



Test Report

Test Report No.:	KT114EF01002		
Registration No.:	KR0023		
Applicant:	BYROBOT Co., Ltd.		
Applicant Address:	#417, Human Sky Valley, 33, Omokcheon-ro 132beon-gil, Gweonseon-gu, Suwon-si, Gyeonggi-do, Korea 441-813		
Product:	Drone Fighter Controller		
FCC ID:	2ABMZ-DF-T01	Model No.	DF-T01
Receipt No.:	14-01002	Date of receipt:	January 21, 2014
Date of Issue:	January 24, 2014		
Testing location	Korea Technology Institute Co., Ltd. 51-19, Sanglim3-Ri, Docheok-Myeon, Gwangju-Shi, Gyeonggi-Do, Korea		
Test Standards:	FCC/ANSI. C63.4: 2003		
Rule Parts: FCC	Part 15.247 Subpart C, ANSI C 63.4-2003		
Method of Measurement	FCC Public Notice KDB 558074		
Test Result:	The above-mentioned product has been tested with compliance.		
Tested by: M. G. Ji / Engineer  Signature Date January 21, 2014		Approved by: S. H. Song /Technical Manager  Signature Date January 23, 2014	
Other Aspects:			
Abbreviations:	* OK, Pass=passed * Fail=failed * N/A=not applicable		
 - This test report is not permitted to copy partly without our permission. - This test result is dependent on only equipment to be used. - This test result is based on a single evaluation of one sample of the above mentioned. - This test report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S Government. - We certify this test report has been based on the measurement standards that is traceable to the national or international standards.			

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1. Verification of compliance

Applicant : BYROBOT CO.,LTD

Address : #417, Human Sky Valley, 33, Omokcheon-ro 132beon-gil, Gweonseon-gu, Suwon-si, Gyeonggi-do,
Korea 441-813

FCC ID : 2ABMZ-DF-T01

Model Name : DF-T01

Brand Name :  BYROBOT

Serial Number : N/A

Date : January 24, 2014

Equipment Class	DTS – PART 15 Digital Transmission System
Kind of Equipment	ZigBee
Measurement Procedures	FCC Public Notice KDB 558074, ANSI C63.4-2003,
Type of Equipment Tested	Pre-Production
Kind of Equipment Authorization Requested	Certification
Equipment Will Be Operated Under FCC Rules Part(s)	FCC PART 15 SUBPART C Section 15.247
Modifications On The Equipment To Achieve Compliance	None
Final Test was Conducted On	10m Open area test site

- The above equipment was tested by Korea Technology Institute Co., Ltd. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanation from equipment are within the compliance requirements.



2. General Information

2.1 Product Description

The BYROBOT CO.,LTD Model DF-T01 (referred to as the EUT in this report) is used to remote controller which has a function of zigbee. The product specification described herein was obtained from product data sheet or user's manual.

Equipment Name	Drone Fighter Controller
Operating Frequency	2405 MHz ~ 2480 MHz
RF Output Power	-2.50 dBm
Number of Channel	16 Channels
Mode of Operation	Duplex
Modulation Type	QPSK
Antenna Type / Gain	PCB Pattern Antenna / 5.3 dBi (Max)
List of Each OSC. Or Crystal. Freq.	26 MHz
Rated Supply Voltage	DC 3.7 V

3. EUT MODIFICATION

- NONE.



4. Test Summary

4.1 Test Items and results

SECTION	TEST ITEMS	RESULT
15.203	Antenna Requirement	-
15.207	Conducted Emission	Compliance
15.247(b)(1)	Maximum Peak Conducted Output Power	Compliance
15.247(a)	6dB BandWidth	Compliance
15.247(b)	RF Output Power (Maximum Peak Conducted Output Power)	Compliance
15.247(d)	Power Spectral Density	Compliance
15.247(c)	Transmitter Radiated Bandedge Emissioins	Compliance
15.247(c)	Transmitter Radiated Unwanted Emissioins	Compliance

Notes: Compliance/pass : The EUT complies with the essential requirements in the standard.

Not Compliance : The EUT does not comply with the essential requirements in the standard.

N/A : The test was not applicable in the standard.

4.2 Additions, deviations, exclusions from standard

No additions, deviations or exclusions have been made from standard.

