

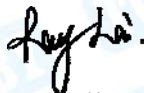
FCC Radio Test Report

FCC ID: 2ANBD-201

Report No. : TB-FCC156348
Applicant : Brightswitch, Inc
Equipment Under Test (EUT)
EUT Name : Brightswitch 201
Model No. : 201
Serial Model No. : N/A
Brand Name : Bright switch
Receipt Date : 2017-06-22
Test Date : 2017-06-23 to 2017-07-01
Issue Date : 2017-07-02
Standards : FCC Part 15, Subpart C (15.249: 2016)
Test Method : ANSI C63.10: 2013
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 : 

Approved & Authorized : 



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.

Contents

CONTENTS.....	2
1. GENERAL INFORMATION ABOUT EUT	3
1.1 Client Information.....	3
1.2 General Description of EUT (Equipment Under Test)	3
1.3 Block Diagram Showing the Configuration of System Tested.....	4
1.4 Description of Support Units	4
1.5 Description of Test Mode.....	4
1.6 Description of Test Software Setting	5
1.7 Measurement Uncertainty	5
1.8 Test Facility.....	6
2. TEST SUMMARY.....	7
3. TEST EQUIPMENT.....	8
4. CONDUCTED EMISSION TEST	9
4.1 Test Standard and Limit.....	9
4.2 Test Setup.....	9
4.3 Test Procedure.....	10
4.4 EUT Operating Mode	10
4.5 Test Data.....	10
5. RADIATED EMISSION TEST	11
5.1 Test Standard and Limit.....	13
5.2 Test Setup.....	14
5.3 Test Procedure.....	15
5.4 EUT Operating Condition	16
5.5 Test Data.....	16
6. BANDWIDTH TEST.....	23
6.1 Test Setup.....	23
6.2 Test Procedure.....	23
6.3 EUT Operating Condition	23
6.4 Test Data.....	23
7. ANTENNA REQUIREMENT.....	25
7.1 Standard Requirement.....	25
7.2 Antenna Connected Construction	25
7.3 Result.....	25

1. General Information about EUT

1.1 Client Information

Applicant : Brightswitch, Inc
Address : 2437 Twin Knolls Dr., # 1, Bend, Oregon, USA 97701
Manufacturer : Brightswitch, Inc
Address : 2437 Twin Knolls Dr., # 1, Bend, Oregon, USA 97701

1.2 General Description of EUT (Equipment Under Test)

EUT Name	:	Brightswitch 201	
Models No.	:	201	
Product Description	Out Power:	75.75dBuV/m@3m Quasi Peak	
	Antenna Gain:	2dBi Internal Antenna	
	Modulation Type:	GFSK	
Power Supply	:	DC Voltage supplied by AC/DC Adapter	
Power Rating	:	AD/DC Adapter Model(201) Input: AC 120V/60Hz Output: 5V/1.5A	
Connecting I/O Port(S)	:	Please refer to the User's Manual	

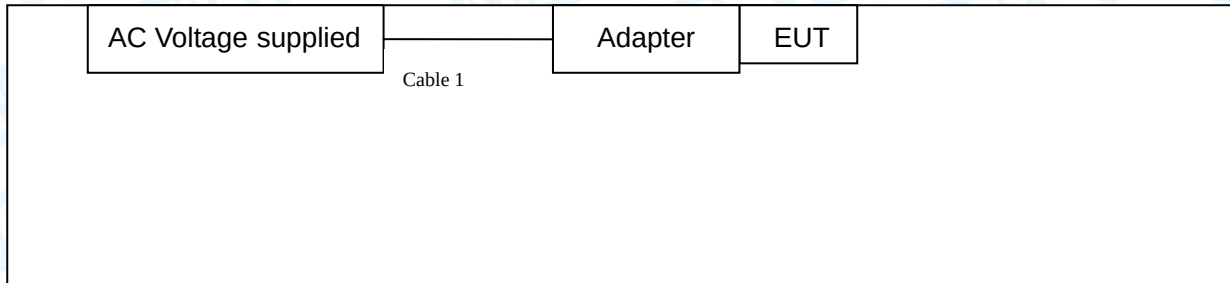
Note:

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

RF General Information				
Frequency Range (MHz)	Modulation	Ch. Frequency (MHz)	Channel Number	Fundamental Field Strength (dBuV/m)
902-928	GFSK	908.4	1	75.75
Note 1: Field strength performed quasi peak level at 3m.				

1.3 Block Diagram Showing the Configuration of System Tested

TX Mode



1.4 Description of Support Units

Equipment Information				
Name	Model	FCC ID/VOC	Manufacturer	Used “√”
Cable Information				
Number	Shielded Type	Ferrite Core	Length	Note
Cable 1	NO	NO	1.3M	

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.

For Conducted Test	
Final Test Mode	Description
Mode 1	Z-wave-Transmit Mode
For Radiated Test	
Final Test Mode	Description
Mode 2	Z-wave-Transmit Mode

Note:

For all test, we have verified the construction and function in typical operation. And all the test modes were carried out with the EUT in transmitting operation in maximum power with all kinds of data rate.

(1)According to ANSI C63.10 standards, the measurements are performed at the highest, middle, lowest available channels.

(2)During the testing procedure, the continuously transmitting with the maximum power

mode was programmed by the customer.

- (3) The EUT is considered a portable unit; it was pre-tested on the positioned of each 3 axis, X-plane, Y-plane and Z-plane. The worst case was found positioned on X-plane. Therefore only the test data of this X-plane was used for radiated emission measurement test.

1.6 Description of Test Software Setting

During testing channel & Power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of RF mode.

