

FCC PART 15.231

TEST REPORT

For

WAC LIGHTING CO

No.390 Qingfeng RD, Qingxi TW, Dongguan City, Guangdong Province, China

FCC ID: 2APNFWAC000001

Report Type: Original Report	Product Type: FAN RF WALL CONTROL
Report Number: RDG180416050-00	
Report Date: 2018-05-30	
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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	3
TEST FACILITY	4
SYSTEM TEST CONFIGURATION.....	5
JUSTIFICATION	5
EQUIPMENT MODIFICATIONS	5
EUT EXERCISE SOFTWARE	5
LOCAL SUPPORT EQUIPMENT LIST AND DETAILS	5
SUPPORT CABLE LIST AND DETAILS	5
BLOCK DIAGRAM OF TEST SETUP	6
SUMMARY OF TEST RESULTS	7
FCC §15.203 - ANTENNA REQUIREMENT.....	8
APPLICABLE STANDARD	8
FCC §15.207 (A)– AC LINE CONDUCTED EMISSIONS	9
APPLICABLE STANDARD	9
EUT SETUP	9
EMI TEST RECEIVER SETUP.....	9
TEST PROCEDURE	10
CORRECTED AMPLITUDE & MARGIN CALCULATION	10
TEST EQUIPMENT LIST AND DETAILS.....	10
TEST DATA	11
FCC §15.205, §15.209, §15.231 (B) - RADIATED EMISSIONS	13
APPLICABLE STANDARD	13
EUT SETUP	14
EMI TEST RECEIVER SETUP.....	14
TEST EQUIPMENT LIST AND DETAILS.....	15
TEST PROCEDURE	15
CORRECTED AMPLITUDE & MARGIN CALCULATION	15
TEST RESULTS SUMMARY	15
TEST DATA	16
FCC §15.231(C) – 20 DB BANDWIDTH TESTING.....	31
REQUIREMENT	31
TEST EQUIPMENT LIST AND DETAILS.....	31
TEST PROCEDURE	31
TEST DATA	31
FCC §15.231(A) - DEACTIVATION TESTING	33
APPLICABLE STANDARD	33
TEST EQUIPMENT LIST AND DETAILS.....	33
TEST DATA	33

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	FAN RF WALL CONTROL
EUT Model:	F-WC-WT
FCC ID:	2APNFWAC000001
Rated Input Voltage:	AC 100~240V
External Dimension:	117mm(L)*70mm(W)*40mm(H)
Serial Number:	180416050
EUT Received Date:	2018.04.16

Objective

This report is prepared on behalf of **WAC LIGHTING CO** in accordance with Part 2, Subpart J, Part 15, Subparts A, and C of the Federal Communications Commission's rules

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.209, 15.35(c) and 15.231 rules.

Related Submittal(s)/Grant(s)

N/A

Test Methodology

All measurements detailed in this Test Report were performed in accordance with ANSI C63.10-2013 "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices".

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical 1G~6GHz: 4.45 dB, 6G~26.5GHz: 5.23 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, 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. : 897218,the FCC Designation No. : CN1220.

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

FINAL

SYSTEM TEST CONFIGURATION

Justification

The system was configured in testing mode which was provided by manufacturer.

The device operation frequency is 315 MHz with ASK modulation.

Equipment Modifications

No modifications were made to the unit tested.

EUT Exercise Software

No software was used in test.

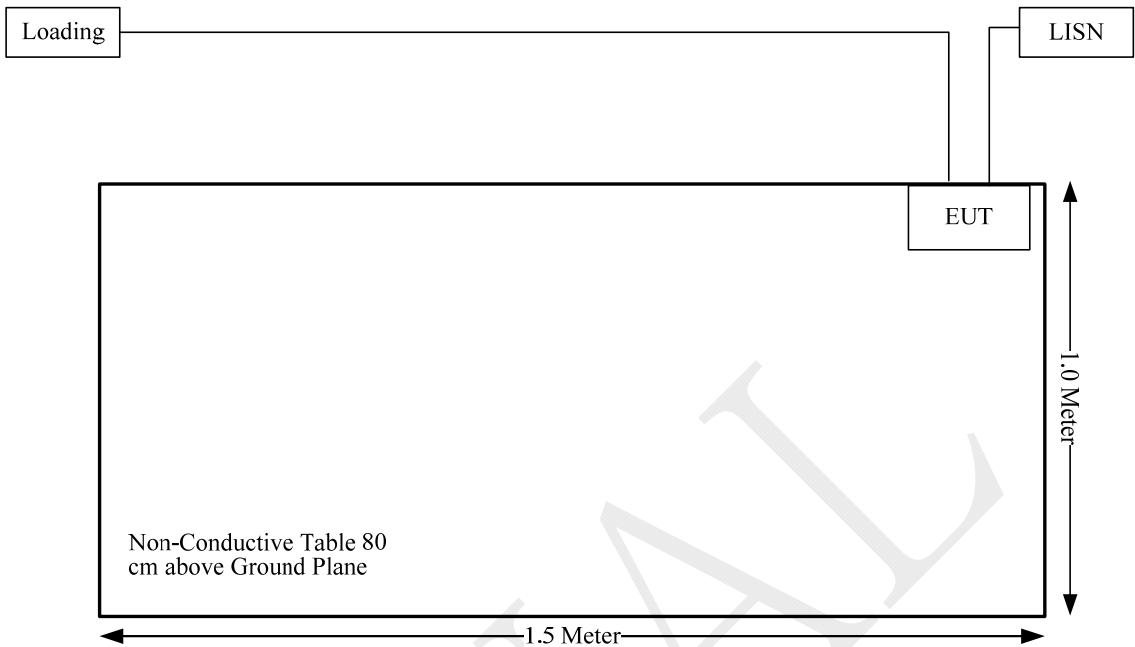
Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Unknown	Loading	5A	/

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From	To
Power Cable	No	No	5.0	EUT	Loading

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207 (a)	Conducted Emissions	Compliance
§15.205, §15.209, §15.231 (b)	Radiated Emissions	Compliance
§15.231 (c)	20dB Bandwidth	Compliance
§15.231 (a)	Deactivation Testing	Compliance

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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.

Result: Compliant.

The EUT has one internal antenna arrangement, which was permanently attached and the antenna gain is 0dBi, fulfill the requirement of this section. Please refer to the EUT photos.

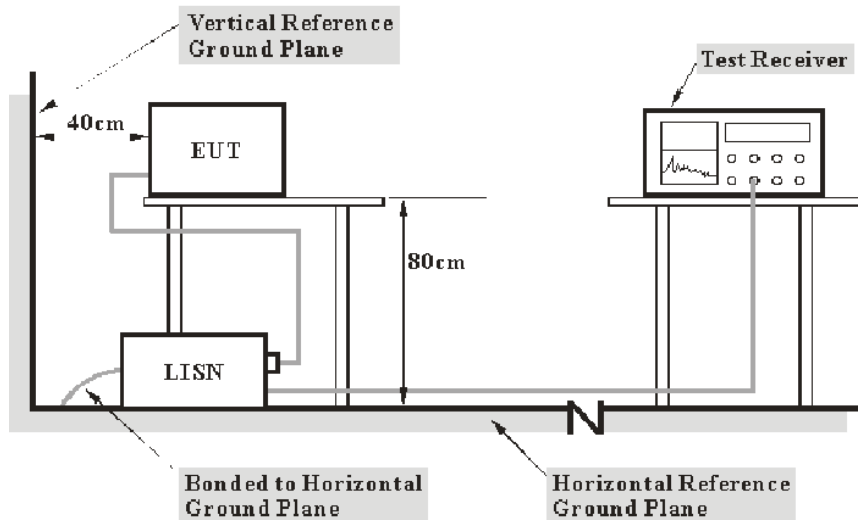
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FCC §15.207 (a)– AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207.

The spacing between the peripherals was 10 cm.

The EUT was connected to the main lisn with a 8 or 24 V/60 Hz AC power source.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the EUT was connected to the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

$$C_f = A_C + VDF$$

Herein,

V_C (cord. Reading): corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF : voltage division factor of AMN

C_f : Correction Factor

The “**Margin**” column of the following data tables indicates the degree of compliance within 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 Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCS 30	830245/006	2017-12-11	2018-12-11
R&S	L.I.S.N	ESH2-Z5	892107/021	2017-09-25	2018-09-25
R&S	Two-line V-network	ENV 216	101614	2017-12-08	2018-12-08
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-01	2017-09-05	2018-09-05

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

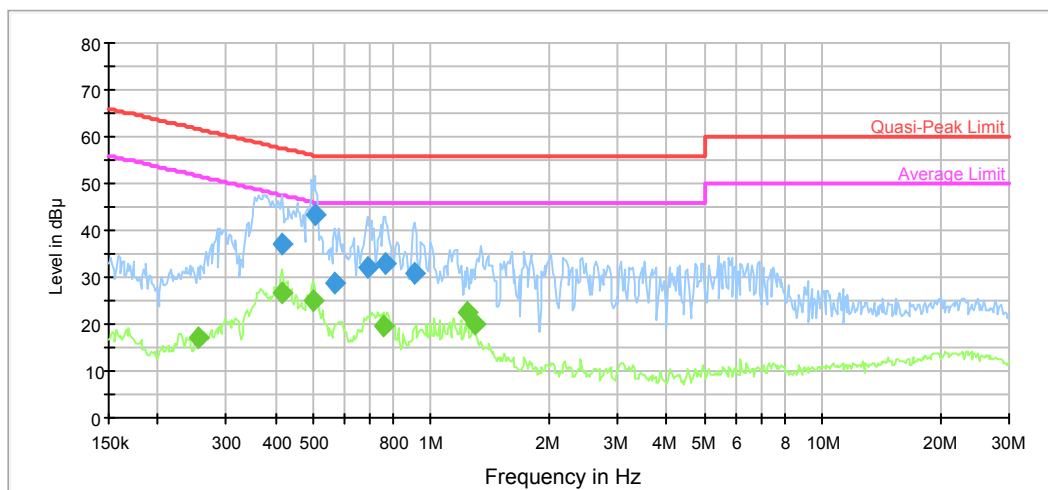
Test Data**Environmental Conditions**

Temperature:	28.2 °C
Relative Humidity:	45 %
ATM Pressure:	102.1 kPa

The testing was performed by Ade Xiao on 2018-05-25.

