FCC RADIO TEST REPORT

Applicant.....	: Raffel Systems
Address.....	: N112 W14600 Mequon Road Germantown Wisconsin United States
Manufacturer.....	: Xiamen Raffel electronic technology co., LTD
Address.....	: Unit 1006, Tianshou operations center 10/F, No. 5 Yilan Road, Guanyinshan CBD, Siming District of Xiamen City, Fujian, China
Factory 1	: FORTRESS ELECTRONICS (XIAMEN) CO.,LTD
Address	: East of the fifth floor, 181 banqiao road, jimei district, Xiamen, Fujian, China
Factory 2	: Xiamen Wellness Technology Co., Ltd
Address	: FL4, No.3, Houbin Road, Xiangan district, Xiamen, China
Product Name.....	: 17 key magic light strip belt controller
Brand Name.....	: Raffel Systems
Model No.	: FTR HC L RF 02
Measurement Standard.....	: 47 CFR FCC Part 15, Subpart C (Section 15.231)
Receipt Date of Samples....	: November 23, 2020
Date of Tested.....	: November 24, 2020 to December 03, 2020
Date of Report.....	: December 03, 2020

This report shows that above equipment is technically compliant with the requirements of the standards above. All test results in this report apply only to the tested sample(s). Without prior written approval of Dongguan Nore Testing Center Co., Ltd, this report shall not be reproduced except in full.

Prepared by

Alina Guo / Project Engineer

Approved by

Iori Fan / Authorized Signatory

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Revision History

Report Number	Description	Issued Date
NTC2011333FV00	Initial Issue	2020-12-03

1. Summary of Test Result

FCC Rules	Description of Test	Result	Remarks
§15.207 (a)	AC Power Line Conducted Emission	N/A see note 2	---
§15.231(b) & 15.209	Radiated Spurious Emission	PASS	---
§15.231(c)	20 dB Occupied bandwidth	PASS	---
§15.231(a)	Transmission time	PASS	---
§15.203	Antenna Requirement	PASS	---

Note: 1. The EUT has been tested as an independent unit. And continual transmitting in maximum power (New batteries were used during test)
2. AC Power Conducted Emission is not applicable due to the EUT only can be powered by battery.

2. General Description of EUT

Product Information	
Product Name:	17 key magic light strip belt controller
Main Model Name:	FTR HC L RF 02
Additional Model Name:	N/A
Model Difference:	N/A
P/N:	RAFFEL202004
Brand Name:	Raffel Systems
Hardware Version:	V01
Software Version:	V01
Rating:	DC 3V(Button battery CR2032)
Classification:	Class B
Typical arrangement:	Table-top
I/O Port:	N/A
Accessories Information	
Adapter:	N/A
Cable:	N/A
Other:	N/A
Additional Information	
Note:	N/A
Remark:	All the information above are provided by the manufacturer. More detailed feature of the EUT please refers to the user manual.

Technical Specification (433MHz Transmitter)	
Declaring the Frequency:	433.92MHz
Modulation Type:	ASK
Antenna Type:	PCB antenna
Antenna Gain:	0 dBi (Declared by manufacturer)
Number of Channels:	1

3. Test Channels and Modes Detail

Mode		Test Frequency (MHz)	Modulation	Data Rate (Mbps)
1	TX	433.92MHz	ASK	----

Note: TX mode means that the EUT was programmed to be in continuously transmitting mode.

4. Configuration of EUT

TX Mode

EUT

5. Modification of EUT

No modifications are made to the EUT during all test items.

6. Description of Support Device

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

No.	Equipment	Brand	M/N	S/N	Cable Specification	Remarks
1.	---	---	---	---	---	---

7. Test Facility and Location

Test Site	:	Dongguan Nore Testing Center Co., Ltd. (Dongguan NTC Co., Ltd.)
Accreditations and Authorizations	:	The Laboratory has been assessed and proved to be in compliance with CNAS/CL01 Listed by CNAS, August 13, 2018 The Certificate Registration Number is L5795. The Certificate is valid until August 13, 2024 The Laboratory has been assessed and proved to be in compliance with ISO17025 Listed by A2LA, November 01, 2017 The Certificate Registration Number is 4429.01 The Certificate is valid until December 31, 2021 Listed by FCC, November 06, 2017 Test Firm Registration Number: 907417 Listed by Industry Canada, June 08, 2017 The Certificate Registration Number. Is 46405-9743A
Test Site Location	:	Building D, Gaosheng Science and Technology Park, Hongtu Road, Nancheng District, Dongguan City, Guangdong Province, China

8. Applicable Standards and References

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

Test Standards:

47 CFR Part 15, Subpart C, 15.231

ANSI C63.10-2013

References Test Guidance:

N/A

9. Deviations and Abnormalities from Standard Conditions

No additions, deviations and exclusions from the standard.

10. Test Conditions

No.	Test Item	Test Mode	Test Voltage	Tested by	Remarks
1.	AC Power Conducted Emission	---	---	---	---
2.	Radiated Emission	1	DC 3V	Ray Ding	See note 1
3.	Max. Conducted Output Power	1	DC 3V	Ray Ding	See note 1
4.	20 dB Occupied bandwidth	1	DC 3V	Ray Ding	See note 1
5.	Transmission time	1	DC 3V	Ray Ding	See note 1
6.	Antenna Requirement	---	---	---	See note 1

Note:

1. The testing climatic conditions for temperature, humidity, and atmospheric pressure are within: 15~35℃, 30~70%, 86~106kPa
2. As the EUT can be operated multiple positions, all X,Y,Z axis were considered during the test and only the worst case X was recorded.