Test Software Version	N/A
Frequency	908.4MHz
GFSK	DEF

1.7 Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

Test Item	Parameters	Expanded Uncertainty (U_{Lab})
Conducted Emission	Level Accuracy: 9kHz~150kHz 150kHz to 30MHz	± 3.42 dB ± 3.42 dB
Radiated Emission	Level Accuracy: 9kHz to 30 MHz	± 4.60 dB
Radiated Emission	Level Accuracy: 30MHz to 1000 MHz	± 4.40 dB
Radiated Emission	Level Accuracy: Above 1000MHz	± 4.20 dB

1.8 Test Facility

The testing report were 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 C(15.249)			
Standard Section	Test Item	Judgment	Remark
15.203	Antenna Requirement	PASS	N/A
15.205	Restricted Bands	PASS	N/A
15.207	AC Power Conducted Emission	PASS	N/A
15.249 &15.209	Radiated Spurious Emission	PASS	N/A
15.215(C)	20dB Bandwidth	PASS	N/A
Note: N/A is an abbreviation for Not Applicable.			

3. Test Equipment

Conducted Emission Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100321	Jul. 22, 2016	Jul. 21, 2017
RF Switching Unit	Compliance Direction Systems Inc	RSU-A4	34403	Jul. 22, 2016	Jul. 21, 2017
AMN	SCHWARZBECK	NNBL 8226-2	8226-2/164	Jul. 22, 2016	Jul. 21, 2017
LISN	Rohde & Schwarz	ENV216	101131	Jul. 22, 2016	Jul. 21, 2017
Radiation Emission Test					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 22, 2016	Jul. 21, 2017
EMI Test Receiver	Rohde & Schwarz	ESPI	100010/007	Jul. 22, 2016	Jul. 21, 2017
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar. 25, 2017	Mar. 24, 2018
Bilog Antenna	ETS-LINDGREN	3142E	00117542	Mar. 25, 2017	Mar. 24, 2018
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar. 25, 2017	Mar. 24, 2018
Horn Antenna	ETS-LINDGREN	3117	00143209	Mar. 25, 2017	Mar. 24, 2018
Loop Antenna	Laplace instrument	RF300	0701	Mar. 25, 2017	Mar. 24, 2018
Pre-amplifier	Sonoma	310N	185903	Mar. 24, 2017	Mar. 23, 2018
Pre-amplifier	HP	8449B	3008A00849	Mar. 29, 2017	Mar. 28, 2018
Cable	HUBER+SUHNER	100	SUCOFLEX	Mar. 29, 2017	Mar. 28, 2018
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A
Antenna Conducted Emission					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Jul. 22, 2016	Jul. 21, 2017
Spectrum Analyzer	Rohde & Schwarz	ESCI	100010/007	Jul. 22, 2016	Jul. 21, 2017
Power Meter	Anritsu	ML2495A	25406005	Jul. 22, 2016	Jul. 21, 2017
Power Sensor	Anritsu	ML2411B	25406005	Jul. 22, 2016	Jul. 21, 2017

4. Conducted Emission Test

4.1 Test Standard and Limit

4.1.1 Test Standard

FCC Part 15.207

4.1.2 Test Limit

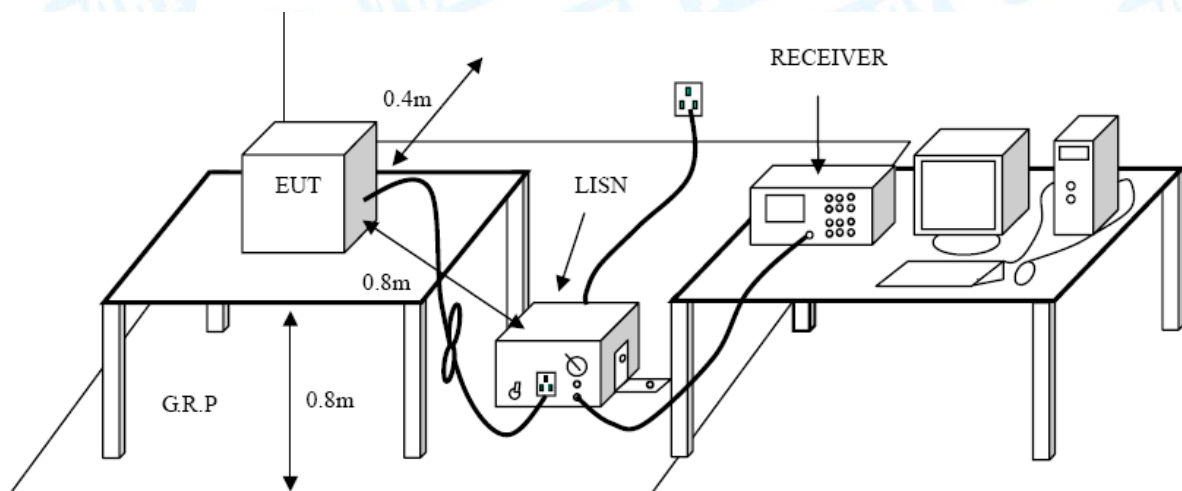
Conducted Emission Test Limit

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.

4.2 Test Setup



4.3 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 is 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.

