



Report No.: HKEM191000099702

Page: 1 of 26

TEST REPORT

Application No.: HKEM1910000997AT
Applicant: Ozmium LLC
Address of Applicant: 140 Seminole Dr, Unit 4, Pagosa Springs, Colorado, 81147, United States
Product Name: TOP KONTROL
Model No.: TK-100
FCC ID: 2AU6QTK-100
Standards: 47 CFR Part 15, Subpart C 15.231(a):2019
Date of Receipt: 2019-12-17
Date of Test: 2020-01-06 to 2020-02-12
Date of Issue: 2020-02-12
Test Result: Pass*

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Keny Xu

Keny Xu
EMC Laboratory Manager



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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2020-02-12		Original

Authorized for issue by:			
Tested by:			
		<u>Vincent Chen</u> /Project Engineer	
Checked by:			
		<u>Eric Fu</u> /Reviewer	



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2 Test Summary

Test	Test Requirement	Test Method	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203:2019	N/A	PASS
Conducted Emissions at Mains Terminals (150 KHz to 30 MHz)	47 CFR Part 15, Subpart C 15.209:2019	ANSI C63.10 (2013) Section 6.2	N/A
Occupied Bandwidth	47 CFR Part 15, Subpart C 15.231(c):2019	ANSI C63.10 (2013) Section 6.9	PASS
Dwell Time	47 CFR Part 15, Subpart C 15.231(a):2019	ANSI C63.10 (2013) Section 7.6.3	PASS
Field Strength of the Fundamental Signal	47 CFR Part 15, Subpart C 15.231(a):2019	ANSI C 63.10: Clause 6.4, 6.5 and 6.6	PASS
Radiated Emission	47 CFR Part 15, Subpart C 15.231(a):2019	ANSI C63.10 (2013) Section 6.4,6.5,6.6	PASS
Remark : 1) N/A: Not applicable 2) ANSI C 63.10 is version ANSI C 63.10:2013			



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4 General Information

4.1 General Description of EUT

Operating frequency: 315 MHz
Antenna type: Integral
Antenna Gain: 0 dBi
Type of modulation: ASK

4.2 Details of EUT

Power Supply: DC 12 V ('27A' size battery x 1)
Power Cord: N/A

4.3 Description of Support Units

The EUT has been tested independently.

4.4 Deviation from Standards

None

4.5 Abnormalities from Standard Conditions

None.

4.6 Other Information Requested by the Customer

None.

4.7 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China.
518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594



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4.8 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.



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4.9 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Radio Frequency	$\pm 7.25 \times 10^{-8}$
2	Duty cycle	$\pm 0.37\%$
3	Occupied Bandwidth	$\pm 3\%$
4	RF Radiated power	$\pm 4.5\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (Above 1GHz)
5	Radiated Spurious emission test	$\pm 4.5\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (Above 1GHz)
6	Temperature test	$\pm 1^\circ\text{C}$
7	Humidity test	$\pm 3\%$
8	Supply voltages	$\pm 1.5\%$
9	Time	$\pm 3\%$

Remark:

The Ulab (lab Uncertainty) is less than Ucispr (CISPR Uncertainty), so the test results

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.



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5 Equipments Used during Test

Radiated Emissions which fall in the restricted bands					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2019-07-11	2020-07-10
EXA Spectrum Analyzer	Agilent Technologies Inc	N9010A	SEM004-12	2019-04-12	2020-04-11
Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12
Horn Antenna (15GHz-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2017-10-17	2020-10-16
Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2019-09-24	2020-09-23
Pre-amplifier (18-26GHz)	Rohde & Schwarz	CH14-H052	SEM005-17	2019-04-01	2020-03-31
Pre-amplifier (26GHz-40GHz)	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2019-04-01	2020-03-31
DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2019-09-24	2020-09-23
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2017-08-22	2020-08-21



