



FCC PART 15.247

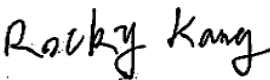
TEST REPORT

For

Cubic Transportation Systems, Inc.

5650 Kearny Mesa Road, San Diego, California 92111, United States

FCC ID: LVC310B

Report Type: Original Report	Product Type: 5300-10009
Report Number: RSZ181011005-00B	
Report Date: 2018-11-23	
Rocky Kang 	
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The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity.

TABLE OF CONTENTS

GENERAL INFORMATION.....	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY	3
MEASUREMENT UNCERTAINTY	4
SYSTEM TEST CONFIGURATION.....	5
DESCRIPTION OF TEST CONFIGURATION	5
EQUIPMENT MODIFICATIONS	6
EUT EXERCISE SOFTWARE	6
SUPPORT EQUIPMENT LIST AND DETAILS	6
EXTERNAL I/O CABLE.....	6
BLOCK DIAGRAM OF TEST SETUP	7
SUMMARY OF TEST RESULTS	8
TEST EQUIPMENT LIST	9
FCC §15.247 (i) & §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE).....	10
APPLICABLE STANDARD	10
RESULT	10
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS.....	12
APPLICABLE STANDARD	12
EUT SETUP	12
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	13
TEST PROCEDURE	13
CORRECTED AMPLITUDE & MARGIN CALCULATION	13
TEST RESULTS SUMMARY	13
TEST DATA	14

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Cubic Transportation Systems, Inc.*'s product, model number: 5300-10009-2 (FCC ID: LVC310B) or the "EUT" in this report was a 5300-10009, which was measured approximately: 125.0 mm (L) * 33.6 mm (W) * 205.0 mm (H), rated with input voltage: DC 3.7 V or DC 12-24V.

Notes: This series products model: 5300-10009-4 and 5300-10009-2 are electrically identical. Model 5300-10009-2 was selected for testing, the detailed information can be referred to the declaration letter.

**All measurement and test data in this report was gathered from production sample serial number: 181011005. (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2018-10-11.*

Objective

This report is prepared on behalf of *Cubic Transportation Systems, Inc.* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

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

Related Submittal(s)/Grant(s)

FCC Part 15.247 DSS and Part 15.225 DXX submissions with FCC ID: LVC310B.

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.

And KDB 558074 D01 15.247 Meas Guidance v05r01.

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: 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 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, 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

For 802.11b and 802.11g, 11 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	/	/
6	2437	/	/
7	2442	/	/

For 802.11b, 802.11g, EUT was tested with Channel 1, 6 and 11

For BLE mode, 40 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

“blue test.exe” exercise software was used for BLE, no software for Wi-Fi.

BLE & Wi-Fi test in the engineer mode.

The device was tested with the worst case was performed as below:

Mode	Data rate	Power level		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	10	9	9
802.11g	6 Mbps	8	8	8
BLE	/	Default	Default	Default

Pre-scan with all the data rates, the above data rate is the worst case for Wi-Fi test.

Support Equipment List and Details

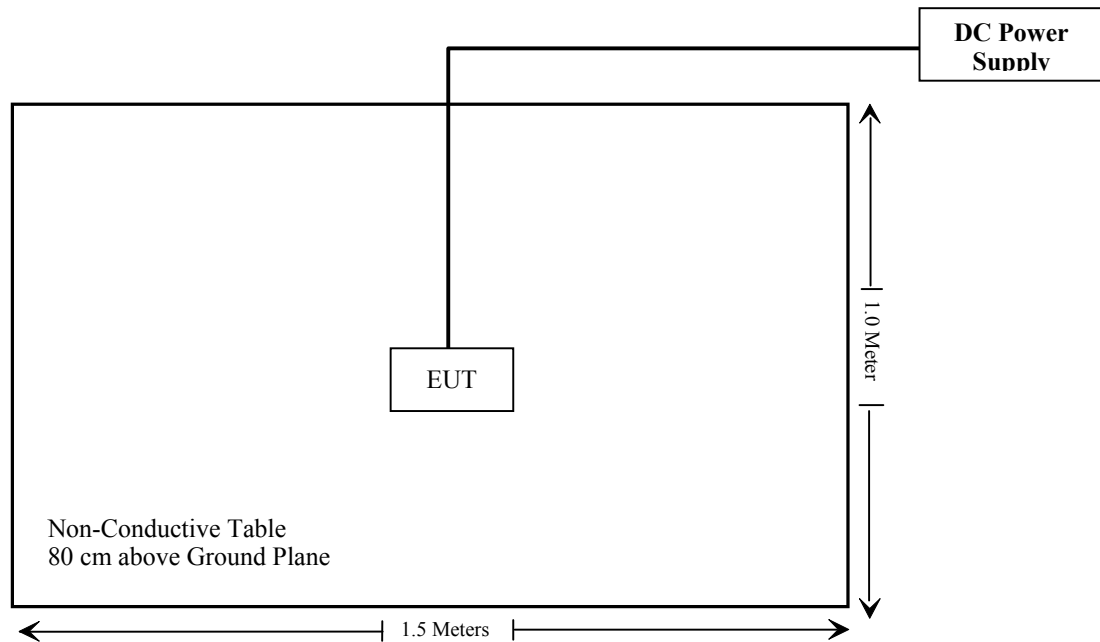
Manufacturer	Description	Model	Serial Number
Pro instrument	DC Power Supply	pps3300	N/A

