

FCC Radio Test Report

FCC ID: Z2F-DBR06

Report No. : TB-FCC142354
Applicant : Liuyang Happiness Firing System Factory
Equipment Under Test (EUT)
EUT Name : Remote Controller For Fireworks
Model No. : DBR06
Serial No. : Please see the page of 4
Brand Name : Smile Face Fireworks
Receipt Date : 2014-10-27
Test Date : 2014-10-27 to 2012-11-05
Issue Date : 2014-11-07
Standards : FCC Part 15, Subpart C (15.231:2014)
Test Method : ANSI C63.4:2003
Conclusions : **PASS**

In the configuration tested, the EUT complied with the standards specified above,

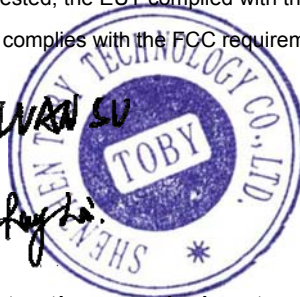
The EUT technically complies with the FCC requirements

Test/Witness Engineer :

WANG SU

Approved& Authorized :

Long Li



This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

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1. General Information about EUT

1.1 Client Information

Applicant	:	Liuyang Happiness Firing System Factory
Address	:	Room 501, NO.148, Laodong Zhong Road, Liuyang City, Hunan, China
Manufacturer	:	Liuyang Happiness Firing System Factory
Address	:	Room 501, NO.148, Laodong Zhong Road, Liuyang City, Hunan, China

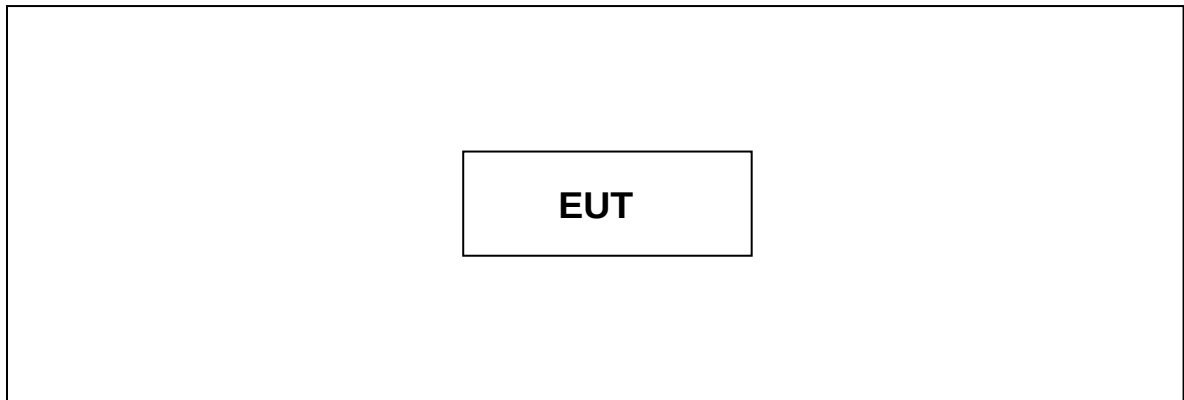
1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	Remote Controller For Fireworks	
Models No.	:	DBR06, DBR06-7, DBR06-14, DBR06-1, DBR06-2, DBR06-3, DBR06-4, DBR06-5, DBR06-6, DBR06-8, DBR06-9, DBR06-10, DBR06-11, DBR06-12, DBR06-13	
Brand Name	:	Smile Face Fireworks	
Model Difference	:	All these models are identical in the same PCB, layout and electrical circuit, the only difference is model name for commercial.	
Product Description	:	Operation Frequency:	433.865 MHz
		Out Power:	85.42 dBuV/m (PK Max.) 77.09 dBuV/m (AV Max.)
		Antenna Gain:	External Antenna(2 dBi)
		Modulation Type:	OOK
Power Supply	:	DC Voltage supplied from battery.	
Power Rating	:	DC Battery: DC 9V	
Connecting I/O Port(S)	:	Please refer to the User's Manual	

Note:

- (1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

1.3 Block Diagram Showing the Configuration of System Tested



1.4 Description of Support Units

The EUT has been tested as an independent unit.

1.5 Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

Test Items	Note
Radiated Emission	Continuously transmitting
Bandwidth	Continuously transmitting
Duty Cycle	Continuously transmitting
Release Time	Normal Mode

Note:

- (1) During the testing procedure, the continuously transmitting mode was programmed by the customer.
- (2) The EUT is considered a portable unit, and it was pre-tested on the positioned of each 3 axis: X axis, Y axis and Z axis. The worst case was found positioned on Z-plane. There for only the test data of this Z-plane were used for radiated emission measurement test.

1.6 Test Facility

The testing was performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at:

1A/F., Bldg.6, Yusheng Industrial Zone, The National Road No.107 Xixiang Section 467, Xixiang, Bao'an, Shenzhen, Guangdong, China.

At the time of testing, the following bodies accredited the Laboratory:

CNAS (L5813)

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

FCC List No.: (811562)

The Laboratory is listed in the United States of American Federal Communications Commission (FCC), and the registration number is 811562.

IC Registration No.: (11950A-1)

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing. The site registration: Site# 11950A-1.

2. Test Summary

FCC Part 15 Subpart (15.231)			
Standard Section	Test Item	Judgment	Remark
15.203	Antenna Requirement	PASS	
15.231	Conducted Emission	N/A	
	Release Time	PASS	
	Radiation Emission	PASS	
	20 dB Bandwidth	PASS	
	Duty Cycle	PASS	
Note: N/A is an abbreviation for Not Applicable.			

