

TEST REPORT

DT&C Co., Ltd. 42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel : 031-321-2664, Fax : 031-321-1664	Report No : DRTFCC1511-0232 Pages:(1) / (16) page	
---	--	---

1. Customer

- Name : BLUEBIRD INC.
- Address : (Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul, South Korea

2. Use of Report : FCC Original Grant

3. Product Name (FCC ID): Enterprise Handheld Computer (SS4EF500)

4. Date of Test : 2015-09-10 ~ 2015-09-30

5. Test Method Used : FCC Part 15.225

6. Testing Environment : See appended test report

7. Test Result : Pass Fail

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by Name : KwiCheol, Yeom 	Technical Manager Name : Geunki Son 
-------------	---	---

2015. 11. 02.

DT&C Co., Ltd.

Test Report Version

Test Report No.	Date	Description
DRTFCC1511-0232	Nov, 02. 2015	Initial issue

CONTENTS

1. General Information	4
1.1. Testing Laboratory.....	4
1.2. Details of Applicant.....	4
1.3. Description of EUT	4
2. Information about test items.....	5
2.1 Test mode.....	5
2.2 Support equipments	5
2.3 Tested frequency	5
2.4 Tested environment.....	5
2.5 EMI Suppression Device(s)/Modifications	5
3. Antenna requirements.....	5
4. Test report	6
4.1 Summary of tests	6
4.2 Transmitter requirements.....	7
4.2.1 20dB bandwidth	7
4.2.2 Occupied bandwidth.....	8
4.2.3 In-band emissions	9
4.2.4 Out-of-band emissions	10
4.2.5 Frequency Stability.....	11
4.2.6 AC Line Conducted Emissions	12
APPENDIX	15

1. General Information

1.1. Testing Laboratory

DT&C Co., Ltd.

FCC test site number 165783

42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935

www.dtnc.net

Telephone : + 82-31-321-2664
FAX : + 82-31-321-1664

1.2. Details of Applicant

Applicant : BLUEBIRD INC.
Address : (Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul, South Korea
Contact person : Jaeho Lee

1.3. Description of EUT

FCC Equipment Class	Low Power Communications Device Transmitter(DXX)
EUT	Enterprise Handheld Computer
Model Name	EF500, EF500R ※ 2 models are same mechanical, electrical and functional. ※ The only difference is the model name, which are changed for marketing purpose.
Serial Number	Identical prototype
Power Supply	Li-ion Battery: DC 3.8 V
Frequency Band	13.56 MHz
Modulation Type	ASK
Channel(s)	1
Antenna type	Loop Antenna

2. Information about test items

2.1 Test mode

Test mode1	Continuous transmitting mode
Test mode2	-

Note: For this test mode, a test program was supported by manufacturer.

2.2 Support equipments

Equipment	Model No.	Serial No.	Manufacturer	Note
-	-	-	-	-

2.3 Tested frequency

Channel	TX Frequency(MHz)	RX Frequency(MHz)
Lowest	13.56	13.56
Middle	-	-
Highest	-	-

2.4 Tested environment

Temperature	: 23 ~ 24 °C
Relative humidity content	: 35 ~ 44 % R.H.
Details of power supply	: DC 3.8 V

2.5 EMI Suppression Device(s)/Modifications

EMI suppression device(s) added and/or modifications made during testing
→ None

3. Antenna requirements

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antenna is attached to the battery cover, and antenna is coupled use the special tension. Therefore this E.U.T Complies with the requirement of §15.203

4. Test report

4.1 Summary of tests

FCC part section(s)	RSS section(s)	Parameter	Limit	Test condition	Status Note 1
2.1049	-	20 dB Bandwidth	-	Radiated	C
-	RSS-Gen [6.6]	Occupied Bandwidth	-		NA
15.225 (a)	RSS-210 [A2.6 (a)]	In-Band Emissions	15,848 μ V/m @ 30 m 13.553 – 13.567 MHz		C
15.225 (b)	RSS-210 [A2.6 (b)]	In-Band Emissions	334 μ V/m @ 30 m 13.410 – 13.553 MHz 13.567 – 13.710 MHz		C
15.225 (c)	RSS-210 [A2.6 (c)]	In-Band Emissions	106 μ V/m @ 30 m 13.110 – 13.410 MHz 13.710 – 14.010 MHz		C
15.225 (d) 15.209	RSS-210 [A2.6 (d)]	Out-of Band Emissions	Emissions outside of the specified band (13.110-14.010 MHz) must meet the radiated limits detailed in 15.209		C
15.225 (e)	RSS-210 [A2.6]	Frequency Stability	\pm 0.01 % of operating frequency	Temp & Humid Test Chamber	C
15.207	RSS-Gen [8.8]	AC Conducted Emissions	FCC Part 15.207	AC Line Conducted	C
15.203	RSS-Gen [6.7]	Antenna Requirements	FCC Part 15.203	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: Semi anechoic chamber registration number is 165783

The sample was tested according to the following specification:

ANSI C-63.10-2013

4.2 Transmitter requirements

4.2.1 20dB bandwidth

- Procedure:

The 20 dB Bandwidth is measured with a spectrum analyzer connected via a receive antenna placed near the EUT while the EUT is operating in transmission mode.