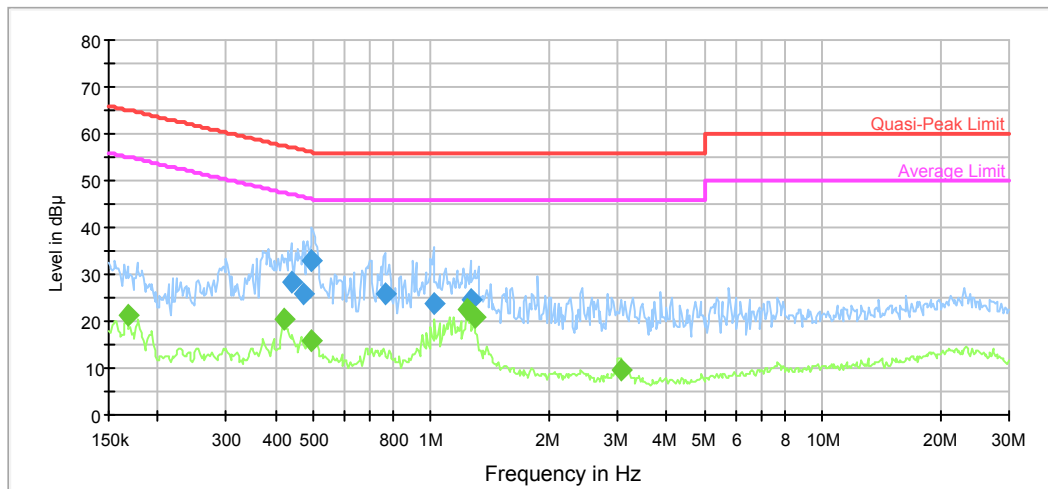
Test Mode: Transmitting

AC120V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.415949	37.0	9.000	L1	10.0	20.5	57.5	Compliance
0.503608	43.5	9.000	L1	9.9	12.5	56.0	Compliance
0.567545	28.9	9.000	L1	9.8	27.1	56.0	Compliance
0.687153	32.2	9.000	L1	9.8	23.8	56.0	Compliance
0.762149	32.9	9.000	L1	9.8	23.1	56.0	Compliance
0.908180	31.0	9.000	L1	9.8	25.0	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.253797	17.2	9.000	L1	10.3	34.4	51.6	Compliance
0.415949	26.8	9.000	L1	10.0	20.7	47.5	Compliance
0.499611	24.9	9.000	L1	9.9	21.1	46.0	Compliance
0.756101	19.7	9.000	L1	9.8	26.3	46.0	Compliance
1.239175	22.3	9.000	L1	9.8	23.7	46.0	Compliance
1.289541	20.1	9.000	L1	9.8	25.9	46.0	Compliance

AC120V, 60 Hz, Neutral:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.439808	28.3	9.000	N	9.9	28.8	57.1	Compliance
0.472507	25.8	9.000	N	9.9	30.7	56.5	Compliance
0.495646	33.0	9.000	N	9.9	23.1	56.1	Compliance
0.762149	26.0	9.000	N	9.8	30.0	56.0	Compliance
1.015358	23.6	9.000	N	9.8	32.4	56.0	Compliance
1.259081	24.7	9.000	N	9.8	31.3	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.167702	21.1	9.000	N	10.9	34.0	55.1	Compliance
0.419276	20.3	9.000	N	10.0	27.2	47.5	Compliance
0.495646	16.0	9.000	N	9.9	30.1	46.1	Compliance
1.239175	22.5	9.000	N	9.8	23.5	46.0	Compliance
1.289541	20.8	9.000	N	9.8	25.2	46.0	Compliance
3.073500	9.7	9.000	N	9.8	36.3	46.0	Compliance

FCC §15.205, §15.209, §15.231 (b) - RADIATED EMISSIONS**Applicable Standard**

FCC §15.205, §15.209, §15.231 (b)

(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

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

¹Linear interpolations.

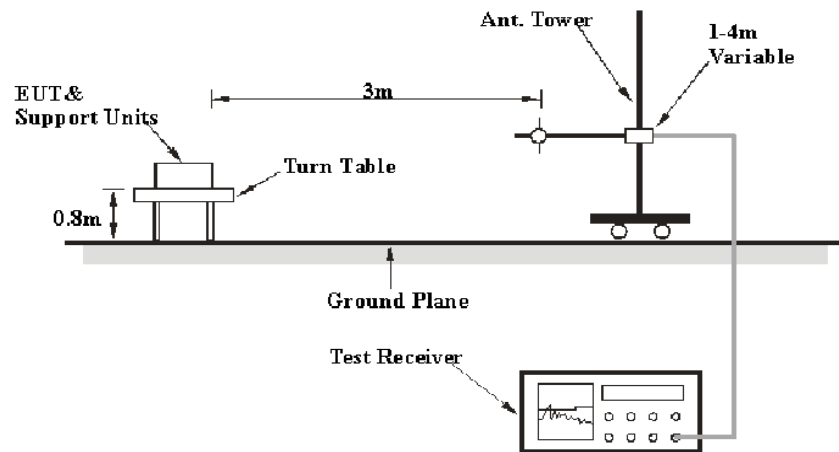
(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

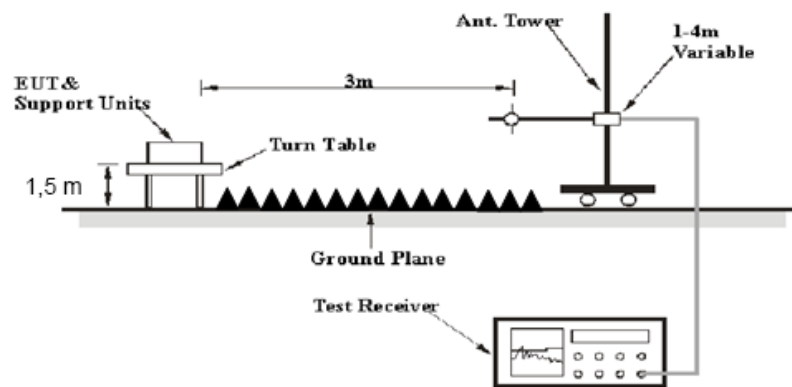
(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

EUT Setup

Below 1 GHz:



Above 1 GHz:



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 § 15.209, 15.205 and 15.231.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 4 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	100 kHz	PK
1 GHz – 5 GHz	1 MHz	3 MHz	/	PK

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2017-09-01	2018-09-01
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2018-11-10
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2017-12-08	2018-12-08
ETS-Lindgren	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-05
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2017-09-05	2018-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A

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

Test Procedure

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

According to §15.231, Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector

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 data in the following table, the EUT complied with the CFR47 §15.205, §15.209, §15.231 (b).

Test Data**Environmental Conditions**

Temperature:	27.2~28.3 °C
Relative Humidity:	60~64 %
ATM Pressure:	100.8 kPa

The testing was performed by Sunny Cen and Steven Zuo on 2018-05-02 and 2018-05-06.

Test mode: Transmitting

Field Strength (Peak)

Frequency	Receiver	Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	15.231(b)	
(MHz)	Reading (dBμV)	Polar (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)
Operating Frequency: 315 MHz								
315.00	67.22	H	13.80	2.14	0.00	83.16	95.62	12.46
315.00	57.11	V	13.80	2.14	0.00	73.05	95.62	22.57
630.00	36.53	H	19.50	3.31	0.00	59.34	75.62	16.28
630.00	33.21	V	19.50	3.31	0.00	56.02	75.62	19.60
945.00	34.53	H	22.70	4.36	0.00	61.59	75.62	14.03
945.00	32.67	V	22.70	4.36	0.00	59.73	75.62	15.89
1260.00	45.66	H	24.38	1.53	35.81	35.76	74.00	38.24
1260.00	44.89	V	24.38	1.53	35.81	34.99	74.00	39.01
1575.00	44.84	H	25.52	1.70	36.03	36.03	74.00	37.97
1575.00	46.13	V	25.52	1.70	36.03	37.32	74.00	36.68
1890.00	44.83	H	26.84	1.66	36.06	37.27	74.00	36.73
1890.00	45.27	V	26.84	1.66	36.06	37.71	74.00	36.29

Note:

Corrected Amplitude = Receiver Reading + Cable loss + Antenna Factor – Amplifier Gain

Margin = Limit- Corr. Amplitude

Field Strength (Average)

Frequency (MHz)	Peak Measurement @ 3m (dBμV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Average Amp. (dBμV/m)	15.231(b)	
					Limit (dBμV/m)	Margin (dB)
Operating Frequency: 315 MHz						
315.00	83.16	H	-12.53	70.63	75.62	4.99
315.00	73.05	V	-12.53	60.52	75.62	15.1
630.00	59.34	H	-12.53	46.81	55.62	8.81
630.00	56.02	V	-12.53	43.49	55.62	12.13
945.00	61.59	H	-12.53	49.06	55.62	6.56
945.00	59.73	V	-12.53	47.2	55.62	8.42
1260.00	35.76	H	-12.53	23.23	54.00	30.77
1260.00	34.99	V	-12.53	22.46	54.00	31.54
1575.00	46.21	H	-12.53	33.68	54.00	20.32
1575.00	44.03	V	-12.53	31.5	54.00	22.5
1890.00	37.27	H	-12.53	24.74	54.00	29.26
1890.00	37.71	V	-12.53	25.18	54.00	28.82

Note: the minimum duty cycle was the worst for calculation.