4.3 Related Submittal(s) / Grant(s)

Original submittal only

4.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in section 2.1.

4.5 Test Methodology

The radiated testing was performed according to the procedures in ANSI C63.4:2003 at a distance of 3 m from EUT to the antenna

4.6 Test Facility

The open area test site and conducted measurement facilities are located on at 51-19, Sanglim3-Ri, Docheok-Myeon, Gwangju-Shi, Gyeonggi-Do, Korea



5. System test Configuration

5.1 Characteristics of equipment

This equipment is Wireless Remote Helicopter. The DF-T01 is an wireless remote implementing s ZIGBEE communication standards, DSSS used frequency band is 2 405 MHz - 2 480 MHz Power source is supplied 3.7 Vdc.

5.2 Used Peripherals list

DEVICE TYPE	Manufacturer	Model	S/N
Notebook PC	SAMSUNG	NT-RV511-S16R	HHA793QB600206F

5.3 Mode of operation during the test

For zigbee function testing, software used to control the EUT for staying in continuous transmitting and receiving mode is programmed. The EUT was set at Low Channel (2 405 MHz), Middle Channel (2 440 MHz), and High Channel (2 480 MHz) with each data transfer rate. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and rotated. The worst data was recorded in this test report.

5.4 Uncertainty

1) Radiated disturbance

U_c (Combined standard Uncertainty) = $\pm 2.61\text{dB}$

Expanded uncertainty $U = K U_c$

$K = 2$

$\therefore U = \pm 5.22\text{dB}$

2) Conducted disturbance

$U_c = \pm 1.40\text{dB}$

$U = K U_c = 2 \times U_c = \pm 2.8\text{dB}$

$\therefore U = \pm 2.8\text{dB}$

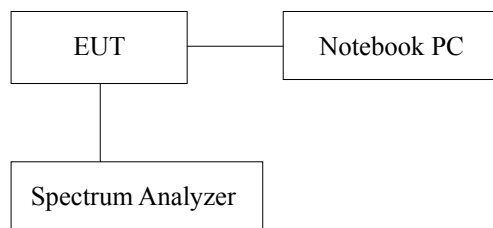


5.5 Test setup of EUT

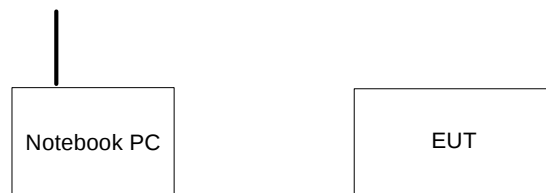
6.5.1 Except Radiated Emissions and AC Conducted Emissions measurement, all measurements were taken in continuous transmit / receive mode using the TEST MODE.

For controlling the EUT as TEST MODE, the test program was provided by the applicant.

The jig board controlled EUT by Notebook PC in TEST MODE.



6.5.2 Radiated Emission and AC Conducted Emissions measurement setup



— SIGNAL
— AC
— POWER



6. Measurement results

6.1 6 dB Bandwidth

Temperature : 22 °C

Relative Humidity : (44 - 45) % R.H.

Procedure

KDB 558074 D01 v01 “Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) Operating Under 15.247”

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 2 MHz (approximately 2 or 3 times of the 20 dB bandwidth)

RBW = 10 kHz (1% of the 20dB bandwidth or more) Sweep = auto

VBW = 30 kHz (VBW ≥ RBW) Detector function = peak

Trace = max hold

Test equipment used

Model NO.	Manufacturer	Description	S/N	Cal. Date	Due to Cal. Date
8564E	H.P	Spectrum Analyzer	3745A01024	2013.04.03	2014.04.03