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielding detachable DC Cable	1.2	EUT	DC Power Supply

Block Diagram of Test Setup

For Radiated Emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1)& §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance*
§15.207 (a)	AC Line Conducted Emissions	Not Applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance*
§15.247(b)(3)	Maximum Conducted Output Power	Compliance*
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance*
§15.247(e)	Power Spectral Density	Compliance*

Note:

Not Applicable: EUT power by battery and used on vehicle.

Compliance*: Model 5300-10009-1, 5300-10009-3 (FCC ID: LVC312B) and this EUT have the identical main board except the EUT removing the 3G module, so adding the test item "MAXIMUM PERMISSIBLE EXPOSURE" and "RADIATED EMISSIONS TEST", the other test data are referred to the report RSZ181011003-00B with model number 5300-10009-1, 5300-10009-3 (FCC ID: LVC312B), issued on 2018-11-23 by Bay Area Compliance Laboratories Corp. (Shenzhen). Please see details in the attestation letter for the differences.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
A.H. System	Horn Antenna	SAS-200/571	135	2018-09-01	2021-08-31
Rohde & Schwarz	Signal Analyzer	FSEM	845987/005	2018-06-23	2019-06-23
COM-POWER	Pre-amplifier	PA-122	181919	2018-05-22	2018-11-22
Sonoma instrument	Amplifier	310N	186238	2017-11-12	2018-11-12
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017-12-22	2020-12-21
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2018-01-11	2019-01-11
Ducommun technologies	RF Cable	UFA147A-2362-100100	MFR64639 231029-003	2018-08-01	2019-02-01
Ducommun technologies	RF Cable	104PEA	218124002	2018-05-21	2018-11-21
Ducommun technologies	RF Cable	RG-214	1	2018-05-21	2018-11-19
Ducommun technologies	RF Cable	RG-214	2	2018-05-22	2018-11-22
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-04	2017-12-29	2020-12-28
Heatsink Required	Amplifier	QLW-18405536-J0	15964001002	2018-08-01	2019-02-01
Sinoscite	Band Reject Filter	BSF2402-2480MN-0898-001	99632	2018-05-21	2018-11-21
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR

* **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) & §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 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)

Frequency (MHz)	Antenna Gain		Max Tune-up Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
	(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi (2412-2462MHz)	2.6	1.8	19	79.4	20	0.028	1.00
Bluetooth (2402-2480MHz)	0.5	1.1	6.5	4.5	20	0.001	1.00

Note 1: The Tune-up power and antenna gain were declared by the applicant.

Note 2: The Wi-Fi and Bluetooth have its own module, so they can transmit at the same time.

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.028/1 + 0.001/1 = 0.029 < 1.0$$