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Radiated Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2019-07-11	2020-07-10
EXA Spectrum Analyzer	Agilent Technologies Inc	N9010A	SEM004-12	2019-04-12	2020-04-11
Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12
Horn Antenna (15GHz-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2017-10-17	2020-10-16
Pre-Amplifier (0.1-26.5GHz)	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2019-09-24	2020-09-23
Pre-amplifier (18-26GHz)	Rohde & Schwarz	CH14-H052	SEM005-17	2019-04-01	2020-03-31
Pre-amplifier (26GHz-40GHz)	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2019-04-01	2020-03-31
DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2019-09-24	2020-09-23
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2017-08-22	2020-08-21



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RE in Chamber					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date	Cal. Due date
3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEM001-01	2017-08-05	2020-08-04
MXE EMI Receiver (20Hz-8.4GHz)	Agilent Technologies	N9038A	SEM004-05	2019-09-24	2020-09-23
BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEM003-01	2017-06-27	2020-06-26
Pre-amplifier (0.1-1300MHz)	Agilent Technologies	8447D	SEM005-01	2019-04-01	2020-03-31
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM025-01	2019-07-11	2020-07-10





6 Test Results

6.1 Antenna Requirement

6.1.1 Standard Requirement

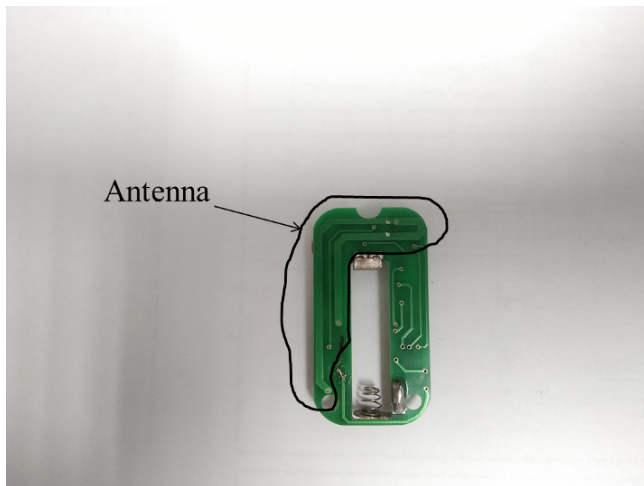
15.203 requirement:

For intentional device. According to 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.

6.1.2 EUT Antenna

The antenna is monopole antenna. The maximum gain of the antenna is 0 dBi.

Photos of the antenna refer to Internal Photos



Test result: The unit does meet the FCC requirements.



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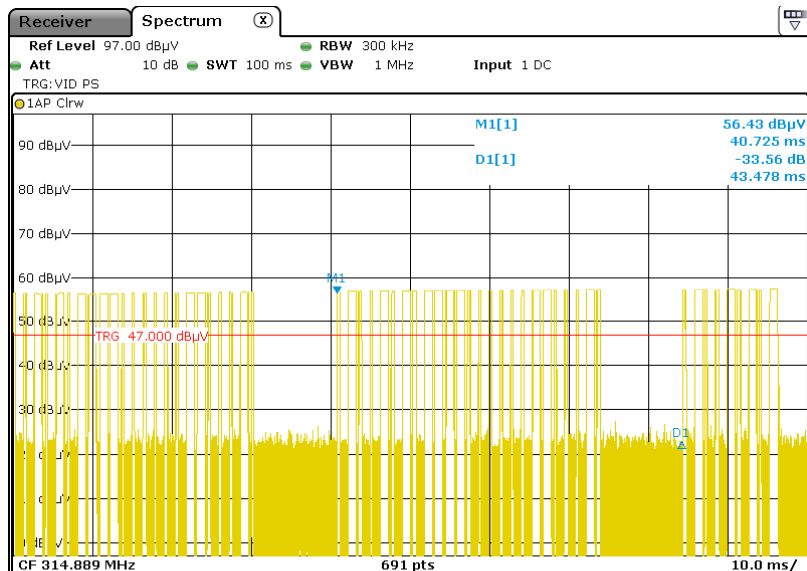