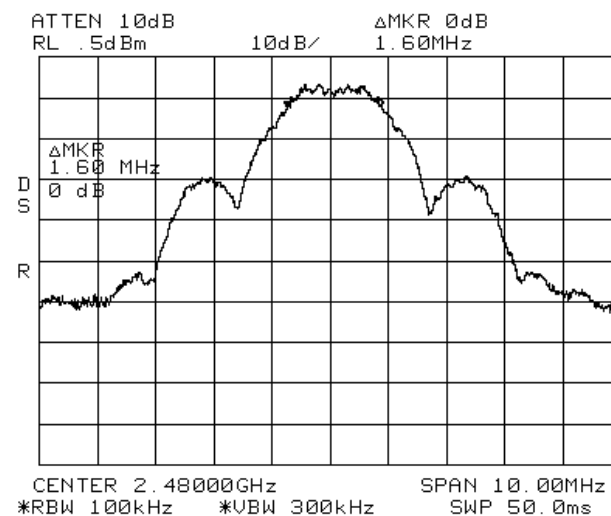
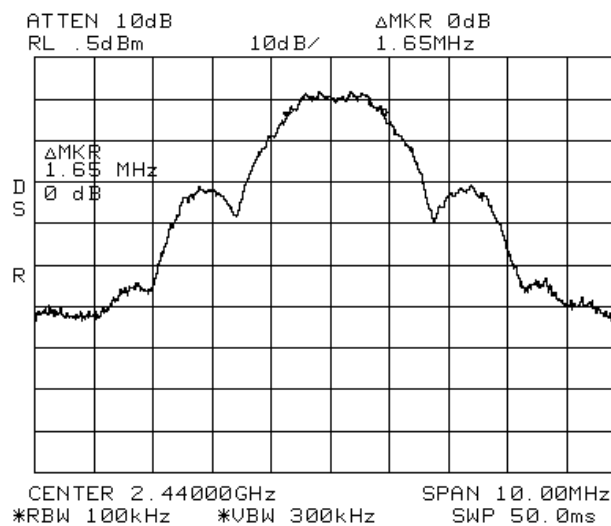
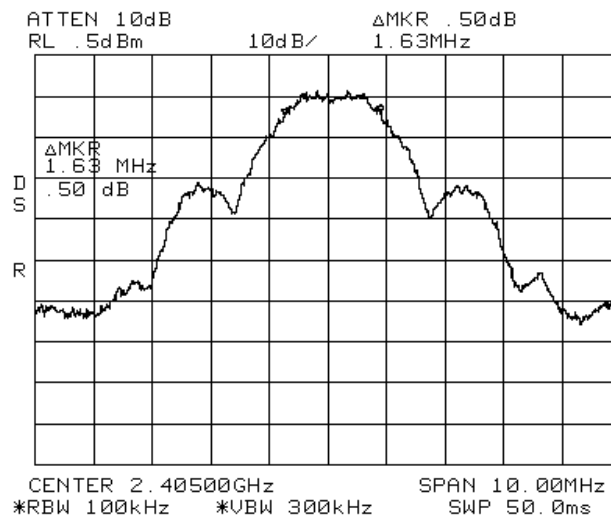
Measurement Data:

Frequency(MHz)	Channel No.	Test Results	Test Results
		99% Bandwidth (MHz)	6dB Bandwidth (MHz)
2405	1	2.667	1.63
2440	8	2.667	1.65
2480	16	2.667	1.60

- See next pages for actual measured spectrum plots.

Limit:

6dB Bandwidth ≥ 500KHz





6.2 Peak Output Power

Temperature : 22 °C

Relative Humidity : (44 - 45) % R.H

Procedure:

KDB 558074 D01 v01 “Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) Operating Under 15.247”

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 5 MHz (approximately 5 times of the 20 dB bandwidth)

RBW = 1 MHz (greater than the 20dB bandwidth of the emission being measured)

VBW = 1 MHz (VBW ≥ RBW)

Detector function = peak

Trace = max hold

Sweep = auto

Test equipment used

Model NO.	Manufacturer	Description	S/N	Cal. Date	Due to Cal. Date
8564E	H.P	Spectrum Analyzer	3745A01024	2013.04.03	2014.04.03