11. Measurement Uncertainty

No.	Test Item	Frequency	Uncertainty	Remarks
1.	Conducted Emission	150KHz ~ 30MHz	±2.52 dB	---
2.	Radiated Emission Test	9kHz ~ 30MHz	±2.60 dB	---
		30MHz ~ 1GHz	±4.68 dB	---
		1GHz ~ 18GHz	±5.14 dB	---
		18GHz ~ 40GHz	±5.14 dB	

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The measurement uncertainly levels above are estimated and calculated according to CISPR 16-4-2.
3. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

12. Sample Calculations

Conducted Emission						
Freq. (MHz)	**Reading Level (dBuV)**	**Correct Factor (dB)**	**Measurement (dBuV)**	**Limit (dBuV)**	**Over (dB)**	**Detector**
0.1900	30.10	10.60	40.70	79.00	-38.30	QP

Where,

Freq.	=Emission frequency in MHz
Reading Level	=Uncorrected Analyzer/Receiver reading
Corrector Factor	= Insertion loss of LISN + Cable Loss + RF Switching Unit attenuation
Measurement	= Reading + Corrector Factor
Limit	=Limit stated in standard
Margin	= Measurement - Limit
Detector	= Reading for Quasi-Peak / Average / Peak

Radiated Spurious Emissions						
Freq. (MHz)	**Reading Level (dBuV)**	**Correct Factor (dB/m)**	**Measurement (dBuV/m)**	**Limit (dBuV/m)**	**Over (dB)**	**Detector**
60.0700	45.88	-18.38	27.50	49.00	-21.50	QP

Where,

Freq.	= Emission frequency in MHz
Reading Level	= Uncorrected Analyzer/Receiver reading
Corrector Factor	= Antenna Factor + Cable Loss - Pre-amplifier
Measurement	= Reading + Corrector Factor
Limit	= Limit stated in standard
Over	= Margin, which calculated by Measurement - Limit
Detector	= Reading for Quasi-Peak / Average / Peak

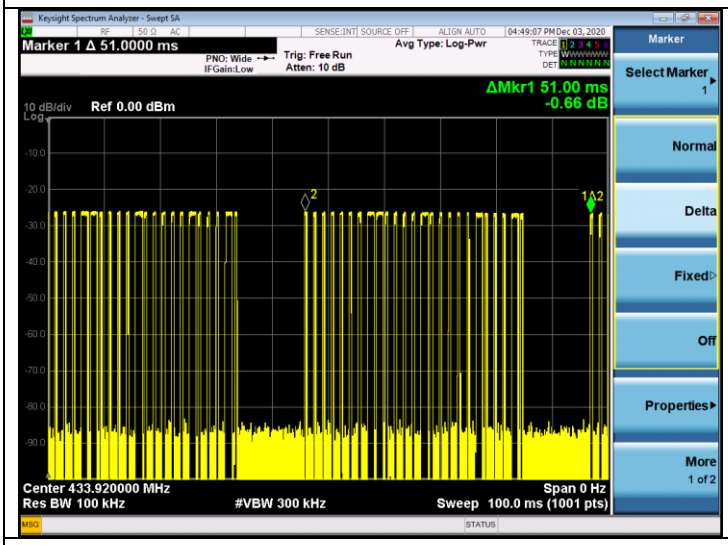
Note: For all conducted test items, the spectrum analyzer offset or transducer is derived from RF cable loss and attenuator factor. The offset or transducer is equal to the RF cable loss plus attenuator factor.

13. Duty Cycle

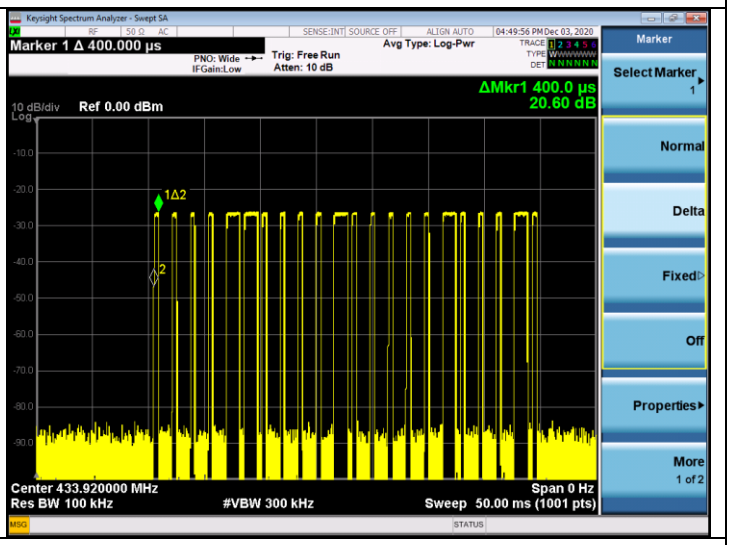
Frequency MHz	TP time (ms)	Ton time (Total) (ms)	Duty cycle	AV Factor
433.92	51.00	12.80	0.25	-12.04