3. Conducted Emission Test

3.1 Test Standard and Limit

3.1.1 Test Standard

FCC Part 15.207

3.1.2 Test Limit

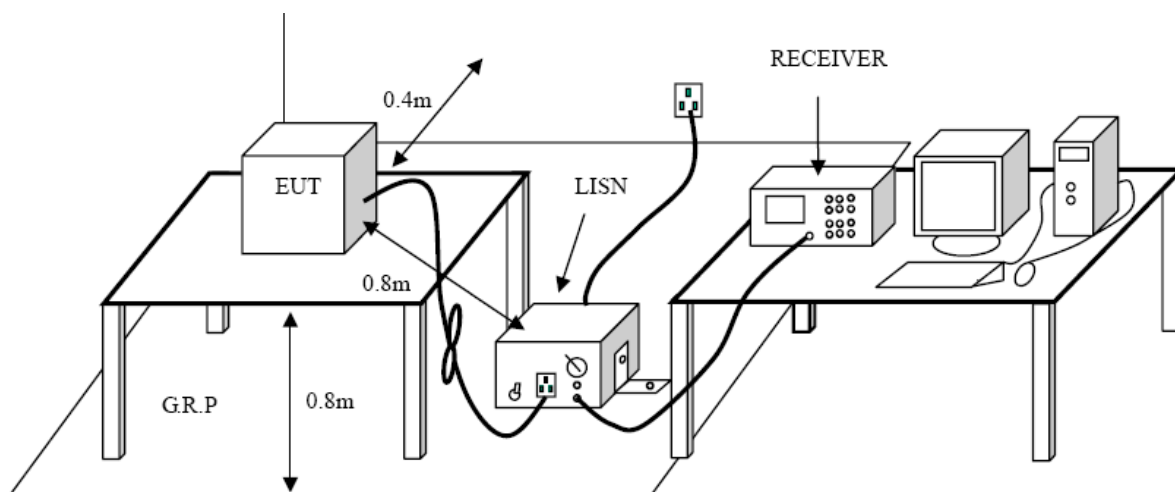
Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dB μ V)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Notes:

- (1) *Decreasing linearly with logarithm of the frequency.
- (2) The lower limit shall apply at the transition frequencies.
- (3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

3.2 Test Setup



3.3 Test Procedure

The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

LISN at least 80 cm from nearest part of EUT chassis.

The bandwidth of EMI test receiver is set at 9kHz, and the test frequency band is from 0.15MHz to 30MHz.

3.4 Test Equipment Used

Description	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due Date
EMI Test Receiver	ROHDE& SCHWARZ	ESCI	100321	Aug. 08, 2014	Aug.07, 2015
50ΩCoaxial Switch	Anritsu	MP59B	X10321	Aug. 08, 2014	Aug.07, 2015
L.I.S.N	Rohde & Schwarz	ENV216	101131	Aug. 08, 2014	Aug.07, 2015
L.I.S.N	SCHWARZBECK	NNBL 8226-2	8226-2/164	Aug. 08, 2014	Aug.07, 2015

3.5 Test Data

The test is not applicable.

4. Radiated Emission Test

4.1 Test Standard and Limit

4.1.1 Test Standard

FCC Part 15.231(a)

4.1.2 Test Limit

According to FCC 15.231(a) requirement:

In addition to the provisions of Section 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 (microvolt/meter) at 3m	Field Strength of Spurious Emissions (microvolt/meter) at 3m
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

** Linear interpolations, the formulas for calculating the maximum permitted fundamental field strengths are as follows:

(1) for the band 130~174 MHz, $\mu\text{V/m}$ at 3 meters= $56.81818(F)-6136.3636$;

(2) for the band 260~470 MHz, $\mu\text{V/m}$ at 3 meter= $41.6667(F)-7083.3333$.

(3) The maximum permitted unwanted emissions level is 20 dB below the maximum permitted fundamental level. In addition field strength of any emissions which appear inside of the restriction band shall not exceed the general radiated emissions limits in Section 15.209(a).

Frequency (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009~0.490	$2400/F(\text{KHz})$	300
0.490~1.705	$2400/F(\text{KHz})$	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3

216~960	200	3
Above 960	500	3

Note:

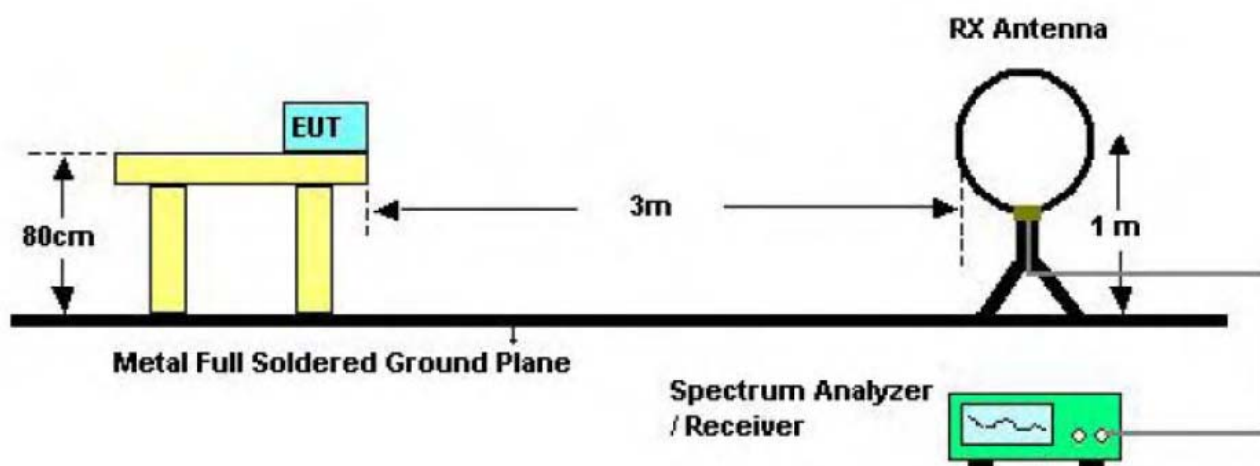
(1) The tighter limit applies at the band edges.