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

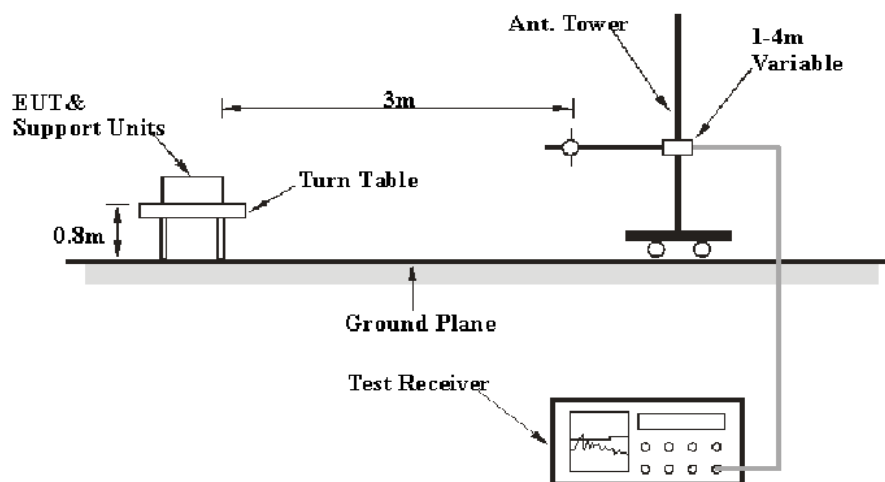
Result: Compliance

FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS**Applicable Standard**

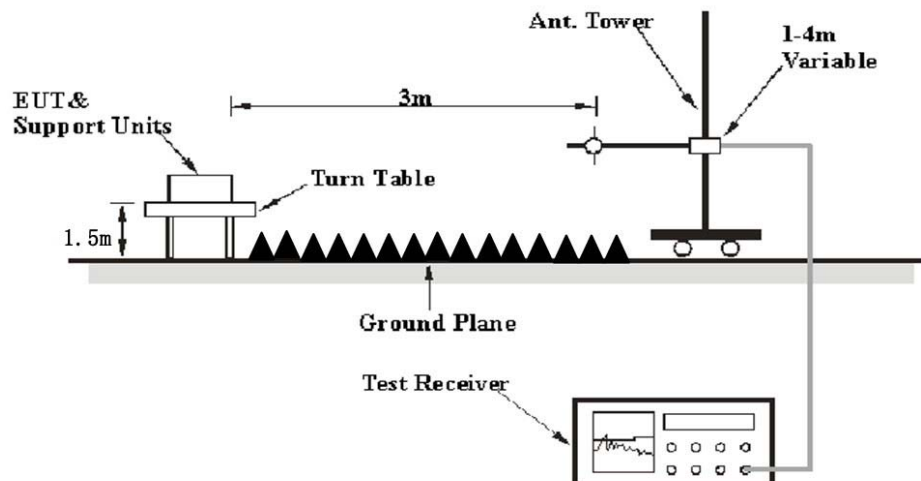
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, 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, 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	1MHz	3 MHz	/	PK
	1MHz	10 Hz ^{Note 1}	/	Average
	1MHz	> 1/T ^{Note 2}	/	Average

Note 1: when duty cycle is no less than 98%

Note 2: when duty cycle is less than 98%

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, 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 Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

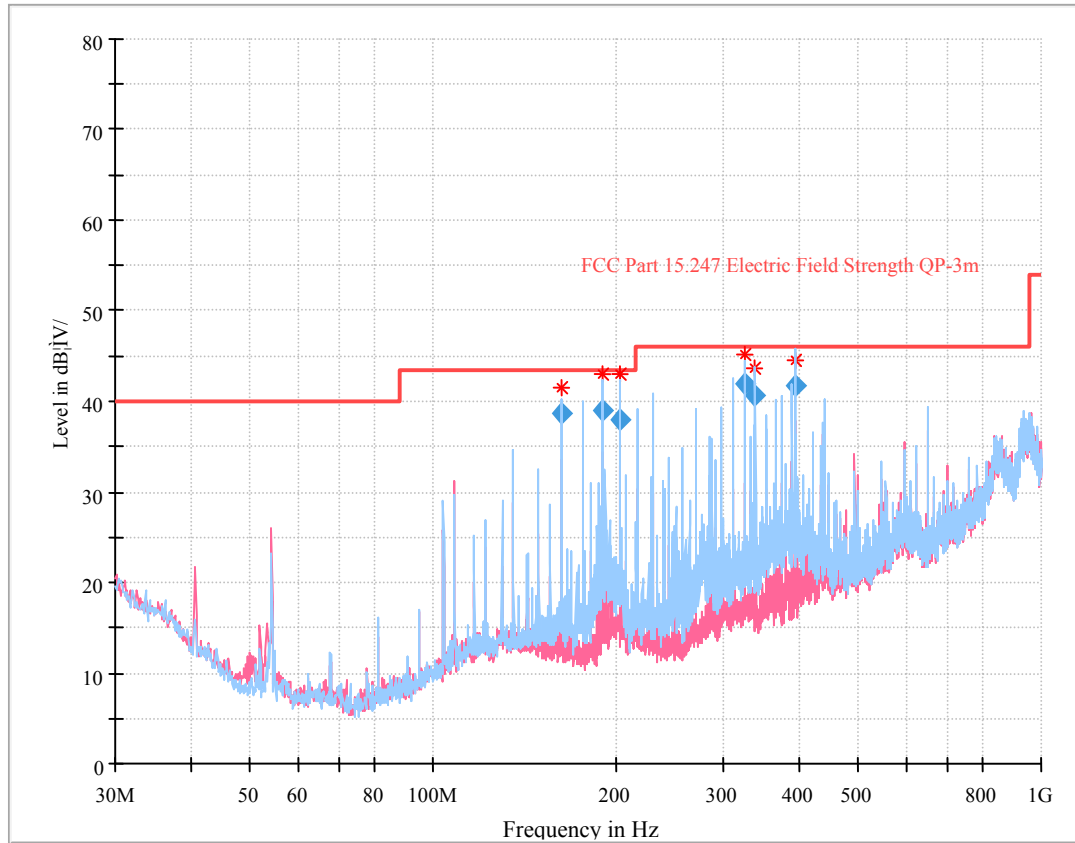
In BACL, $U_{(Lm)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Tracy Hu on 2018-11-05.