6.2 Average Factor

6.2.1 Measurement Data

Time Domain Plots (Fundamental frequency):

Test results on operation with control for transmission mode :

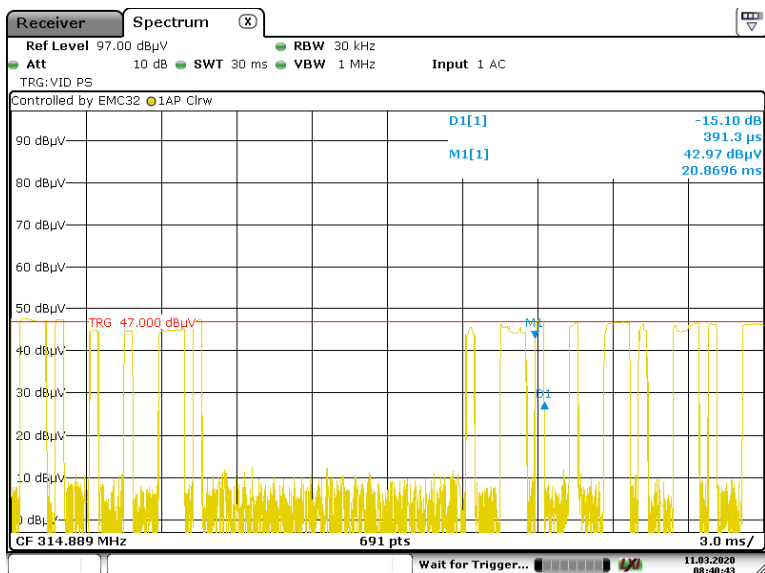


Pulse cycle period 100ms

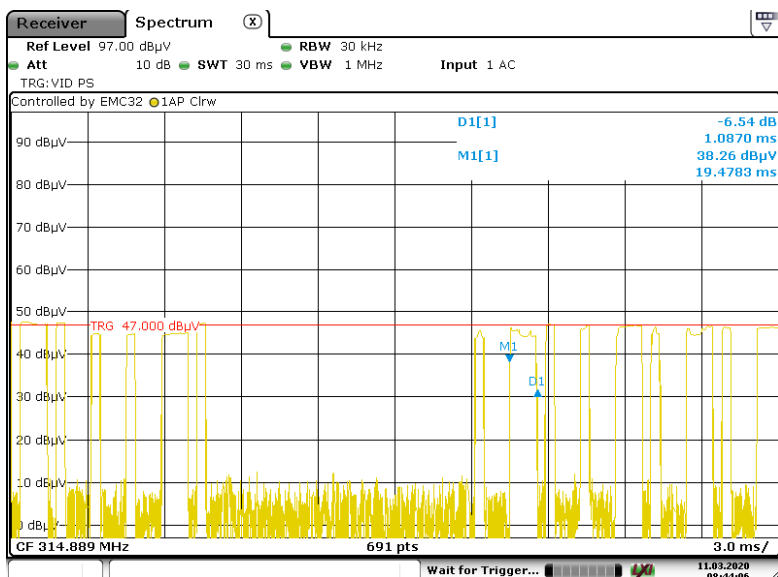


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Pulse width = 0.3913 ms (total no. of pulse : 14)



Pulse width = 1.0870 ms (total no. of pulse : 10)



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Calculation for radiation (average) :

Formula :

$$\text{Duty cycle} = (N_1L_1 + N_2L_2 + \dots + N_{n-1}L_{n-1} + N_nL_n) / 100 \text{ or } T$$

where

N_1 is the number of type 1 pulse, L_1 is length of type 1 pulse, etc.