(2) Emission Level(dBuV/m)=20log Emission Level(uV/m)

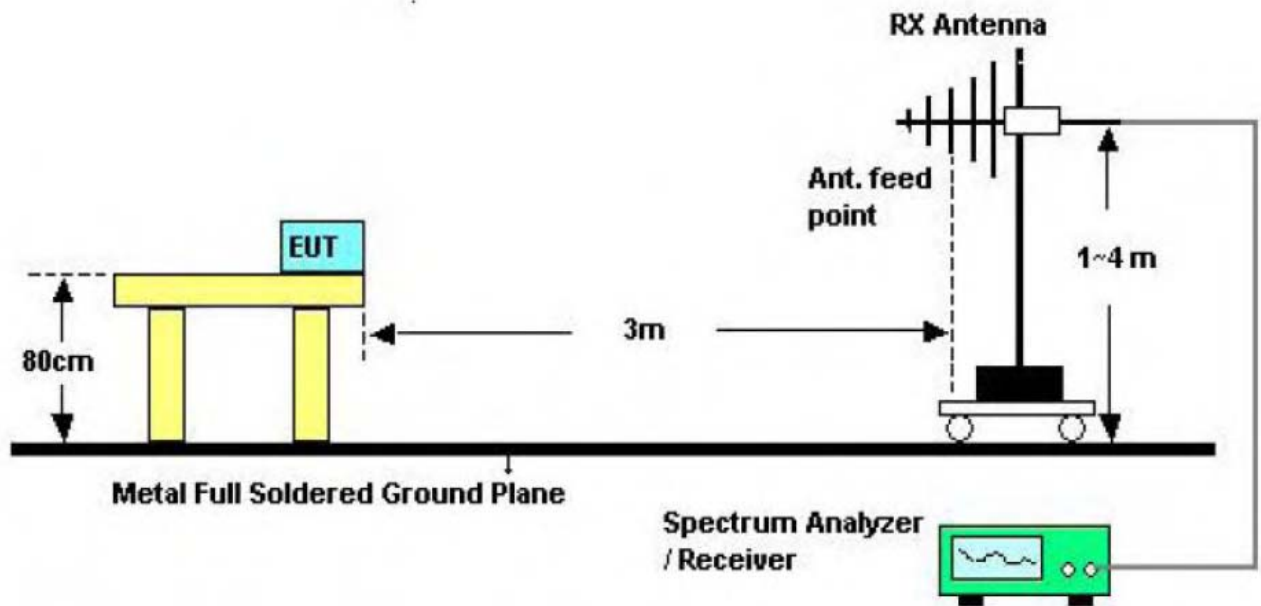
So the field strength of emission limits have been calculated in below table.

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolt/meter) at 3m
433.865 MHz	80.82 (Average)
433.865 MHz	100.82 (Peak)

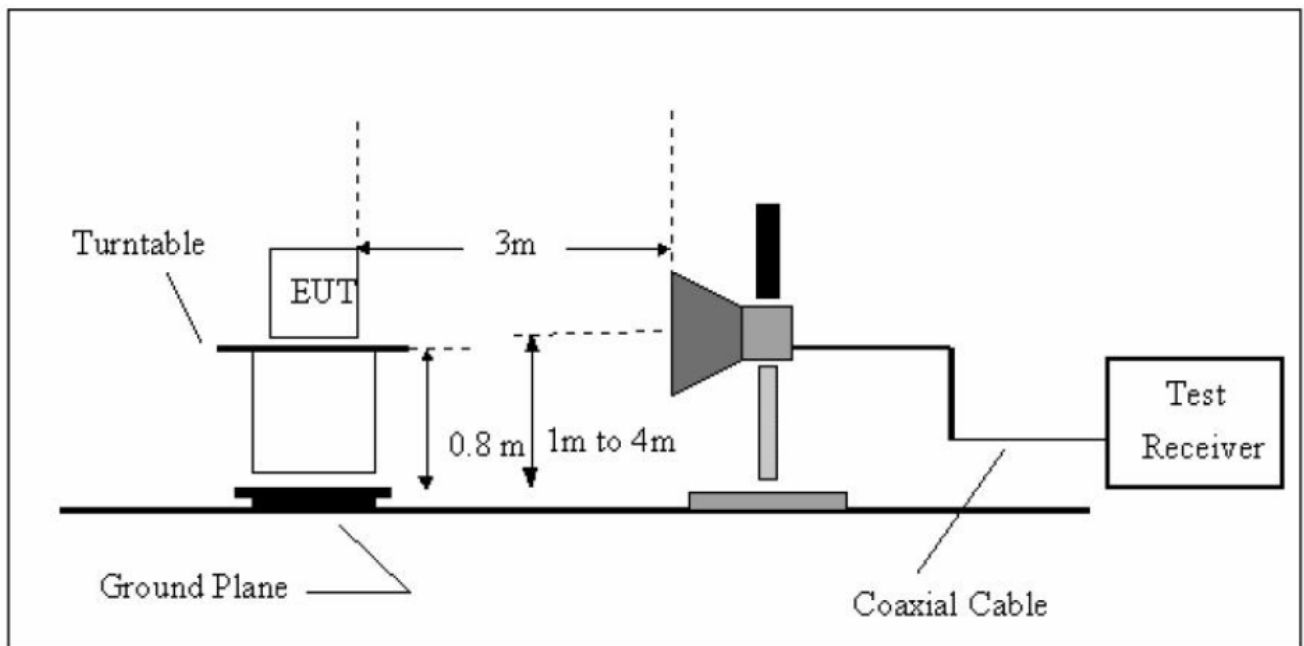
4.2 Test Setup



Bellow 30MHz Test Setup



Bellow 1000MHz Test Setup



Above 1GHz Test Setup

4.3 Test Procedure

- (1) The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1 GHz. The EUT was placed on a rotating 0.8m high above ground, the table was rotated 360 degrees to determine the position of the highest radiation.
- (2) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are

set to make measurement.

- (3) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- (4) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.
- (5) For the actual test configuration, please see the test setup photo.

4.4 EUT Operating Condition

The Equipment Under Test was set to Continual Transmitting in maximum power.

