



Shenzhen Academy of Metrology & Quality Inspection

NETC National Digital Electronic Product Testing Center

FCC TEST REPORT

For

Bluetooth In-wall Switch

Model Number: BT4001

FCC ID: U2ZBT4001

Report Number : WT148004856

Test Laboratory : Shenzhen Academy of Metrology and Quality Inspection

National Digital Electronic Product Testing Center

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1. TEST RESULTS SUMMARY

Table 1 Test Results Summary

Test Items	FCC Rules	Test Results
6dB DTS bandwidth measurement	15.247 (a) (2)	Pass
Maximum Peak Conducted Power	15.247 (b) (3)	Pass
Maximum Power Spectral Density Level	15.247 (3)	Pass
Conducted Band Edge and Spurious	15.247 (d)	Pass
Radiated Band Edge and Spurious	15.247 (d)	Pass
	15.209	
	15.205	
Conducted emission test for AC power port	15.207	Pass
Antenna Requirement	15.203	Pass

Remark: “ N/A” means “ Not applicable.”



2. GENERAL INFORMATION

2.1. Report information

2.1.1. This report is not a certificate of quality; it only applies to the sample of the specific product/equipment given at the time of its testing. The results are not used to indicate or imply that they are application to the similar items. In addition, such results must not be used to indicate or imply that SMQ approves recommends or endorses the manufacture, supplier or use of such product/equipment, or that SMQ in any way guarantees the later performance of the product/equipment.

2.1.2. The sample/s mentioned in this report is/are supplied by Applicant, SMQ therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture or any information supplied.

2.1.3. Additional copies of the report are available to the Applicant at an additional fee. No third part can obtain a copy of this report through SMQ, unless the applicant has authorized SMQ in writing to do so.

2.2. Laboratory Accreditation and Relationship to Customer

The testing report were performed by the Shenzhen Academy of Metrology and quality Inspection EMC Laboratory (Guangdong EMC compliance testing center), in their facilities located at No.4 TongFa Road, Xili Town, Nanshan District, Shenzhen, China. At the time of testing, Laboratory is accredited by the following organizations:

China National Accreditation Service for Conformity Assessment (CNAS) accredits the Laboratory for conformance to FCC standards, EMC international standards and EN standards. The Registration Number is CNAS L0579.

The Laboratory is listed in the United States of American Federal Communications Commission (FCC), and the registration number are 446246 806614 994606(semi anechoic chamber).

The Laboratory is registered to perform emission tests with Industry Canada (IC), and the registration number is 11177A.

TUV Rhineland accredits the Laboratory for conformance to IEC and EN standards, the registration number is E2024086Z02.



2.3. Measurement Uncertainty

Conducted Emission

9kHz~30MHz 3.5dB

Radiated Emission

30MHz~1000MHz 4.5dB

1GHz~25GHz 4.6dB

3. PRODUCT DESCRIPTION

3.1. EUT Description

Description	:	Bluetooth In-wall Switch
Manufacturer	:	KONIG ELECTRONIC (HUIZHOU) LTD.
Model Number	:	BT4001
Rated Input	:	AC 120V/60Hz
Power supply	:	AC 120V/60Hz
Operate Frequency	:	2.402GHz~2.480GHz
Bluetooth Version	:	v4.1 LE
Data Rate (Mbps)	:	1Mbps
Antenna Designation	:	Integral antenna

3.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: U2ZBT4001, filing to comply with Section 15.207 , 15.209 , 15.247 of the FCC Part 15, Subpart C Rules.

3.3. Block Diagram of EUT Configuration



Figure 1 EUT setup



3.4. Operating Condition of EUT

Worst-case mode and channel used for power line conducted emissions was the mode and channel with the highest output power.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Test mode 1: TX, Low channel, 2402MHz

Test mode 2: TX, Middle channel, 2440MHz

Test mode 3: TX, High channel, 2480MHz

Test mode 4: Receive

3.5. Support Equipment List

Table 2 Support Equipment List

Name	Model No	S/N	Manufacturer	FCC Approval
--	--	--	--	--

3.6. Test Conditions

Date of test : Dec.30, 2014-Jan.16, 2015

Date of EUT Receive : Dec.08, 2014

Temperature: 20°C

Relative Humidity: 45-61%

3.7. Special Accessories

Not available for this EUT intended for grant.

3.8. Equipment Modifications

Not available for this EUT intended for grant.



4. TEST EQUIPMENT USED

Table 3 Test Equipment

No.	Equipment	Manufacturer	Model No.	Last Cal.	Cal. Interval
SB3319	EMI Test Receiver	Rohde & Schwarz	ESCS30	Dec.29,2014	1 Year
SB4357	AMN	Rohde & Schwarz	ENV216	Oct.14,2014	1 Year
SB8501/09	EMI Test Receiver	Rohde & Schwarz	ESU40	Mar.28, 2014	1 Year
SB9060	Spectrum analyzer	Rohde & Schwarz	FSQ40	May.13, 2014	1 Year
SB3955	Broadband antenna	SCHWARZBECK	VULB9163	Jan.20, 2014	1 Year
SB8501/01	Horn Antenna	Rohde & Schwarz	HF907	Mar.28, 2014	1 Year
SB8501/10	Horn Antenna	Rohde & Schwarz	3160-09	Mar.28, 2014	3 Years
SB8501/12	Horn Antenna	Rohde & Schwarz	3160-10	Mar.28, 2014	3 Years
SB8501/17	Preamplifier	Rohde & Schwarz	SCU-18	Mar.28, 2014	1 Year
SB8501/16	Preamplifier	Rohde & Schwarz	SCU-26	Mar.28, 2014	1 Year
SB9059	Preamplifier	Rohde & Schwarz	SCU-40	May.13, 2014	1 Year



5. 6DB BANDWIDTH MEASUREMENT

5.1. Limits of 6dB Bandwidth Measurement

CFR 47 (FCC) part 15.247 (a) (2)

5.2. Test Procedure

Reference to KDB558074 D01 DTS Meas Guidance v03r02,

The transmitter output was connected to the spectrum analyzer.

