

FCC PART 15.247 TEST REPORT

For

Thundercomm Technology Co., Ltd

Building 4, No. 99, Data Valley Middle Road Xiantao District, Yubei District,
Chongqing, China

FCC ID: 2AOHHTURBOXSOMD845

Report Type: Class II Permissive Change	Product Type: Thundersoft TurboX D845 SOM
Report Number: SZ1210330-09079E-00BA1	
Report Date: 2021-04-25	
Reviewed By: RF Engineer	Jacob Kong
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Thundersoft TurboX D845 SOM
Tested Model	TurboX-D845-SOM
Frequency Range	Bluetooth: 2402~2480MHz
Maximum conducted Peak output power	Bluetooth: 1.44dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification*	PCB Antenna: 1.5dBi(It is provided by the applicant)
Voltage Range	DC 3.8 V
Date of Test	2021-04-09 to 2021-04-13
Sample number	SZ1210330-09079E-RF-A1-S1(Assigned by BACL, Shenzhen)
Received date	2021-03-30
Sample/EUT Status	Good condition

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

This is a CIIPC application of the device; the differences between the original device and the current one are as follows:

- (1) Add a kind of antenna.
- (2) Changing the company address to "Building 4, No. 99, Data Valley Middle Road Xiantao District, Yubei District, Chongqing, China".

Based on above difference listed, the modifications will impact the test item of "Radiated Emissions", "Antenna Requirement" and "Maximum Permissible Exposure(MPE)", so in this report, we will updated those items and related photos, the other test data and photos please refer to the original report.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For Radiated Emissions testing, please refer to DA 00-705 Released March 30, 2000, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1 °C
Humidity		±6%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) ,6F,7F,the 3rd Phase of Wan Li Industrial Building D,Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

“QRCT”* software was made to the EUT tested, and the power level is 7*. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

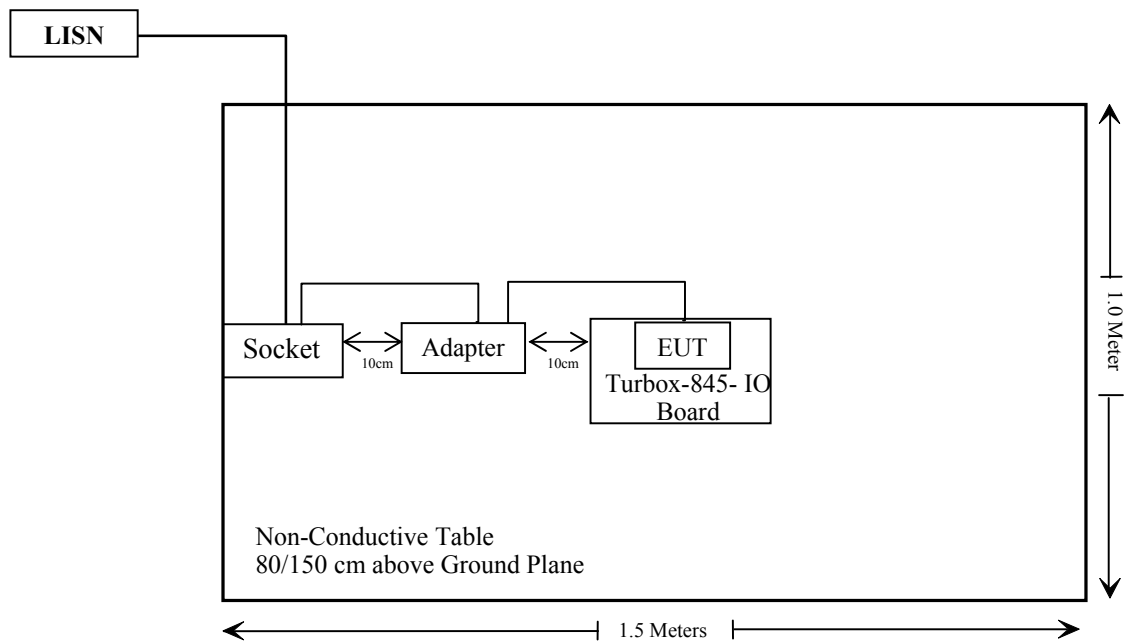
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Thundercomm Technology CO.,Ltd	Turbox-845- IO Board	V02	V02
Thundercomm Technology CO.,Ltd	Adapter	TurboX D845SOM	TurboX D845SOM