4.5 Test Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Mar. 20, 2014	Mar. 19, 2015
Spectrum Analyzer	Rohde & Schwarz	FSP30	DE25181	Aug. 08, 2014	Aug.07, 2015
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Aug. 08, 2014	Aug.07, 2015
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar. 07, 2014	Mar.06, 2015
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar. 07, 2014	Mar.06, 2015
Pre-amplifier	HP	11909A	185903	Mar. 07, 2014	Mar.06, 2015
Pre-amplifier	HP	8447B	3008A00849	Mar. 07, 2014	Mar.06, 2015
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar. 07, 2014	Mar.06, 2015
Signal Generator	Rohde & Schwarz	SML03	IKW682-054	Feb. 11, 2014	Feb.10, 2015
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A

4.6 Test Condition

Temperature	:	25 °C
Relative Humidity	:	65 %
Pressure	:	1010 hPa
Test Power	:	DC 9V

4.7 Test Data

Radiated Emission Bellow 1 GHz

Freq. (MHz)	Ant.Pol. H/V	Emission Leve (dBuV/m)	Limit 3m (dBuV/m)	Margin (dB)	Note
34.5170	H	10.64	40.00	29.36	PK
159.7844	H	8.23	43.50	35.27	PK
393.4723	H	14.61	46.00	31.39	PK
528.2458	H	18.60	46.00	27.40	PK
711.6734	H	21.18	46.00	24.82	PK
932.2713	H	23.01	46.00	22.99	PK
35.1278	V	10.31	40.00	26.69	PK
100.9338	V	5.97	43.50	37.53	PK
150.0107	V	10.13	43.50	33.37	PK
226.8934	V	18.27	46.00	27.73	PK
280.0237	V	14.70	46.00	31.30	PK
896.4832	V	22.28	46.00	23.72	PK

- Note:**
- (1) All Readings are Peak Value.
 - (2) Emission Level= Reading Level+ Probe Factor +Cable Loss
 - (3) The QP measurement was not performed when the peak measured data under the limit of QP detection.

Fundamental and Harmonics emissions

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
434.0651	V	82.15	73.82	100.82	80.82	18.67	7.00
869.1302	V	59.89	51.56	80.82	60.82	20.93	9.26
1300.000	V	53.45	45.12	74.00	54.00	10.55	8.88
1735.000	V	49.33	41.00	74.00	54.00	24.67	13.98
2166.010	V	48.35	40.02	74.00	54.00	25.65	13.98
2601.280	V	45.37	37.04	74.00	54.00	28.63	16.96
---	V	---	---	74.00	54.00	---	---
---	V	---	---	74.00	54.00	---	---
---	V	---	---	74.00	54.00	---	---
---	V	---	---	74.00	54.00	---	---
434.0651	H	85.42	77.09	100.82	80.82	15.4	3.73
869.1302	H	63.27	54.94	80.82	60.82	17.55	5.88
1300.000	H	56.98	48.65	74.00	54.00	17.02	5.35
1735.000	H	48.77	40.44	74.00	54.00	25.23	16.98
2166.010	H	45.35	37.02	74.00	54.00	28.65	16.98
2601.280	H	41.95	33.62	74.00	54.00	32.05	20.38
---	H	---	---	74.00	54.00	---	---
---	H	---	---	74.00	54.00	---	---
---	H	---	---	74.00	54.00	---	---
---	H	---	---	74.00	54.00	---	---

Other harmonics emissions are lower than 20dB below the allowable limit.

- Note:**
- (1) All Readings are Peak Value and AV. And AV is calculated by the following:
Average =Peak Value + 20log(Duty Cycle), Final AV=PK-8.33
 - (2) Emission Level= Reading Level + Probe Factor +Cable Loss
 - (3) Data of measurement within this frequency range shown “ -- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

Pulse Desensitization Correction Factor

Note:

(1) The Total Pulse Width (PW) = 17.85 ms

(2) $2/PW = 2/17.85 \text{ (ms)} = 0.112 \text{ kHz} < 100 \text{ kHz}$

Because $2/PW < RBW$, so the PDCF is not needed.

5. Bandwidth

5.1 Test Standard and Limit

5.1.1 Test Standard

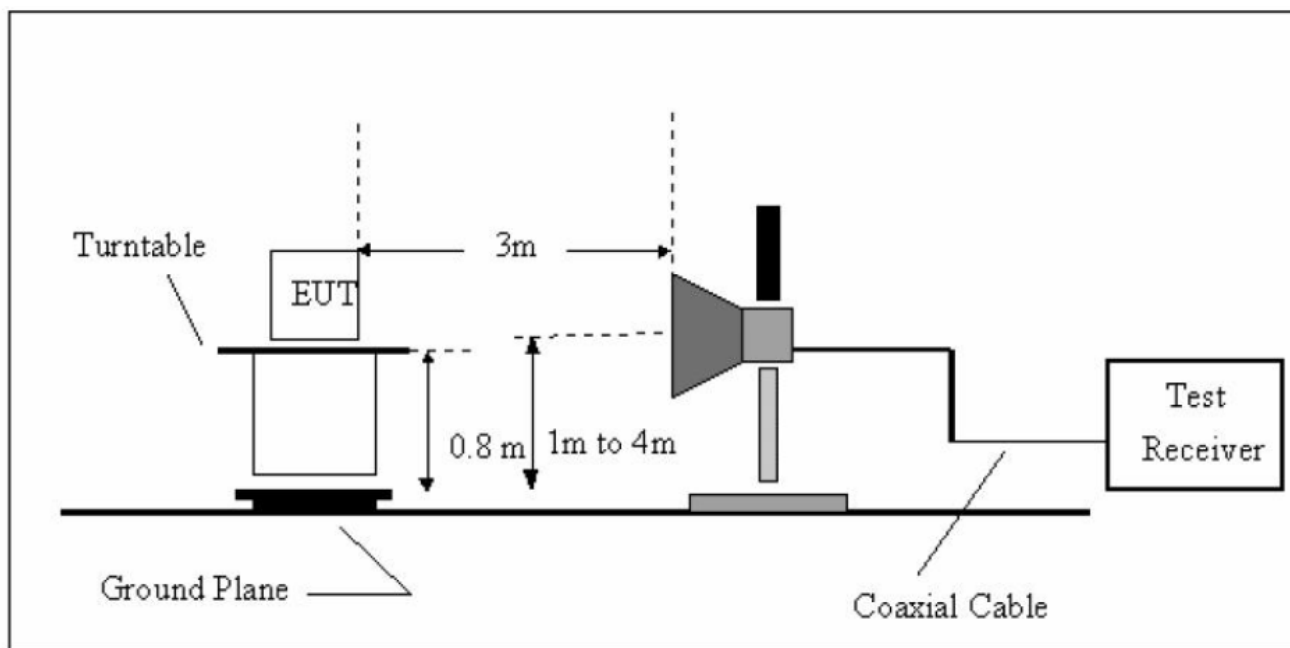
FCC Part 15.231

5.1.2 Test Limit

The bandwidth of the emissions shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. So the emission bandwidth limits have been calculated in below table.