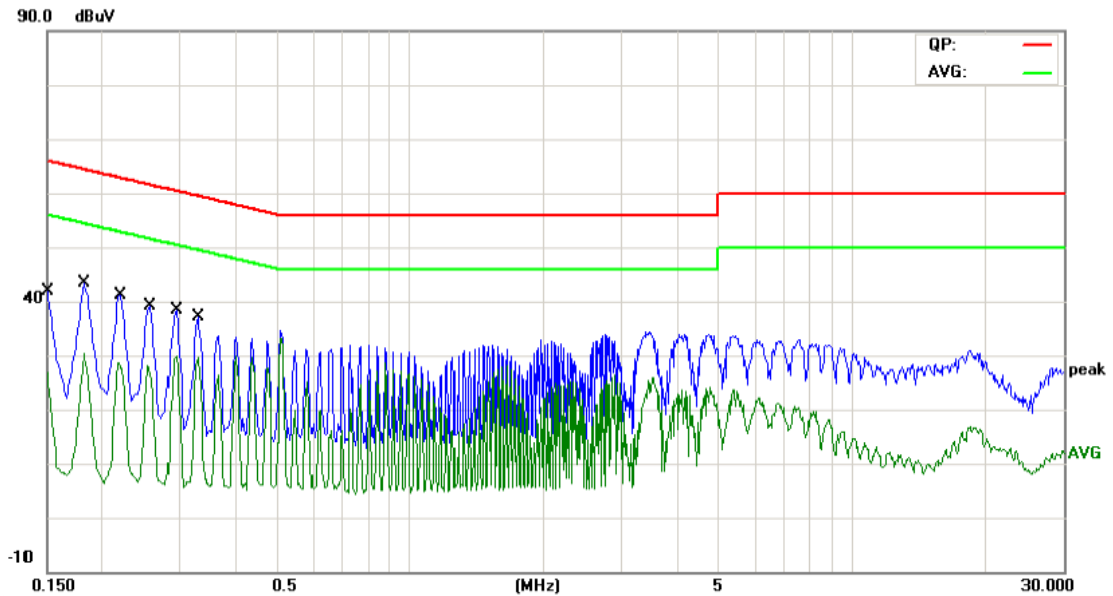
4.4 EUT Operating Mode

Please refer to the description of test mode.

4.5 Test Data

Please see the next page.

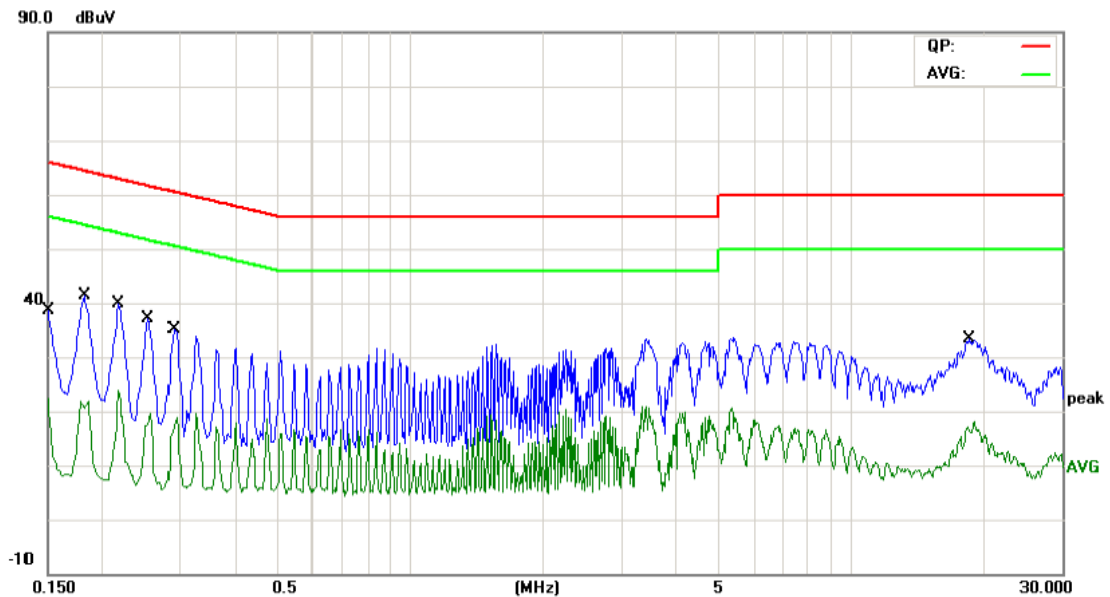
EUT:	Brightswitch 201	Model Name :	201
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Terminal:	Line		
Test Mode:	Charging with TX Mode		
Remark:	Only worse case is reported		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1499	-8.67	9.58	0.91	66.00	-65.09	QP
2		0.1499	-10.52	9.58	-0.94	56.00	-56.94	AVG
3		0.1819	31.57	9.58	41.15	64.39	-23.24	QP
4		0.1819	19.46	9.58	29.04	54.39	-25.35	AVG
5		0.2220	25.77	9.58	35.35	62.74	-27.39	QP
6		0.2220	15.71	9.58	25.29	52.74	-27.45	AVG
7		0.2580	24.05	9.59	33.64	61.49	-27.85	QP
8		0.2580	15.40	9.59	24.99	51.49	-26.50	AVG
9		0.2940	26.35	9.59	35.94	60.41	-24.47	QP
10	*	0.2940	20.25	9.59	29.84	50.41	-20.57	AVG
11		0.3300	22.54	9.59	32.13	59.45	-27.32	QP
12		0.3300	18.51	9.59	28.10	49.45	-21.35	AVG

Emission Level= Read Level+ Correct Factor

EUT:	Brightswitch 201	Model Name :	201
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Terminal:	Neutral		
Test Mode:	Charging with TX Mode		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dB	dBuV	dBuV	dB	
1		0.1500	25.33	9.64	34.97	65.99	-31.02	QP
2		0.1500	8.95	9.64	18.59	55.99	-37.40	AVG
3	*	0.1819	30.26	9.65	39.91	64.39	-24.48	QP
4		0.1819	12.96	9.65	22.61	54.39	-31.78	AVG
5		0.2180	28.57	9.64	38.21	62.89	-24.68	QP
6		0.2180	11.71	9.64	21.35	52.89	-31.54	AVG
7		0.2540	25.91	9.61	35.52	61.62	-26.10	QP
8		0.2540	9.76	9.61	19.37	51.62	-32.25	AVG
9		0.2900	24.56	9.58	34.14	60.52	-26.38	QP
10		0.2900	9.78	9.58	19.36	50.52	-31.16	AVG
11		18.4660	16.26	10.64	26.90	60.00	-33.10	QP
12		18.4660	3.99	10.64	14.63	50.00	-35.37	AVG