- Measurement Data: Comply



- Minimum Standard: NA

4.2.2 Occupied bandwidth

- Procedure:

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 x RBW.

- Measurement Data: NA

- Minimum Standard: NA

4.2.3 In-band emissions

- Procedure:

The EUT was placed on a 0.8 m high non-conductive table inside a 10 m semi anechoic chamber. An antenna was placed at 3 m distance from the EUT. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions. A loop antenna was used for this test item.

And the loop antenna was rotated about vertical axis.

- Measurement Data: Comply

Tested Frequency : 13.56 MHz
 Measurement Distance : 3 Meters

Test Frequency Band [MHz]	Freq. [MHz]	EUT Posi.	Reading Level [dBuV]	T.F	Field Strength @3 m [dBuV/m]	Field Strength @30 m [dBuV/m]	Limit [dBuV/m]	Margin [dB]
13.110 ~ 13.410	13.348	Z	37.50	11.50	49.00	9.00	40.51	31.51
13.410 ~ 13.553	13.552	Z	53.20	11.40	64.60	24.60	50.47	25.87
13.553 ~ 13.567	13.560	Z	59.40	11.40	70.80	30.80	84.00	53.20
13.567 ~ 13.710	13.568	Z	52.50	11.40	63.90	23.90	50.47	26.57
13.710 ~ 14.010	13.772	Z	36.20	11.40	47.60	7.60	40.51	32.91

Note 1. This test item was performed using a loop antenna.

Note 2. This test item was performed at 3 m and the data were extrapolated to the specified measurement distance of 30 m using the square of an inverse linear distance extrapolation factor (40 dB/decade) as specified in §15.31(f)2.

- Extrapolation Factor = $20 \log_{10}(30/3)^2 = 40$ dB

Note 3. All data were recorded using a spectrum analyzer employing a peak detector.

If PK results were meet Quasi-peak limit, Quasi-peak measurements were omitted.

Note 4. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Field Strength} @ 30 \text{ m} \quad / \quad \text{Field Strength} @ 30 \text{ m} = \text{Field Strength} @ 3 \text{ m} - 40 \text{ dB}$$

$$\text{Field Strength} @ 3 \text{ m} = \text{Reading} + \text{T.F} \quad / \quad \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

- Minimum Standard: Part 15.225(a), (b), (c)& RSS-210 [A2.6(a), (b), (c)]

Frequency Band [MHz]	Limit	
	[uV/m]	[dBuV/m]
13.553-13.567	15,848	84.00
13.410-13.553	334	50.47
13.567-13.710		
13.110-13.410	106	40.51
13.710-14.010		

4.2.4 Out-of-band emissions

- Procedure:

The EUT was tested from 9 kHz up to the 1 GHz excluding the band 13.110-14.010 MHz. All measurements were recorded with spectrum analyzer employing a peak detector for emissions below 30 MHz. Above 30 MHz a Quasi-peak detector was used. All out-of-band emissions must not exceed the limits §15.209. A loop antenna was used for searching for emissions below 30 MHz.

- Measurement Data: Comply

Tested Frequency : 13.56 MHz
 Measurement Distance : 3 Meters

Frequency [MHz]	EUT Posi.	ANT Pol	Reading [dBuV]	T.F [dB/m]	Distance factor	Field Strength [dBuV/m]	Limit [dBuV/m]	Margin [dB]
0.010	X	N/A	48.9	19.70	80	-11.4	47.6	59.0
0.184	Z	N/A	47.6	13.40	80	-19.0	22.3	41.3
0.514	X	N/A	39.3	13.10	40	12.4	33.4	21.0
23.180	Z	N/A	20.2	10.20	40	-9.6	29.5	39.1
40.670	Z	V	41.2	-17.30	0	23.9	40.0	16.1
189.804	Z	H	41.7	-16.40	0	25.3	43.5	18.2
533.300	Z	V	31.5	-6.80	0	24.7	46.0	21.3
718.854	Z	H	28.3	-3.90	0	24.4	46.0	21.6

Note 1. All measurements were recorded using a spectrum analyzer employing a peak detector for below 30 MHz and a Quasi-peak detector for above 30 MHz.