Test Photo

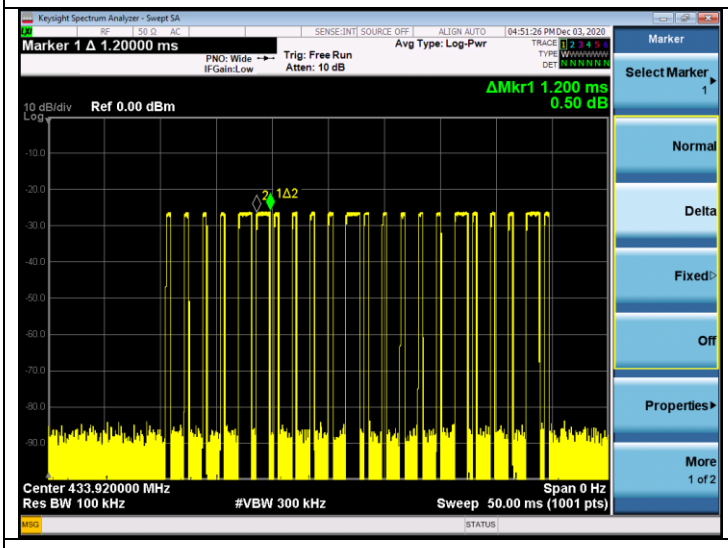
TP time



Ton 1 time



Ton 2 time



Note: Duty Cycle = (Total Ton time / TP time) x 100%

Total Ton time = Ton 1 x n1 + Ton 2 x n2 + ….+ Ton n x n = 0.4*17 + 1.2 * 5 =12.8ms

AV Factor = 20log(Duty Cycle).

14. Test Items and Results

14.1 Conducted Emissions Measurement

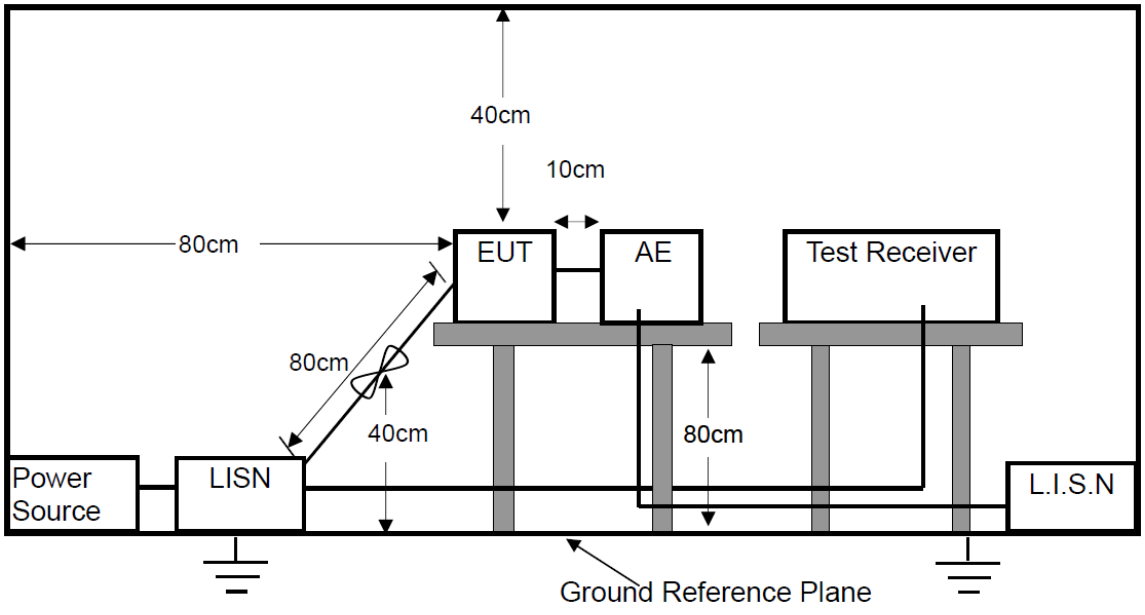
LIMIT

According to the requirements of FCC PART 15.207, the limits are as follows:

Frequency (MHz)	Quasi-peak	Average
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5	56	46
5 to 30	60	50

Note:
1. If the limits for the average detector are met when using the quasi-peak detector, then the limits for the measurements with the average detector are considered to be met.
2. The lower limit shall apply at the transition frequencies.
3. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5MHz.

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

a. The EUT was placed on a wooden table 0.8m height from the metal ground plan and 0.4m from the conducting wall of the shielding room and it was kept at 0.8m from any other grounded conducting surface.

b. All I/O cables and support devices were positioned as per ANSI C63.10.

c. Connect mains power port of the EUT to a line impedance stabilization network (LISN).

d. Connect all support devices to the other LISN and AAN, if needed.

e. Scan the frequency range from 150KHz to 30MHz at both sides of AC line for maximum conducted interference checking and record the test data.

TEST RESULTS

Not applicable.

14.2 Radiated Spurious Emissions Measurement

LIMIT

Frequency range MHz	Distance Meters	Field Strengths Limit (15.209)
		μV/m
0.009 ~ 0.490	300	2400/F(kHz)
0.490 ~ 1.705	30	24000/F(kHz)
1.705 ~ 30	30	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960	3	500

Remark:
(1) Emission level (dB)μV = 20 log Emission level μV/m
(2) The smaller limit shall apply at the cross point between two frequency bands.
(3) As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.
(4) The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.
(5) §15.247(d) specifies that emissions which fall in the restricted bands, as defined in §15.205 comply with radiated emission limits specified in §15.209.

