TEST REPORT

DT&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC1801-0015
2. Customer
   - Name : Bluebird Inc.
   - Address : (Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul South Korea
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : Touch Mobile Computer / EF501R
   FCC ID : SS4EF501R
5. Test Method Used : ANSI C63.10-2013
   Test Specification : FCC Part 15.225
6. Date of Test : 2017.12.22 ~ 2018.01.03
7. Testing Environment : Refer to appended test report.
8. Test Result : Refer to the attached test result.

Affirmation	Tested by Name : JungWoo Kim (Signature)	Reviewed by Name : GeunKi Son (Signature)

2018 . 01 . 15 .

DT&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description
DRTFCC1801-0015	Jan. 15, 2018	Initial issue

CONTENTS

1. General Information

1.1. Testing Laboratory

DT&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The site is constructed in conformance with the requirements. **- FCC MRA Accredited Test Firm No. : KR0034**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.2. Testing Environment

Ambient Condition	
▪ Temperature	+20 ~ 24 ℃
▪ Relative Humidity	39 ~ 44 %

1.3. Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C 63.4-2014. All measurement uncertainty values are shown with a coverage factor of *k* = 2 to indicate a 95 % level of confidence.

Parameter	Measurement uncertainty
AC conducted emission	*± 2.4 dB (The confidence level is about 95 %, k = 2)*
Radiated Disturbance (Below 1 GHz)	*± 5.1 dB (The confidence level is about 95 %, k = 2)*

1.4. Details of Applicant

Applicant	:	Bluebird Inc.
Address	:	(Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul South Korea
Contact person	:	Yongsik Jang

1.5. Description of EUT

FCC Equipment Class	Low Power Communications Device Transmitter(DXX)
EUT	Touch Mobile Computer
Model Name	EF501R
Add Model Name	NA
Serial Number	Identical prototype
Power Supply	DC 3.8 V
Frequency Band	13.56 MHz
Modulation Type	ASK
Channel(s)	1
Antenna type	Loop Antenna

1.6. EUT CAPABILITIES

This ETU contains the following capabilities:
850/1900 GSM/GPRS/EGPRS, WCDMA/HSUPA, Multi-band LTE , 802.11b/g/n WLAN(2.4GHz), 802.11a/n/ac WLAN(5GHz), Bluetooth(BDR, EDR, LE), NFC

2. Information about test items

2.1 Test mode

Test mode1	Continuous transmitting mode

Note 1: The worst case data rate was determined according to the fundamental emission level. And data rate was tested at the worst case(212kbps).

2.2 Tested frequency

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

2.3 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 internal antenna is attached on the main PCB using the special spring tension. (Refer to Internal Photo file.)
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 Note 2	C
-	RSS-Gen [6.6]	Occupied Bandwidth	-		NA
15.225 (a)	RSS-210 [B6(a)]	In-Band Emissions	15,848 μN/m @ 30 m 13.553 – 13.567 MHz		C
15.225 (b)	RSS-210 [B6(b)]	In-Band Emissions	334 μN/m @ 30 m 13.410 – 13.553 MHz 13.567 – 13.710 MHz		C
15.225 (c)	RSS-210 [B6(c)]	In-Band Emissions	106 μN/m @ 30 m 13.110 – 13.410 MHz 13.710 – 14.010 MHz		C
15.225 (d) 15.209	RSS-210 [B6(d)] RSS-GEN [8.9]	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 [B6]	Frequency Stability	±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	-	Antenna Requirements	FCC Part 15.203	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable
Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.

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.

And spectrum analyzer setting use following test procedure of **ANCSI C63.10-2013 – Section 6.9.2.**

1. Center frequency = EUT channel center frequency
2. Span = 2 ~ 5 times the OBW
3. RBW = 1 % ~ 5 % OBW
4. VBW ≥ 3 x RBW
5. Detector = Peak
6. Trace = Max hold
7. The trace was allowed to stabilize
8. Determine the reference value = Set the spectrum analyzer marker to the highest level of the displayed trace
9. Using the marker-delta function of the instrument, determine the "−xx dB down amplitude" using [(reference value) − xx].
10. Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