Average = peak+ Duty Cycle Correction Factor

Duty Cycle Correction Factor Calculation:

Keys	Pulse 1 width (ms)	Pulse 1 Numbers	Pulse 2 width (ms)	Pulse 2 Numbers	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
Light	0.48	36	0.96	6	23.04	-12.75
Light Up	0.48	33	0.96	7	22.56	-12.93
Light Down	0.48	38	1.08	5	23.64	-12.53
Fan	0.48	40	0.96	4	23.04	-12.75
Fan Up	0.48	36	0.96	6	23.04	-12.75
Fan Down	0.48	32	0.96	8	23.04	-12.75
Circle	0.48	34	0.96	7	23.04	-12.75

Note:

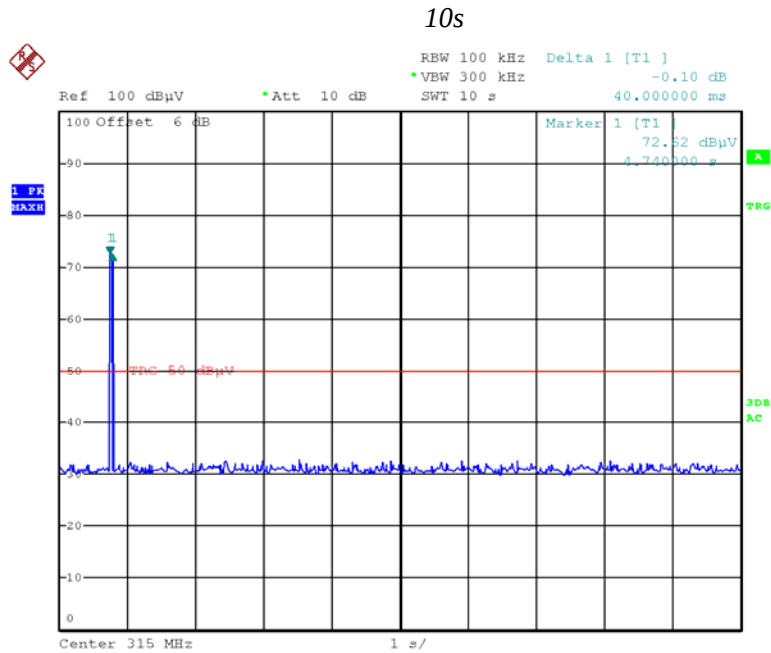
Duty cycle=(Pulse 1 Width*Pulse 1 Number + Pulse 2 Width*Pulse 2 Number)/100ms

Duty Cycle Correction Factor= 20*log(Duty cycle)

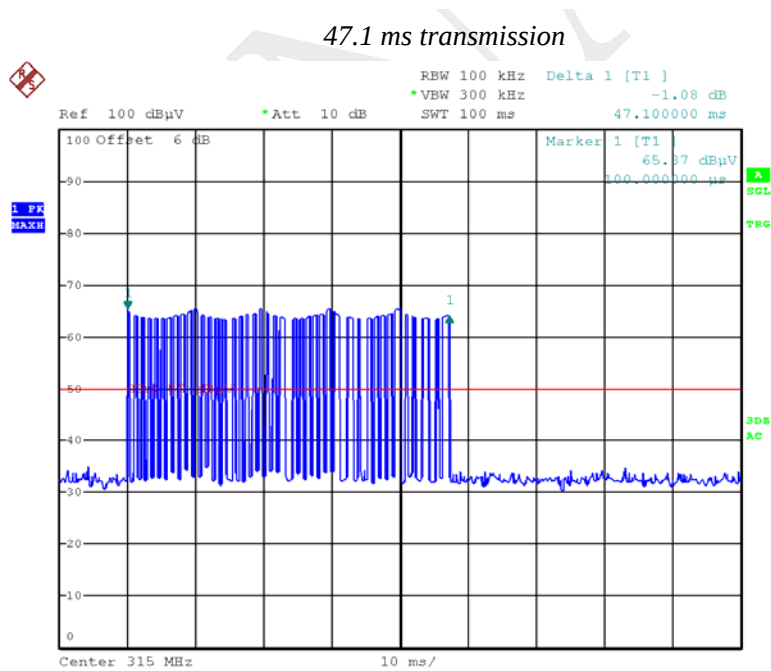
Please refer to the following plots for duty cycle test:

(Note: the 10s test plot only report one key since similar test result per pretest)

Light:

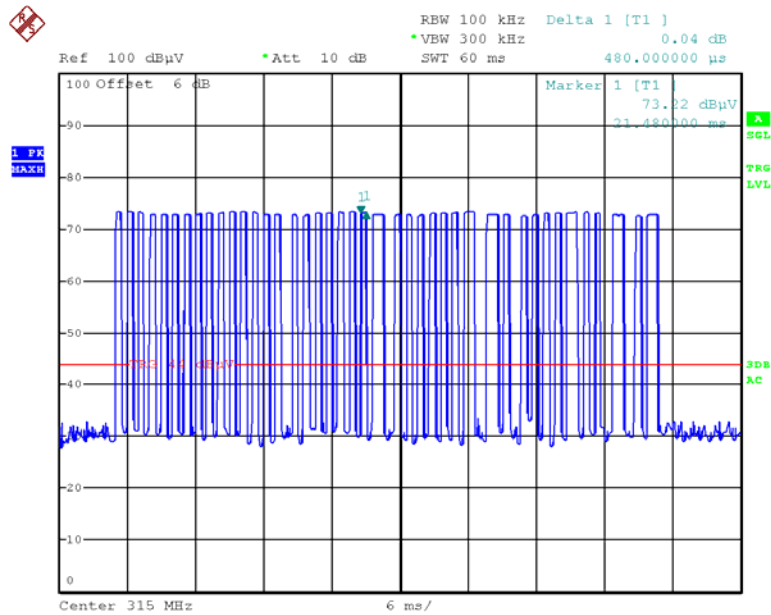


Date: 15.MAY.2018 05:26:23



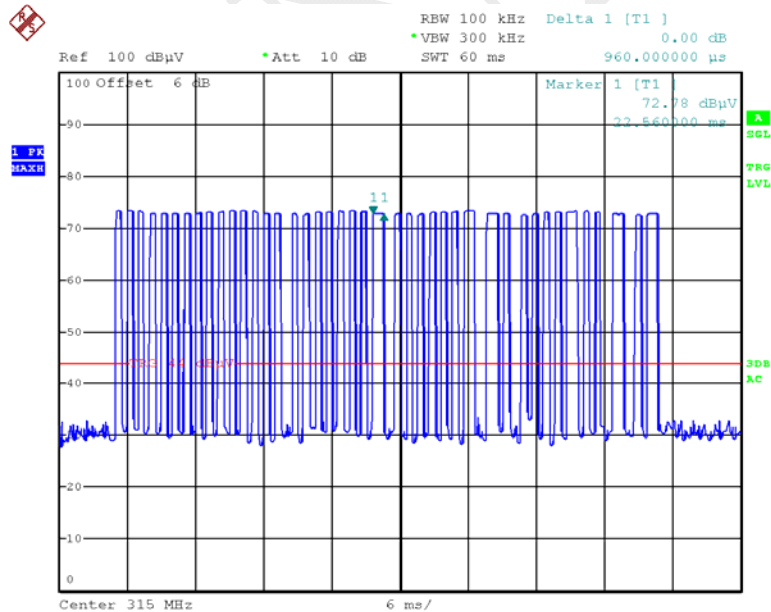
Date: 15.MAY.2018 05:14:36

*Pulse1 0.48ms *36*



Date: 15.MAY.2018 06:36:25

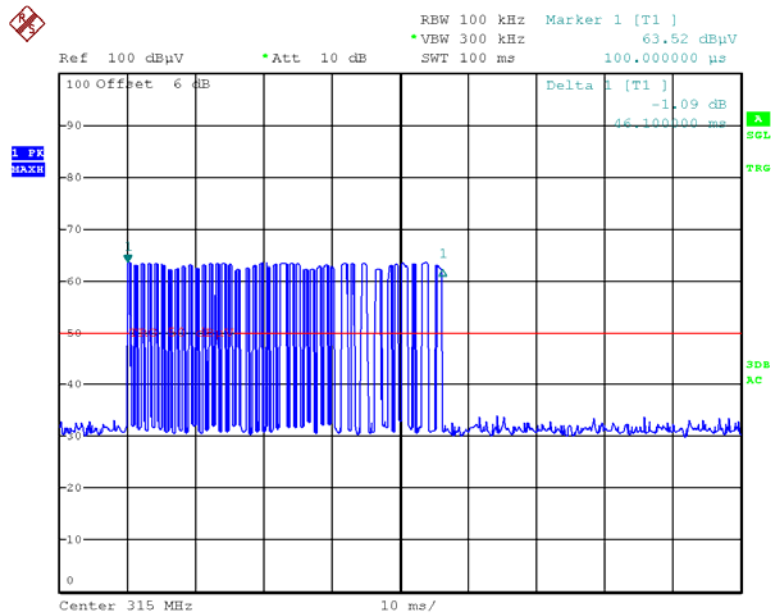
*Pulse2 0.96ms *6*



Date: 15.MAY.2018 06:36:49

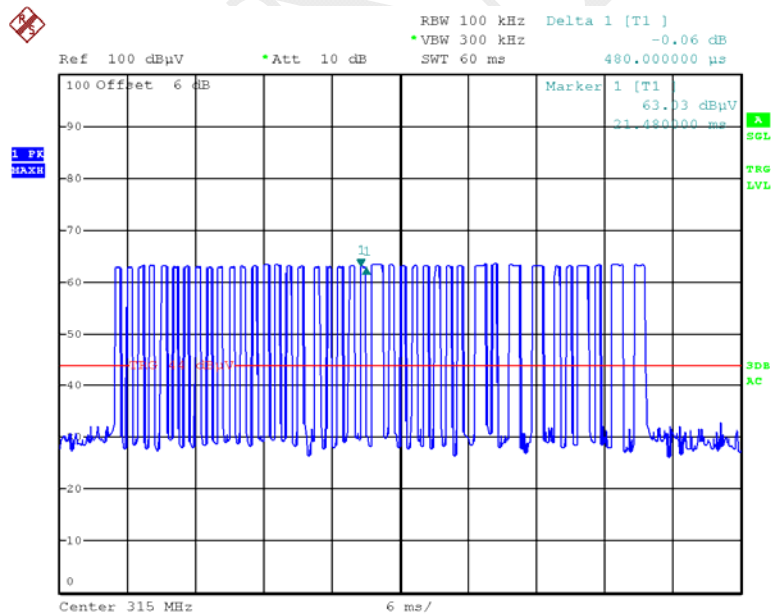
Light Up

46.1ms transmission



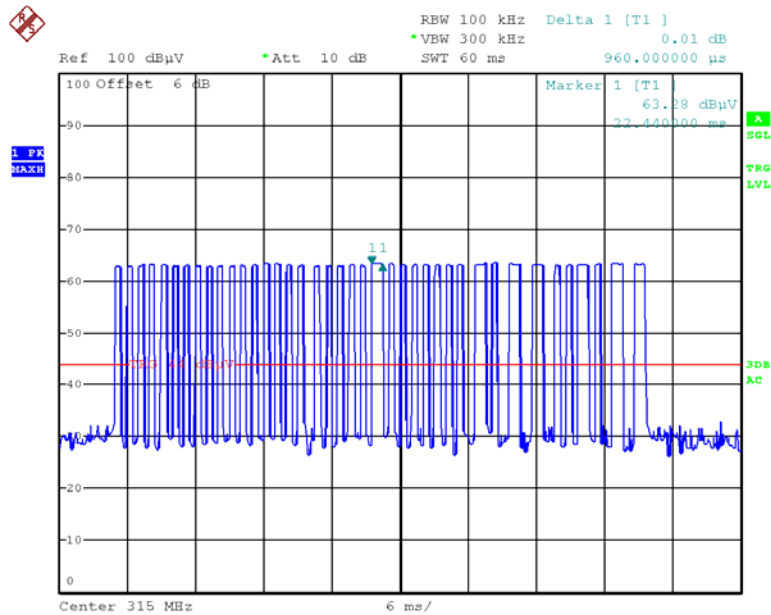
Date: 15.MAY.2018 05:15:16

Pulse1 0.48ms *33



Date: 15.MAY.2018 06:52:04

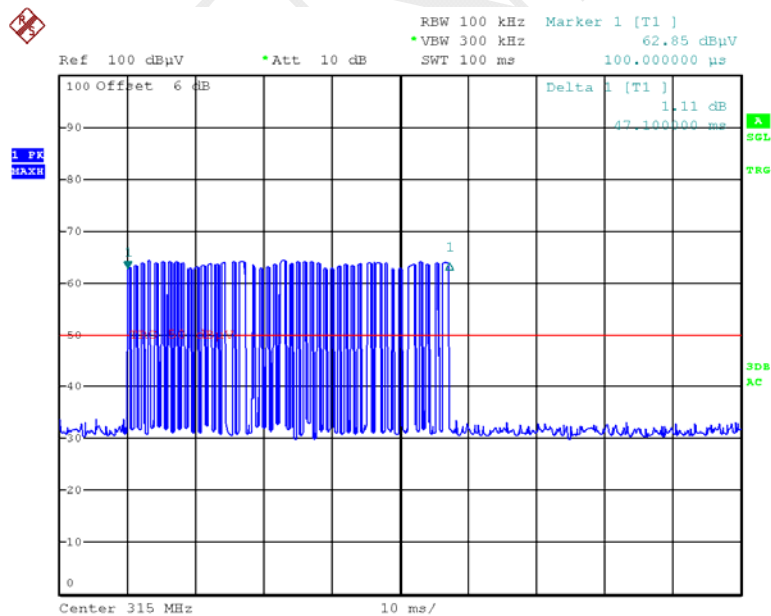
Pulse2 0.96ms *7



Date: 15.MAY.2018 06:52:38

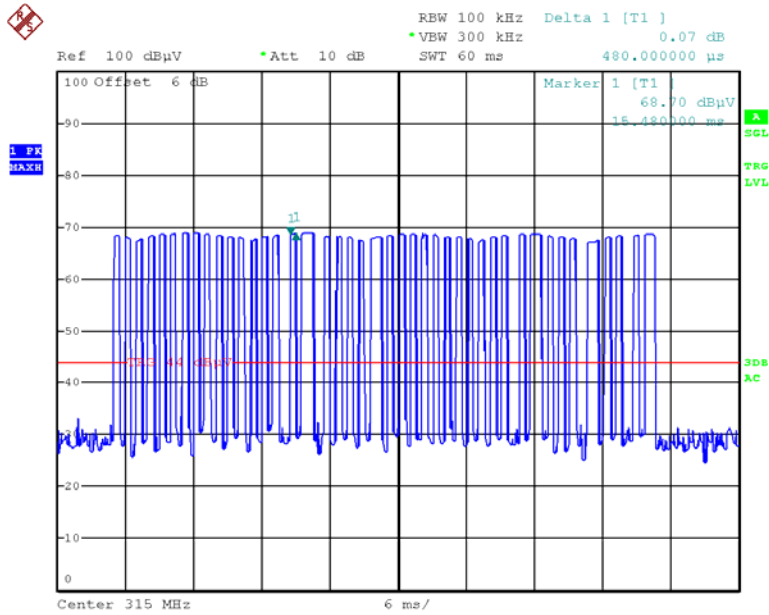
Light Down

47.1ms transmission