EUT operation mode: Transmitting

30 MHz~1 GHz(worst case: 802.11g mode middle channel)

Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
162.730125	38.99	160.0	H	100.0	-14.6	43.50	4.51
189.847500	39.38	175.0	H	98.0	-15.2	43.50	4.12
203.396875	38.65	110.0	H	287.0	-13.8	43.50	4.85
325.444250	42.00	388.0	H	101.0	-10.7	46.00	4.00
339.007625	40.60	102.0	H	105.0	-10.8	46.00	5.40
395.197875	41.21	109.0	H	77.0	-10.4	46.00	4.79

1 GHz-25 GHz (BLE):

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)									
2389.00	27.46	PK	301	1.5	H	33.00	60.46	74	13.54
2389.00	13.35	Ave.	301	1.5	H	33.00	46.35	54	7.65
2483.50	27.58	PK	5	1.1	H	33.20	60.78	74	13.22
2483.50	13.24	Ave.	5	1.1	H	33.20	46.44	54	7.56
4804.00	42.96	PK	346	2.5	H	7.88	50.84	74	23.16
4804.00	28.50	Ave.	346	2.5	H	7.88	36.38	54	17.62
Middle Channel (2440 MHz)									
4880.00	42.33	PK	177	1.2	H	9.21	51.54	74	22.46
4880.00	28.10	Ave.	177	1.2	H	9.21	37.31	54	16.69
High Channel (2480 MHz)									
2390.00	27.35	PK	69	1.2	H	33.00	60.35	74	13.65
2390.00	13.27	Ave.	69	1.2	H	33.00	46.27	54	7.73
2483.50	34.11	PK	341	1.6	H	33.20	67.31	74	6.69
2483.50	17.66	Ave.	341	1.6	H	33.20	50.86	54	3.14
4960.00	42.61	PK	201	1.9	H	9.07	51.68	74	22.32
4960.00	28.44	Ave.	201	1.9	H	9.07	37.51	54	16.49

1 GHz-25 GHz:**802.11b Mode:**

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 (2412 MHz)									
2388.56	27.45	PK	146	2.3	H	33.00	60.45	74	13.55
2388.56	13.20	Ave.	146	2.3	H	33.00	46.20	54	7.80
2483.60	27.96	PK	351	1.9	H	33.20	61.16	74	12.84
2483.60	13.09	Ave.	351	1.9	H	33.20	46.29	54	7.71
4824.00	42.56	PK	174	2.0	H	7.88	50.44	74	23.56
4824.00	28.95	Ave.	174	2.0	H	7.88	36.83	54	17.17
Middle Channel (2437MHz)									
4874.00	42.15	PK	65	1.9	H	9.21	51.36	74	22.64
4874.00	28.04	Ave.	65	1.9	H	9.21	37.25	54	16.75
High Channel (2462 MHz)									
2388.56	27.60	PK	309	1.0	H	33.00	60.60	74	13.40
2388.56	13.35	Ave.	309	1.0	H	33.00	46.35	54	7.65
2483.60	27.81	PK	15	1.4	H	33.20	61.01	74	12.99
2483.60	13.32	Ave.	15	1.4	H	33.20	46.52	54	7.48
4924.00	42.98	PK	71	1.7	H	9.21	52.19	74	21.81
4924.00	28.55	Ave.	71	1.7	H	9.21	37.76	54	16.24