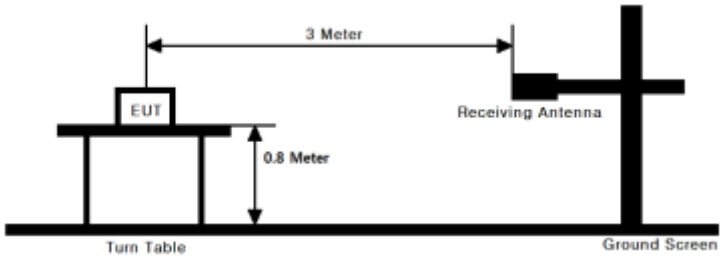
- Measurement Data: Comply

- Minimum Standard: NA

4.2.2 In-band emissions

- Test Configuration

Below 30MHz



- Procedure: The radiated emission was tested according to the **section 6.4 of the ANSI C63.10-2013.**

The EUT was placed on a 0.8 m high non-conductive table and it was placed at 3m distance from the antenna. Measurements were performed for each of the three antenna orientations. (ie. parallel, perpendicular, and ground-parallel)
Also, measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

RBW = As specified in below table, VBW ≥ 3 x RBW, Sweep = Auto, Detector = Peak
Trace mode = Max Hold until the trace stabilizes.

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

- Minimum Standard: Part 15.225(a), (b), (c) & RSS-210 [B6(a), (b), (c)]

Frequency Band [MHz]	Limit at 30 m measurement distance	
	[uV/m]	[dBuV/m]
13.553-13.567	15,848	84.00
13.410-13.553 13.567-13.710	334	50.47
13.110-13.410 13.710-14.010	106	40.51

- **Measurement Data:**

Tested Frequency : **13.56 MHz**

Measurement Distance : **3 Meters**

Test Frequency Band [MHz]	Freq. [MHz]	EUT Axis.	Reading Level [dBuV]	T.F [dB/m]	Field Strength @3 m [dBuV/m]	Field Strength @30 m [dBuV/m]	Limit [dBuV/m]	Margin [dB]
13.110 ~ 13.410	13.347	Y	26.10	20.20	46.30	6.30	40.51	34.21
13.410 ~ 13.553	13.553	Y	46.60	20.20	66.80	26.80	50.47	23.67
13.553 ~ 13.567	13.559	Y	51.50	20.20	71.70	31.70	84.00	52.30
13.567 ~ 13.710	13.568	Y	43.20	20.20	63.40	23.40	50.47	27.07
13.710 ~ 14.010	13.772	Y	24.40	20.20	44.60	4.60	40.51	35.91

Note 1. Loop antenna orientation
"P": Parallel, **"V"**: perpendicular, **"G"**: ground-parallel

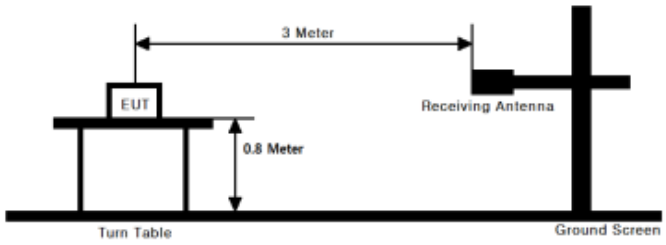
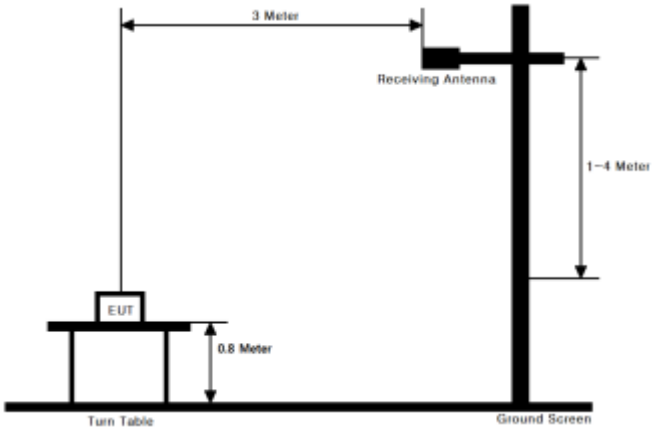
Note 2. This test item was performed at 3 m and the data were extrapolated to the specified measurement distance of 30 m using the square of an inverse linear distance extrapolation factor (40 dB/decade) as specified in §15.31(f)2.
▪ Extrapolation Factor = 20 $\log_{10}(30/3)^2$ = 40 dB