T is the period of the pulse train (if less than 100ms)

According to the time domain plots shown on the next two pages :

$$\text{Duty cycle of the EUT} = (0.3913 \times 14 + 1.0870 \times 10) / 43.478 = 0.376$$

$$\begin{aligned} \text{Av correction factor} &= 20 \times \log(0.376) \text{ dB} \\ &= -8.5 \text{ dB} \end{aligned}$$

Remarks:

The worst case average factor is shown above.



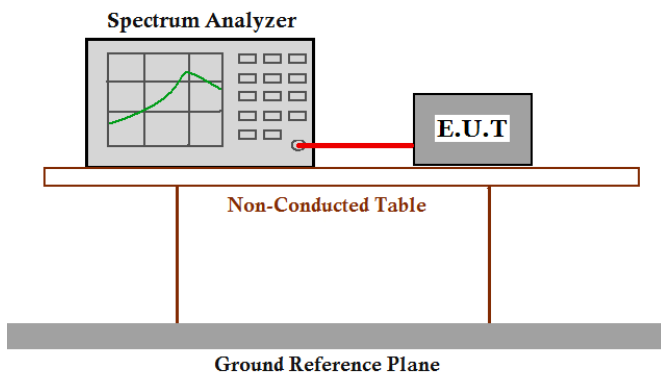
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6.3 Occupied Bandwidth

Test Requirement: FCC Part 15 C section 15.231(c)
Test Method: ANSI C63.10 (2013): Clause 6.9
Test Status: Transmitting mode with modulation.
Test Configuration:

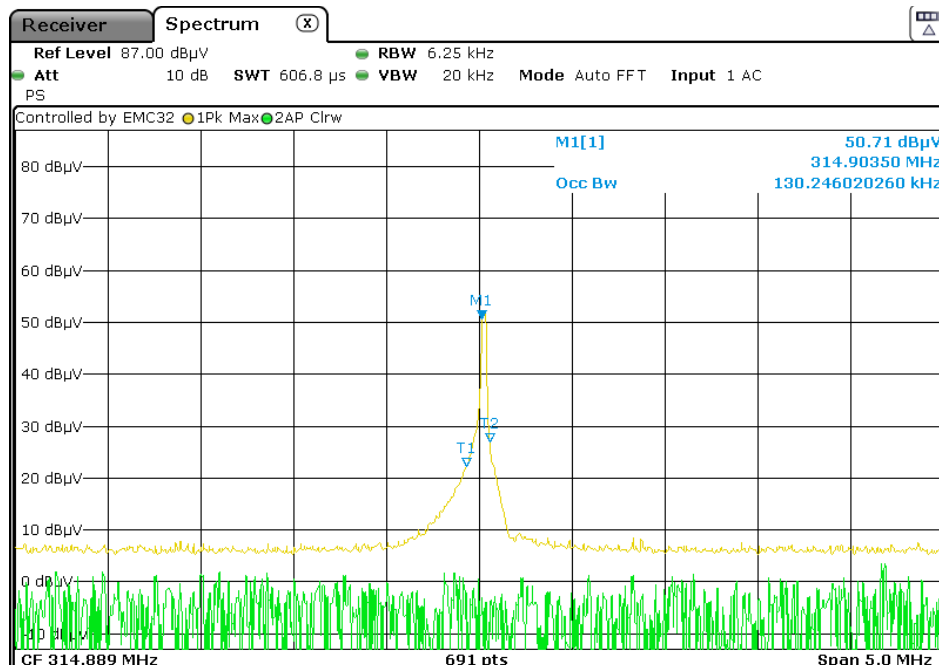


Test result:



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Test Channel	Bandwidth(kHz)	limit (kHz)
315 MHz	130.246	787.5

Limit:

$$F_{\text{center}} * 0.25\% = 787.5 \text{ kHz}$$

Where F_{center} is the operation frequency.