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-shielding Un-Detachable DC Cable	1.2	Turbox-845- IO Board	Adapter

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance*
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance*
§15.247(a)(1)	Channel Separation Test	Compliance*
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance*
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance*
§15.247(b)(1)	Peak Output Power Measurement	Compliance*
§15.247(d)	Band edges	Compliance*

Compliance*: Please refer to the original report RSZ181105003-00B with FCC ID: 2AOHHTURBOXSOMD845, issued by Bay Area Compliance Laboratories Corp. (Shenzhen).

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2020/08/04	2021/08/03
Sonoma instrument	Pre-amplifier	310 N	186238	2020/08/04	2021/08/03
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2020/12/22	2023/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2020/11/29	2021/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2020/11/29	2021/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2020/08/04	2021/08/03
COM-POWER	Pre-amplifier	PA-122	181919	2020/11/29	2021/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2020/11/29	2021/11/28
Sunol Sciences	Horn Antenna	3115	9107-3694	2021/01/15	2024/01/14
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2020/11/29	2021/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2020/11/29	2021/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2020/04/20	2021/04/20
Ducommun Technologies	Horn antenna	ARH-4223-02	1007726-02 1304	2020/12/06	2023/12/05

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (Minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Mode	Frequency (MHz)	Antenna Gain		Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BT	2402-2480	1.5	1.41	2	1.58	20	0.00044	1.0
BLE	2402-2480	1.5	1.41	6.5	4.47	20	0.0013	1.0
2.4GHz Wi-Fi	2412-2472	1.5	1.41	24.5	281.84	20	0.079	1.0
	2422-2462	1.5	1.41	22.5	177.83	20	0.050	1.0
5GHz Wi-Fi	5150-5250	5.7	3.72	15	31.62	20	0.023	1.0
	5250-5350	5.7	3.72	15	31.62	20	0.023	1.0
	5470-5725	5.7	3.72	14	25.12	20	0.019	1.0
	5725-5850	5.7	3.72	15	31.62	20	0.023	1.0

Note:

1) The conducted power is the tune-up power of the Max Conducted Output Power.

2) BT and Wi-Fi can transmit simultaneously, 2.4GHz Wi-Fi and 5GHz Wi-Fi can't transmit simultaneously for this device.

Simultaneous transmitting consideration:

The ratio= $MPE_{Wi-Fi}/limit + MPE_{BT}/limit = 0.079/1 + 0.0013/1 = 0.0803 < 1.0$

So simultaneous exposure comply with the limit.