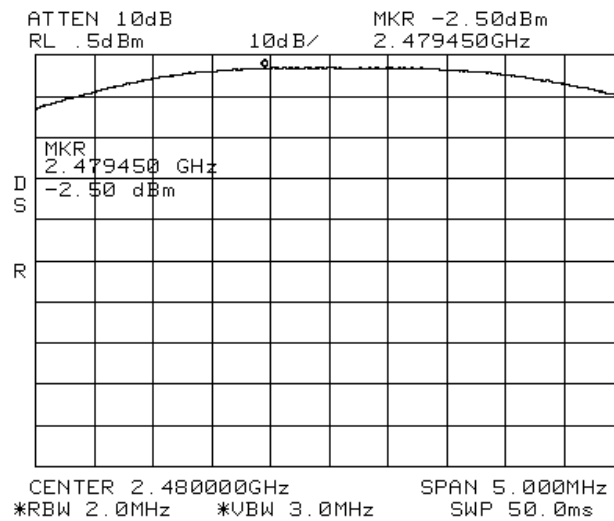
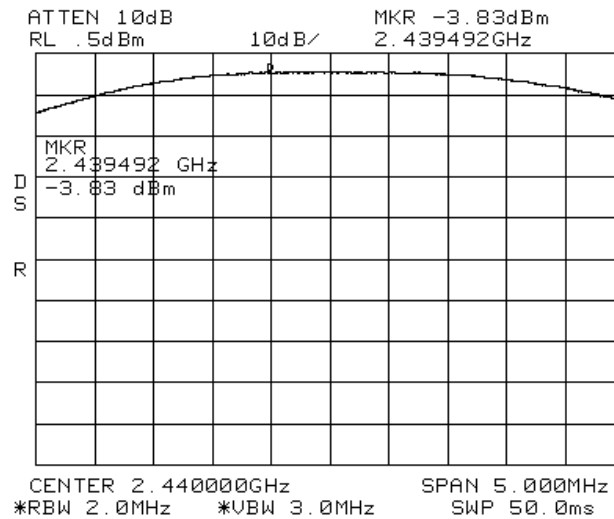
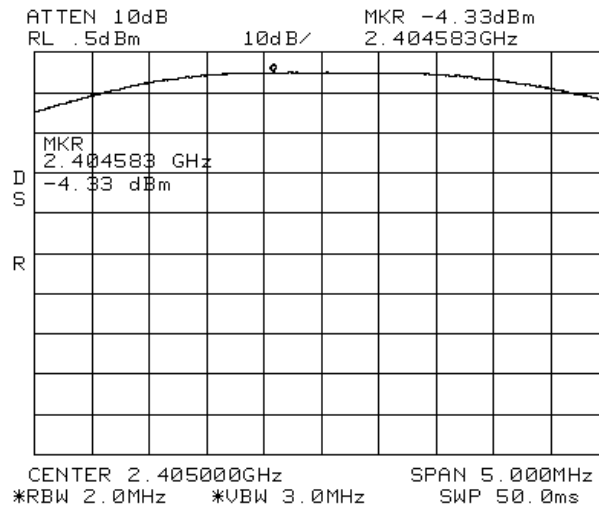
Measurement Data:

Frequency (MHz)	Ch.	Test Results		
		dBm	W	Result
2405	1	-4.33	0.00036	Compliance
2440	8	-3.83	0.00041	Compliance
2480	16	-2.50	0.00056	Compliance

- See next pages of actual measured spectrum plots.

Minimum Standard:

< 1W





6.3 Power Spectral Density

Temperature : 22 °C

Relative Humidity : (44 - 45) % R.H

Procedure:

Power spectral density procedures that the same method as used to determine the conducted output power shall be used to determine the power spectral density. In addition, the use of a peak PSD procedure will always result in a “worst-case” measured level for comparison to the limit. Therefore, whenever the DTS bandwidth exceeds 500 kHz, it is acceptable to utilize the peak PSD procedure to demonstrate compliance to the PSD limit, regardless of how the fundamental output power was measured.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 3 kHz