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6.4 Dwell Time

Test Requirement: FCC Part 15 C section 15.231(a)
Test Method: ANSI C63.10 (2013): Clause 7.6.3
Test Status: Transmitting mode with modulation.
Limit:

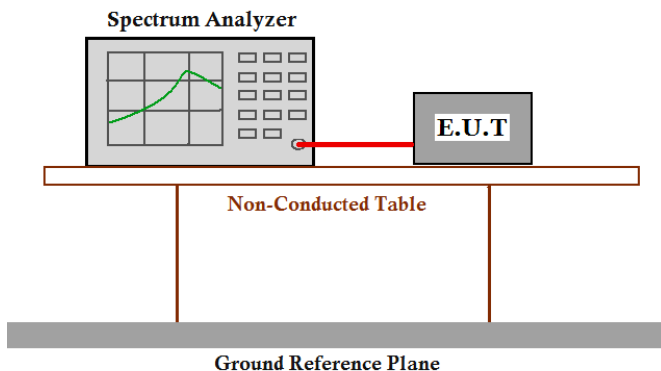
15.231(a)(1) requirement:

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

15.231(a)(2) requirement:

A transmitter activated automatically shall cease transmission within 5 seconds after activation.

Test Configuration:

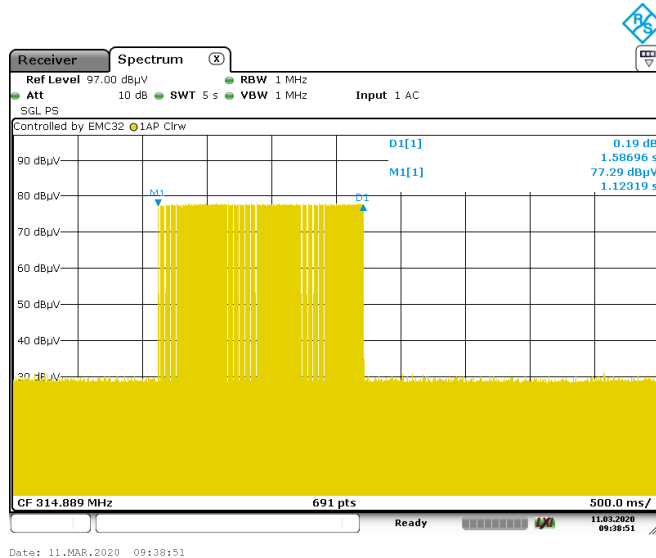


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Test result:



Result: 1.59s

Pass, the EUT transmits while the button is being pressed and it has been deactivated immediately of being released within 5 seconds.



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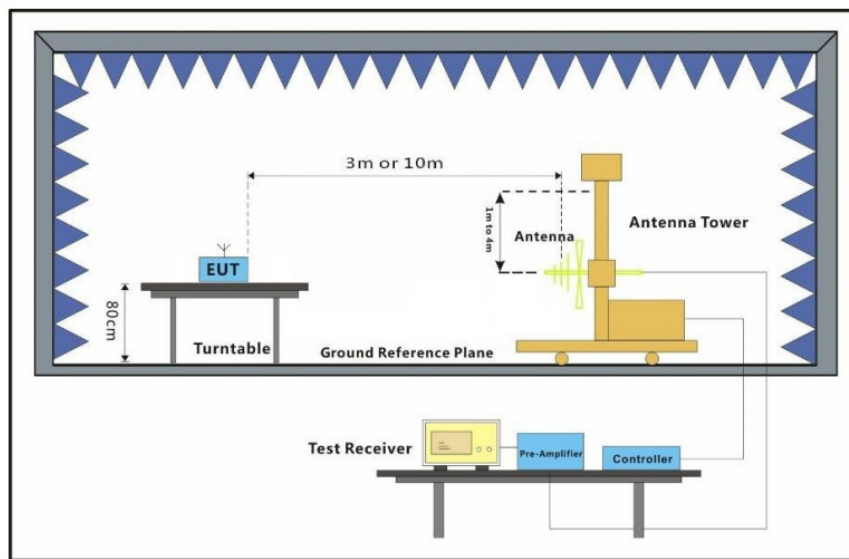