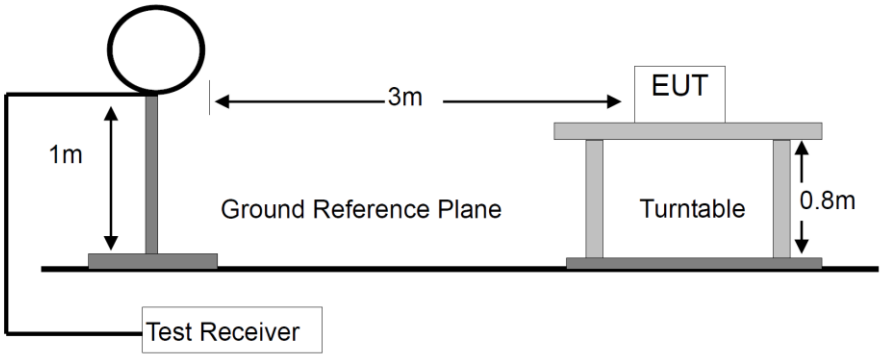
According to 15.231(b), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/ meter)	spurious emissions (microvolts/meter)
40.66 - 40.70	2250	225
70 - 130	1250	125
130 - 174	1250 to 3750*	125 to 375*
174 - 260	3750	375
260 - 470	3750 to 12500*	375 to 1250*
Above 470	12500	1250

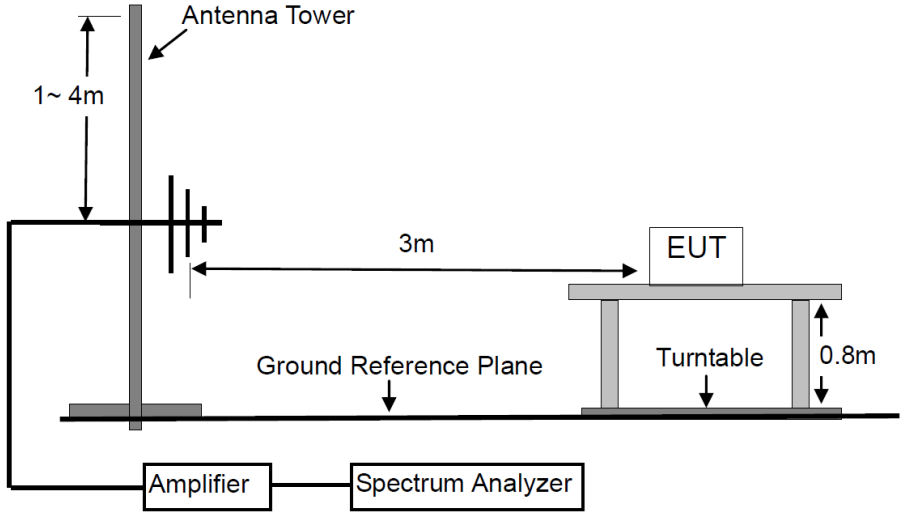
Remark:
(1) * Linear interpolations
(2) Emission level (dB)μV = 20 log Emission level μV/m
(3) The smaller limit shall apply at the cross point between two frequency bands.

BLOCK DIAGRAM OF TEST SETUP

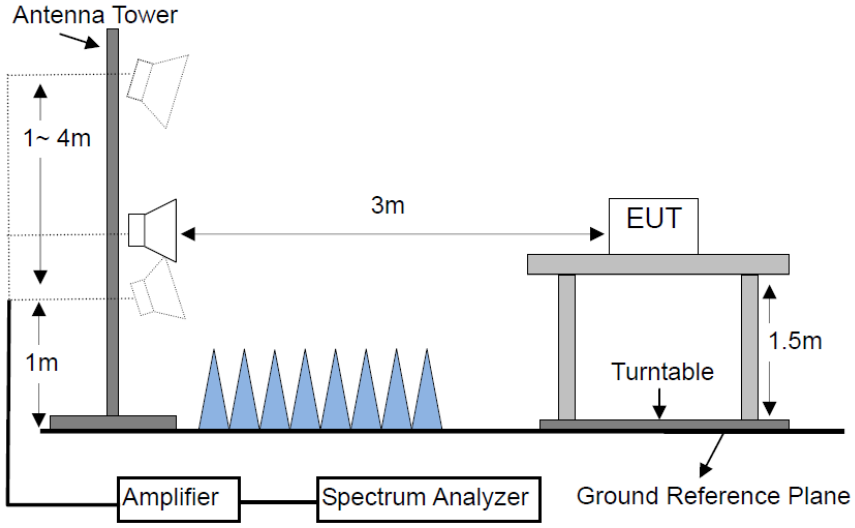
For Radiated Emission below 30MHz



For Radiated Emission 30-1000MHz



For Radiated Emission Above 1000MHz.



TEST PROCEDURES

a. Below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi- anechoic chamber room.

b. For the radiated emission test above 1GHz:

The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode.

f. A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Frequency Band (MHz)	Detector	Resolution Bandwidth	Video Bandwidth
30 to 1000	QP	120 kHz	300 kHz
Above 1000	Peak	1 MHz	3 MHz
	Average	1 MHz	10 Hz