VBW $\geq$ RBW

Span = 1.5 MHz

Detector function = peak

Trace = max hold

Sweep = auto

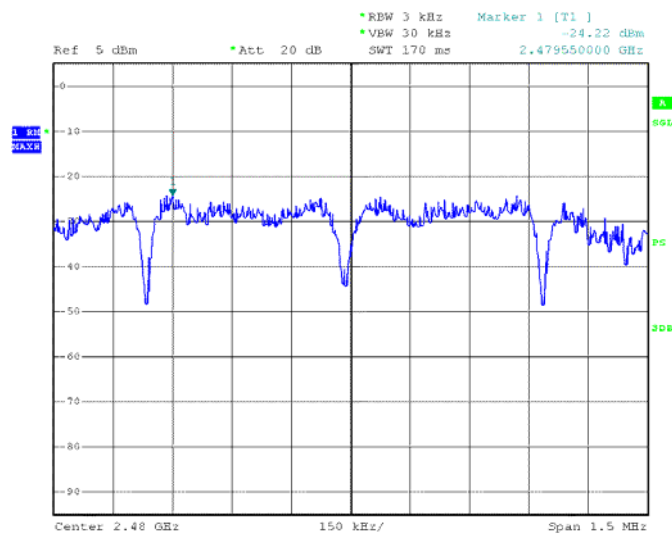
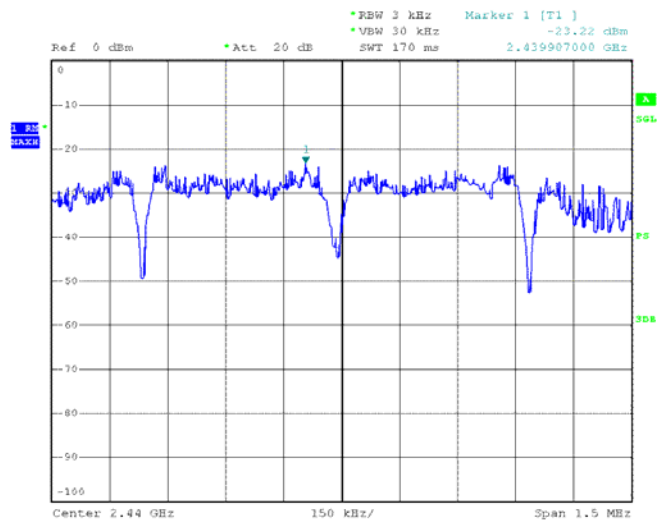
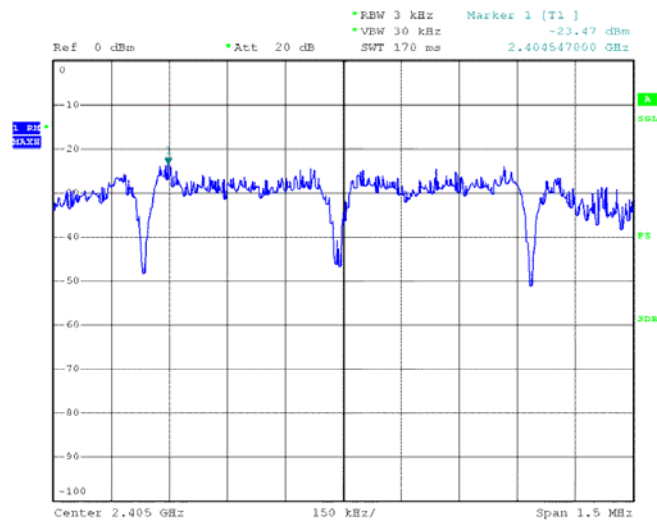
Test equipment used

Model NO.	Manufacturer	Description	S/N	Cal. Date	Due to Cal. Date
ESCI	R&S	RECEIVER	100025	2013.09.23	2014.09.23

Measurement Data:

Frequency (MHz)	Setting Channel (CH)	Test Results	
		Measured value (dBm)	Result
2405	1	-23.47	Compliance
2440	8	-23.22	Compliance
2480	16	-24.22	Compliance

Limit (dBm)	> 8 dBm
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6.4 Test data for radiated emission

Above 1 GHz Electric Field strength was measured in accordance with ANSI C 63.4 (2003). The test setup was made according to ANSI C 63.4 (2003) on an Anechoic chamber, which allows a 3m distance measurement. The EUT was placed in the center of wooden turntable. The height of this table was 0.8m. The measurement was conducted with both horizontal and vertical antenna polarization. The turntable has fully rotated.