Fundamental Frequency	20 dB Bandwidth Limits (MHz)
433.865 MHz	1.084

5.2 Test Setup



5.3 Test Procedure

- (1) Set Spectrum Analyzer Center Frequency= Fundamental Frequency, RBW=10 kHz, VBW= 30 kHz, Span= 1 MHz.
- (2) Measured the spectrum width with power higher than 20 dB below carrier.

5.4 EUT Operating Condition

The Equipment Under Test was Programmed to be in continuously transmitting mode.

5.5 Test Equipment

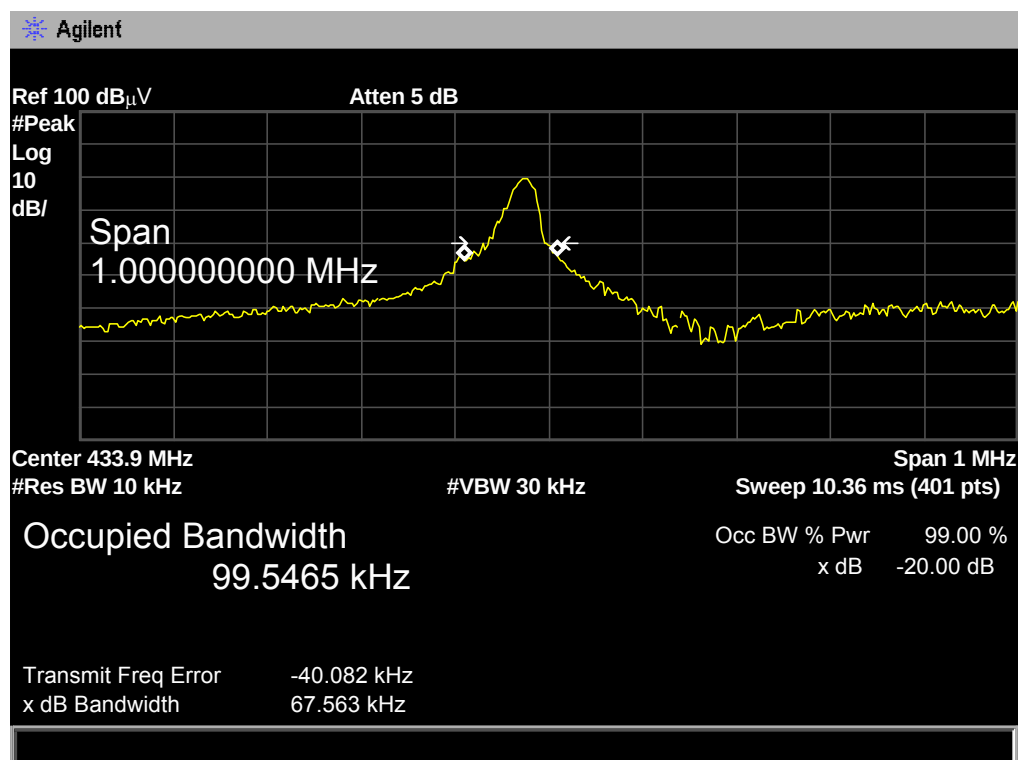
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Mar. 20, 2014	Mar. 19, 2015
Spectrum Analyzer	Rohde & Schwarz	FSP30	DE25181	Aug. 08, 2014	Aug.07, 2015
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Aug. 08, 2014	Aug.07, 2015
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar. 07, 2014	Mar.06, 2015
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar. 07, 2014	Mar.06, 2015
Pre-amplifier	HP	11909A	185903	Mar. 07, 2014	Mar.06, 2015
Pre-amplifier	HP	8447B	3008A00849	Mar. 07, 2014	Mar.06, 2015
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar. 07, 2014	Mar.06, 2015
Signal Generator	Rohde & Schwarz	SML03	IKW682-054	Feb. 11, 2014	Feb.10, 2015
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A

5.6 Test Condition

Temperature	:	25 °C
Relative Humidity	:	65 %
Pressure	:	1010 hPa
Test Power	:	DC 9V

5.7 Test Data

Frequency (MHz)	20 dBc Bandwidth (kHz)	Result
433.865	67.563	PASS



6. Release Time Measurement

6.1 Test Standard and Limit

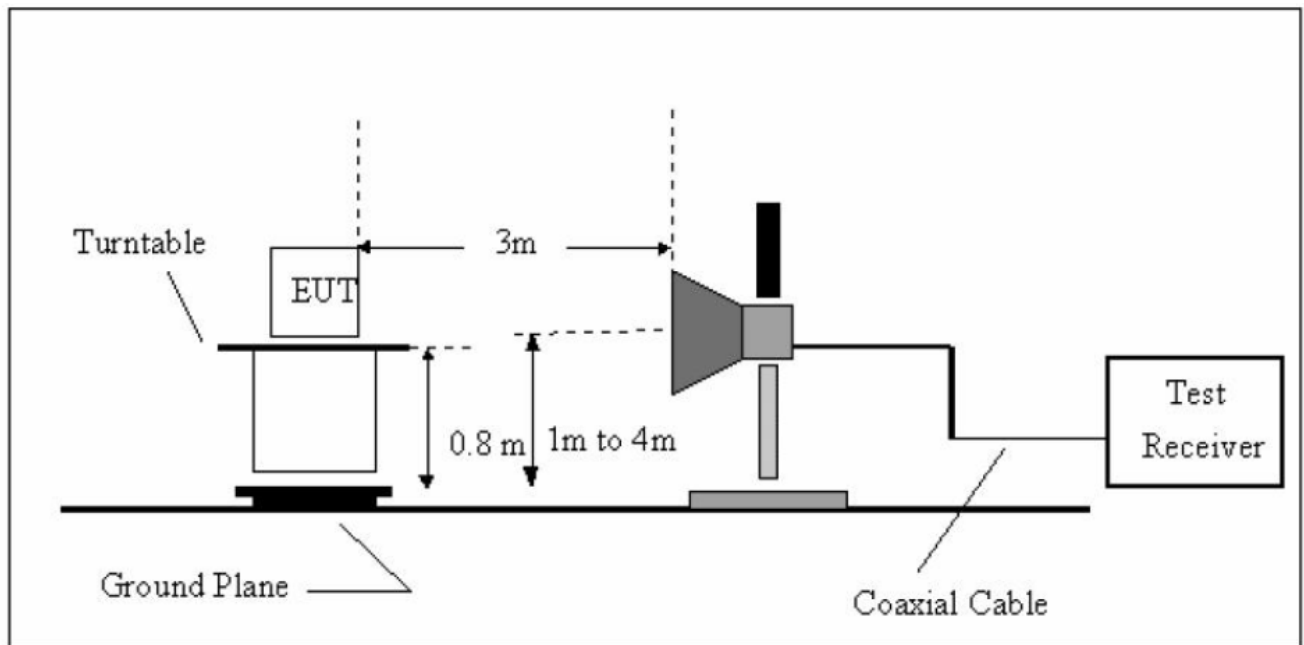
5.1.1 Test Standard

FCC Part 15.231 (a)(1)

5.1.2 Test Limit

According to FCC Part 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.