6.5 Field Strength of the Fundamental Signal

Test Requirement: FCC Part 15 C section 15.231(a)
Test Method: ANSI C63.10 (2013): Clause 6.5
Test Status: Transmitting mode with modulation.
Measurement Distance: 3m
Limit

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	¹ 1,250 to 3,750	¹ 125 to 375
174-260	3,750	375
260-470	¹ 3,750 to 12,500	¹ 375 to 1,250
Above 470	12,500	1,250

Test Configuration:





Frequency (MHz)	Level (dBuV/m)	Pol	Margin (dB)	Limit (dBuV/m)	Result	Remark
314.889000	62.3	H	-31.9	94.2	Pass	Peak
314.889000	60.0	V	-34.2	94.2	Pass	Peak
314.889000	53.8	H	-20.4	74.2	Pass	Average
314.889000	51.5	V	-22.7	74.2	Pass	Average

Remark:

1. The filed strength is calculated by adding Antenna Factor, Cable Factor and Preamplifier. The basic equation with s sample calculation is as follows:

Final Test Level = Receiver Reading - Antenna Factor + Cable Factor – Preamplifier Factor

Remark:

2. According to 15.35 (b) When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules, e.g., see Section 15.255.
3. The average values were calculated with the formula below: (The duty cycle was measured on clause 6.2.1)

Average = Peak value + 20log (Duty cycle)



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6.6 Radiated Emissions

Test Requirement:	FCC Part15 Subpart C Section 15.231(a), 15.209
Test Method:	ANSI C63.10 (2013): Clause 6.4&6.5&6.6
Measurement Distance:	3m
Limit	The limits on the filed strength of th spurious emissions in the above table are based on the fundamental frequency of the international radiator. Spuriopus emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shoed in this table or to the general limits shown in 15.209, whichever limit permits a higher filed strength.

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	¹ 1,250 to 3,750	¹ 125 to 375
174-260	3,750	375
260-470	¹ 3,750 to 12,500	¹ 375 to 1,250
Above 470	12,500	1,250