Emission Level= Read Level+ Correct Factor

5. Radiated Emission Test

5.1 Test Standard and Limit

5.1.1 Test Standard

FCC Part 15.209

5.1.2 Test Limit

Radiated Emission Limit (9kHz~1000MHz)

Frequency (MHz)	Field Strength (microvolt/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

Radiated Emission Limit (Above 1000MHz)

Frequency (MHz)	Distance Meters (at 3m)	
	Peak	Average
Above 1000	74	54

Note:

- (1) The tighter limit applies at the band edges.
- (2) Emission Level(dBuV/m)=20log Emission Level(Uv/m)

Limits of radiated emission measurement (15.249)

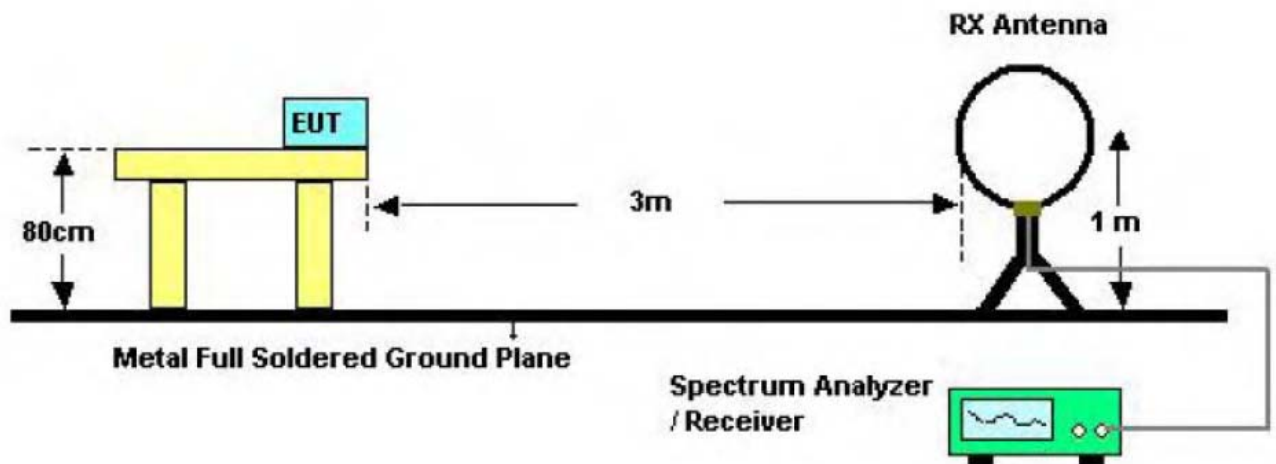
FCC Part 15 (15.249), Subpart C	
Limit	Frequency Range (MHz)
Field strength of fundamental 50000 μ V/m (94 dB μ V/m)- Quasi Peak @ 3 m	902~928

Restricted bands requirement for equipment operating in 902MHz to 928MHz (15.249)

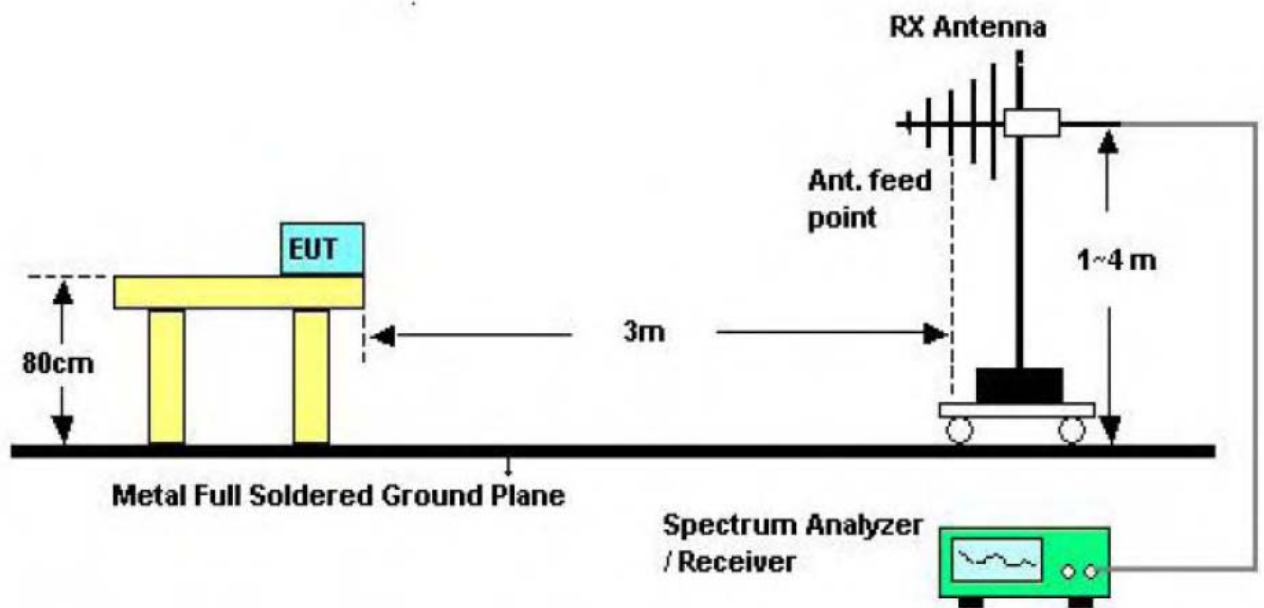
(dBuV/m)(at 3 M)

Attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation

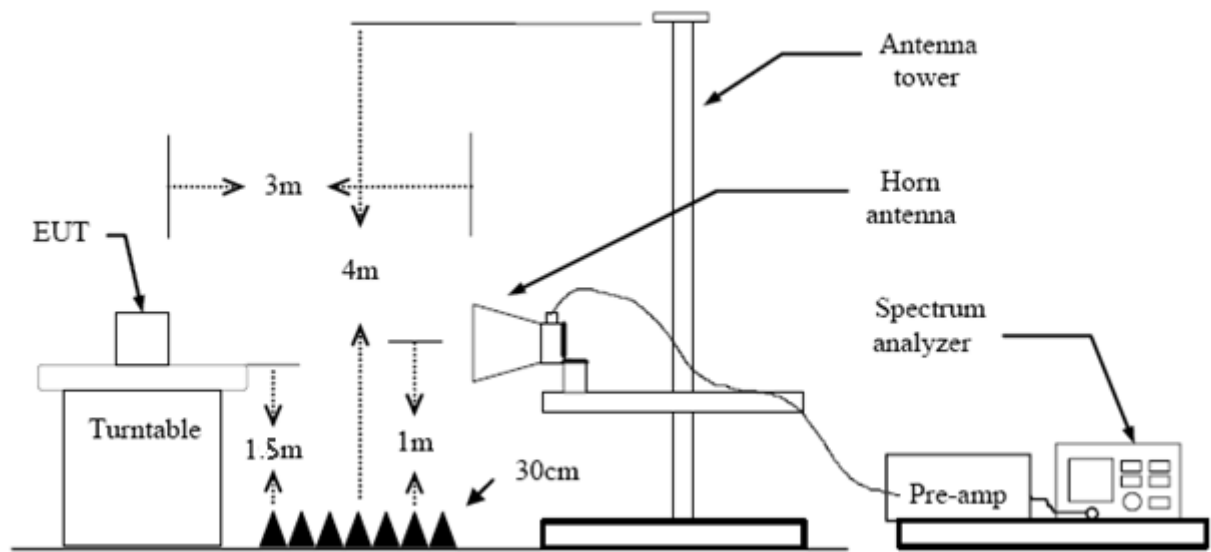
5.2 Test Setup



Bellow 30MHz Test Setup



Bellow 1000MHz Test Setup



Above 1GHz Test Setup

5.3 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) Measurements at frequency above 1GHz. The EUT was placed on a rotating 1.5m high above the ground. RF absorbers covered the ground plane with a minimum area of 3.0m by 3.0m between the EUT and measurement receiver antenna. The RF absorber shall not exceed 30cm in high above the conducting floor. The table was rotated 360 degrees to determine the position of the highest radiation.
- (3) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.
- (4) 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.
- (5) 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.
- (6) Testing frequency range below 1GHz the measuring instrument use VBW=120 kHz with Quasi-peak detection.
- (7) Testing frequency range above 1GHz the measuring instrument use RBW=1 MHz and VBW=3 MHz with Peak Detector for Peak Values, and use RBW=1 MHz and VBW=10 Hz with Peak Detector for Average Values.
- (8) For the actual test configuration, please see the test setup photo.

5.4 EUT Operating Condition

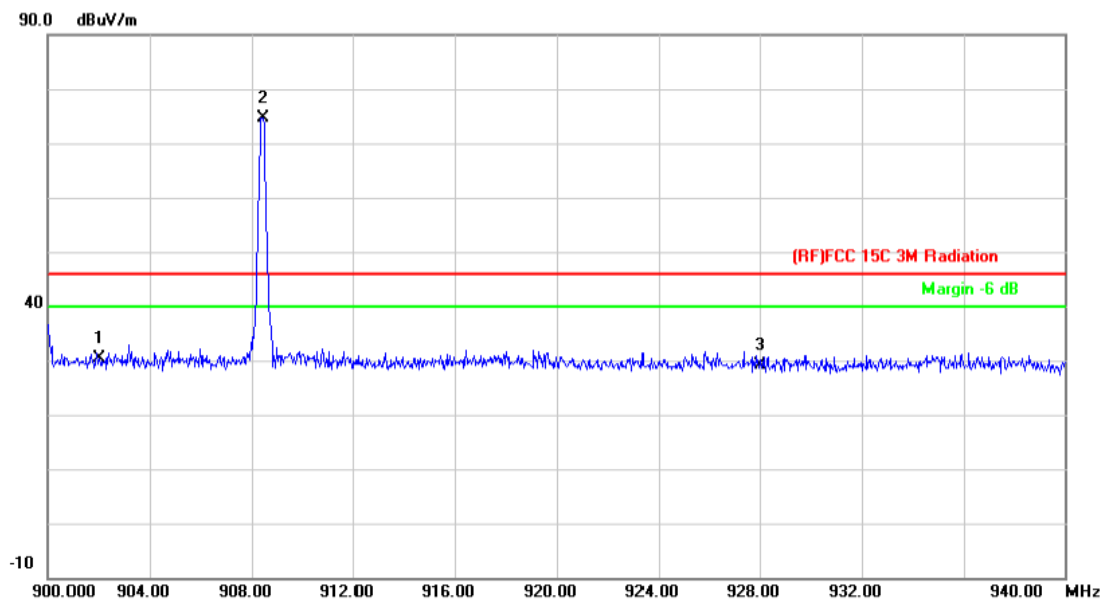
The EUT was set to Continual Transmitting in maximum power, and new batteries are used during testing.

5.5 Test Data

Please see the next page.