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.
Margin = Limit – Field Strength @ 30 m / Field Strength @ 30 m = Field Strength @ 3 m – 40 dB
Field Strength @ 3 m = Reading + T.F / T.F = AF + CL
Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss

4.2.4 Out-of-band emissions

- Test configuration

Below 30MHz	30MHz ~ 1GHz
	

- Procedure: The radiated emission was tested according to the **section 6.4, 6.5 of the ANSI C63.10-2013.**

The EUT was tested from 9 kHz up to the 1 GHz excluding the band 13.110-14.010 MHz.
A The EUT was placed on a 0.8 m high non-conductive table and it was placed at 3m distance from the antenna.
For measurements below 30MHz were performed for each of the three antenna orientations. (ie. parallel, perpendicular, and ground-parallel) For measurements above 30MHz were performed for each of the both horizontal and vertical polarizations.
Also, measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

RBW = As specified in below table, VBW ≥ 3 x RBW, Sweep = Auto, Detector = Peak
Trace mode = Max Hold until the trace stabilizes.

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

- Minimum Standard: Part 15.209, 225(d) & RSS-210[B6(d)], RSS-GEN[8.9]

▪ 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.

- Measurement Data:

Tested Frequency : **13.56 MHz**

Measurement Distance : **3 Meters**

Frequency [MHz]	EUT Axis.	Reading [dBuV]	T.F [dB/m]	Distance factor [dB]	Field Strength [dBuV/m]	Limit [dBuV/m]	Margin [dB]
0.044	Y	35.4	19.6	80	-25	34.7	59.7
0.669	Y	15.6	19.7	40	-4.7	31.1	35.8
3.196	Y	40.7	20.2	40	20.9	29.5	8.6
47.945	Y	26	-15.9	0	10.1	40	29.9
143.003	Y	26.8	-13.4	0	13.4	43.5	30.1
878.818	Y	28.1	2.7	0	30.8	46	15.2
981.539	Y	26.8	4.1	0	30.9	54	23.1
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

Note 1. Loop antenna orientation (30 MHz Below)
"P"= Parallel, **"V"**= perpendicular, **"G"**= ground-parallel
Bilog antenna polarization (30 MHz above)
"H"= Horizontal, **"V"**= Vertical

Note 2. 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 3. No other spurious and harmonic emissions were reported greater than listed emissions above table.

Note 4. Sample calculation
Margin = Limit – Field Strength
Field Strength = Reading + T.F – Distance factor
T.F = AF + CL – AG
Distance factor = 20log(Measurement distance / The measured distance)^2
Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

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 (℃)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100%	3.80	+20(ref)	13,559,308	-692	0.005105
100%		-20	13,559,433	-567	0.004180
100%		-10	13,559,365	-635	0.004680
100%		0	13,559,444	-556	0.004100
100%		+10	13,559,499	-501	0.003693
100%		+20	13,559,308	-692	0.005105
100%		+30	13,559,368	-632	0.004660
100%		+40	13,559,208	-792	0.005841
100%		+50	13,559,192	-808	0.005960
115%	4.37	+20	13,559,421	-579	0.004270
BATT.ENDPINIT	3.40	+20	13,559,468	-532	0.003922

- Minimum Standard: Part 15. 225(e) & RSS-210 [B6]

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 μH/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