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.3. Test Setup

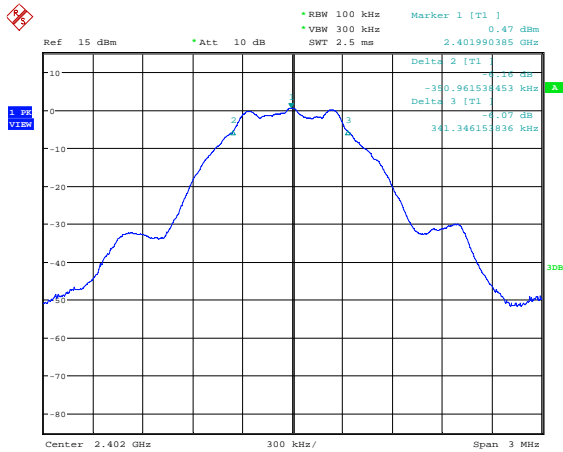




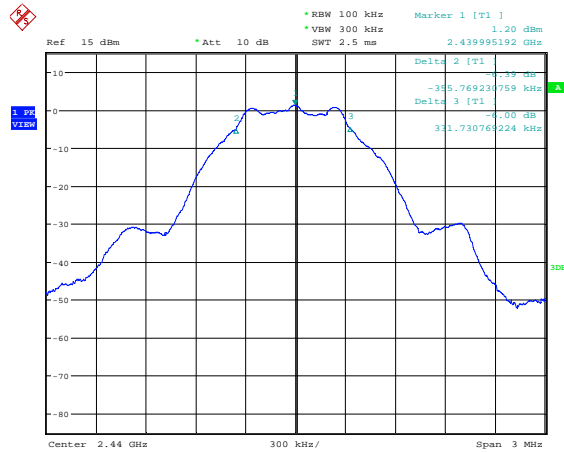
5.4. Test Data

Table 4 6dB Bandwidth Test Data

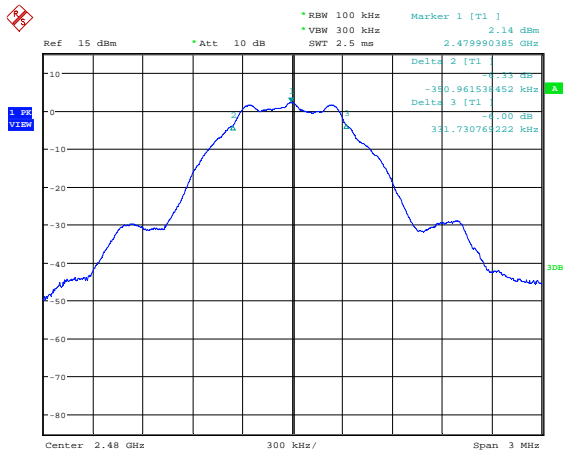
CHANNEL FREQUENCY (MHz)	6dB BANDWIDTH (MHz)	results
2402MHz	0.692	Pass
2440MHz	0.687	Pass
2480MHz	0.683	Pass



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Date: 16.JAN.2015 08:40:54



6. MAXIMUM PEAK CONDUCTED OUTPUT POWER MEASUREMENT

6.1. Limits of Maximum Peak Conducted Output Power Measurement

CFR 47 (FCC) part 15.247 (b) (3)

6.2. Test Procedure

Reference to KDB558074 D01 DTS Meas Guidance v03r02,

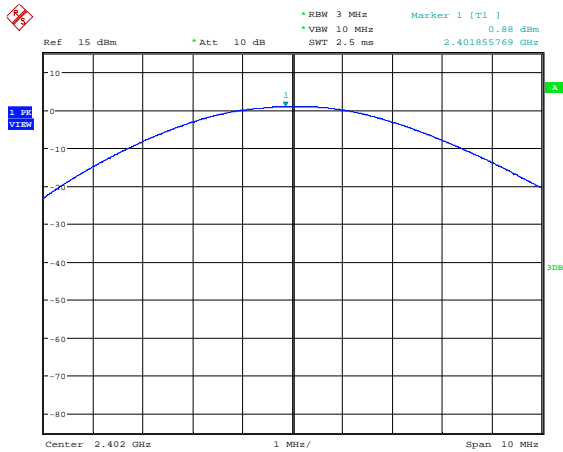
The transmitter output was connected to the spectrum analyzer.

- a) Set the RBW = 3 MHz
- b) Set the VBW $\geq 3 \times$ RBW
- c) Set the span $\geq 3 \times$ RBW
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

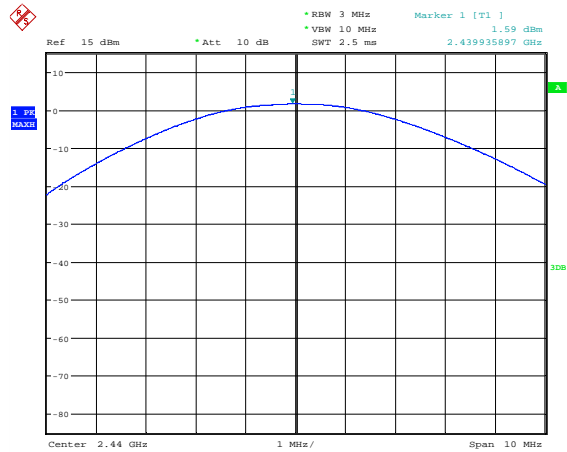
6.3. Test Data

Table 5 Maximum Peak Conducted Output Power Test Data

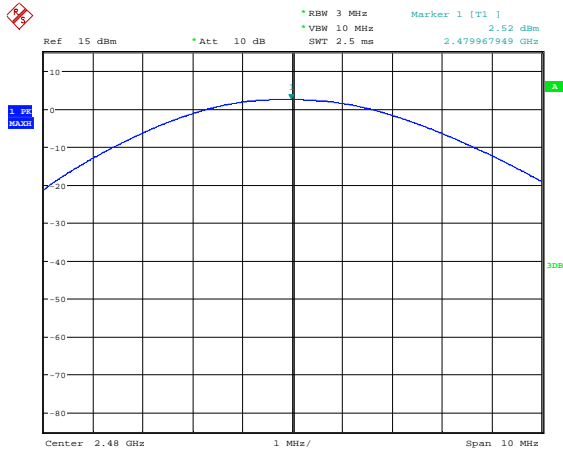
CHANNEL FREQUENCY (MHz)	Meas. Level (Cond.) [dBm]	Limit [dBm]	Result
2402MHz	0.9	< 30	Pass
2440MHz	1.6	< 30	Pass
2480MHz	2.5	< 30	Pass