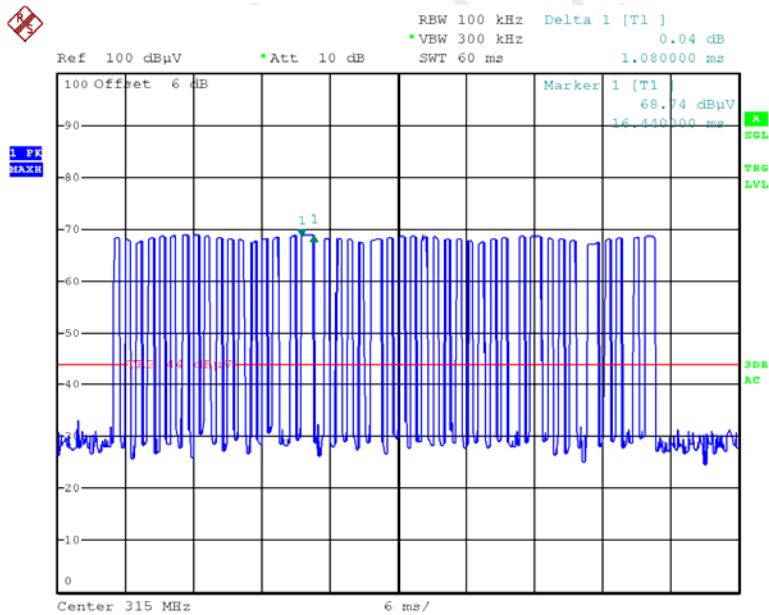
Date: 15.MAY.2018 05:16:05

*Pulse1 0.48ms *38*



Date: 15.MAY.2018 06:39:52

*Pulse2 1.08ms *5*



Date: 15.MAY.2018 06:49:21

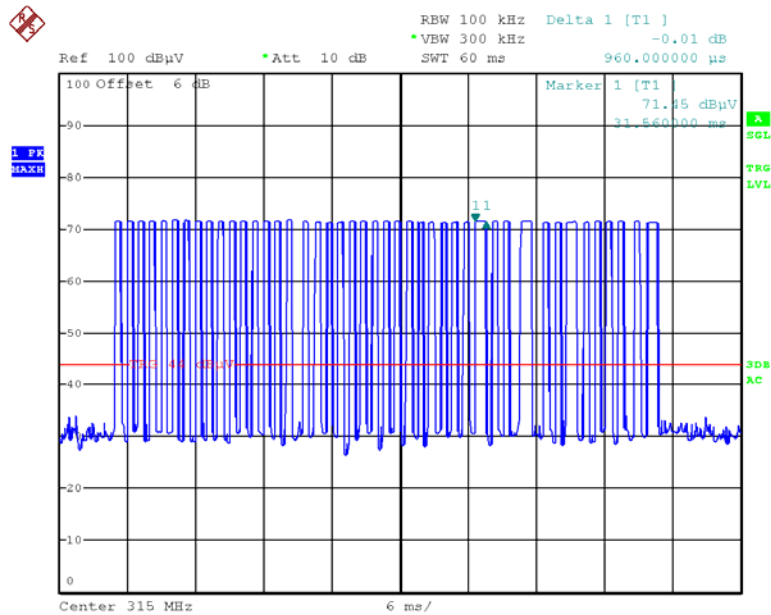
47.1ms transmission



Pulse1 0.48ms *40



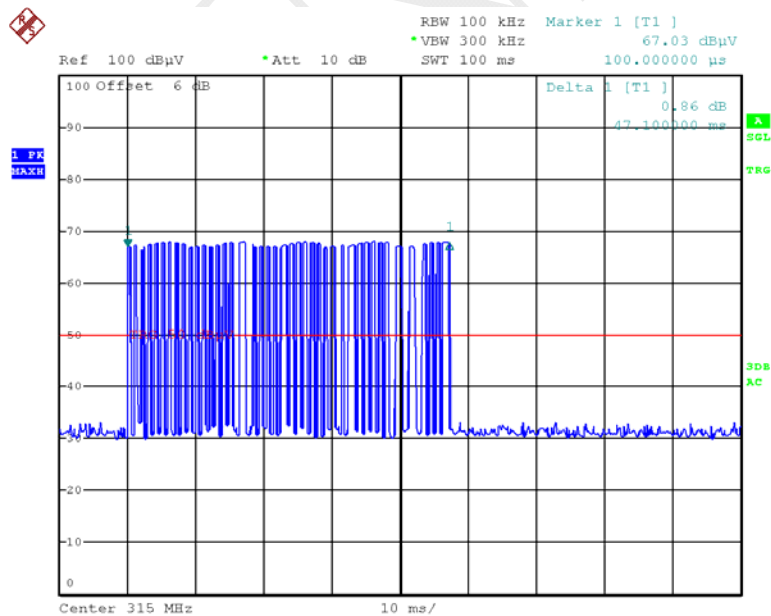
Pulse2 0.96ms *4



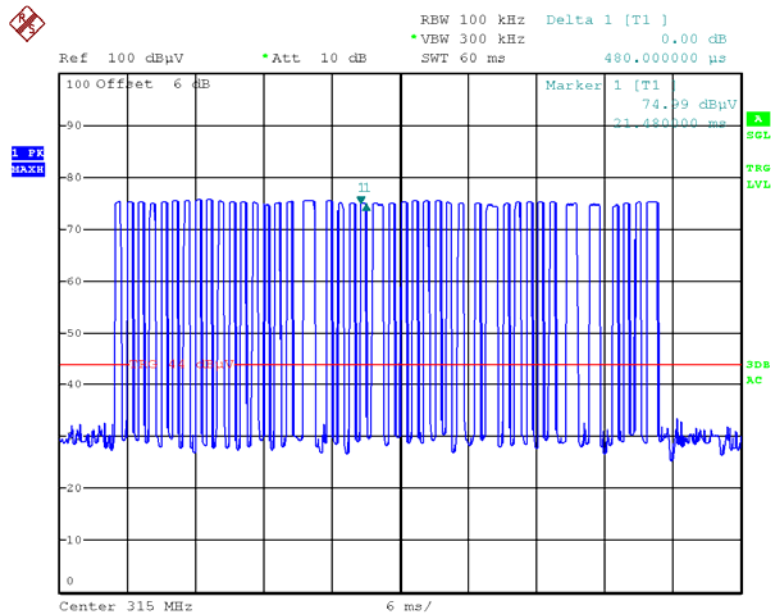
Date: 15.MAY.2018 06:38:27

Fan Up

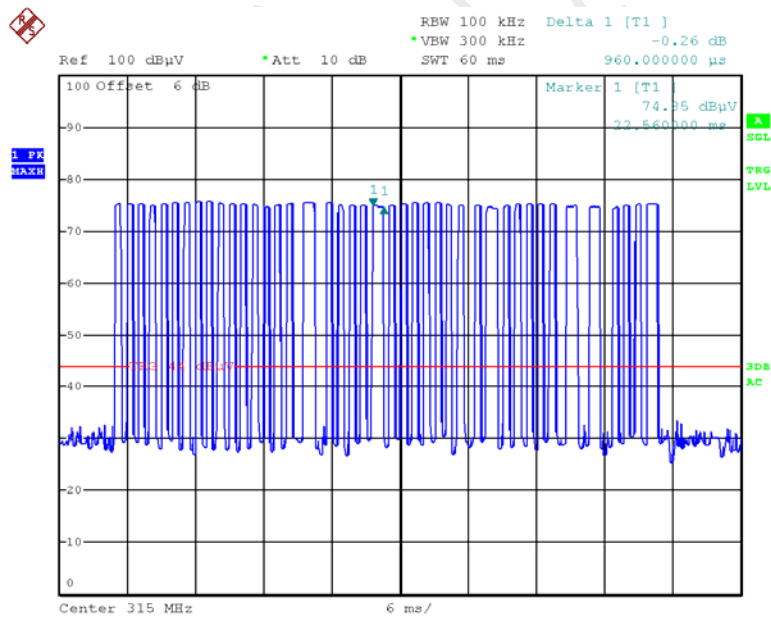
47.1ms transmission



Date: 15.MAY.2018 05:18:00

*Pulse1 0.48ms *36*

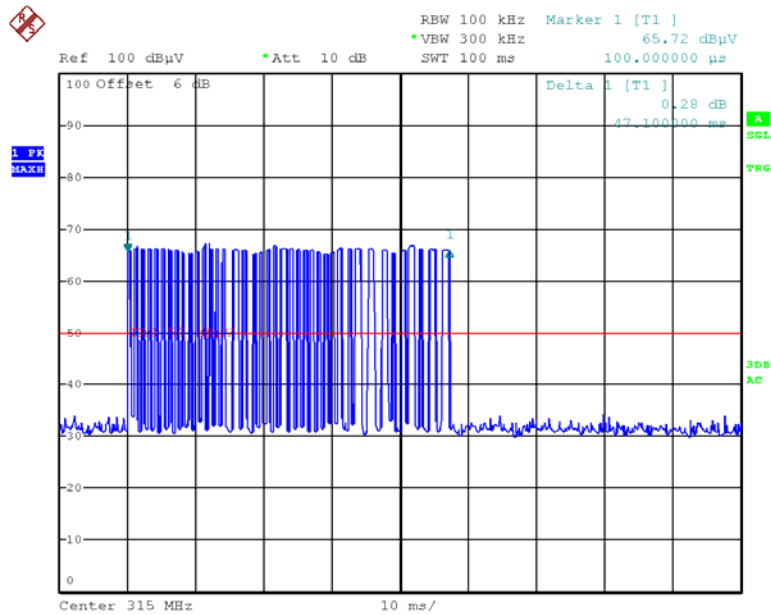
Date: 15.MAY.2018 06:54:56

*Pulse2 0.96ms *6*

Date: 15.MAY.2018 06:55:14

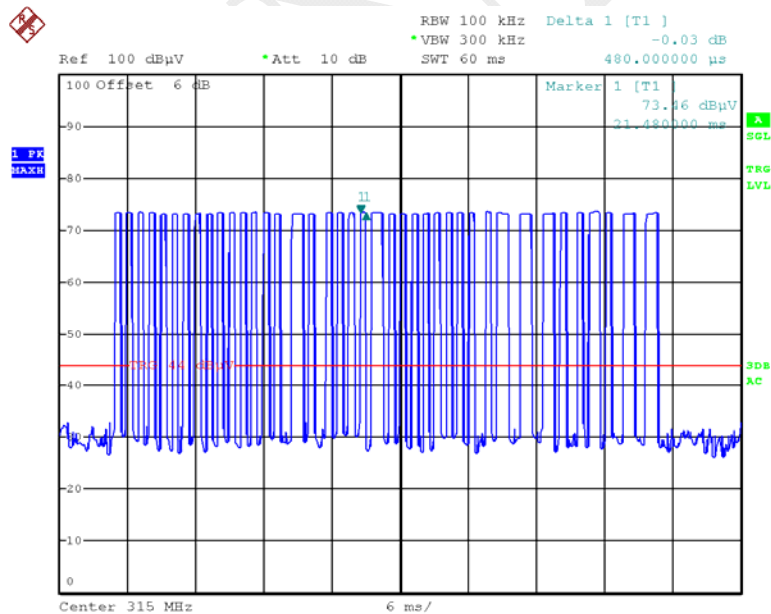