TEST RESULTS

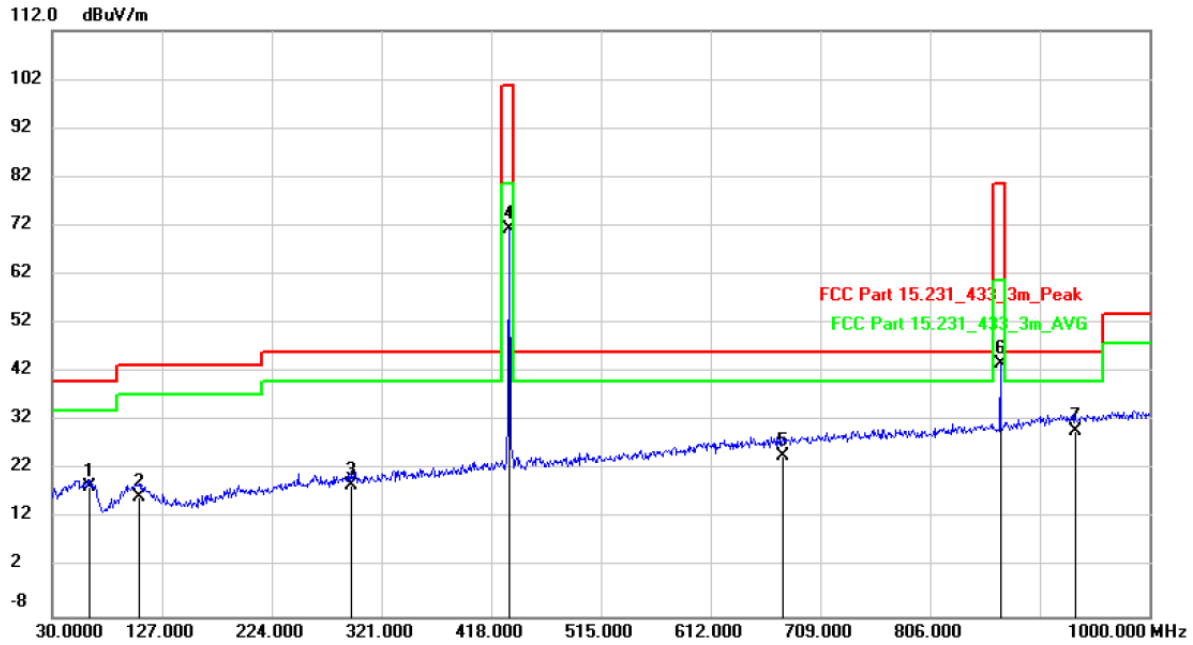
PASS

Please refer to the following pages.

M/N: FTR HC L RF 02	Testing Voltage: DC 3V
Polarization: Horizontal	Detector: QP
Test Mode: TX	Distance: 3m

Radiated Emission Measurement

Date: 2020/12/2 Time: 12:30:02



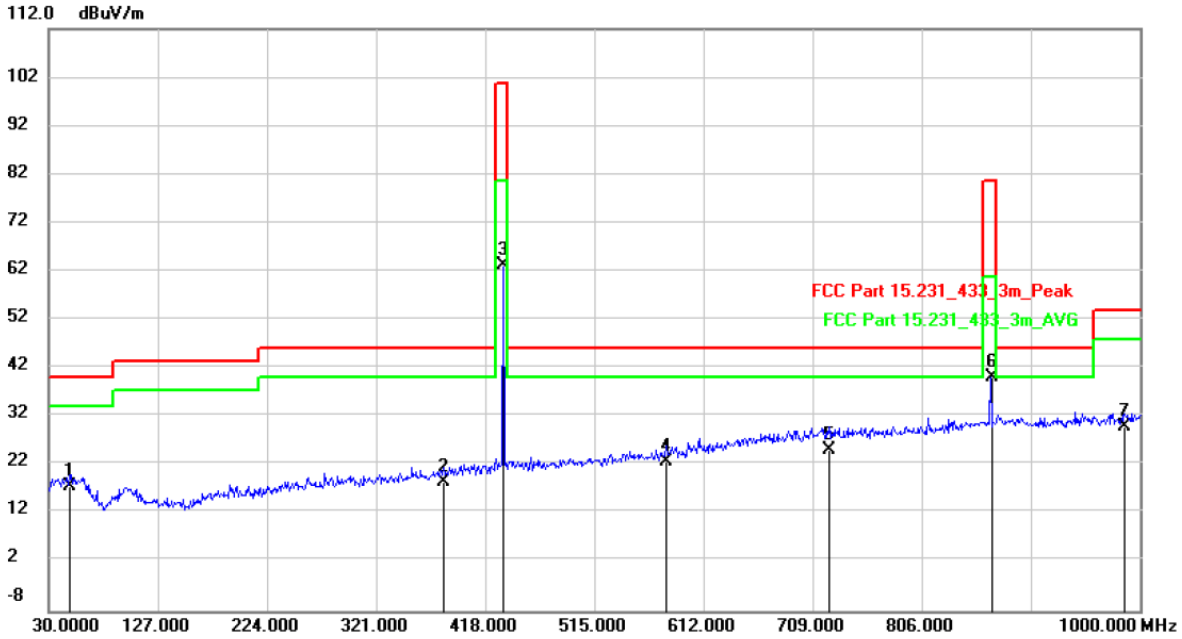
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		62.9800	4.55	14.10	18.65	40.00	-21.35	QP	
2		106.6300	2.71	13.83	16.54	43.50	-26.96	QP	
3		293.8400	3.47	15.27	18.74	46.00	-27.26	QP	
4		433.9200	53.13	18.22	71.35	100.80	-29.45	peak	
5		676.0200	2.50	22.47	24.97	46.00	-21.03	QP	
6		867.8400	18.18	25.50	43.68	80.80	-37.12	peak	
7	*	934.0400	2.66	27.18	29.84	46.00	-16.16	QP	

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

M/N: FTR HC L RF 02	Testing Voltage: DC 3V
Polarization: Vertical	Detector: QP
Test Mode: TX	Distance: 3m