5.6.1 Field Strength of the Fundamental

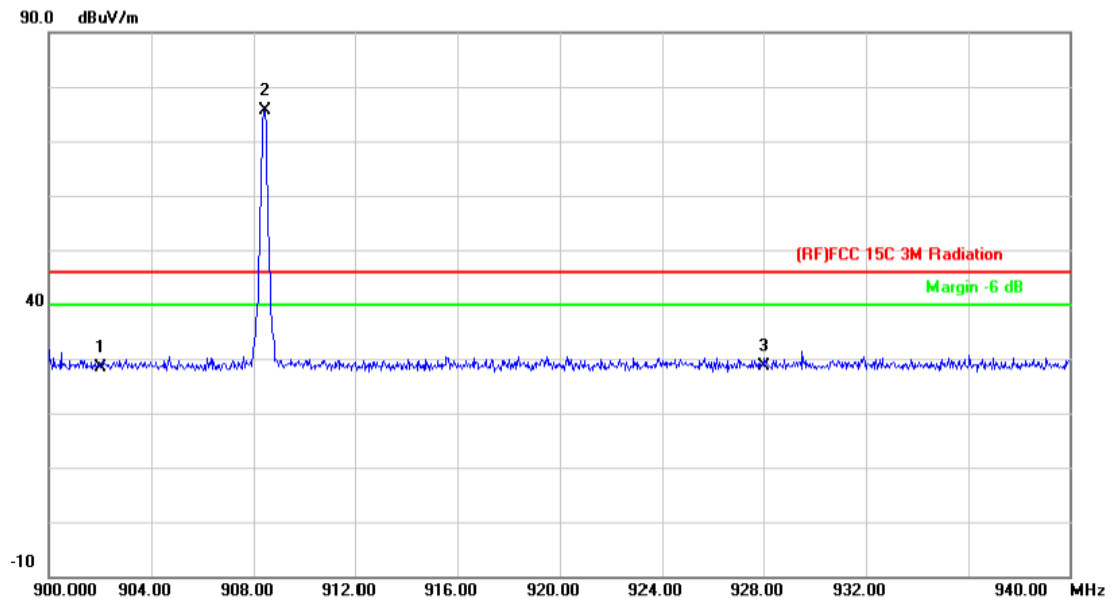
EUT:	Brightswitch 201	Model Name :	201
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX 908.4MHz		
Remark:			



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		902.0000	34.10	-3.72	30.38	46.00	-15.62	peak
2	*	908.4400	78.39	-3.65	74.74	94.00	-19.26	peak
3		928.0000	32.54	-3.47	29.07	46.00	-16.93	peak

Emission Level= Read Level+ Correct Factor

EUT:	Brightswitch 201	Model Name :	201
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX 908.4MHz		
Remark:			



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		902.0000	31.99	-3.72	28.27	46.00	-17.73	peak
2	*	908.4400	79.40	-3.65	75.75	94.00	-18.25	peak
3		928.0000	32.19	-3.47	28.72	46.00	-17.28	peak

Emission Level= Read Level+ Correct Factor

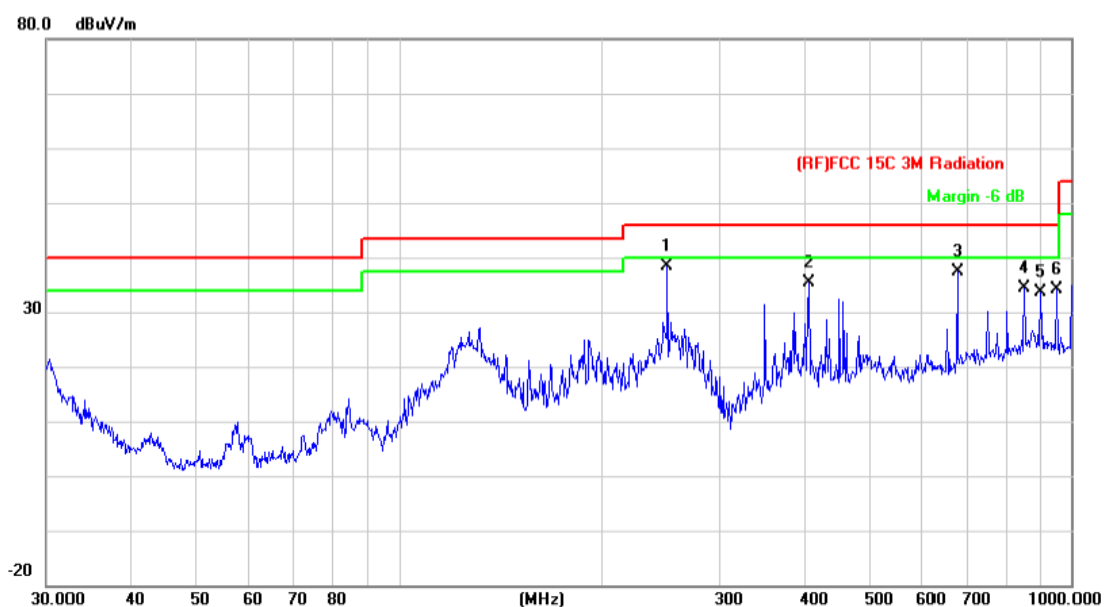
5.6.2 Radiated Spurious Emission (9 KHz~30 MHz)