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7. MAXIMUM POWER SPECTRAL DENSITY LEVEL MEASUREMENT

7.1. Limits of Maximum Power Spectral Density Level Measurement

CFR 47 (FCC) part 15.247 (e)

7.2. Test Procedure

Reference to KDB558074 D01 DTS Meas Guidance v03r02,

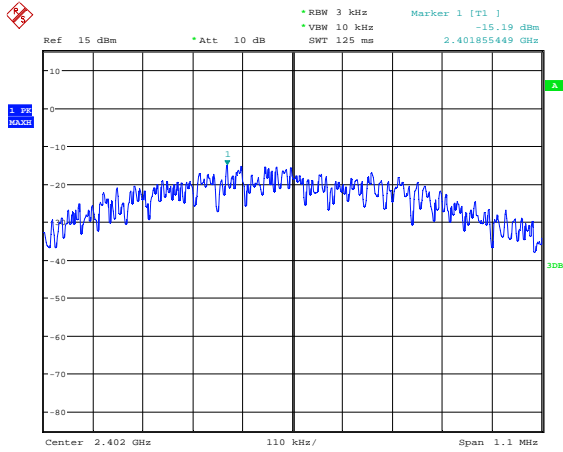
The transmitter output was connected to the spectrum analyzer.

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3\text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

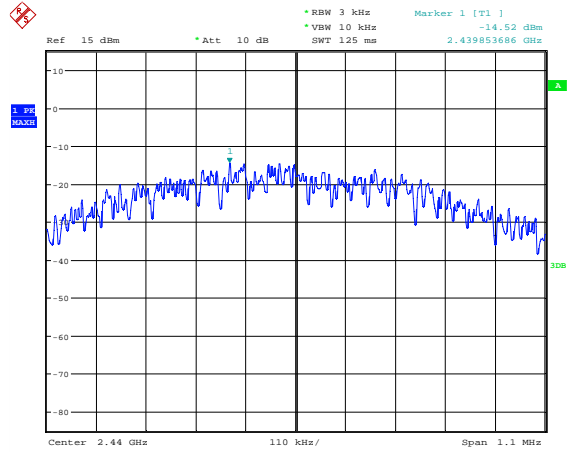
7.3. Test Data

Table 6 Maximum Power Spectral Density Level Test Data

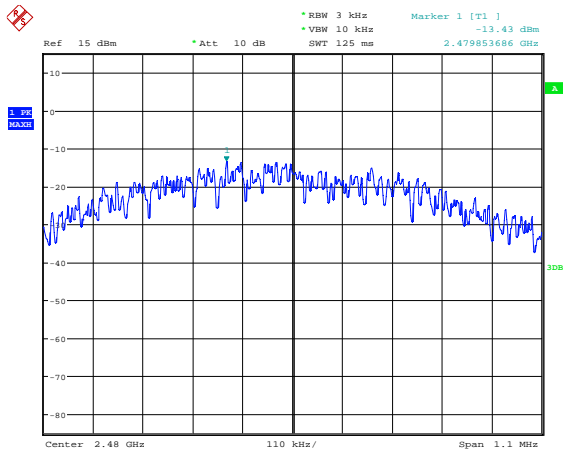
CHANNEL FREQUENCY (MHz)	PSD [dBm]	Limit [dBm]	Result
2402MHz	-15.1	8	Pass
2440MHz	-14.5	8	Pass
2480MHz	-13.4	8	Pass



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Date: 16.JAN.2015 09:21:27



8. CONDUCTED BANDEDGE AND SPURIOUS MEASUREMENT

8.1. Limits of Conducted Band Edge and Spurious Measurement

CFR 47 (FCC) part 15.247 (d)

8.2. Test Procedure

Reference to KDB558074 D01 DTS Meas Guidance v03r02,

The transmitter output was connected to the spectrum analyzer.

Establish a reference level by using the following procedure:

- a) Set instrument center frequency to DTS channel center frequency.
- b) Set the span to ≥ 1.5 times the DTS bandwidth.
- c) Set the RBW = 100 kHz.
- d) Set the VBW $\geq 3 \times$ RBW.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum PSD level.