Radiated Emission Measurement

Date: 2020/12/2 Time: 12:37:25



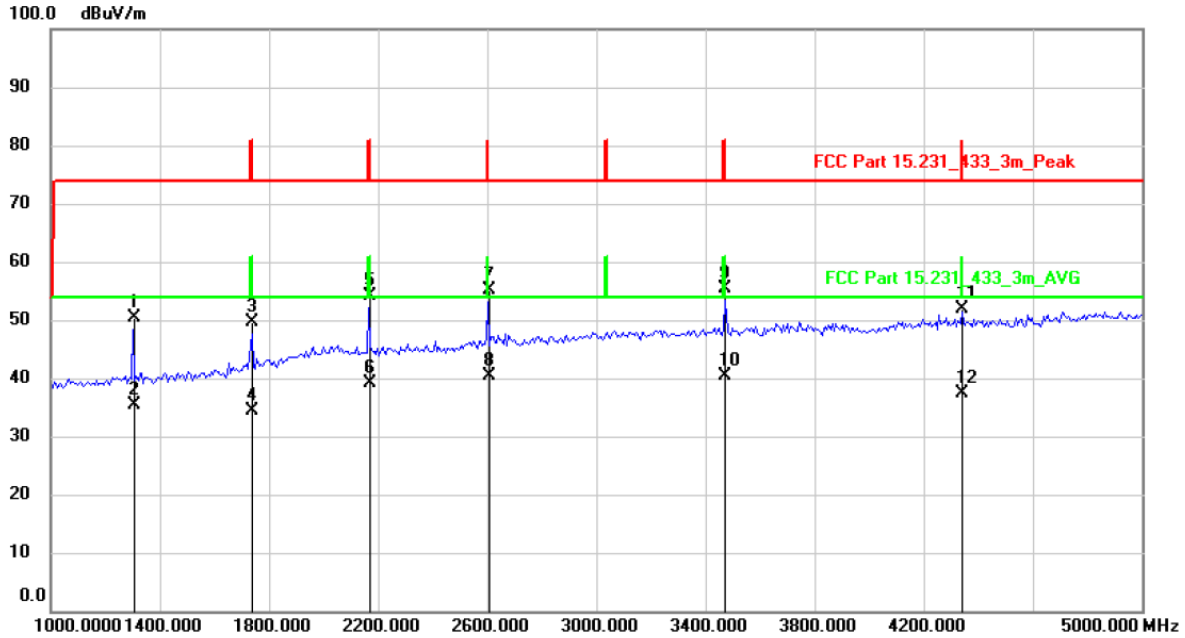
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		48.4300	3.42	14.22	17.64	40.00	-22.36	QP	
2		381.1400	2.24	16.27	18.51	46.00	-27.49	QP	
3		433.9200	45.88	17.22	63.10	100.80	-37.70	peak	
4		579.0200	2.58	20.05	22.63	46.00	-23.37	QP	
5	*	723.5500	1.75	23.29	25.04	46.00	-20.96	QP	
6		867.8400	14.59	25.50	40.09	80.80	-40.71	peak	
7		986.4200	3.58	26.40	29.98	54.00	-24.02	QP	

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

M/N: FTR HC L RF 02	Testing Voltage: DC 3V
Polarization: Horizontal	Detector: Peak & AVG
Test Mode: TX	Distance: 3m

Radiated Emission Measurement

Date: 2020/12/2 Time: 12:44:56

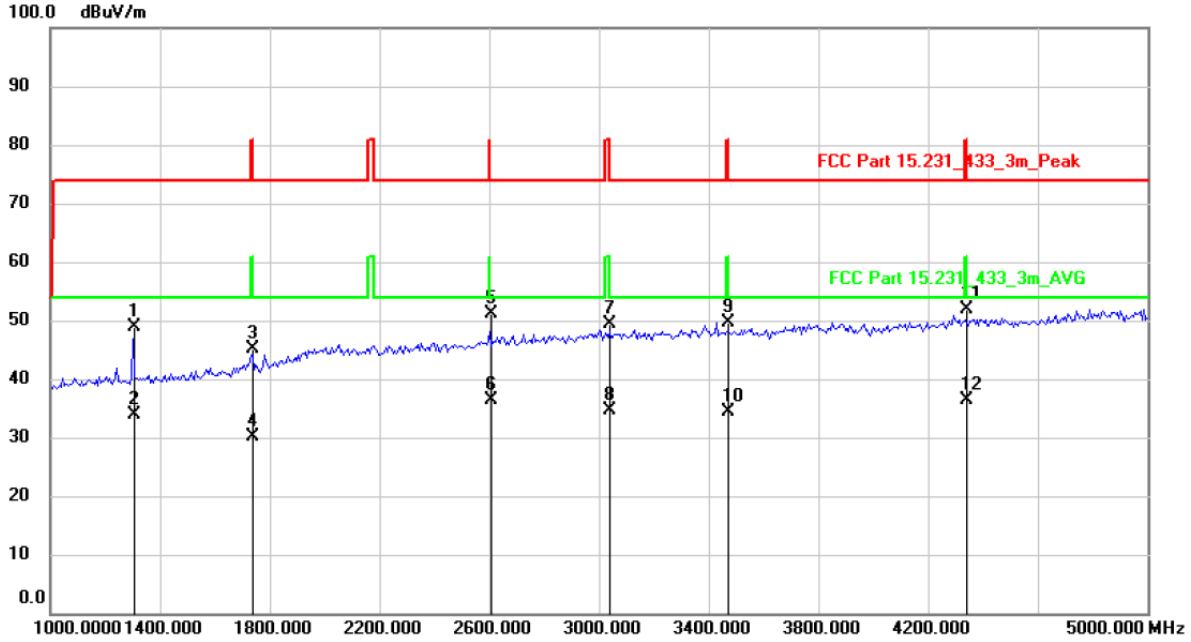


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		1301.760	57.98	-7.61	50.37	74.00	-23.63	peak	
2	*	1301.760	42.89	-7.61	35.28	54.00	-18.72	AVG	
3		1735.680	54.07	-4.33	49.74	80.80	-31.06	peak	
4		1735.680	38.82	-4.33	34.49	60.80	-26.31	AVG	
5		2169.600	54.57	-0.47	54.10	80.80	-26.70	peak	
6		2169.600	39.72	-0.47	39.25	60.80	-21.55	AVG	
7		2603.520	54.32	0.77	55.09	80.80	-25.71	peak	
8		2603.520	39.52	0.77	40.29	60.80	-20.51	AVG	
9		3471.360	52.61	2.68	55.29	80.80	-25.51	peak	
10		3471.360	37.65	2.68	40.33	60.80	-20.47	AVG	
11		4339.200	47.22	4.75	51.97	80.80	-28.83	peak	
12		4339.200	32.52	4.75	37.27	60.80	-23.53	AVG	