From 9 KHz to 30 MHz: Conclusion: PASS

Note: The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

5.6.3 Radiated Spurious Emission (Below 1 GHz)

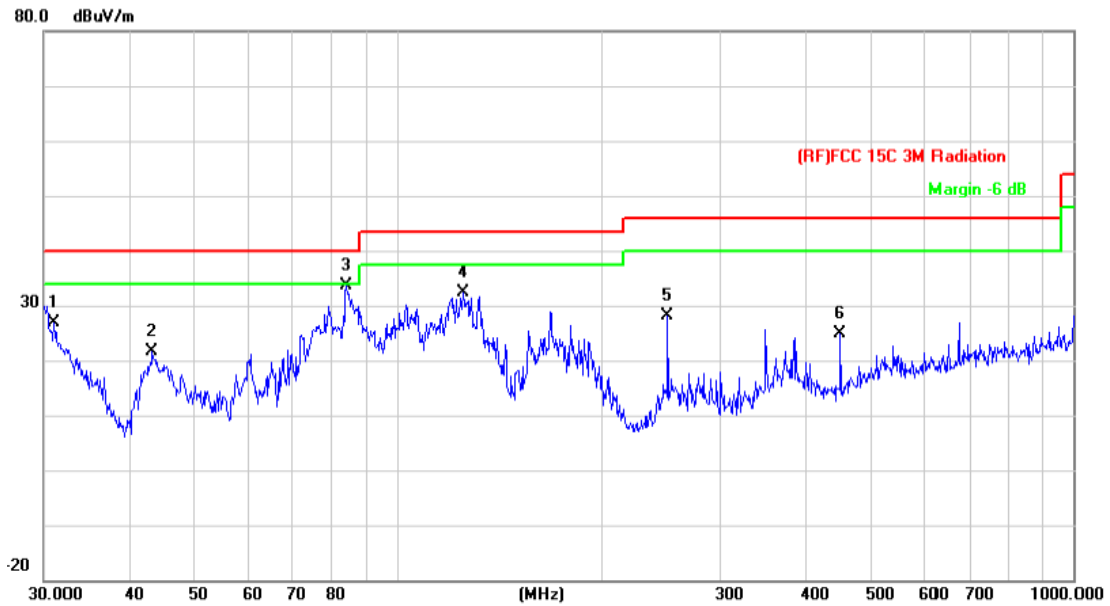
EUT:	Brightswitch 201	Model Name :	201
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX 908.4MHz		
Remark:	Only worse case is reported		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1	*	250.3012	55.82	-17.39	38.43	46.00	-7.57	QP
2		406.0880	47.52	-12.02	35.50	46.00	-10.50	QP
3		675.2080	43.83	-6.54	37.29	46.00	-8.71	QP
4		851.0353	39.90	-5.43	34.47	46.00	-11.53	QP
5		900.1474	37.45	-3.75	33.70	46.00	-12.30	QP
6		952.0937	37.48	-3.45	34.03	46.00	-11.97	QP

Emission Level= Read Level+ Correct Factor

EUT:	Brightswitch 201	Model Name :	201
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX 908.4MHz		
Remark:	Only worse case is reported		

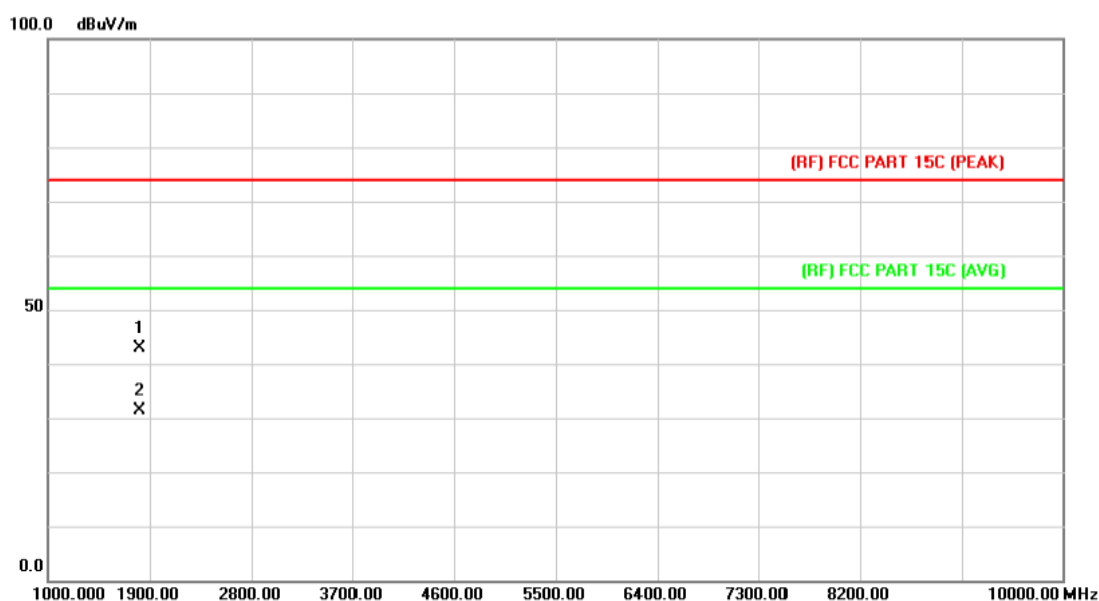


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector
1		31.0706	41.28	-14.43	26.85	40.00	-13.15	QP
2		43.3534	42.87	-21.30	21.57	40.00	-18.43	QP
3	*	84.1100	56.37	-22.66	33.71	40.00	-6.29	QP
4		125.0066	54.28	-21.89	32.39	43.50	-11.11	QP
5		250.3012	45.56	-17.39	28.17	46.00	-17.83	QP
6		451.1350	36.51	-11.60	24.91	46.00	-21.09	QP

