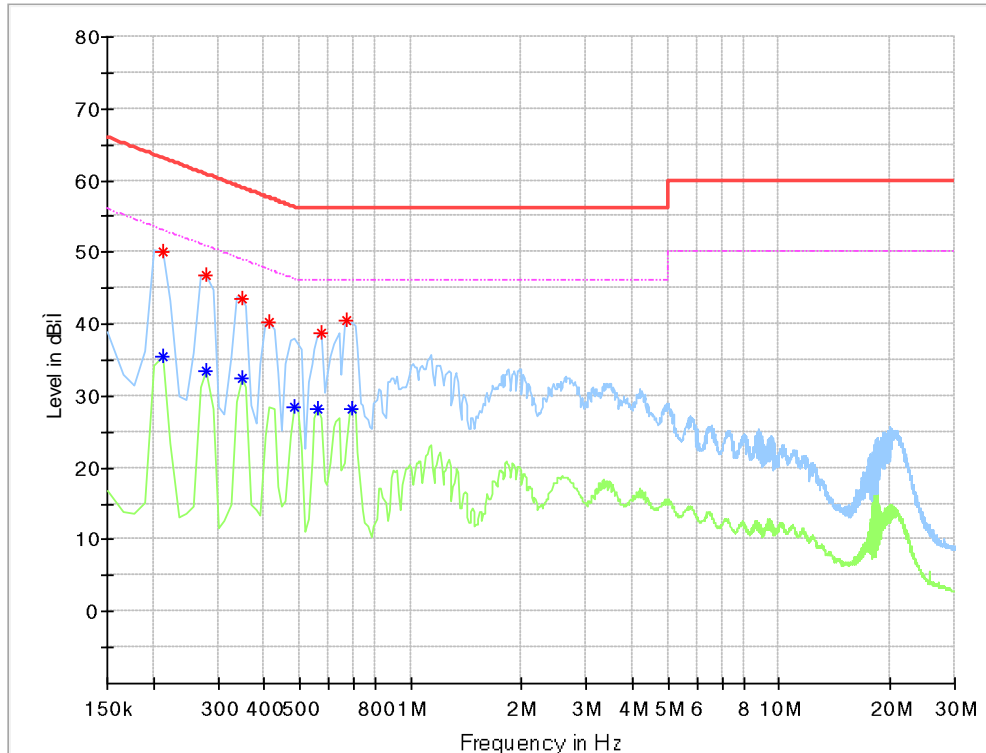


5.2 Emission in the Frequency Range up to 30MHz

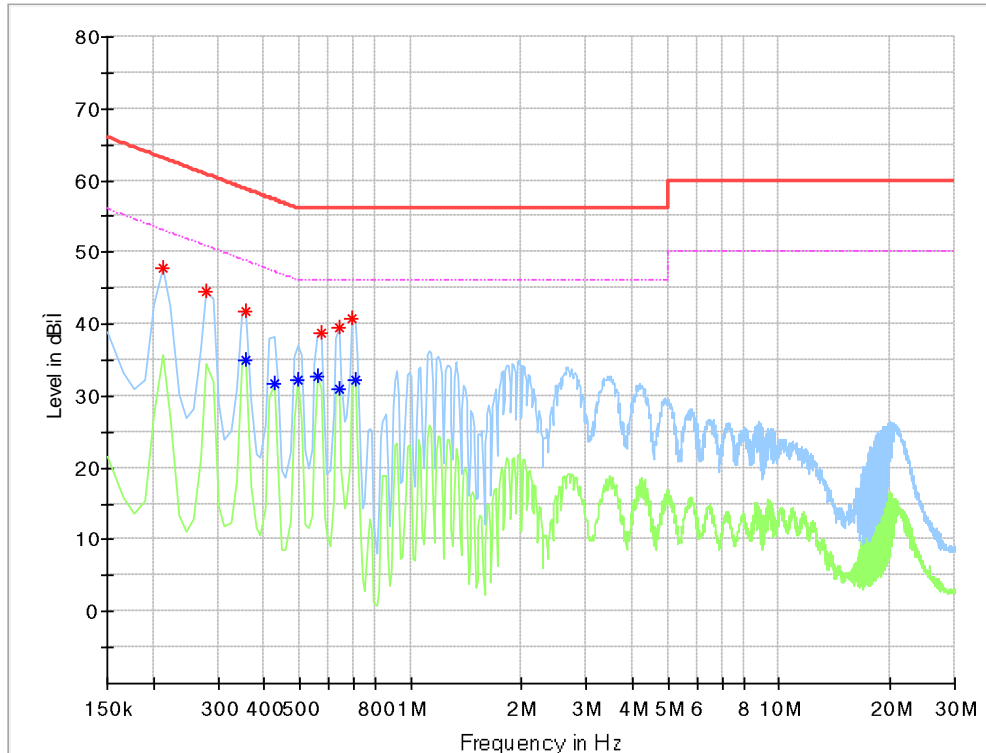
5.2.1 Conducted Emission

RESULT:**Pass**

Date of testing : 2021-07-01
Ambient temperature : 23.3°C
Relative humidity : 52.4%
Atmospheric pressure : 101kPa
Test requirement : FCC Part 15.207 (a)
RSS-Gen Issue 5, Amendment 2, February 2021, Clause 8.8
Test procedure : ANSI C63.10: 2013
Test voltage : AC 120V/60Hz
Test modes applied : TM19

Figure 8: Conducted Emission, L

Critical_Freqs

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter
0.560625	---	28.15	46.00	17.85	L1	ON
0.695625	---	28.33	46.00	17.67	L1	ON
0.481875	---	28.56	46.31	17.75	L1	ON
0.346875	---	32.50	49.04	16.54	L1	ON
0.279375	---	33.57	50.83	17.27	L1	ON
0.211875	---	35.63	53.13	17.51	L1	ON
0.211875	50.00	---	63.13	13.13	L1	ON
0.279375	46.77	---	60.83	14.06	L1	ON
0.346875	43.62	---	59.04	15.42	L1	ON
0.414375	40.23	---	57.56	17.33	L1	ON
0.571875	38.74	---	56.00	17.26	L1	ON
0.673125	40.58	---	56.00	15.42	L1	ON