AC Line Conducted Emission

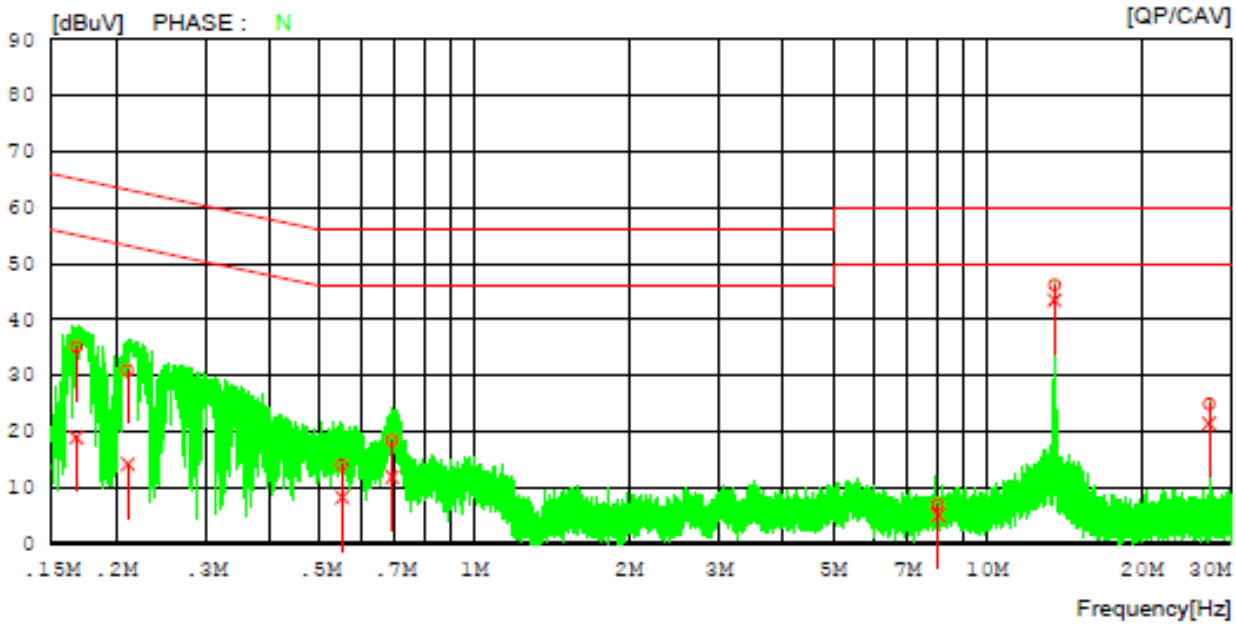
DT&C

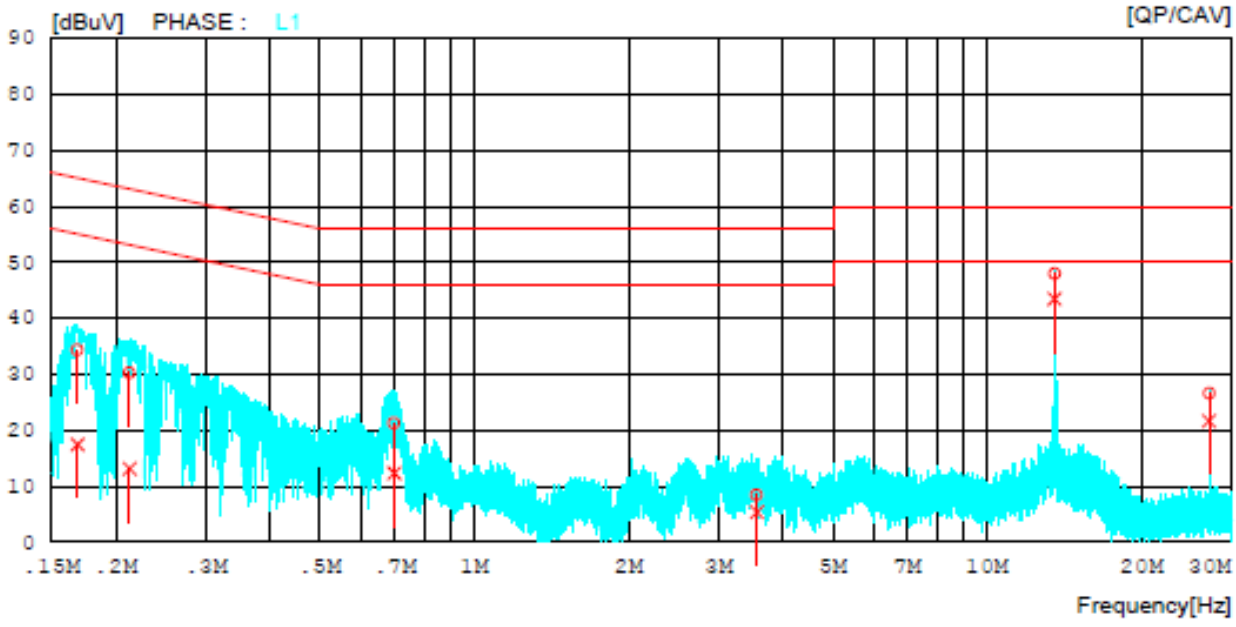
Date 2017-12-29

Model	EF501R
Power Supply	120 V / 60Hz
Temp/Humi/Atm	24'C / 39%
Test Condition	NFC

Note

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





Measurement Data

AC Line Conducted Emission

DT&C Date 2017-12-29

Model	EF501R
Power Supply	120 V / 60Hz
Temp/Humi/Atm	24'C / 39%
Test Condition	NFC

Note

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

NO	FREQ	READING QP	READING CAV	C.FACTOR	RESULT QP	RESULT CAV	LIMIT QP	LIMIT CAV	MARGIN QP	MARGIN CAV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.16743	25.43	9.30	9.64	35.07	18.94	65.09	55.09	30.02	36.15	N
2	0.21096	21.27	4.50	9.64	30.91	14.14	63.17	53.17	32.26	39.03	N
3	0.55256	4.28	-1.39	9.64	13.92	8.25	56.00	46.00	42.08	37.75	N
4	0.69133	8.70	2.22	9.65	18.35	11.87	56.00	46.00	37.65	34.13	N
5	8.01828	-2.91	-4.78	9.83	6.92	5.05	60.00	50.00	53.08	44.95	N
6	13.55929	36.31	33.64	9.87	46.18	43.51	60.00	50.00	13.82	6.49	N
7	27.11868	14.91	11.40	9.99	24.90	21.39	60.00	50.00	35.10	28.61	N
8	0.16830	24.48	7.70	9.74	34.22	17.44	65.04	55.04	30.82	37.60	L1
9	0.21267	20.44	3.30	9.74	30.18	13.04	63.10	53.10	32.92	40.06	L1