6.2 Test Setup



6.3 Test Procedure

- (1) Setup the EUT as show in the block diagram above.
- (2) Set Spectrum Analyzer Centre Frequency= Fundamental Frequency, RBW=100 kHz, VBW= 100 kHz, Span= 0 Hz. Sweep Time= 5 Seconds.
- (3) Setup the EUT as normal operation and press Transmitter button.
- (4) Set Spectrum Analyzer View, Delta Mark time.

6.4 EUT Operating Condition

The EUT was set to work in transmitting mode.

6.5 Test Equipment

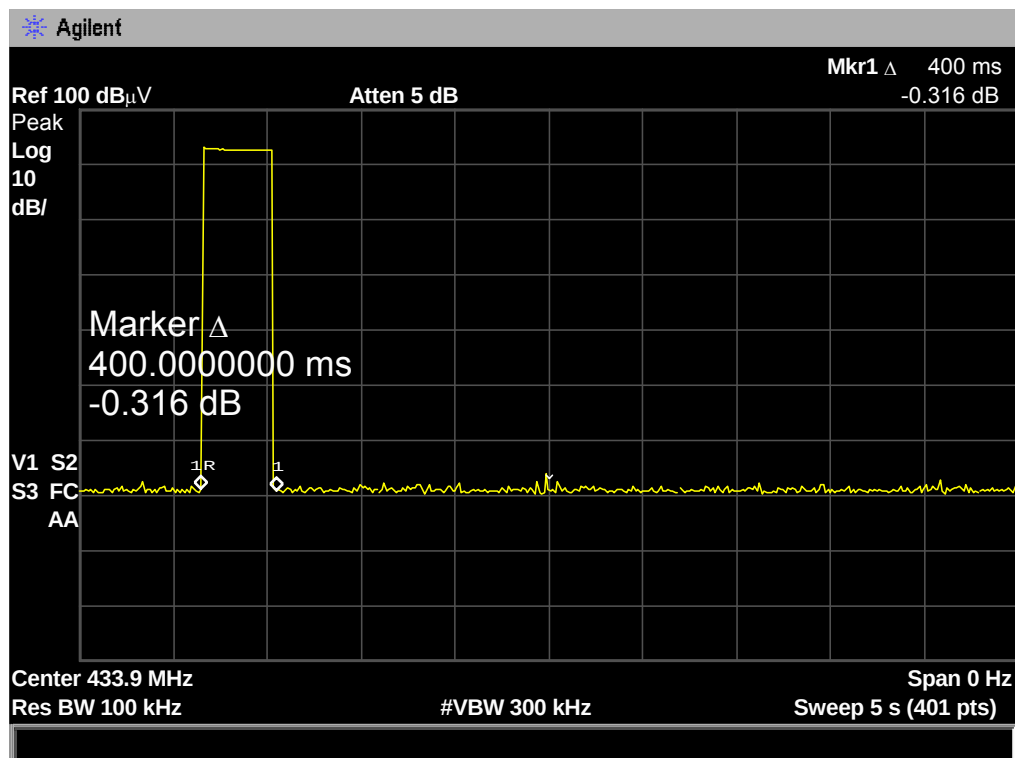
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
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Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A

6.6 Test Condition

Temperature	:	25 °C
Relative Humidity	:	65 %
Pressure	:	1010 hPa
Test Power	:	DC 9V