Emission Level= Read Level+ Correct Factor

5.6.4 Radiated Spurious Emission (Above 1 GHz)

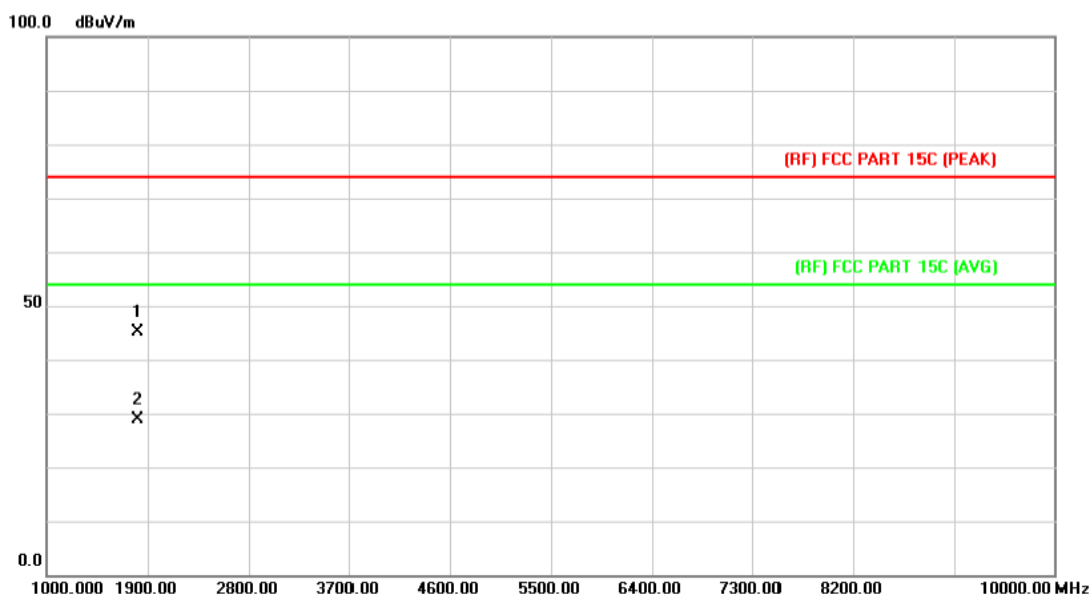
EUT:	Brightswitch 201	Model Name :	201
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Horizontal		
Test Mode:	TX 908.4MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		1809.570	46.24	-3.42	42.82	74.00	-31.18	peak
2	*	1810.600	34.84	-3.42	31.42	54.00	-22.58	AVG

Emission Level= Read Level+ Correct Factor

EUT:	Brightswitch 201	Model Name :	201
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60Hz		
Ant. Pol.	Vertical		
Test Mode:	TX 908.4MHz		
Remark:	No report for the emission which more than 10 dB below the prescribed limit.		

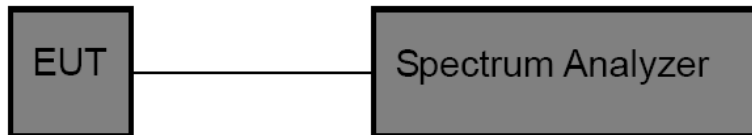


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1		1810.462	48.53	-3.42	45.11	74.00	-28.89	peak
2	*	1810.600	32.31	-3.42	28.89	54.00	-25.11	AVG

Emission Level= Read Level+ Correct Factor

6. Bandwidth Test

6.1 Test Setup



6.2 Test Procedure

- (1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- (2) Spectrum Setting:
Bandwidth: RBW=10kHz, VBW=30kHz.
- (3) The bandwidth is measured at an amplitude level reduced 20dB from the reference level. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst –case (i.e the widest) bandwidth.

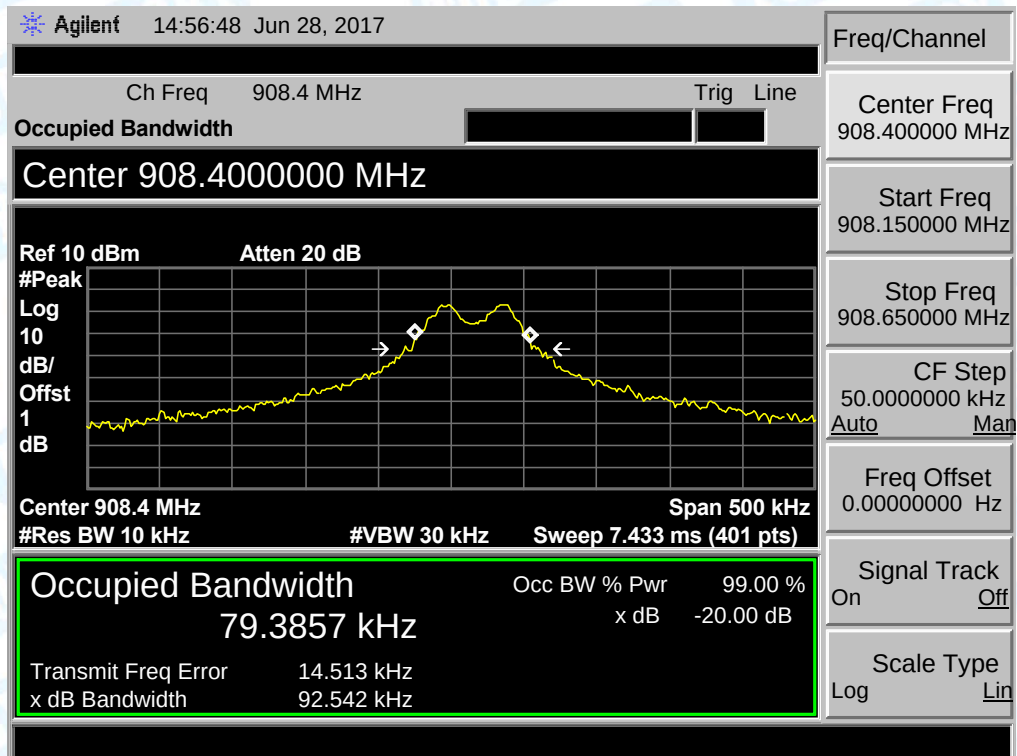
6.3 EUT Operating Condition

The EUT was set to continuously transmitting for the Bandwidth Test.

6.4 Test Data

Low Channel Frequency (MHz)	20dB Bandwidth (kHz)
908.4	92.542

908.4MHz



7. Antenna Requirement

7.1 Standard Requirement

7.1.1 Standard

FCC Part 15.203

7.1.2 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.

7.2 Antenna Connected Construction

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

7.3 Result

The EUT antenna is a Internal Antenna. It complies with the standard requirement.

Antenna Type
☒ Permanent attached antenna
☐ Unique connector antenna
☐ Professional installation antenna

-----END OF REPORT-----