Note 2. Both Vertical and Horizontal polarities of the receiver antenna were evaluated with the worst case emissions being reported. For 30 MHz below the loop antenna was rotated about vertical axis.

Note 3. No other spurious and harmonic emissions were reported greater than listed emissions above table.

Note 4. Sample calculation

$$\text{Margin} = \text{Limit} - \text{Field Strength}$$

$$\text{Field Strength} = \text{Reading} + \text{T.F} - \text{Distance factor}$$

$$\text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

$$\text{Distance factor} = 20\log(\text{Measurement distance} / \text{The measured distance})^2$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

- Minimum Standard: Part 15.209, 225(d) & RSS-210[A2.6 (d)]

- FCC Part 15.209(a):

Frequency [MHz]	Field Strength [uV/m]	Measurement Distance [Meters]
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	200	3

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

- FCC Part 15.209(b):

In the emission table above, the tighter limit applies at the band edges.

4.2.5 Frequency Stability

- Procedure:

Part 15.225 requires that devices operating in the 13.553 – 13.567 MHz shall maintain the carrier frequency within 0.01 % of the operating frequency over the temperature variation of -20 degrees to + 50 degrees C at normal supply voltage.

- Measurement Data: Comply

Operating Frequency : 13,560,000 Hz

VOLTAGE (%)	POWER (V _{DC})	TEMP (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100%	3.80	+25(ref)	13,560,012	12	0.000088
100%		-20	13,560,008	8	0.000059
100%		-10	13,560,017	17	0.000125
100%		0	13,560,015	15	0.000111
100%		+10	13,560,013	13	0.000096
100%		+20	13,560,021	21	0.000155
100%		+30	13,560,025	25	0.000184
100%		+40	13,560,029	29	0.000214
100%		+50	13,560,033	33	0.000243
115%	4.37	+25	13,560,006	6	0.000044
BATT.ENDPOINT	3.23	+25	13,560,010	10	0.000074

- Minimum Standard: Part 15. 225(e) & RSS-210 [A2.6]

The frequency tolerance of the carrier signal shall be maintained within ±0.01 % of the operating frequency.

4.2.6 AC Line Conducted Emissions

- Test Requirements and limit

For an intentional radiator that is designed to be connected to the public utility (AC)power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.

- Measurement Data: **Comply** (refer to the next page)

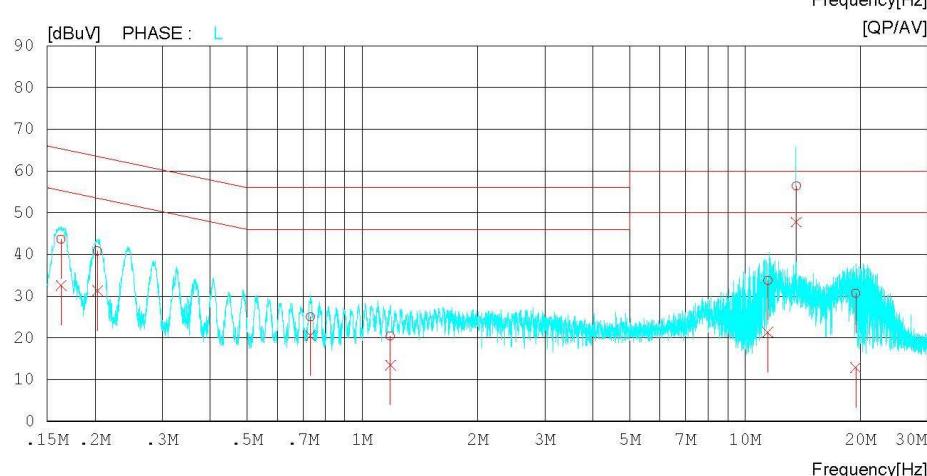
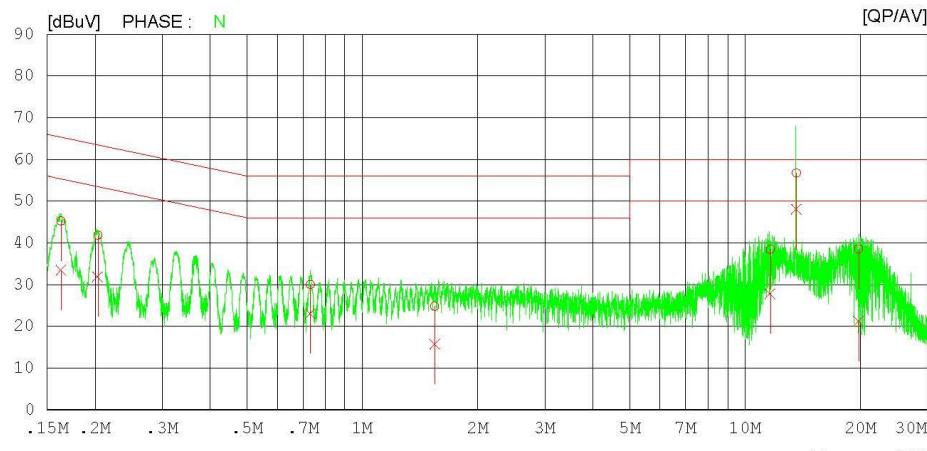
Measurement Data