802.11g Mode:

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 (2412 MHz)									
2390.00	33.97	PK	57	2.5	H	33.00	66.97	74	7.03
2390.00	16.63	Ave.	57	2.5	H	33.00	49.63	54	4.37
2484.00	27.48	PK	191	2.4	H	33.20	60.68	74	13.32
2484.00	13.52	Ave.	191	2.4	H	33.20	46.72	54	7.28
4824.00	42.52	PK	59	1.6	H	7.88	50.40	74	23.60
4824.00	28.40	Ave.	59	1.6	H	7.88	36.28	54	17.72
Middle Channel (2437MHz)									
4874.00	42.60	PK	23	2.2	H	9.21	51.81	74	22.19
4874.00	28.31	Ave.	23	2.2	H	9.21	37.52	54	16.48
High Channel (2462 MHz)									
2387.00	27.94	PK	77	1.4	H	33.00	60.94	74	13.06
2387.00	13.50	Ave.	77	1.4	H	33.00	46.50	54	7.50
2483.50	31.98	PK	89	2.2	H	33.20	65.18	74	8.82
2483.50	15.54	Ave.	89	2.2	H	33.20	48.74	54	5.26
4924.00	42.53	PK	95	1.2	H	9.21	51.74	74	22.26
4924.00	28.24	Ave.	95	1.2	H	9.21	37.45	54	16.55

Note:

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

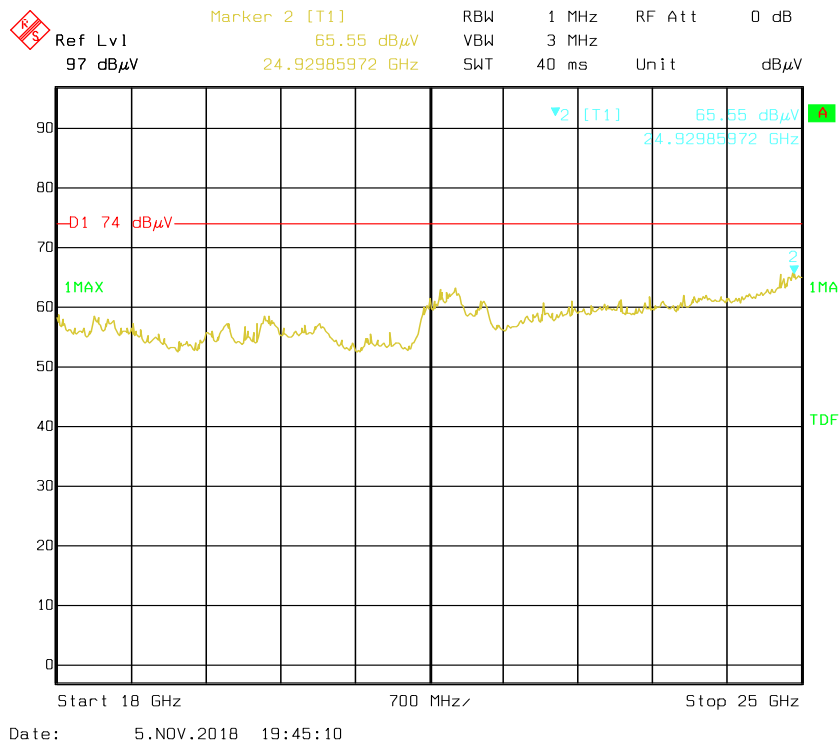
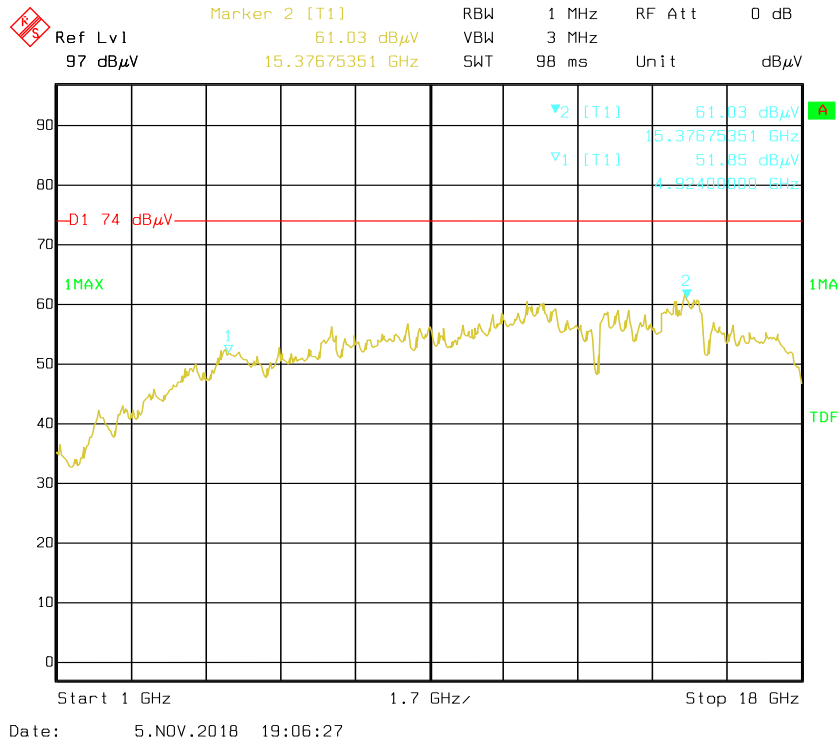
Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