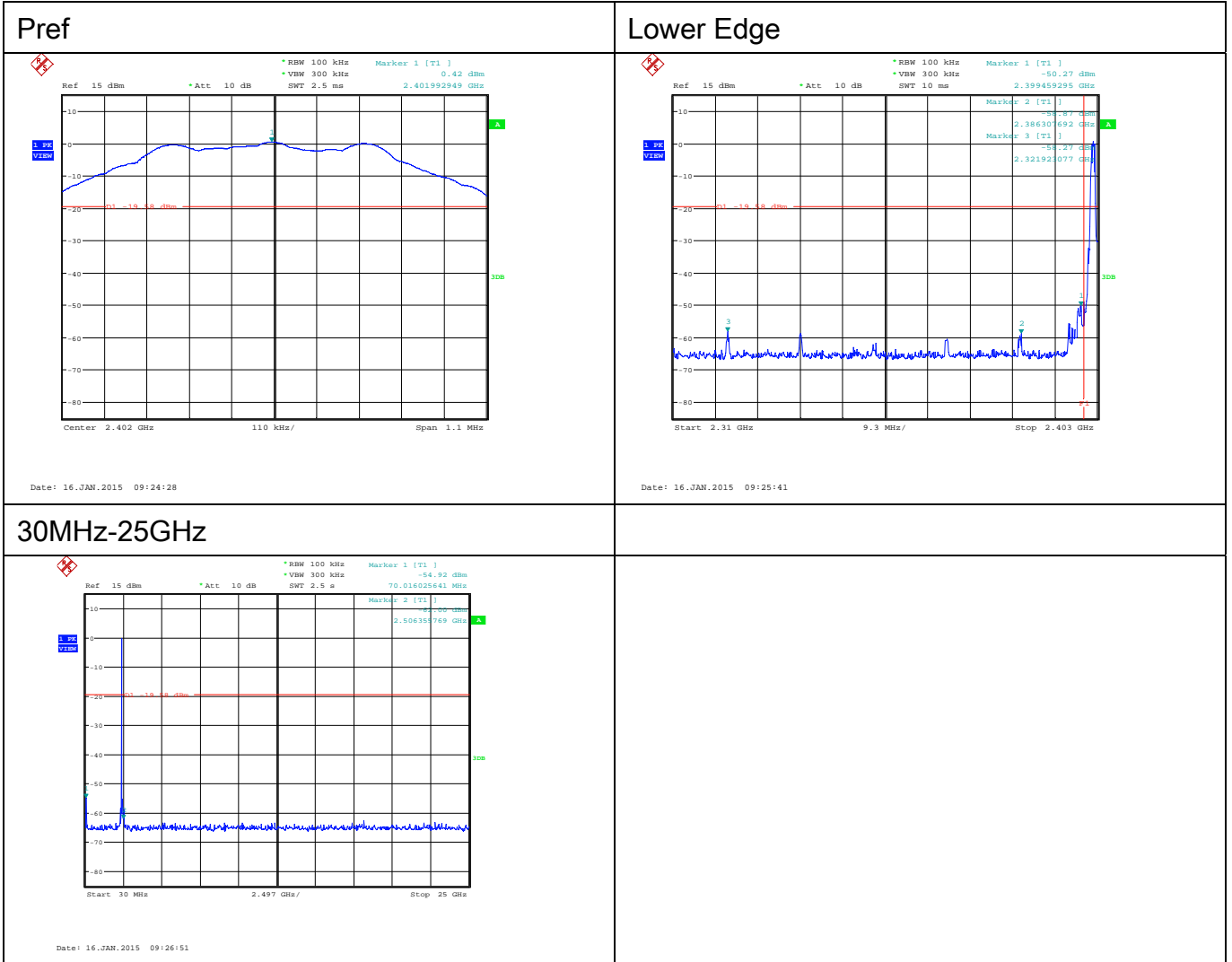
Emission level measurement

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW $\geq 3 \times$ RBW.
- d) Detector = peak.
- e) Ensure that the number of measurement points \geq span/RBW
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level.