6.4.1 Radiated Emission which fall in the Restricted Band

Temperature : 3 °C

Relative Humidity : (55 - 56) % R.H

Center frequency = the highest and the lowest channels

RBW = 1 MHz for Peak and Average Mode

VBW = 1 MHz for Peak Mode, 10 Hz for Average Mode

Sweep = auto

Result : PASSED

Test equipment used

Model NO.	Manufacturer	Description	S/N	Cal. Date	Due to Cal. Date
ESIB40	R&S	RECEIVER	100093	2013.05.13	2014.05.13
3115	ETS	HORN ANTENNA	6443	2012.10.21	2014.10.21
KT1-HD-1080	KTI	HORN ANTENNA	130001	2013.04.10	2015.04.10
6502	EMCO	LOOP ANTENNA	3434	2012.03.15	2014.03.15
VULB9163	S/B	BI-LOG ANTENNA	281	2012.10.28	2014.10.28

Measurement Data

Frequency (MHz)	Reading. (dBμV)	Detector Mode	Ant. Pol.	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2138.40	39.76	Peak	H	27.84	6.95	23.05	51.5	74.00	22.50
	13.66	Average	H				25.4	54.00	28.60
	24.26	Peak	V				36.0	74.00	38.00
	11.16	Average	V				22.9	54.00	31.10
Test Data for High Channel									
2490.64	29.18	Peak	H	28.88	7.62	22.38	43.3	74.00	30.70
	15.28	Average	H				29.4	54.00	24.60
	28.78	Peak	V				42.9	74.00	31.10
	15.78	Average	V				29.9	54.00	24.10



Notes : “H” : Horizontal, “V” : Vertical

Each data transfer rate, BDR Mode and EDR Mode was tested, but the worst data was recorded.

6.4.2 Spurious Radiated Emission above 1 GHz

Temperature : 3 °C

Relative Humidity : (55 - 56) % R.H

Center frequency = the highest, middle and the lowest channels

RBW = 1 MHz for Peak and Average Mode for the emissions fall in restricted band,

100 kHz for Peak Mode for the emissions outside restricted band

VBW = 1 MHz

z for Peak Mode, 10 Hz for Average Mode

Measurement distance : 3m

Frequency Range : 1 GHz ~ 25 GHz

Result : PASSED

Frequency (MHz)	Reading. (dBμV)	Detector Mode	Ant. Pol.	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2405.00	58.59	Peak	H	28.61	7.45	22.55	72.1	-	72.10
	63.79	Peak	V				77.3	-	77.30
4810.00*	25.81	Peak	H	33.59	10.35	19.65	50.1	74.00	23.90
	7.61	Average	H				31.9	54.00	22.10
	19.51	Peak	V				43.8	74.00	30.20
	6.61	Average	V				30.9	54.00	23.1
Test Data for Middle Channel									
2440.00	59.63	Peak	H	28.73	7.52	22.48	73.4	-	73.40
	61.53	Peak	V				75.3	-	75.30
4880.00*	28.81	Peak	H	33.67	10.36	19.64	53.2	74.00	20.80
	6.21	Average	H				30.6	54.00	23.40
	18.51	Peak	V				42.9	74.00	31.10
	5.51	Average	V				29.9	54.00	24.10



Frequency (MHz)	Reading. (dBμV)	Detector Mode	Ant. Pol.	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for high Channel									
2 480.00	56.25	Peak	H	28.85	7.60	22.40	70.3	-	70.30
	61.55	Peak	V				75.6	-	75.60
4 960.00*	25.31	Peak	H	33.75	10.37	19.63	49.8	74.00	24.20
	8.11	Average	H				32.6	54.00	21.40
	20.81	Peak	V				45.3	74.00	28.70
	6.31	Average	V				30.8	54.00	23.20

- Notes:
- 1.All modes of operation were investigated.
And the worst-case emission are reported.
 - 2.All other emission is non-significant.
 - 3.All readings are calibrated by self-mode in receiver.
 - 4.Measurements using CISPR peak mode.
 5. Correction Factor(dB)= Cable Factor(dB) + Amp. Factor (dB)
 6. H = Horizontal, V = Vertical Polarization
 - 7."*" Frequency fall in restricted band



6.4.3 Spurious Radiated Emission below 1 GHz

Temperature : 3 °C

Relative Humidity : (55 - 56) % R.H

RBW = 120 kHz

Measurement distance : 3m

Frequency Range : 30 MHz ~ 1 GHz

Result : PASSED

Frequency (MHz)	Reading. (dBμV)	Ant. Pol.	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)
42.72	1.07	V	1.04	184	14.42	0.51	16.0	30.00	14.00
75.16	3.85	V	1.10	318	9.61	0.74	14.2	30.00	15.80
125.32	14.2	V	1.25	270	10.31	0.89	25.4	30.00	4.60
360.00	5.79	V	2.85	180	16.00	1.91	23.7	37.00	13.30
583.44	0.47	H	2.20	180	19.59	2.54	22.6	37.00	14.40
720.00	4.89	H	1.95	165	20.51	2.80	28.2	37.00	8.80