Fan Down

47.1ms transmission



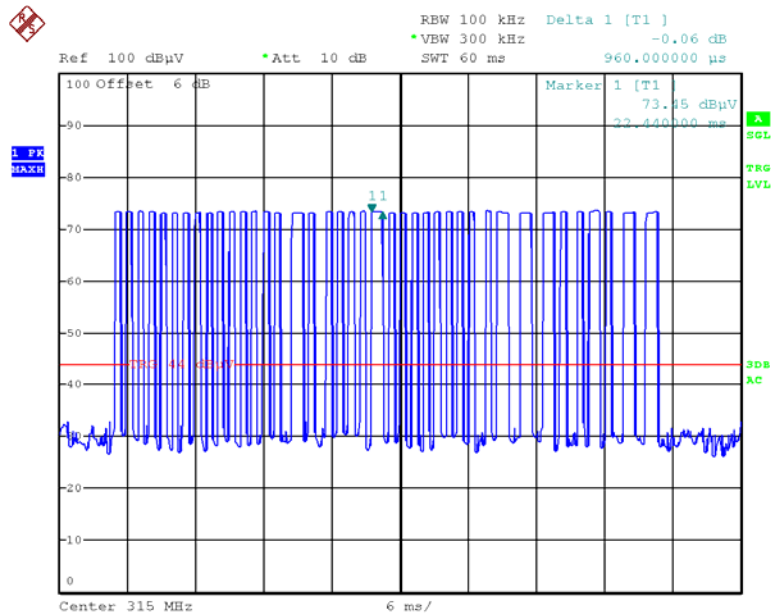
Date: 15.MAY.2018 05:18:47

Pulse1 0.48ms *32



Date: 15.MAY.2018 06:53:39

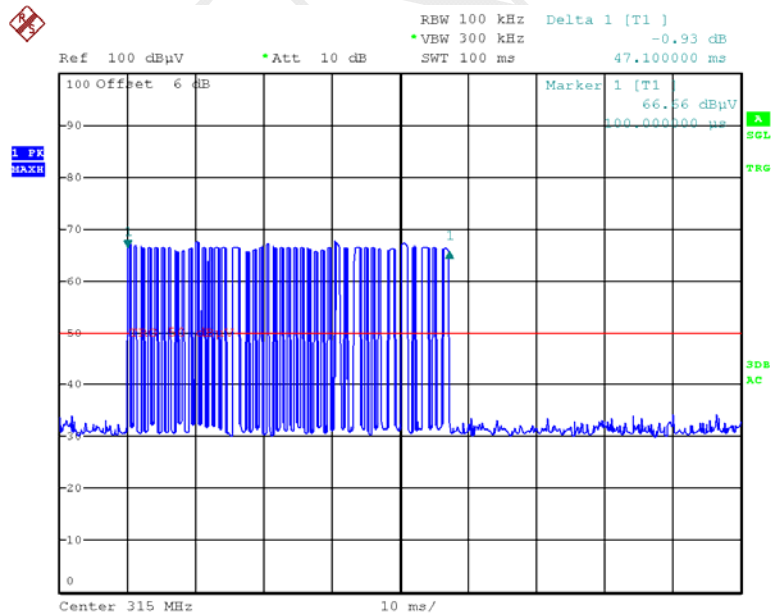
Pulse2 0.96ms *8



Date: 15.MAY.2018 06:54:02

Circle

47.1ms transmission



Date: 15.MAY.2018 05:19:40

100 Offset 6 dB

Ref 100 dBuV Att 10 dB

RBW 100 kHz Delta 1 [T1]

VEW 300 kHz 0.07 dB

SWT 60 ms 480.000000 μ s

Marker 1 [T1]

76.64 dBuV

120.000000 μ s

1 PK MAXH

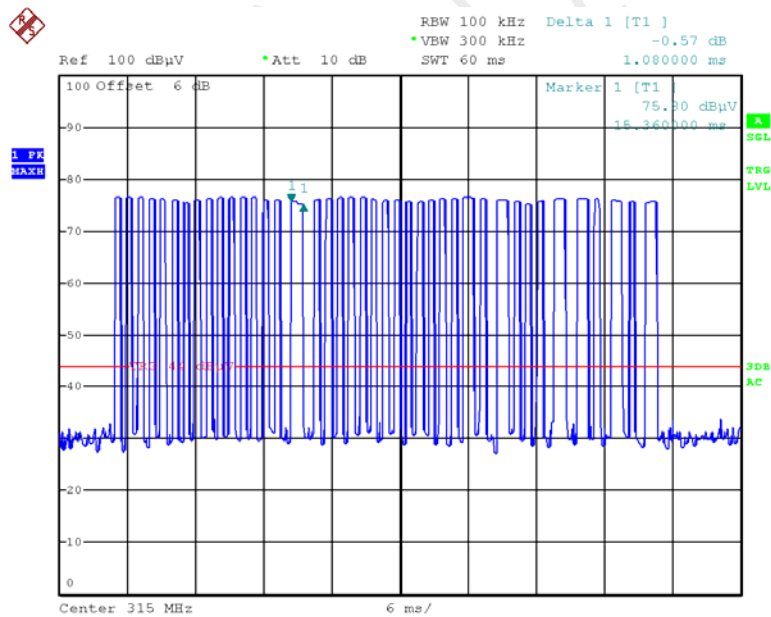
TRF 44 dBuV

3dB AC

Center 315 MHz

6 ms/

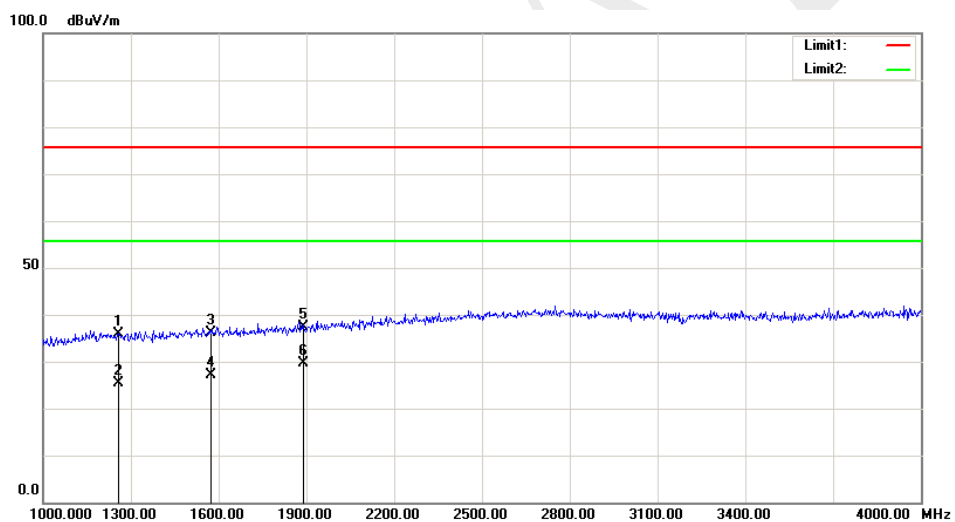
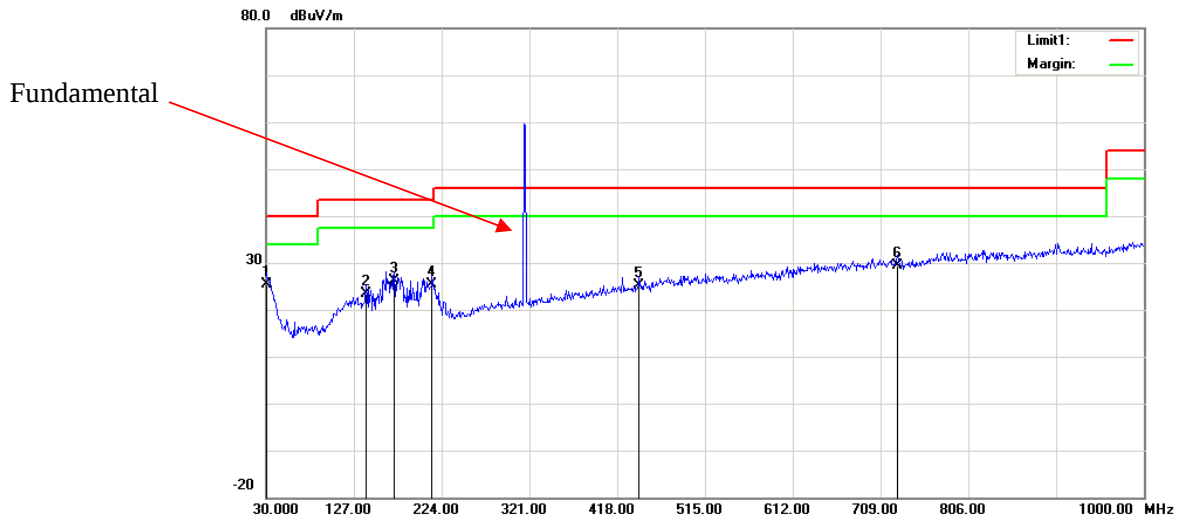
Pulse2 0.96ms *7