10	0.69746	11.44	2.57	9.75	21.19	12.32	56.00	46.00	34.81	33.68	L1
11	3.55330	-1.49	-4.44	9.79	8.30	5.35	56.00	46.00	47.70	40.65	L1
12	13.55932	37.92	33.53	9.94	47.86	43.47	60.00	50.00	12.14	6.53	L1
13	27.11855	16.53	11.64	9.99	26.52	21.63	60.00	50.00	33.48	28.37	L1

APPENDIX

TEST EQUIPMENT FOR TESTS

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	17/09/06	18/09/06	MY48011075
Multimeter	FLUKE	17B	17/04/12	18/04/12	26030065WS
DC Power Supply	Agilent Technologies	66332A	17/09/05	18/09/05	MY43000394
Signal Generator	Rohde Schwarz	SMBV100A	17/01/04	18/01/04	255571
Temp & Humi Test Chamber	SJ Science	SJ-TH-S50	17/01/25	18/01/25	SJ-TH-S50-140205
Thermohygrometer	BODYCOM	BJ5478	17/04/11	18/04/11	120612-1
Loop Antenna	Schwarzbeck	FMZB1513	16/04/22	18/04/22	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	16/11/11	18/11/11	3151
PreAmplifier	TSJ	MLA-010K01-B01-27	17/03/06	18/03/06	1844538
EMI Test Receiver	Rohde Schwarz	ESR7	17/02/16	18/02/16	101061
EMI Test Receiver	Rohde Schwarz	ESR7	17/11/16	18/11/16	101109
TRANSIENT LIMITER	EMCIS	TL-B0930A	17/09/07	18/09/07	11002
SINGLE-PHASE MASTER	NF	4420	17/09/01	18/09/01	3049354420023
TWO-LINE V-NETWORK	Rohde Schwarz	ENV216	17/10/10	18/10/10	101979

Note: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.