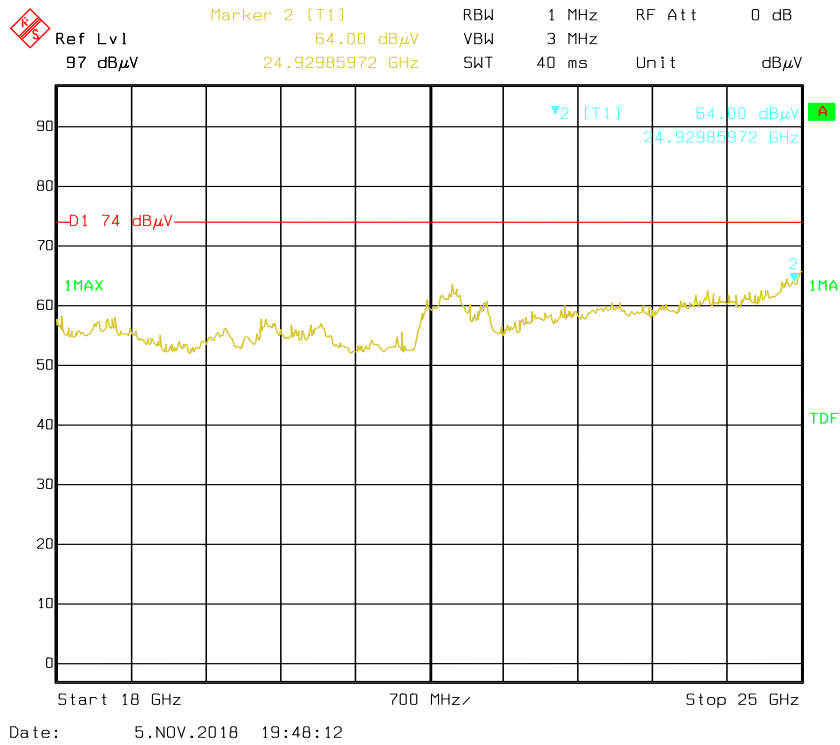
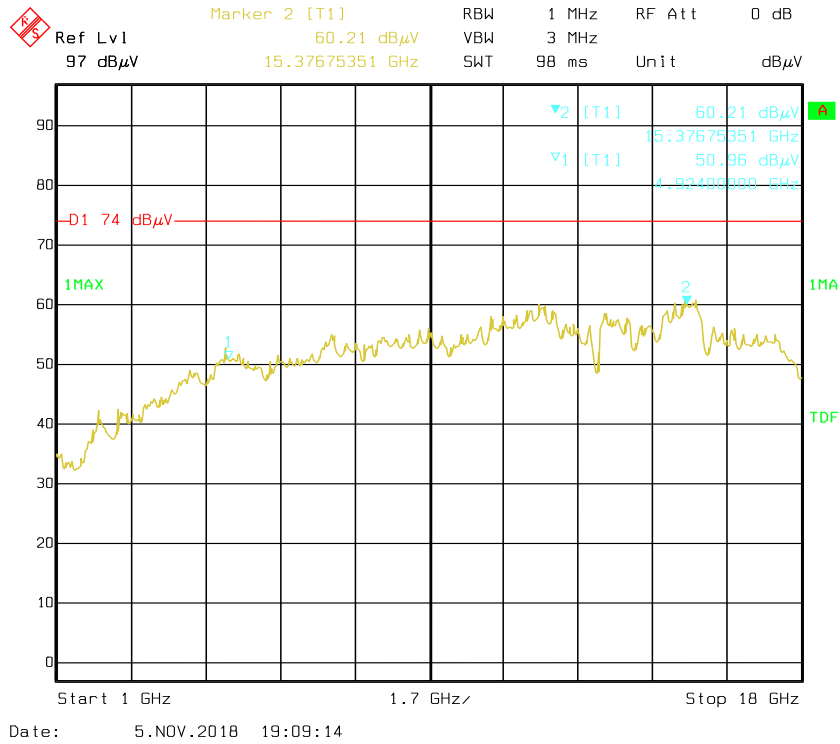
The other spurious emission which is 20dB to the limit was not recorded.