Notes : "H" : Horizontal, "V" : Vertical,



6.4.4 Spurious Radiated Emission below 30 MHz

Temperature : 3 °C

Relative Humidity : (55 - 56) % R.H

RBW = 200 Hz(from 9 kHz to 0.15 MHz), 9 kHz(from 0.15 MHz to 30 MHz)

Measurement distance : 3m

Frequency Range : 9 kHz ~ 30 MHz

Result : PASSED

Frequency (MHz)	Reading. (dBμV)	Ant. Pol.	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)
0.02	21.06	V	1.30	186	14.4	0.34	35.8	121.71	85.91
0.05	18.46	V	1.85	180	10.8	0.34	29.6	109.14	79.54
0.18	9.16	V	1.30	0	10.2	0.34	19.7	71.89	52.19

Notes : “H” : Horizontal, “V” : Vertical,



6.5 AC Conducted Emissions

Temperature : 22 °C

Relative Humidity : (44 - 45) % R.H

Procedure

AC power line conducted emissions from the EUT were measured according to the dictates ANSI C64.4:2003.

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold.

While the measurement, EUT had middle channels in line with Section 15.31(m).

Test equipment used

Equipment	Manufacturer	Model	S/N	Cal. Date	Due to Cal. Date
Receiver	R & S	ESCI	100025	2013.09.23	2014.09.23
LISN	R & S	KNW407	8-1157-2	2013.03.04	2014.03.04
LISN	R & S	EM-7823	115019	2013.05.25	2014.05.25
Conducted Cable	N / A	N / A	N / A	2013.11.13	2014.02.13

Measurement Data

<Line-PE>

Frequency (MHz)	(1) Reading (dBμV)		Line	(2) Limit (dBμV)		(3) Margin (dB)	
	QP	AV		QP	AV	QP	AV
0.166	50.9	30.1	L1	65.2	55.2	14.3	25.1
0.266	43.0	23.3	L1	61.2	51.2	18.2	27.9
0.394	41.8	27.2	L1	58.0	48.0	16.2	20.7
11.31	31.6	23.7	L1	60.0	50.0	28.4	26.3
20.67	40.7	33.6	L1	60.0	50.0	19.3	16.4

<Neutral-PE>

Frequency (MHz)	(1) Reading (dBμV)		Line	(2) Limit (dBμV)		(3) Margin (dB)	
	QP	AV		QP	AV	QP	AV
0.158	48.0	31.4	L2	65.6	55.6	17.5	24.1
0.278	42.3	23.1	L2	60.9	50.9	18.5	27.8
0.450	44.7	26.8	L2	56.9	46.9	12.1	20.1
16.26	42.2	34.1	L2	60.0	50.0	17.8	15.9
28.79	44.6	35.5	L2	60.0	50.0	15.4	14.5

**NOTES:**

1. All modes of operation were investigated and the worst-case emissions are reported.
2. All other emissions are non-significant.
3. All readings are calibrated by self-mode in receiver.
4. Measurements using CISPR quasi-peak mode.
5. L1 = LINE-PE, L2 = NEUTRAL-PE
6. The limit for Class B digital device is 66dBuV to 56dBuV from 150KHz to 500KHz, 56dBuV from 500KHz to 5MHz, 60dBuV Above 5MHz.

♠ **Margin Calculation**

(3) Margin = (2) Limit – (1) Reading

6.6 Antenna Requirement

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by responsible party shall be used with the device.

The use of a permanently attached antenna or of an antenna that user 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 broken antenna can be replaced by the user, but the Use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(4)(1), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi

According to above requirement standard's This product's antenna type is an PCB type and it's gain is 5.3 dBi, So radiated emission field strength from EUT is below requirement standard limit

Frequency Band	Gain (dBi)	Limit (dBi)	Results
2400 ~ 2484 MHz	5.30	≤ 6	Compliance