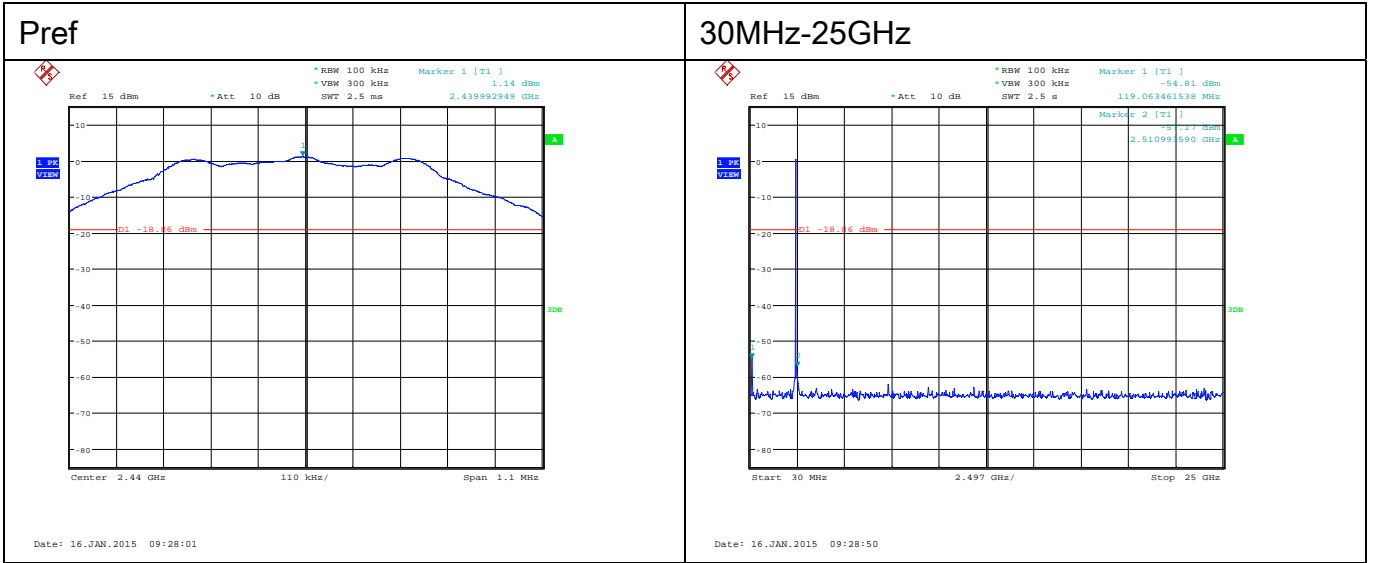
8.3. Test Data

Low channel

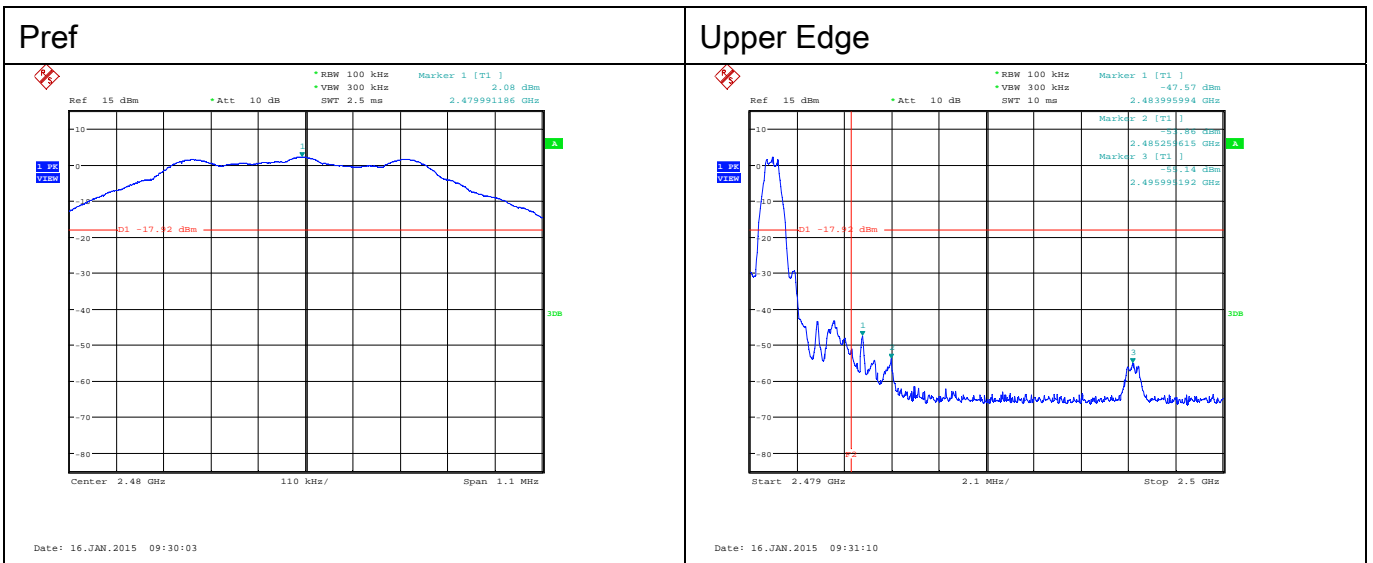




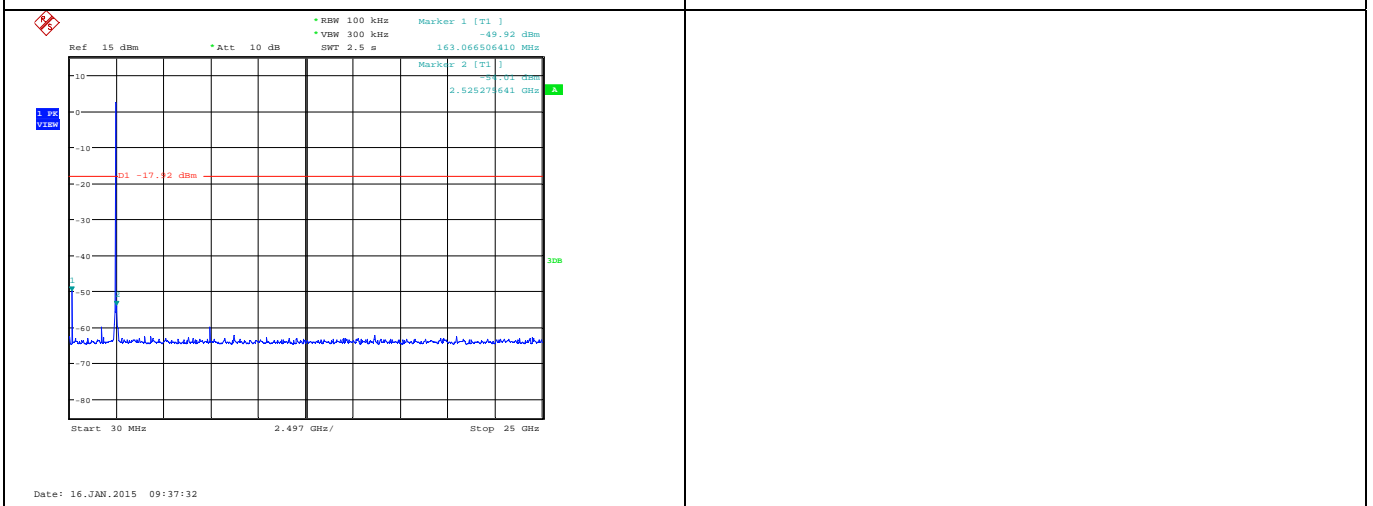
Middle channel



High channel



30MHz-25GHz





9. RADIATED BAND EDGE AND SPURIOUS MEASUREMENT

9.1. Limits of Radiated Band Edge And Spurious Measurement

CFR 47 (FCC) part 15.247 (d)

9.2. TEST PROCEDURE

1. The testing follows the guidelines in ANSI C63.10: 2009 and KDB558074 D01 DTS Meas Guidance v03r02.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
6. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz; VBW \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f > 1$ GHz for peak measurement.
Set RBW = 1 MHz, and 1/T (on time) for average measurement. $1/T = 1 / 0.000389s$, VBW is set to 3kHz.

9.3. Test Data



Table 7 Radiated Emission Test Data

Model No.: BT4001								
Test mode: 1								
Frequency (MHz)	Polarization	Correction Factor (dB)	Antenna Factor (dB/m)	Reading Value (dB μ V)	Emission Level dB (μ V/m)	Limits dB (μ V/m)	EUT axes	Note
4803.495	Vertical	-39.4	34.0	55.7	50.3	74	X	Harmonics PK
4803.495	Vertical	-39.4	34.0	50.6	45.2	54	X	Harmonics AV
4803.495	Vertical	-39.4	34.0	55.7	50.3	74	X	Harmonics PK
4803.495	Vertical	-39.4	34.0	50.6	45.2	54	X	Harmonics AV

Table 8 Radiated Emission Test Data

Model No.: BT4001								
Test mode: 2								
Frequency (MHz)	Polarization	Correction Factor (dB)	Antenna Factor (dB/m)	Reading Value (dB μ V)	Emission Level dB (μ V/m)	Limits dB (μ V/m)	EUT axes	Note
4879.460	Vertical	-39.4	34.0	56.3	50.9	74	X	Harmonics PK
4879.460	Vertical	-39.4	34.0	50.8	45.4	54	X	Harmonics AV
4879.460	Horizontal	-39.4	34.0	55.4	50.0	74	X	Harmonics PK
4879.460	Horizontal	-39.4	34.0	49.7	44.3	54	X	Harmonics AV