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

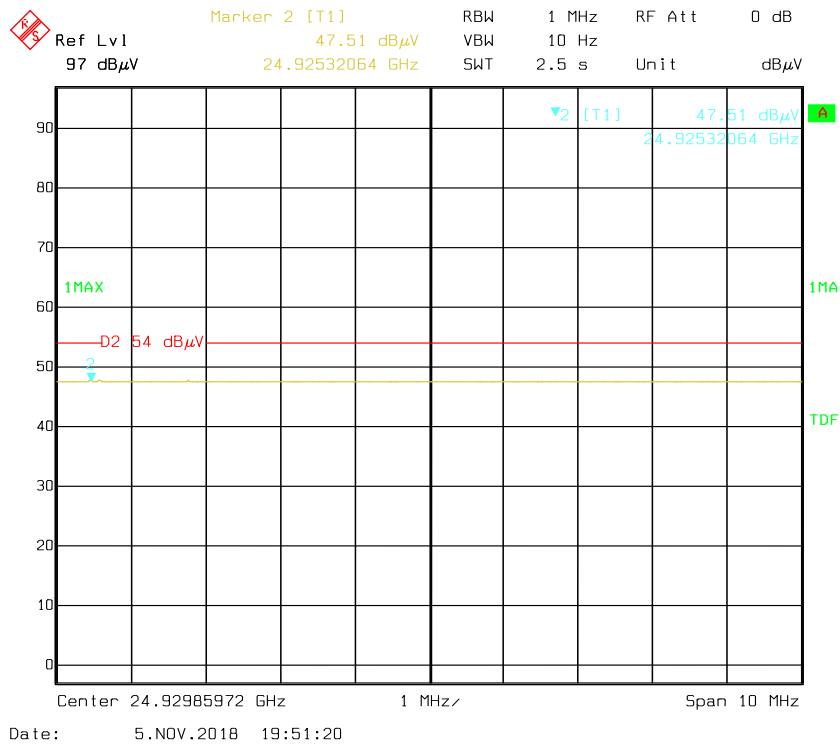
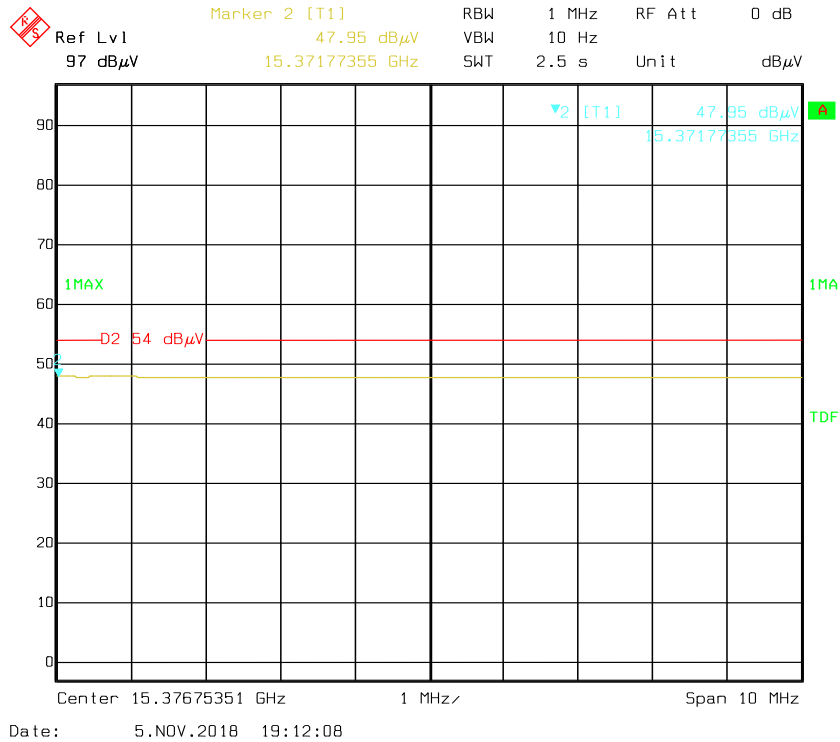
Pre-scan with 802.11G Mode, High channel Horizontal