6.7 Test Data

Release Time (s)	Limit (s)	Result
0.4	5	PASS

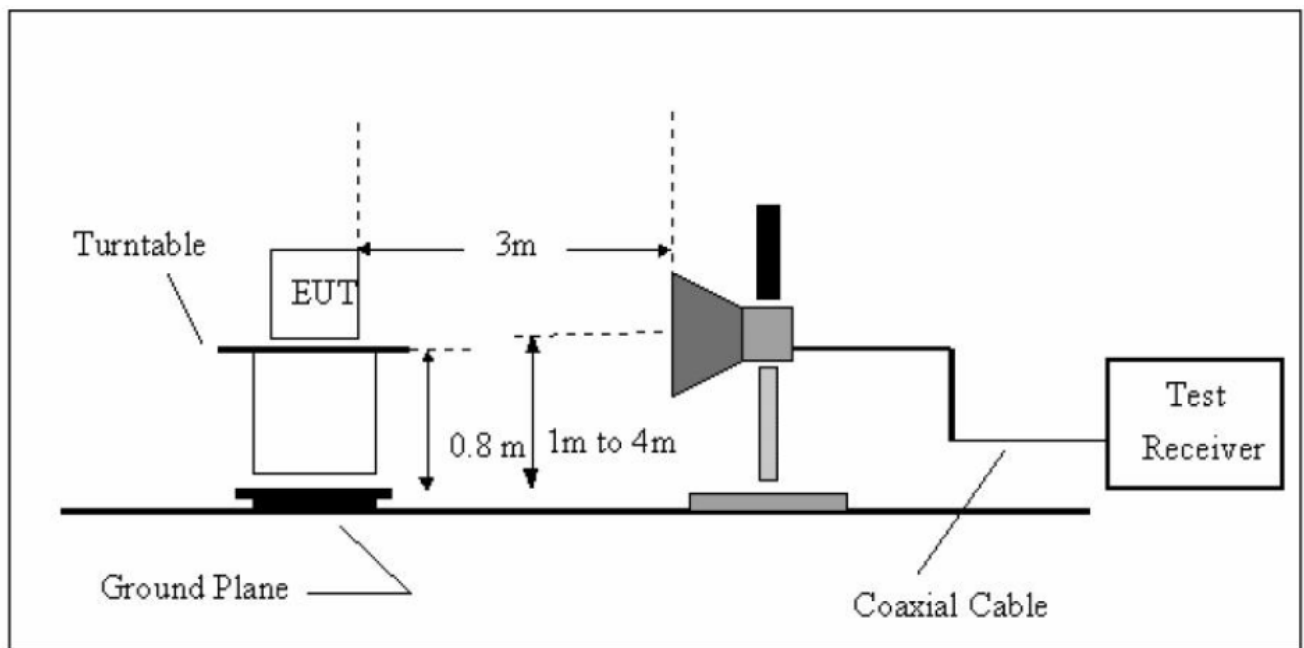


7. Duty Cycle

7.1 Test Standard and Limit

5.1.1 Test Standard
FCC Part 15.231

7.2 Test Setup



7.3 Test Procedure

- (1) The EUT was placed on a turntable which is 0.8m above ground plane.
- (2) Set EUT operating in continuous transmitting mode.
- (3) Set the Spectrum Analyzer to the transmitter carrier frequency, and set the spectrum analyzer resolution bandwidth (RBW) to 100 kHz and video bandwidth (VBW) to 300 kHz, Span was set to 0 Hz.
- (4) The Duty Cycle was measured and recorded.

7.4 EUT Operating Condition

The EUT was programmed to be in transmitting mode.

7.5 Test Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Mar. 20, 2014	Mar. 19, 2015
Spectrum Analyzer	Rohde & Schwarz	FSP30	DE25181	Aug. 08, 2014	Aug.07, 2015
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Aug. 08, 2014	Aug.07, 2015
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Cable	HUBER+SUHNER	100	SUCOFLEX	Mar. 07, 2014	Mar.06, 2015
Signal Generator	Rohde & Schwarz	SML03	IKW682-054	Feb. 11, 2014	Feb.10, 2015
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A

7.6 Test Condition

Temperature	:	25 °C
Relative Humidity	:	65 %
Pressure	:	1010 hPa
Test Power	:	DC 9V

7.7 Test Data

Please refer the following pages:

Plot 1: transmit once in 100ms, and each cycle is 46.60 ms

Plot 2: there are two kinds of pulse in each cycle, the large pulses total 10, the small pulses total 15

Plot 3: one large pulse in a time period of 1.14 ms

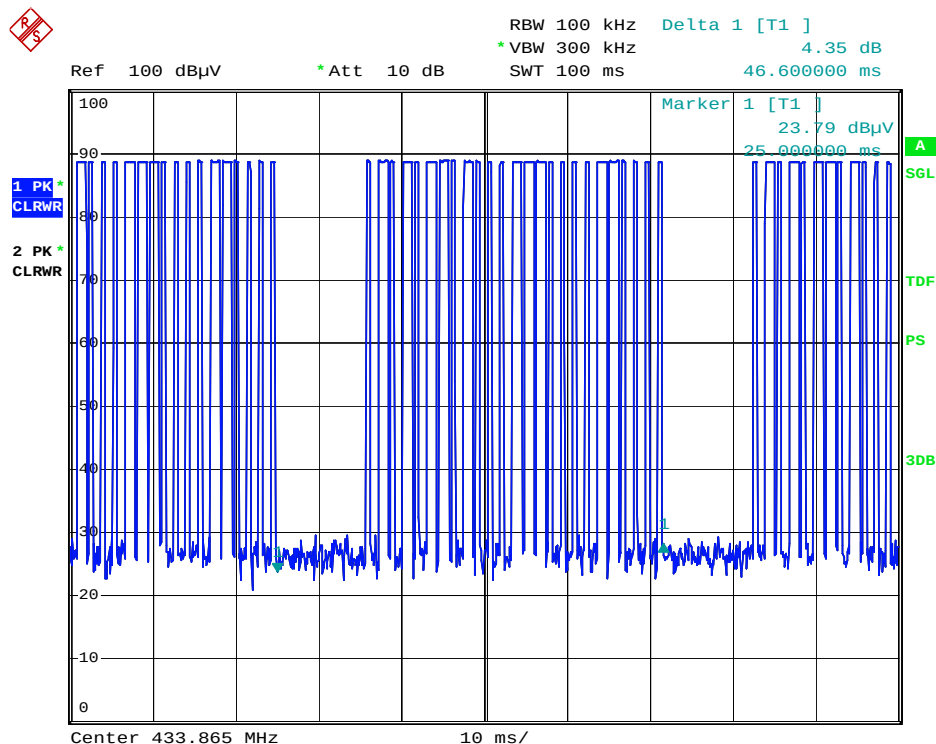
Plot 4: one small pulse in a time period of 0.43 ms.