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

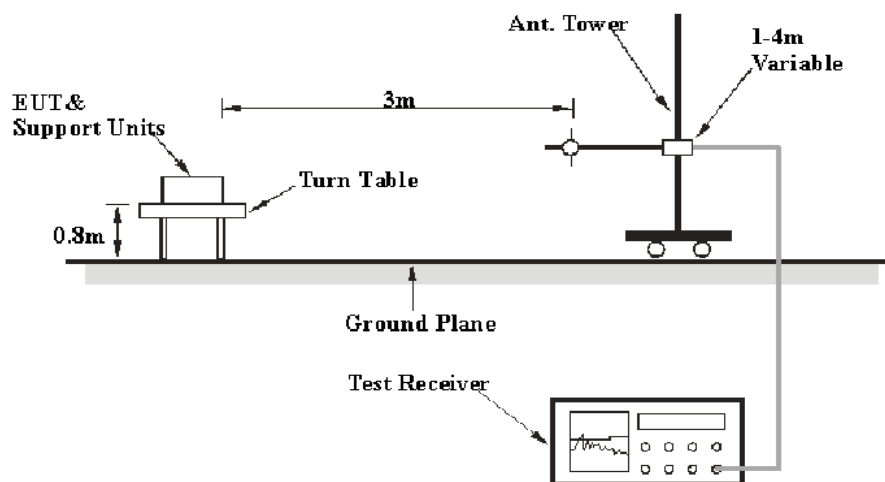
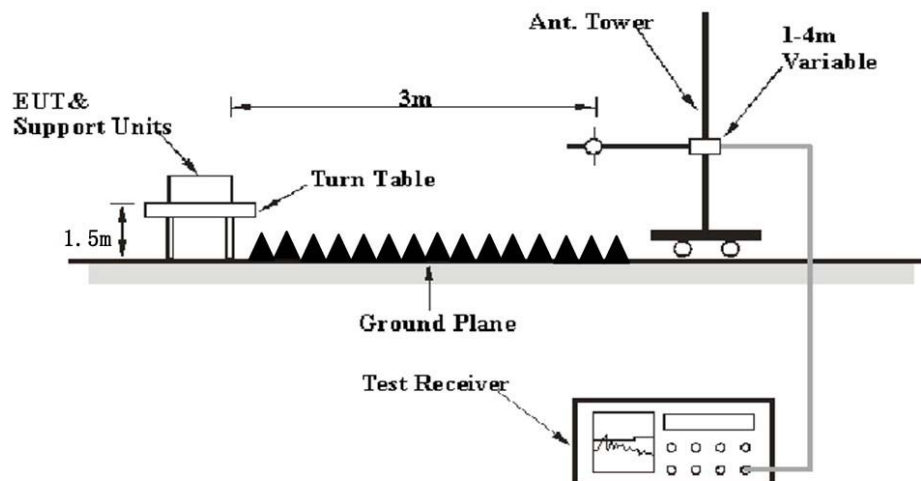
Antenna Connector Construction

The EUT has one PCB antenna arrangement for Bluetooth, which was attached to EUT use the MHF-Type connector and the antenna gain is 1.5 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS**Applicable Standard**

FCC §15.205; §15.209; §15.247(d)

EUT Setup**Below 1 GHz:****Above 1GHz:**

The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, according to the DA 00-705 Released March 30, 2000, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Average