M/N: FTR HC L RF 02	Testing Voltage: DC 3V
Polarization: Vertical	Detector: Peak & AVG
Test Mode: TX	Distance: 3m

Radiated Emission Measurement

Date: 2020/12/2 Time: 12:51:00



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		1301.760	56.37	-7.61	48.76	74.00	-25.24	peak	
2	*	1301.760	41.37	-7.61	33.76	54.00	-20.24	AVG	
3		1735.680	49.47	-4.33	45.14	80.80	-35.66	peak	
4		1735.680	34.58	-4.33	30.25	60.80	-30.55	AVG	
5		2603.520	50.26	0.77	51.03	80.80	-29.77	peak	
6		2603.520	35.60	0.77	36.37	60.80	-24.43	AVG	
7		3037.440	47.53	1.85	49.38	80.80	-31.42	peak	
8		3037.440	32.74	1.85	34.59	60.80	-26.21	AVG	
9		3471.360	46.84	2.68	49.52	80.80	-31.28	peak	
10		3471.360	31.70	2.68	34.38	60.80	-26.42	AVG	
11		4339.200	47.10	4.75	51.85	80.80	-28.95	peak	
12		4339.200	31.74	4.75	36.49	60.80	-24.31	AVG	

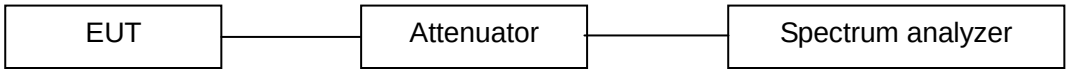
14.3 20dB Occupied Bandwidth

LIMIT

According to 15.231(C), the bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz.

Limit = 433.92MHz*0.25% = 1084.8 KHz

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

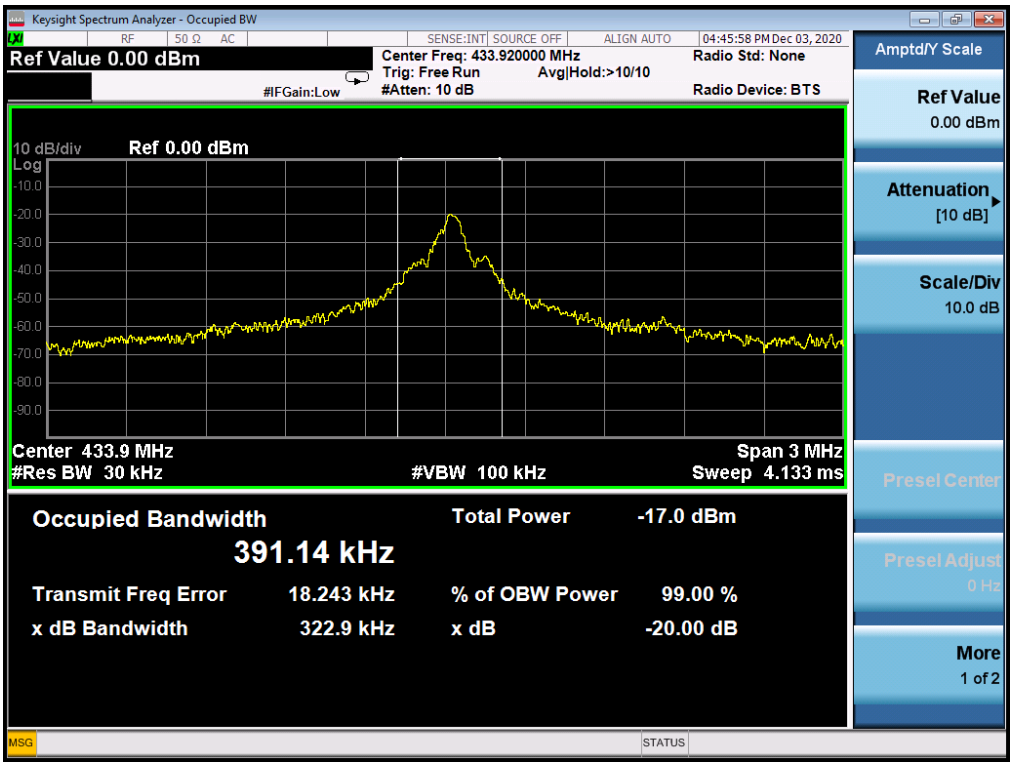
1. The output port (antenna) from the transmitter was connected to an attenuator and then to the input of the RF Spectrum analyzer.
2. Spectrum analyzer set the corresponding parameters for measurement and record the tested data

TEST RESULTS

PASS

Please refer to the following table.

Frequency (MHz)	20 dB Bandwidth (KHz)	Limit (KHz)	Result
433.92	322.9	1084.8	PASS
Test Photo			



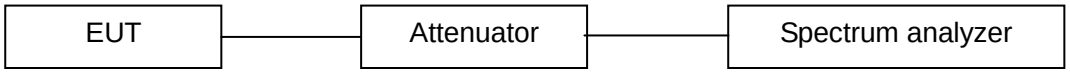
14.4 Transmission time

LIMIT

15.231 (a) (1) 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) A transmitter activated automatically shall cease transmission within 5seconds after activation.