Table 9 Radiated Emission Test Data

Model No.: BT4001								
Test mode: 3								
Frequency (MHz)	Polarization	Correction Factor (dB)	Antenna Factor (dB/m)	Reading Value (dB μV)	Emission Level dB (μV/m)	Limits dB (μV/m)	EUT axes	Note
4959.495	Vertical	-39.5	34.0	55.6	50.1	74	X	Harmonics PK
4959.495	Vertical	-39.5	34.0	49.2	43.7	54	X	Harmonics AV
7439.285	Vertical	-37.7	35.6	58.7	56.6	74	X	Harmonics PK
7439.285	Vertical	-37.7	35.6	53.1	51.0	54	X	Harmonics AV
4959.495	Horizontal	-39.5	34.0	56.1	50.6	74	X	Harmonics PK
4959.495	Horizontal	-39.5	34.0	50.0	44.5	54	X	Harmonics AV
7439.285	Horizontal	-37.7	35.6	56.7	54.6	74	X	Harmonics PK
7439.285	Horizontal	-37.7	35.6	48.8	46.7	54	X	Harmonics AV

- Note: 1. Emission level(dBuV/m)=Reading Value(dBuV) + Correction Factor(dB)+Antenna Factor (dB/m)
 2. Correction Factor(dB) = Cable Factor (dB)+Amplifier Factor(dB)
 3. No other spurious and harmonic emissions were reported greater than listed emissions above table.



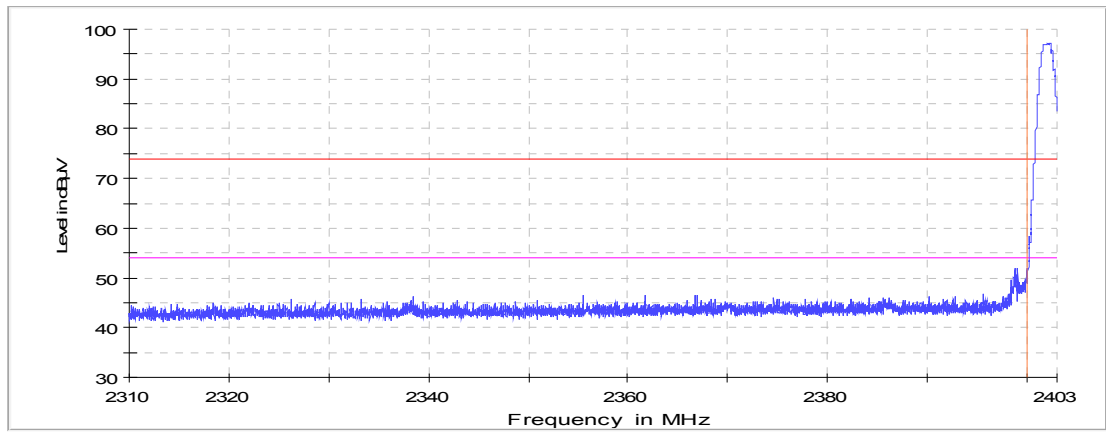
Band Edge

Radiated Emission

EUT Information

EUT Model Name: BT4001
Operation mode: TX, Low channel
Test Voltage:
Comment:

FCC Electric Field Strength 2.4GHz Bandedge-PK

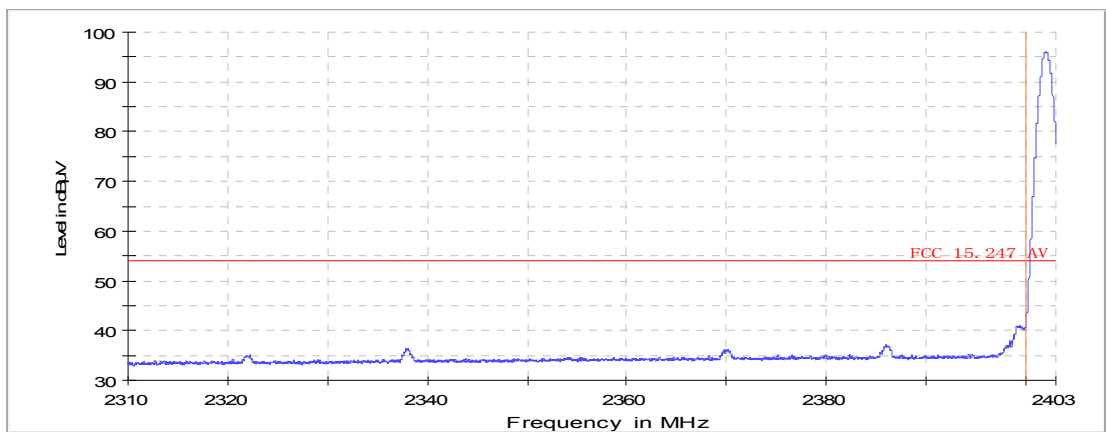


Radiated Emission

EUT Information

EUT Model Name: BT4001
Operation mode: TX, Low channel
Test Voltage:
Comment:

FCC Electric Field Strength 2.4GHz Bandedge-AV



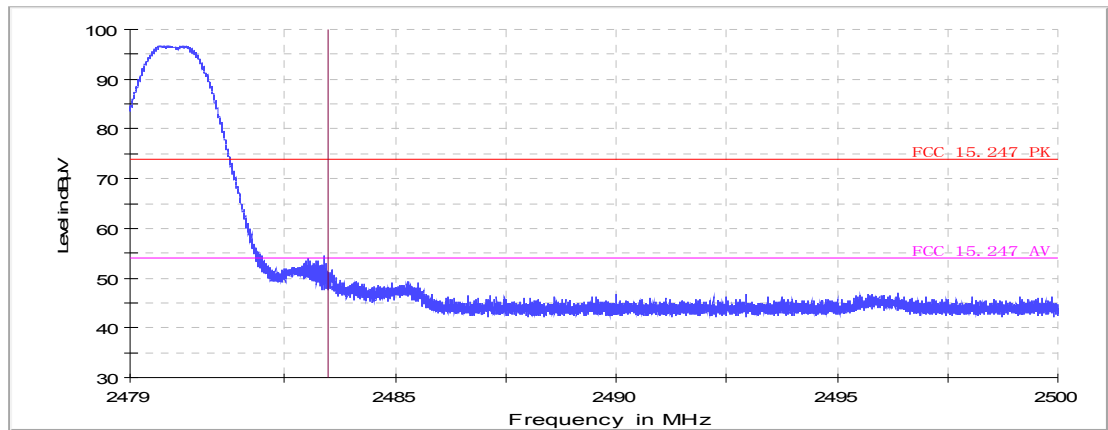


Radiated Emission

EUT Information

EUT Model Name: BT4001
Operation mode: TX.High channel
Test Voltage:
Comment:

FCC Electric Field Strength 2.4GHz Bandedge-PK

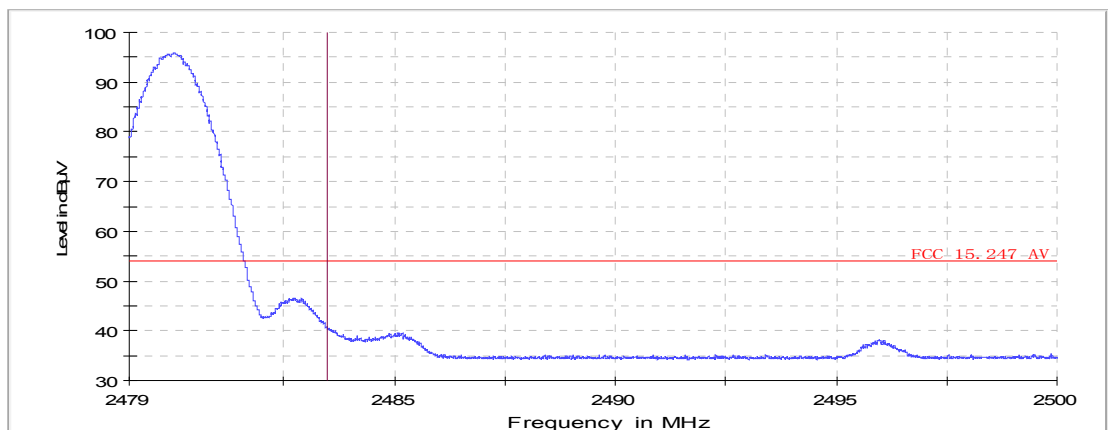


Radiated Emission

EUT Information

EUT Model Name: BT4001
Operation mode: TX.High channel
Test Voltage:
Comment:

FCC Electric Field Strength 2.4GHz Bandedge-AV





10. CONDUCTED EMISSION TEST FOR AC POWER PORT MEASUREMENT

10.1. Test Standard and Limit

10.1.1. Test Standard

FCC Part 15 15.207

10.1.2. Test Limit

Table 10 Conducted Disturbance 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

* Decreasing linearly with logarithm of the frequency

* The lower limit shall apply at the transition frequency.

10.2. Test Procedure

The EUT is put on a table of non-conducting material that is 80cm high. The vertical conducting wall of shielding is located 40cm to the rear of the EUT. The power line of the EUT is connected to the AC mains through an Artificial Mains Network (A.M.N.). An EMI test receiver is used to test the emissions from both sides of AC line. According to the requirements in ANSI C63.10: 2009. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode.

The bandwidth of EMI test receiver is set at 9kHz.

10.3. Test Arrangement

The arrangement of the equipment is installed to meet the standards and operating in a manner, which tends to maximize its emission characteristics in a normal application. The detailed information refers to test picture.



10.4. Test Data

The emissions don't show in below are too low against the limits. Refer to the test curves.

Table 11 Conducted Disturbance Test Data

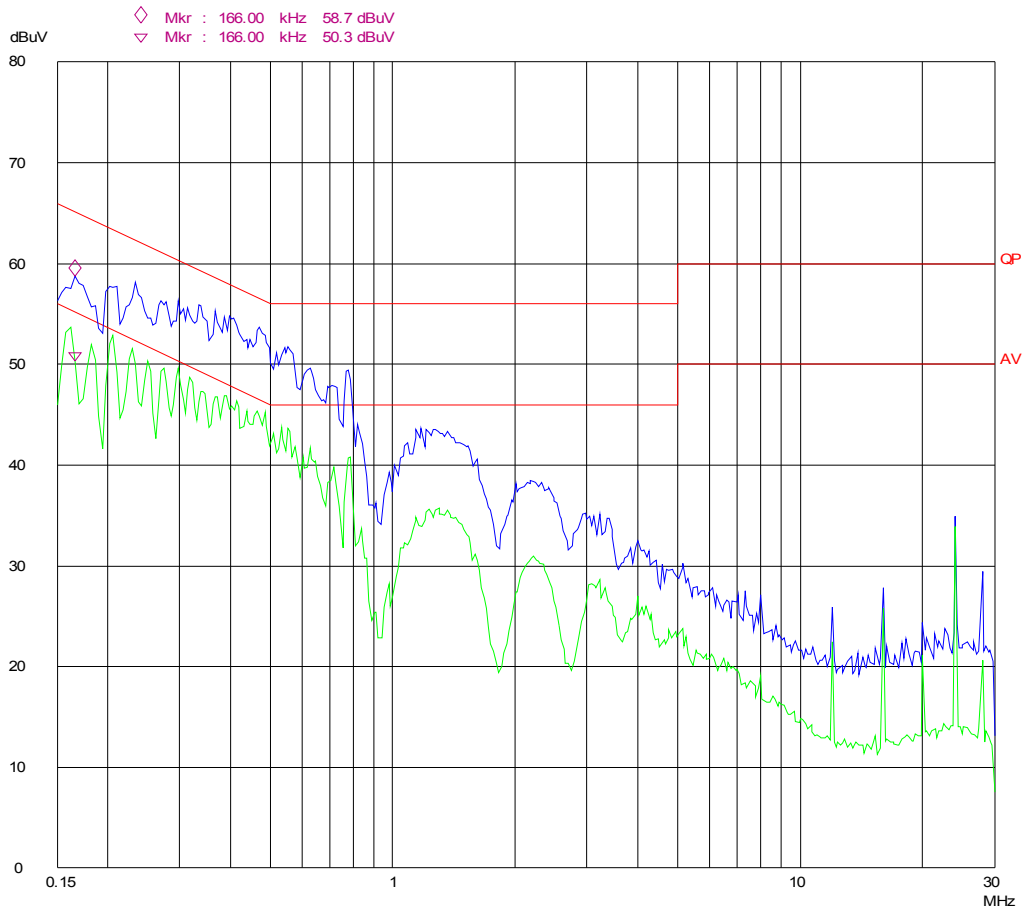
Model No.: BT4001							
Test mode: Worst-case							
Line							
Frequency MHz	QP		AV		QP	AV	Factor (dB)
	Level (dBuV)	Limit (dBuV)	Level (dBuV)	Limit (dBuV)	Reading (dBuV)	Reading (dBuV)	
0.162	55.7	65.4	53.3	55.4	46.0	43.6	9.7
0.206	54.8	63.4	52.4	53.4	45.1	42.7	9.7
0.298	52.5	60.3	49.3	50.3	42.8	39.6	9.7
0.778	45.9	56	40.9	46	36.1	31.1	9.8
1.322	38.8	56	35.0	46	29.0	25.2	9.8
24.000	33.8	60	33.8	50	23.6	23.6	10.2
Neutral							
Frequency MHz	QP		AV		QP	AV	Factor (dB)
	Level (dBuV)	Limit (dBuV)	Level (dBuV)	Limit (dBuV)	Reading (dBuV)	Reading (dBuV)	
0.162	55.6	65.4	53.0	55.4	45.9	43.3	9.7
0.206	55.1	63.4	52.5	53.4	45.4	42.8	9.7
0.274	53.1	61.0	49.5	51.0	43.4	39.8	9.7
0.370	51.0	58.5	47.3	48.5	41.3	37.6	9.7
0.774	44.9	56	39.5	46	35.1	29.7	9.8
24.000	33.8	60	33.6	50	23.6	23.4	10.2