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

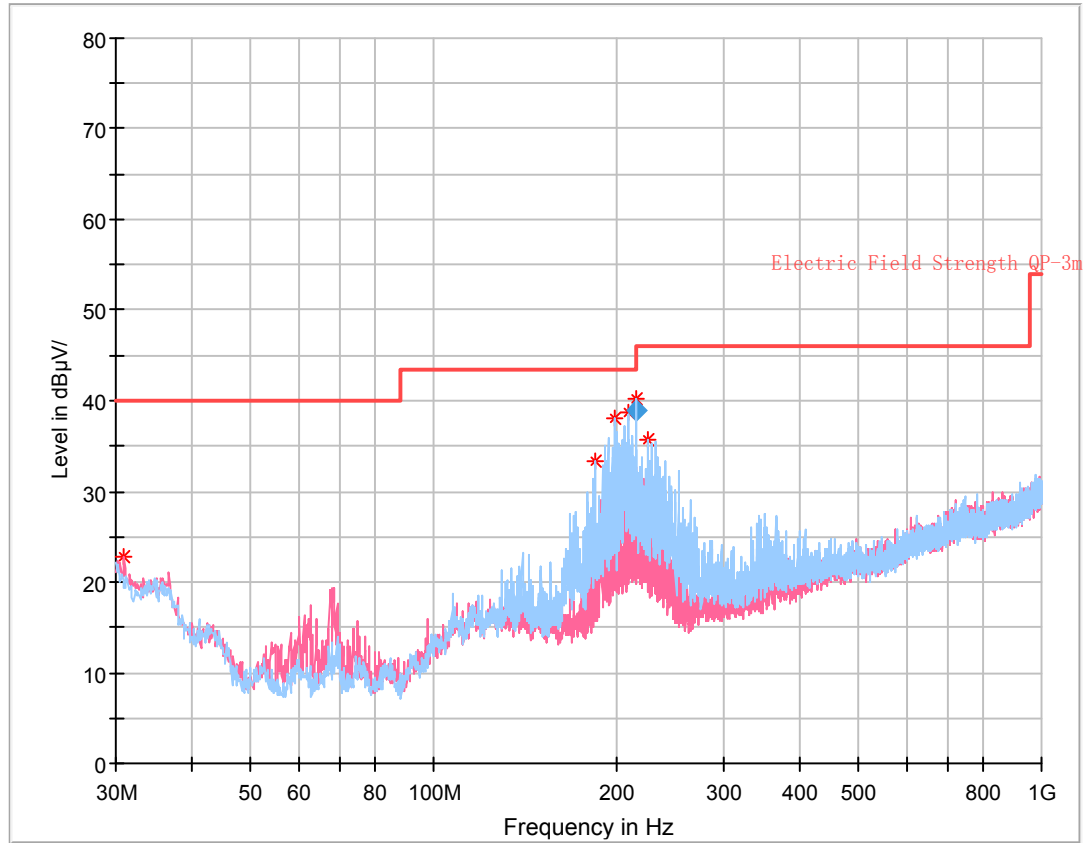
Test Data

Environmental Conditions

Temperature:	25~25.8 °C
Relative Humidity:	51~52 %
ATM Pressure:	101.0~101.2 kPa

The testing was performed by Kilroy Deng on 2021-04-09 for below 1GHz and Brace Lin on 2021-04-13 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz: (BT&2.4G Wifi transmit)**Final Result**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
197.939750	28.20	43.50	15.30	153.0	H	66.0	-11.3
208.876250	30.89	43.50	12.61	111.0	H	90.0	-11.2
215.985625	38.85	43.50	4.65	145.0	H	91.0	-11.3

Critical Freqs

Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.970000	22.82	40.00	17.18	100.0	V	156.0	-4.3
184.593750	33.27	43.50	10.23	200.0	H	83.0	-12.2
224.970000	35.63	46.00	10.37	100.0	H	102.0	-11.5

Note: QP measurement not performed when the Peak value is more than 6dB lower than limit.

1 GHz - 25 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2385.58	28.15	PK	173	2.0	H	31.87	60.02	74	13.98
2385.58	13.59	Ave.	173	2.0	H	31.87	45.46	54	8.54
2486.28	28.63	PK	301	1.9	H	32.13	60.76	74	13.24
2486.28	13.65	Ave.	301	1.9	H	32.13	45.78	54	8.22
4804.00	44.25	PK	164	2.3	H	6.28	50.53	74	23.47
4804.00	28.14	Ave.	164	2.3	H	6.28	34.42	54	19.58
Middle Channel (2441 MHz)									
4882.00	44.73	PK	151	1.3	H	6.76	51.49	74	22.51
4882.00	28.24	Ave.	30	1.1	H	6.76	35.00	54	19.00
High Channel (2480 MHz)									
2381.94	28.47	PK	222	1.1	H	31.87	60.34	74	13.66
2381.94	13.67	Ave.	222	1.1	H	31.87	45.54	54	8.46
2484.22	28.67	PK	236	2.2	H	32.13	60.80	74	13.20
2484.22	13.74	Ave.	236	2.2	H	32.13	45.87	54	8.13
4960.00	44.68	PK	105	2.1	H	6.80	51.48	74	22.52
4960.00	28.61	Ave.	327	1.7	H	6.80	35.41	54	18.59

Note:

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

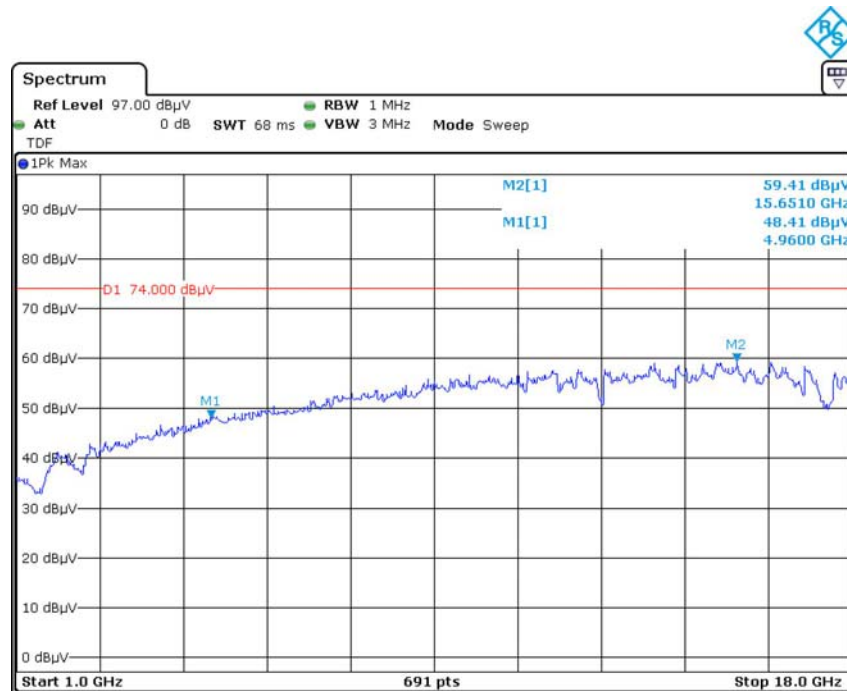
Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

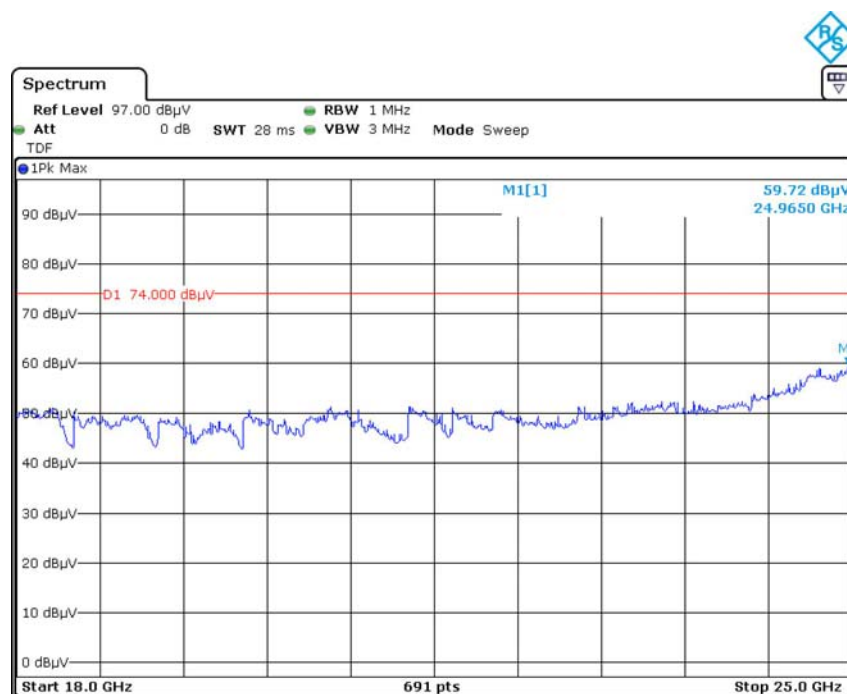
The other spurious emission which is 20dB to the limit was not recorded.

And for the pre-scan is performed with the 2400-2483.5MHz band filter.