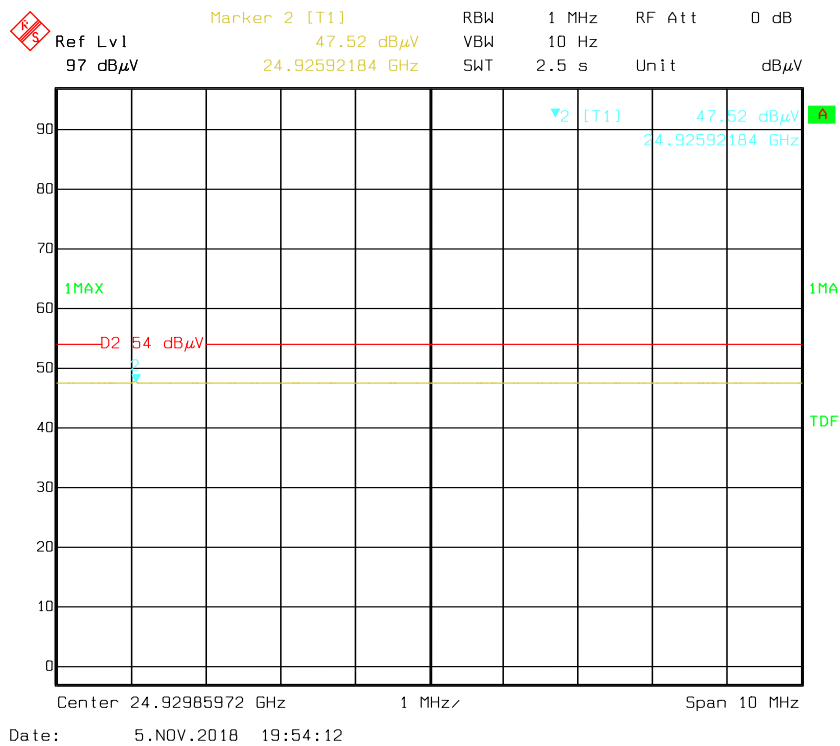
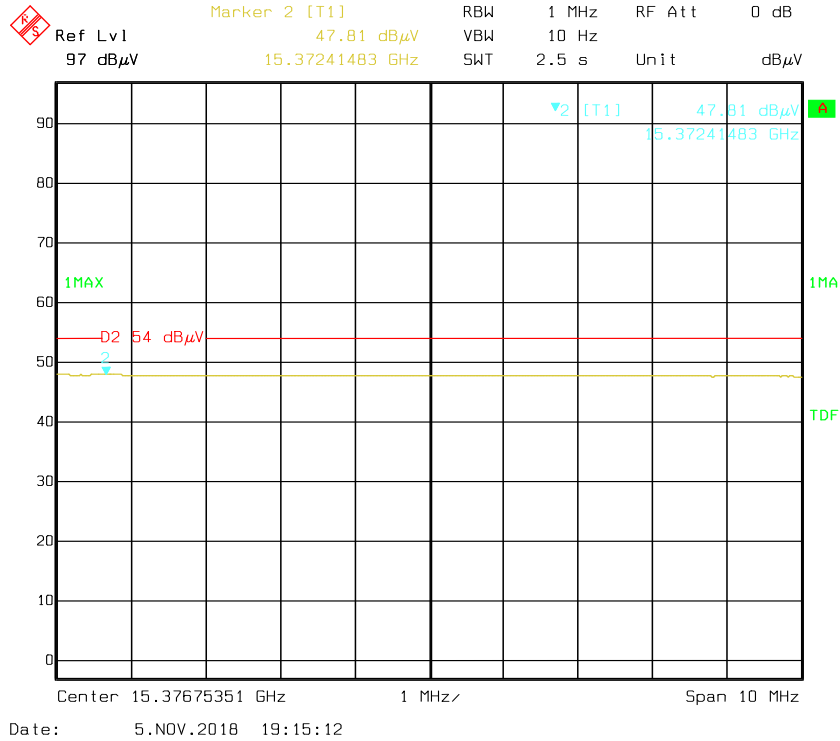
Vertical



Pre-scan for Average Horizontal



Vertical



***** END OF REPORT *****