Figure 9: Conducted Emission, N

Critical_Freqs

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line
0.639375	---	31.08	46.00	14.92	N
0.425625	---	31.79	47.34	15.55	N
0.493125	---	32.16	46.12	13.96	N
0.706875	---	32.28	46.00	13.72	N
0.560625	---	32.75	46.00	13.25	N
0.358125	---	34.88	48.77	13.89	N
0.211875	47.90	---	63.13	15.23	N
0.279375	44.56	---	60.83	16.27	N
0.358125	41.76	---	58.77	17.01	N
0.571875	38.84	---	56.00	17.16	N
0.639375	39.54	---	56.00	16.46	N
0.695625	40.68	---	56.00	15.32	N

5.3 Emission in the Frequency Range above 30MHz

5.3.1 Radiated Band-Edge

RESULT:**Pass**

Date of testing	:	2021-07-27
Ambient temperature	:	23.1°C
Relative humidity	:	46.2%
Atmospheric pressure	:	101kPa
Test requirement	:	FCC Part 15.247(d) FCC Part 15.205(a) FCC Part 15.209(a) RSS-Gen Issue 5, Amendment 2, February 2021, Clause 8.9 RSS-Gen Issue 5, Amendment 2, February 2021, Clause 8.10 RSS-247 Issue 2, February 2017, Clause 5.5
Test procedure	:	ANSI C63.10: 2013
Test voltage	:	DC 7.2V
Test modes applied	:	TM1, TM3, TM4, TM6, TM7, TM9