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

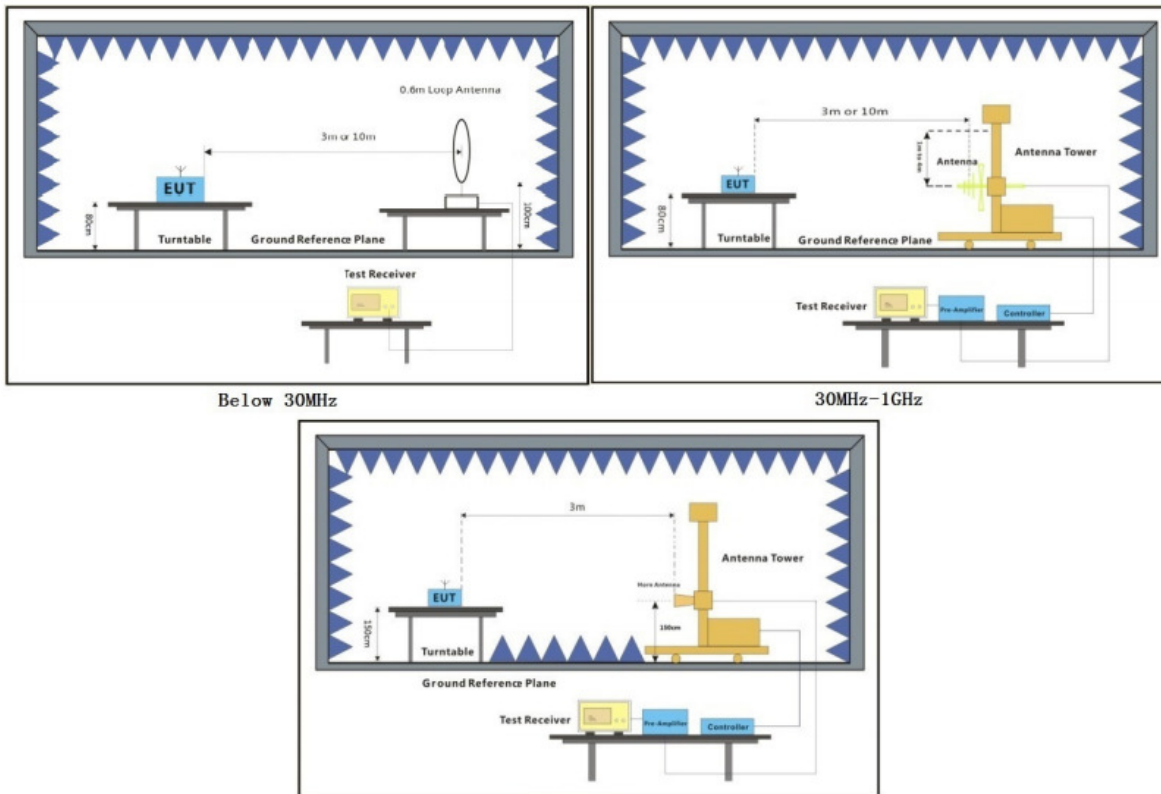


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Test Configuration:



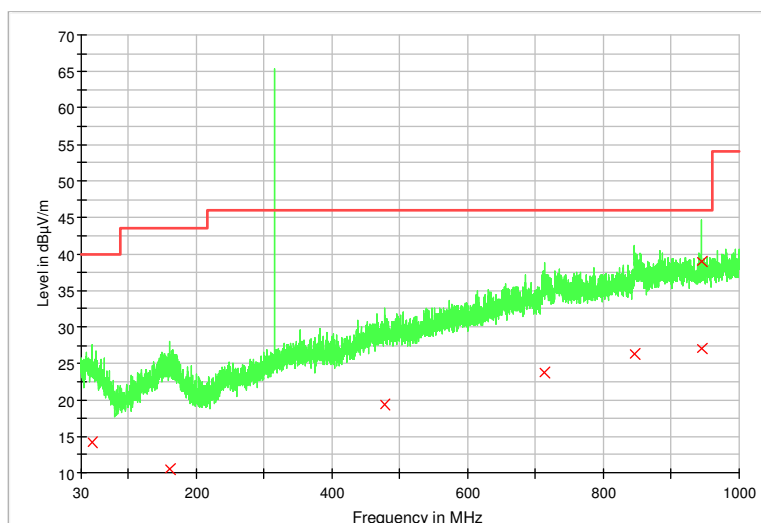


Test result:

Below 1GHz

Horizontal:

Quasi-peak measurement :



Frequency (MHz)	Pol.	QuasiPeak (dBuV/m)	Corr. (dB/m)	Limit (dBuV/m)	Margin	Result
45.229000	H	14.2	14.5	40.0	-25.8	Pass
160.562000	H	10.5	14.6	43.5	-33.0	Pass
477.364000	H	19.3	18.9	46.0	-26.7	Pass
713.656000	H	23.7	23.5	46.0	-22.3	Pass
845.867000	H	26.4	25.6	46.0	-19.6	Pass
944.613000	H	39.0	26.7	46.0	-7.0	Pass

Remark:

1. All readings are Quasi-Peak values.
2. Correction Factor = Antenna Factor + Cable Loss.
3. Pol. = antenna polarization