Pre-scan with high channel Peak Horizontal



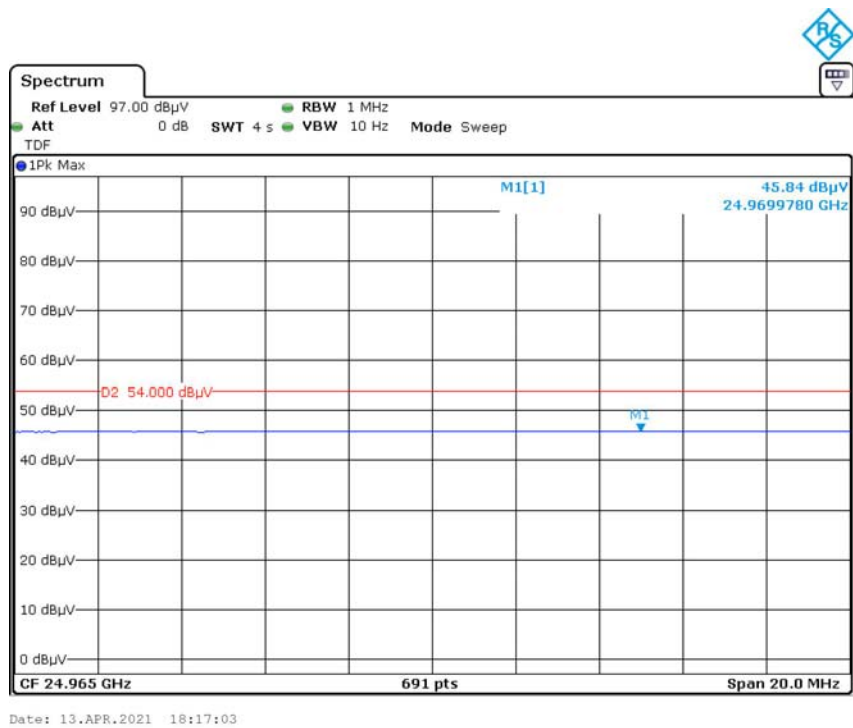
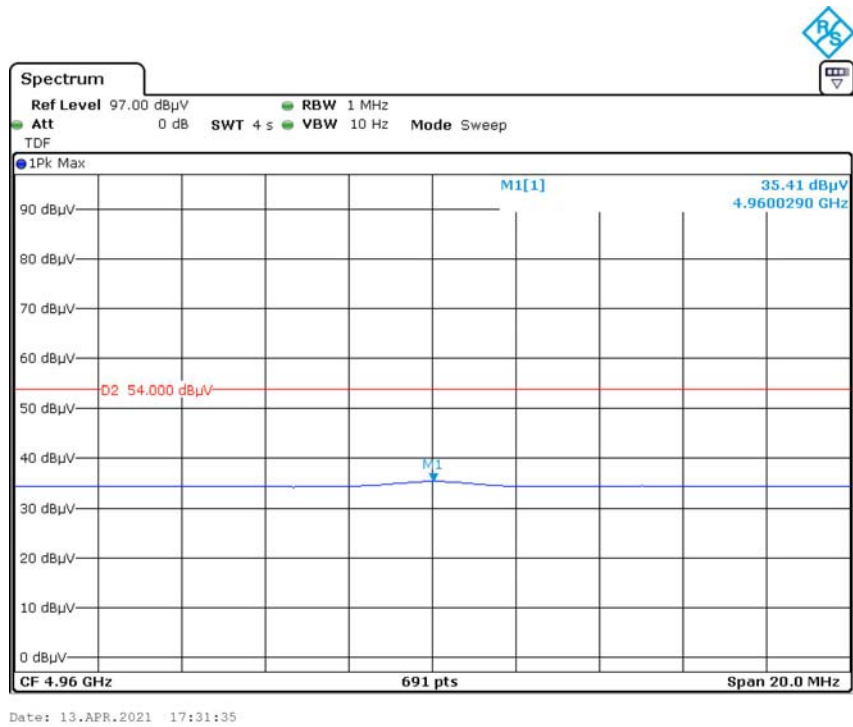
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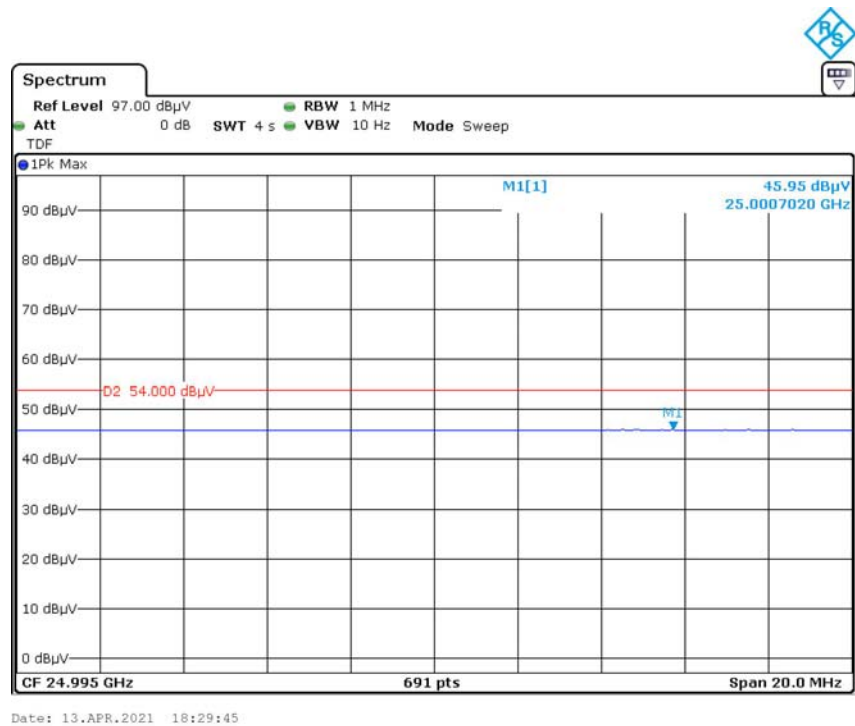