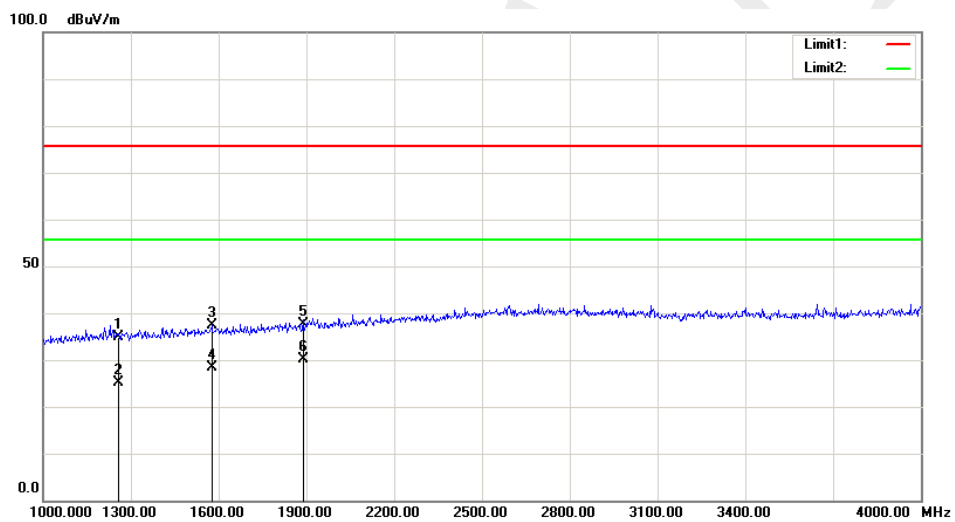
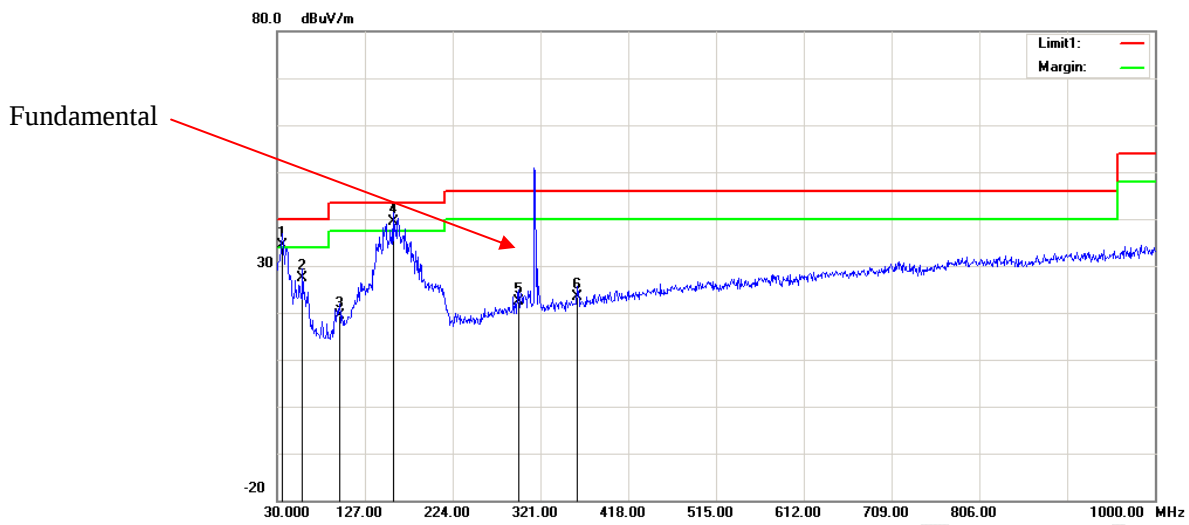
Page 28 of 37

Peak Test plots(Light Down was the worst)

Horizontal:



Vertical:



FCC §15.231(c) – 20 dB BANDWIDTH TESTING

Requirement

Per 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2017-09-01	2018-09-01
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2018-11-10
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05

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

Test Procedure

The waveform was received by the test antenna which was connected to the spectrum analyzer, plot the 20 dB bandwidth.

Test Data

Environmental Conditions

Temperature:	27.2 °C
Relative Humidity:	64 %
ATM Pressure:	100.8 kPa

The testing was performed by Sunny Cen on 2018-05-15.

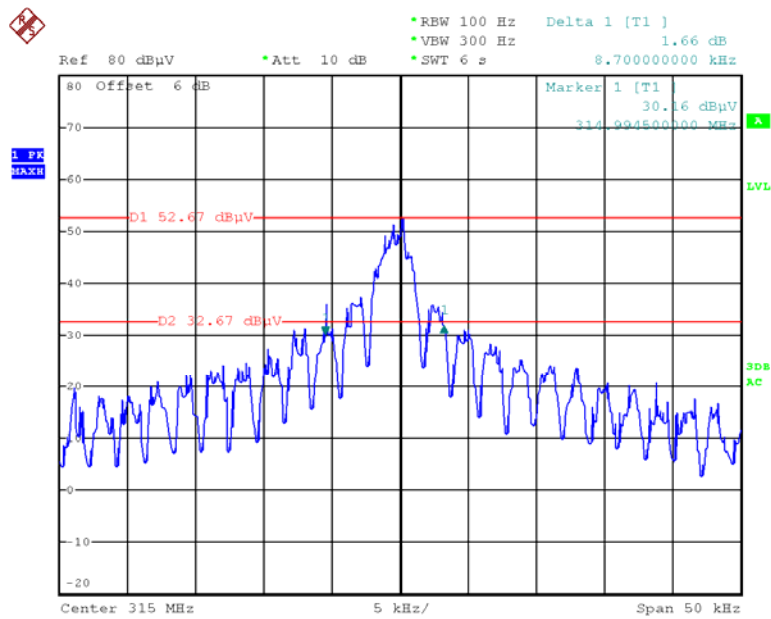
Test Mode: Transmitting

Please refer to following table and plot.

Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (kHz)	Result
315	8.7	787.5	Pass

Note: Limit = 0.25% * Center Frequency = 0.25%*315MHz = 787.5kHz

20 dB Bandwidth



Date: 15.MAY.2018 08:00:28

FCC §15.231(a) - DEACTIVATION TESTING

Applicable Standard

Per 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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2017-09-01	2018-09-01
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2018-11-10
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05

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

Test Data

Environmental Conditions

Temperature:	28.3°C
Relative Humidity:	60%
ATM Pressure:	100.8kPa

The testing was performed by Sunny Cen on 2018-05-15.

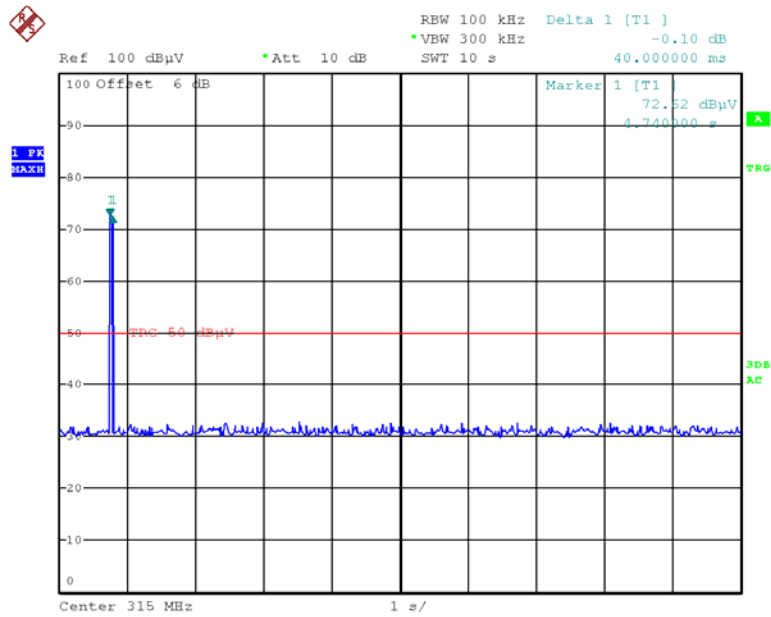
Test Mode: Transmitting

Test Result: Compliance. Please refer to following plot.

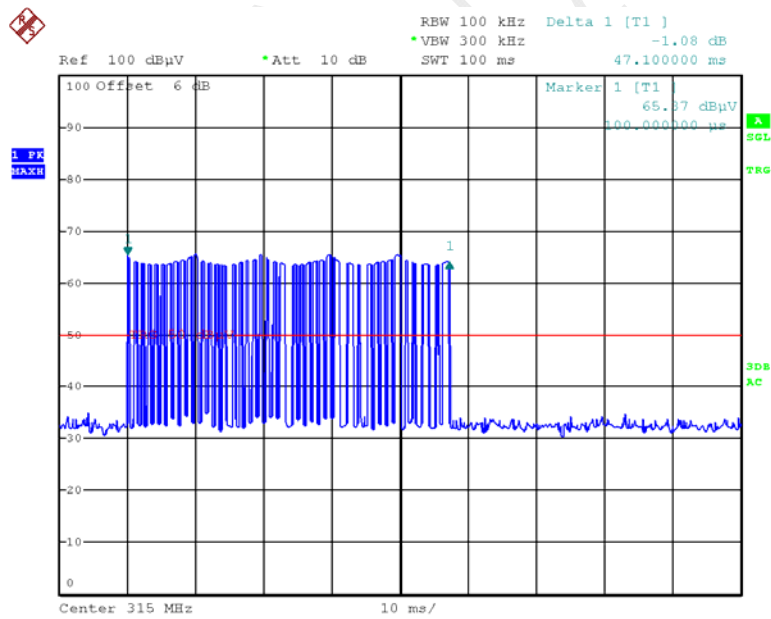
Maximum Deactivate Time (s)	Limit	Result
0.047	<5s	Pass

Note: the 10s test plot only report one key since similar test result per pretest