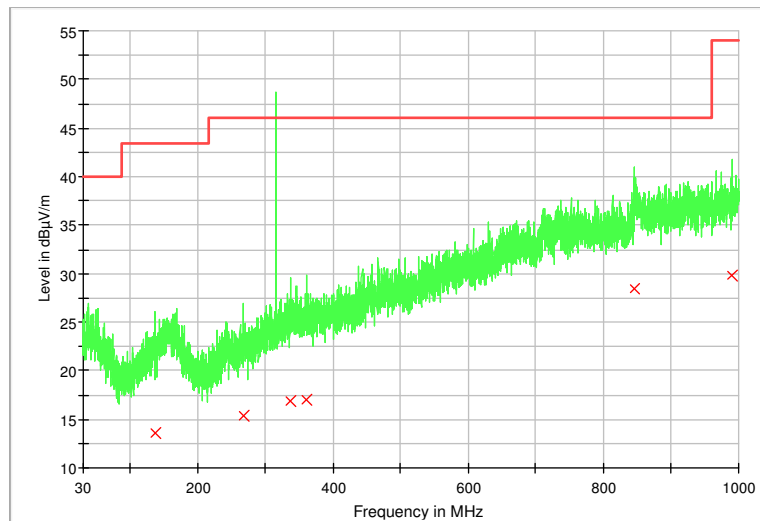
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Vertical:

Quasi-peak measurement :



Frequency (MHz)	Pol.	QuasiPeak (dBuV/m)	Corr. (dB/m)	Limit (dBuV/m)	Margin	Result
136.654890	V	13.5	13.1	43.5	-30.0	Pass
267.359000	V	15.3	12.9	46.0	-30.7	Pass
336.025488	V	16.9	15.6	46.0	-29.1	Pass
359.864648	V	17.0	15.8	46.0	-29.0	Pass
845.486548	V	28.5	25.6	46.0	-17.5	Pass
990.651840	V	29.8	27.1	54.0	-24.2	Pass

Remark:

1. All readings are Quasi-Peak values.
2. Correction Factor = Antenna Factor + Cable Loss.
3. Pol. = antenna polarization



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Above 1GHz

Frequency (MHz)	Antenna Polarization	Emission Level (dBμV/m)		Limit (dBμV/m)		Margin (dB)		Remark
		Peak	Average	Peak	Average	Peak	Average	
1248.625000	H	58.1	49.6	74.0	54.0	-15.9	-4.4	Pass
2245.250000	H	60.8	52.3	74.0	54.0	-13.2	-1.7	Pass
2292.000000	H	61.7	53.2	74.0	54.0	-12.3	-0.8	Pass
2315.375000	H	61.9	53.4	74.0	54.0	-12.1	-0.6	Pass
2438.625000	H	61.0	52.5	74.0	54.0	-13.0	-1.5	Pass
2500.250000	H	61.7	53.2	74.0	54.0	-12.3	-0.8	Pass
1321.564510	V	55.3	46.8	74.0	54.0	-18.7	-7.2	Pass
1546.532100	V	56.6	48.1	74.0	54.0	-17.4	-5.9	Pass
1978.781500	V	57.9	49.4	74.0	54.0	-16.1	-4.6	Pass
2321.156486	V	59.2	50.7	74.0	54.0	-14.8	-3.3	Pass
2564.486510	V	60.2	51.7	74.0	54.0	-13.8	-2.3	Pass
2654.743200	V	60.4	51.9	74.0	54.0	-13.6	-2.1	Pass

Remark:

1. The field strength is calculated by adding Antenna Factor, Cable Factor and Preamplifier. The basic equation with sample calculation is as follows:

Final Test Level = Receiver Reading - Antenna Factor + Cable Factor - Preamplifier Factor

2. The peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the above measurement data were shown in the report.
3. The average values were calculated with the formula below: (The duty cycle was measured on clause 6.2.1)

Average = Peak value + 20log (Duty cycle)



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7 Photographs

7.1 Radiated Emissions Test Setup

Remark: Photos refer to Setup photo.

7.2 EUT Constructional Details

Remark: Photos refer to Appendix: External photo and internal photo.

End of the Report



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