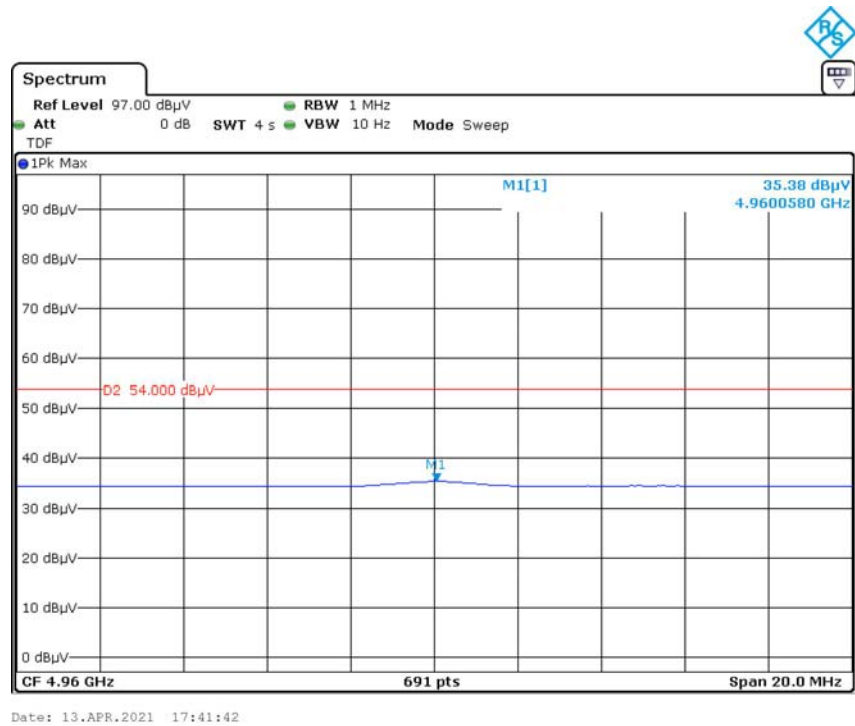
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Average Horizontal



Vertical



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