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

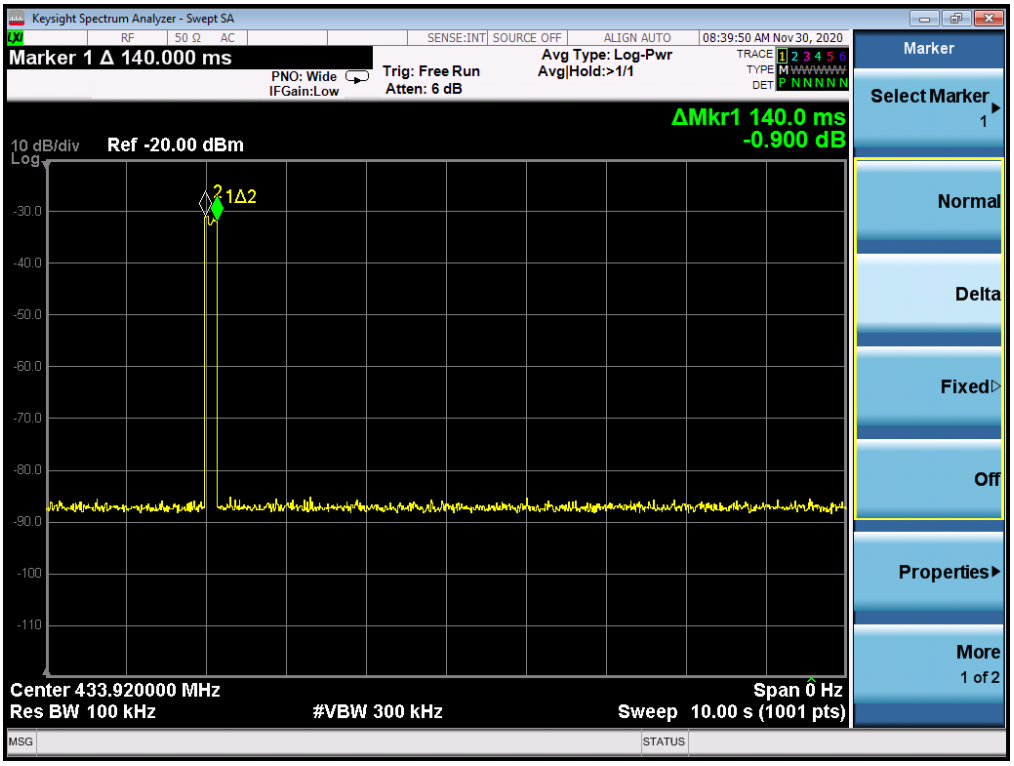
1. The output port (antenna) from the transmitter was connected to an attenuator and then to the input of the RF Spectrum analyzer.
2. Spectrum analyzer set the corresponding parameters for measurement and record the tested data.

TEST RESULTS

PASS

Please refer to the following table.

Frequency (MHz)	Transmission time (sec)	Limit (sec)	Result
433.92	0.14	5	PASS
Test Photo			



14.5 Antenna Requirement

STANDARD APPLICABLE

According to of FCC part 15C section 15.203 and 15.240:

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, 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 CONNECTED CONSTRUCTION

The antenna is PCB antenna that no antenna other than furnished by the responsible party shall be used with the device, and the best case gain of the antenna is 0.0 dBi, Therefore, the antenna is consider meet the requirement.

15. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI7	100837	Mar. 13, 2020	1 Year
2.	Antenna	Schwarzbeck	VULB9162	9162-010	Mar. 23, 2020	1 Year
3.	Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	Mar. 13, 2020	1 Year
4.	Spectrum Analyzer	Keysight	N9020A	MY54200831	Mar. 13, 2020	1 Year
5.	Spectrum Analyzer	Rohde & Schwarz	FSV40	101094	Mar. 13, 2020	1 Year
6.	Horn Antenna	Schwarzbeck	BBHA9170	9170-172	Mar. 22, 2019	2 Year
7.	Power Sensor	DARE	RPR3006W	15I00041SNO64	Mar. 13, 2020	1 Year
8.	Communication Tester	Rohde & Schwarz	CMW500	149004	Mar. 13, 2020	1 Year
9.	Horn Antenna	COM-Power	AH-118	071078	Mar. 23, 2020	1 Year
10.	Pre-Amplifier	HP	HP 8449B	3008A00964	Mar. 13, 2020	1 Year
11.	Pre-Amplifier	HP	HP 8447D	1145A00203	Mar. 13, 2020	1 Year
12.	Loop Antenna	Schwarzbeck	FMZB 1513	1513-272	Mar. 23, 2020	1 Year
13.	Test Receiver	Rohde & Schwarz	ESCI	101152	Mar. 14, 2020	1 Year
14.	L.I.S.N	Rohde & Schwarz	ENV 216	101317	Mar. 13, 2020	1 Year
15.	L.I.S.N	Rohde & Schwarz	ESH2-Z5	893606/014	Mar. 13, 2020	1 Year
16.	RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	38311	Mar.13, 2020	1 Year
17.	Temperature & Humidity Chamber	REMAFEE	SYHR225L	N/A	Mar. 13, 2020	1 Year
18.	DC Source	Maynuo	MY8811	N/A	Mar. 13, 2020	1 Year
19.	Temporary antenna connector	TESCOM	SS402	N/A	N/A	N/A
20.	Chamber	SAEMC	9*7*7m	N/A	Jun. 20, 2019	2 Year
21.	Test Software	EZ	EZ_EMC	N/A	N/A	N/A

Note: For photographs of EUT and measurement, please refer to appendix in separate documents.

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