Duty Cycle=ON/Total=(10*1.14+15*0.43)/46.6=17.85/46.6=38.3%

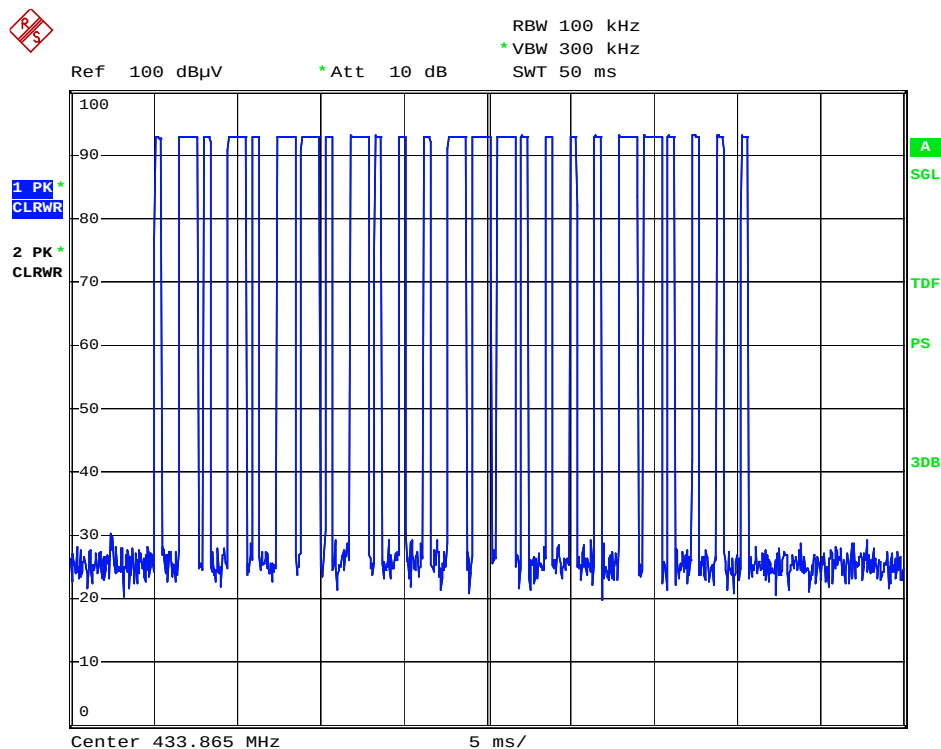
20 log(Duty Cycle)=-8.33

Average=Peak value+ 20log(Duty Cycle), AV=PK-8.33

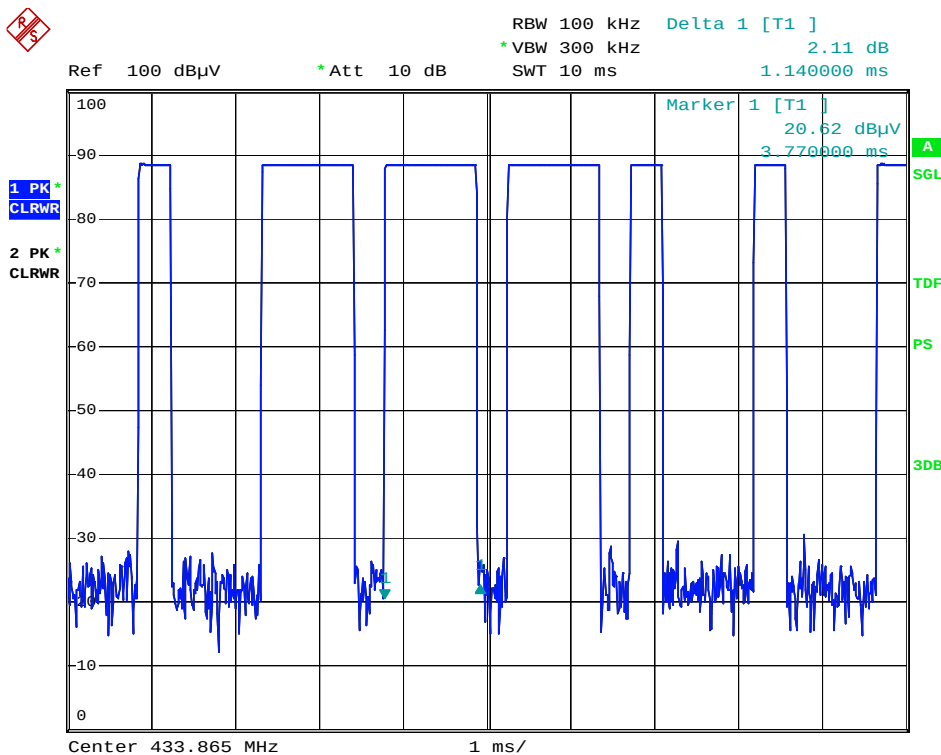
Plot 1



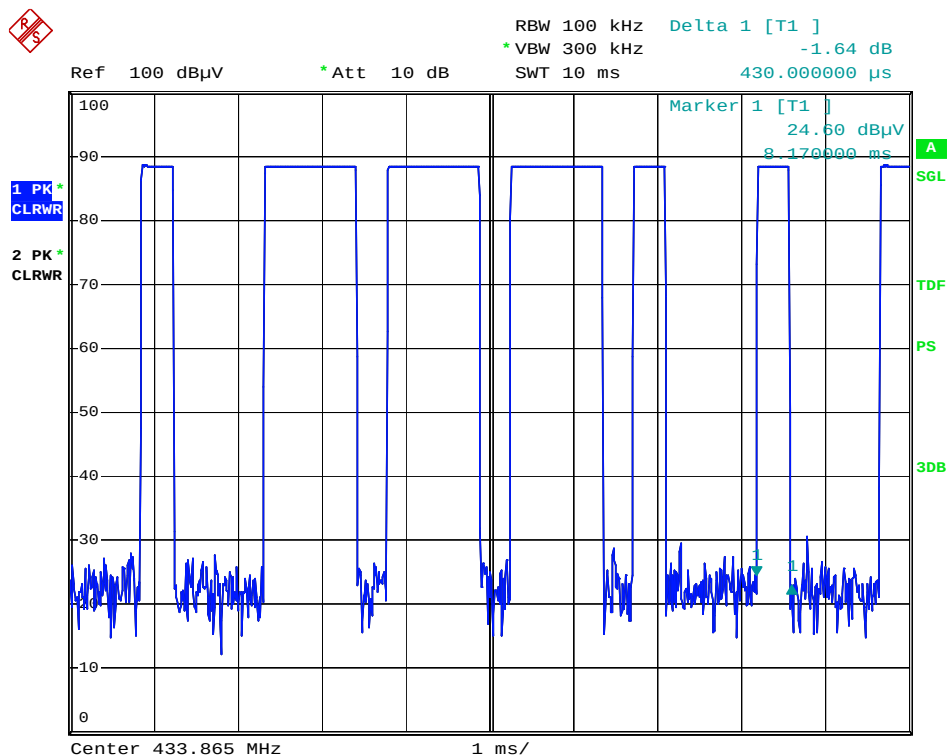
Plot 2



Plot 3



Plot 4



8. Antenna Requirement

8.1 Standard Requirement

11.1.1 Standard

FCC Part 15.203

11.1.2 Requirement

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.

8.2 Antenna Connected Construction

The directional gains of the antenna used for transmitting is 2 dBi, and the antenna connector is de-signed with permanent attachment and no consideration of replacement. Please see the EUT photo for details.

8.3 Result

The EUT antenna is an External Antenna. It complies with the standard requirement.