Light

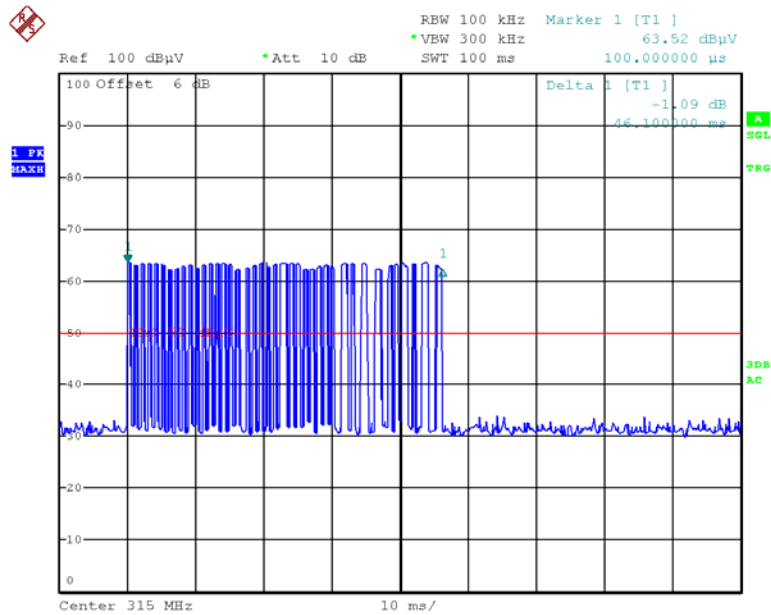


Date: 15.MAY.2018 05:26:23



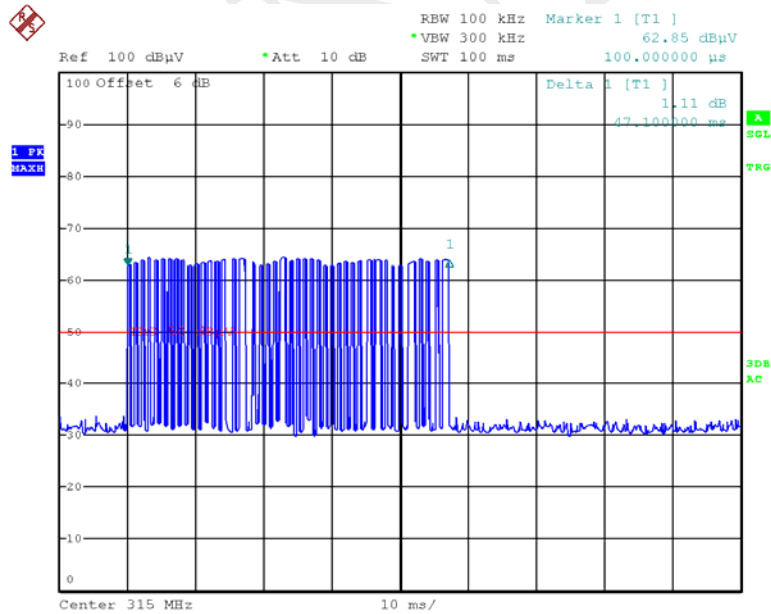
Date: 15.MAY.2018 05:14:36

Light Up



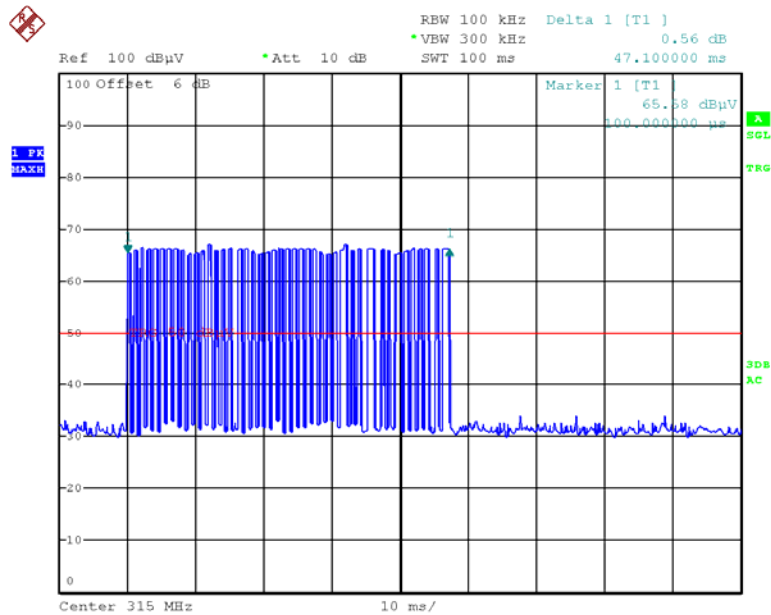
Date: 15.MAY.2018 05:15:16

Light Down



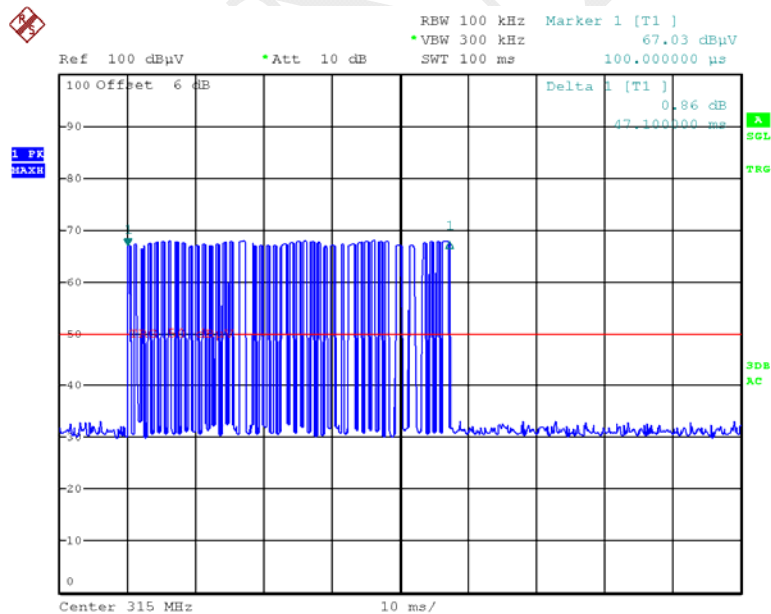
Date: 15.MAY.2018 05:16:05

Fan



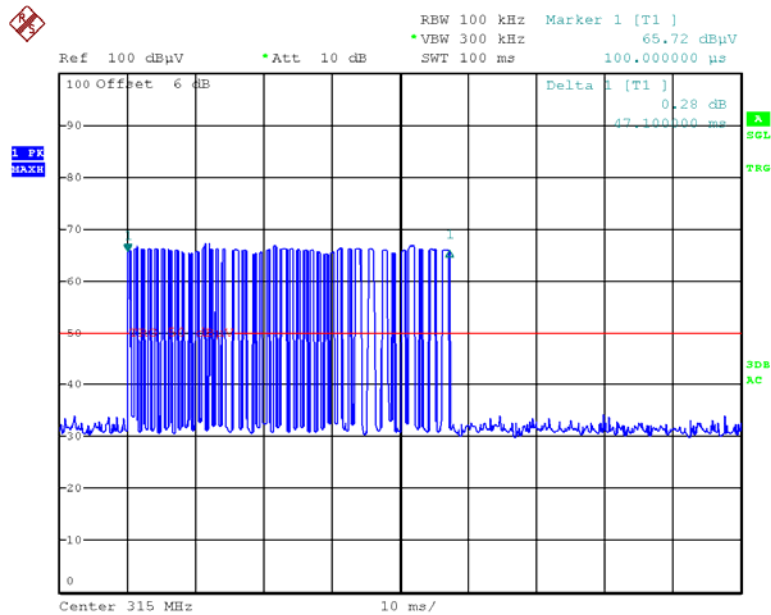
Date: 15.MAY.2018 05:16:57

Fan Up



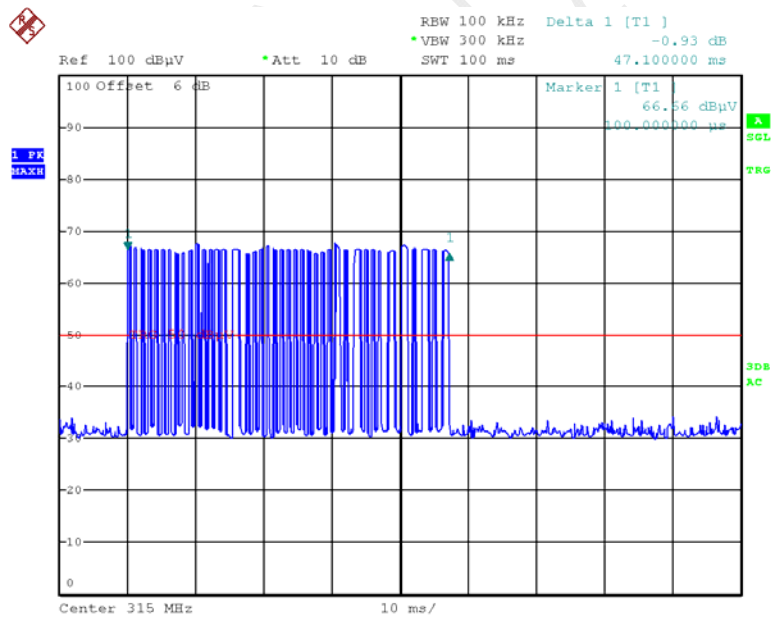
Date: 15.MAY.2018 05:18:00

Fan Down



Date: 15.MAY.2018 05:18:47

Circle



Date: 15.MAY.2018 05:19:40

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