- REMARKS: 1. Emission level(dBuV)=Read Value(dBuV) + Correction Factor(dB)
 2. Correction Factor(dB) =LISN Factor (dB) + Cable Factor (dB)+Limiter Factor(dB)
 3. The other emission levels were very low against the limit.



Conducted Disturbance

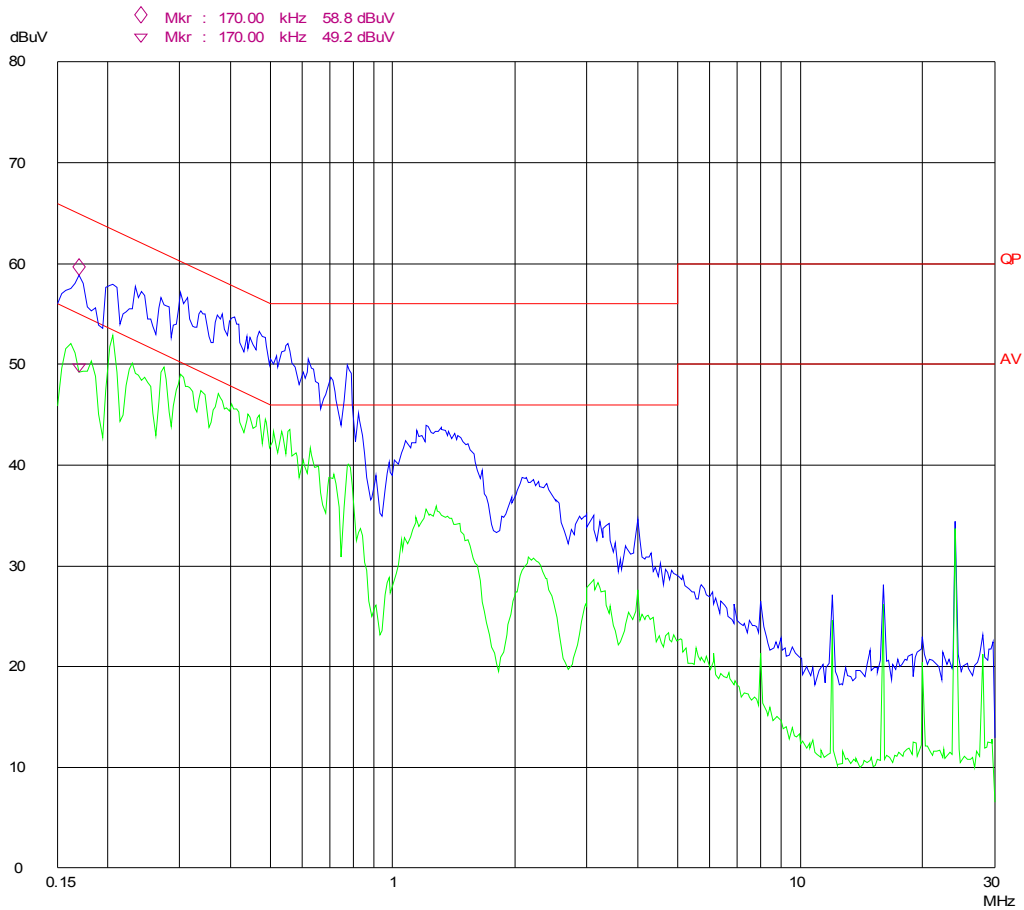
EUT: BT4001
Op Cond: worst-case
Test Spec: L
Comment: AC 120V/60Hz





Conducted Disturbance

EUT: BT4001
Op Cond: worst-case
Test Spec: N
Comment: AC 120V/60Hz





11. ANTENNA REQUIREMENTS

11.1. Applicable requirements

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

11.2. Antenna Connector

The EUT has not external antenna connector and built in monopole antenna which is integrated inside the enclosure.

11.3. Antenna Gain

The antenna gain of EUT is less than 6 dBi.