Results of Conducted Emission

DTNC

Date : 2015-09-30

Order No.	:	EF500	Reference No.	:
Model No.	:		Power Supply	: 120 V 60 Hz
Serial No.	:		Temp/Humi.	: 23 'C 44 % R.H.
Test Condition	:	NFC	Operator	: K.C.Yeom
Memo :				
LIMIT : FCC P15.207 QP FCC P15.207 AV				



Measurement Data

Results of Conducted Emission

DTNC

Date : 2015-09-30

Order No.	:	Reference No.	:
Model No.	:	Power Supply	:
Serial No.	:	Temp/Humi.	:
Test Condition	:	Operator	:

Memo	:
------	---

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.16293	35.1	23.3	10.1	45.2	33.4	65.3	55.3	20.1	21.9	N
2	0.20345	31.7	21.8	10.1	41.8	31.9	63.5	53.5	21.7	21.6	N
3	0.73117	19.9	12.9	10.1	30.0	23.0	56.0	46.0	26.0	23.0	N
4	1.54700	14.5	5.5	10.2	24.7	15.7	56.0	46.0	31.3	30.3	N
5	11.63940	27.8	17.2	10.6	38.4	27.8	60.0	50.0	21.6	22.2	N
6	13.63160	46.1	37.4	10.6	56.7	48.0	60.0	50.0	3.3	2.0	N
7	19.82000	27.8	10.5	10.7	38.5	21.2	60.0	50.0	21.5	28.8	N
8	0.16299	33.5	22.4	10.1	43.6	32.5	65.3	55.3	21.7	22.8	L
9	0.20324	30.6	21.2	10.1	40.7	31.3	63.5	53.5	22.8	22.2	L
10	0.73202	14.9	10.3	10.1	25.0	20.4	56.0	46.0	31.0	25.6	L
11	1.18340	10.2	3.2	10.2	20.4	13.4	56.0	46.0	35.6	32.6	L
12	11.47980	23.0	10.7	10.7	33.7	21.4	60.0	50.0	26.3	28.6	L
13	13.62440	45.5	36.9	10.8	56.3	47.7	60.0	50.0	3.7	2.3	L
14	19.45960	19.9	2.0	10.8	30.7	12.8	60.0	50.0	29.3	37.2	L

APPENDIX

TEST EQUIPMENT FOR TESTS

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
MXA Signal Analyzer	Agilent	N9020A	15/02/26	16/02/26	MY50200816
DC Power Supply	SM techno	SDP30-5D	15/01/06	16/01/06	305DLJ204
Vector Signal Generator	Rohde Schwarz	SMBV100A	15/01/06	16/01/06	255571
Multimeter	Agilent Technologies	34401A	15/01/06	16/01/06	US36099541
Temp & Humi Test Chamber	SJ Science	SJ-TH-S50	15/02/26	16/02/26	SJ-TH-S50-140205
Low Noise Pre Amplifier	tsj	MLA-010K01-B01-27	15/04/09	16/04/09	1844538
Loop Antenna	ETS-Lindgren	6502	15/04/27	17/04/27	3471
TRILOG Broadband Test-Antenna(30MHz-1GHz)	Schwarzbeck	VULB 9160	14/07/31	16/07/31	3362
EMI TEST RECEIVER	R&S	ESR7	14/10/21	15/10/21	101109
			15/10/19	16/10/19	
Thermohygrometer	BODYCOM	BJ5478	15/05/08	16/05/08	120612-2
EMI TEST RECEIVER	R&S	ESCI	15/02/25	16/02/25	100364
SINGLE-PHASE MASTER	NF	4420	14/09/11	15/09/11	3049354420023
			15/09/09	16/09/09	
ARTIFICIAL MAINS NETWORK	Narda S.T.S. / PMM	PMM L2-16B	15/06/26	16/06/26	000WX20305