TEST REPORT

Report No.: 16091066HKG-002R1

Sensible Object Ltd

Application
For
Certification
(Original Grant)
(FCC ID: 2AIQLBOB001)
(IC: 21568-BOB001)

Transceiver
The report contains 13.56MHz part only

This report supersedes previous report with report number 16091066HKG-002 dated October 31, 2016.

Prepared and Checked by:

Signed On File
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Approved by:

Digitally signed by Koo Wai Ip
Location: Intertek Testing Services Hong Kong Ltd.

Koo Wai Ip
Assistant Supervisor
Date: November 01, 2016

GENERAL INFORMATION

Grantee:	Sensible Object Ltd
Grantee Address:	Vault 9, Makerversity, Somerset House, London, WC2R 1LA, United Kingdom
Contact Person:	Chris Shaw
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Manufacturer:	Sensible Object Ltd
Manufacturer Address:	Vault 9, Makerversity, Somerset House, London, WC2R 1LA, United Kingdom
Brand Name:	Beasts of Balance
Model:	BOB001
Type of EUT:	Transceiver
Description of EUT:	Beasts of Balance
Serial Number:	N/A
FCC ID / IC:	2AIQLBOB001 / 21568-BOB001
Date of Sample Submitted:	September 26, 2016
Date of Test:	September 26, 2016 to October 05, 2016
Report No.:	16091066HKG-002R1
Report Date:	November 01, 2016
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%

SUMMARY OF TEST RESULT

TEST SPECIFICATION	REFERENCE	RESULTS
Transmitter Field Strength Frequency Stability	15.225 / RSS-210 A2.6	Pass
Radiated Emission Radiated Emission on the Bandedge	15.209 / RSS-210 2.5	Pass
Radiated Emission in Restricted Bands	15.205 / RSS-210 2.2	Pass

The equipment under test is found to be complying with the following standards:
FCC Part 15, October 1, 2014 Edition
RSS-210 Issue 8, December 2010
RSS-Gen Issue 4, November 2014

Note: 1. The EUT uses a permanently attached antenna which, in accordance to section 15.203, is considered sufficient to comply with the pervisions of this section.
2. Pursuant to FCC part 15 Section 15.215(c), the 20 dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.
3. Please refer TY-S16-0286 Letter issued on November 01, 2016 for amendment/ supersede notification.

Table of Contents

1.0 General Description

1.1 Product Description

The Equipment Under Test (EUT) is a Plinth, which contains a Bluetooth 4.0 module and a 13MHz reader. The Bluetooth 4.0 module is operating from 2402MHz to 2480MHz with 2MHz channel spacing. The EUT is powered by 3 X 1.5V AA batteries. Press the button on the base of the Plinth to switch it on, then the Plinth uses Bluetooth to connect to the BoB app on the smartphone or tablet. After placing the tags on the Plinth, the tags can be recognised (through 13MHz reader) and displayed (through Bluetooth) on the smartphone or tablet.

Antenna Type: Internal, Integral

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is a single application for certification of a transceiver.

1.3 Test Methodology

Radiated emission measurements was performed according to the procedures in ANSI C63.10 (2013). All radiated measurements were performed in an 3m Chamber. Preliminary scans were performed in the 3m Chamber only to determine worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the **"Justification Section"** of this Application.

1.4 Test Facility

The 3m Chamber facility used to collect the radiated data is located at Workshop No. 3, G/F., World-Wide Industrial Centre, 43-47 Shan Mei Street, Fo Tan, Sha Tin, N.T., Hong Kong. This test facility and site measurement data have been placed on file with the FCC and IC No. 2042V.

2.0 System Test Configuration

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The device was powered by new 3 x 1.5V AA Batteries. (DC4.5V)

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the centre of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. For maximizing emission at and above 30 MHz, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data report in Exhibit 3.0.

The rear of unit shall be flushed with the rear of the table.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was mounted to a plastic stand if necessary and placed on the wooden turntable, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

For simultaneous transmission, both Bluetooth and NFC portions are also switched on when taking radiated emission for determining worst-case spurious emission.

2.2 EUT Exercising Software

There was no special software to exercise the device. Once the unit is powered up, it transmits the RF signal continuously.

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

2.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

2.5 Support Equipment List and Description

3.0 Emission Results

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

3.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any), Average Factor (optional) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG - AV

where FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
AV = Average Factor in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:

FS = RR + LF

where FS = Field Strength in dBµV/m
RR = RA - AG - AV in dBµV
LF = CF + AF in dB

Assume a receiver reading of 52.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB are added. The amplifier gain of 29 dB and average factor of 5 dB are subtracted, giving a field strength of 27 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 52.0 dBµV/m
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
AV = 5.0 dB
RR = 18.0 dBµV
LF = 9.0 dB
FS = RR + LF
FS = 18 + 9 = 27 dBµV/m

Level in µV/m = Common Antilogarithm [(27 dBµV/m)/20] = 22.4 µV/m

3.2 Radiated Emission Configuration Photograph

The worst case in radiated emission was found at 868.114 MHz

For electronic filing, the worst case radiated emission configuration photographs are saved with filename: radiated photos.pdf.

3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgment: Passed by 7.7 dB

Company: Sensible Object Ltd Date of Test: October 05, 2016
Model: BOB001
Worst-Case Operating Mode: Transmitting

Table 1
Radiated Emissions
Pursuant to FCC Part 15 Section 15.225 / RSS-210 A2.6 Requirement

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Distance Factor (-dB)	Calculated at 30m (dBµV/m)	Limit at 30m (dBµV/m)	Margin (dB)
V	13.560	48.9	0	10.8	59.7	40.0	19.7	84.0	-64.3
V	27.120	11.9	0	9.5	21.4	40.0	-18.6	29.5	-48.1

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
V	40.680	28.4	16	10.0	22.4	40.0	-17.6
V	54.240	30.2	16	11.0	25.2	40.0	-14.8
V	67.800	34.3	16	8.0	26.3	40.0	-13.7
H	81.360	29.1	16	7.0	20.1	40.0	-19.9
H	94.920	29.7	16	11.0	24.7	43.5	-18.8
H	***108.480***	***24.4***	***16***	***14.0***	***22.4***	***43.5***	***-21.1***
H	122.040	27.6	16	14.0	25.6	43.5	-17.9
H	***135.640***	***30.3***	***16***	***14.0***	***28.3***	***43.5***	***-15.2***
H	149.210	28.1	16	14.0	26.1	43.5	-17.4

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative sign in the column shows value below limit.

4. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 Section 2.2.

5. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

6. Loop antenna is used for the emissions below 30MHz.

Company: Sensible Object Ltd Date of Test: October 05, 2016
Model: BOB001
Worst-Case Operating Mode: Transmitting

Table 2
Radiated Emissions
Pursuant to FCC Part 15 Section 15.209 / RSS-210 2.5 Requirement

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
H	***162.626***	***28.8***	***16***	***16.0***	***28.8***	***43.5***	***-14.7***
H	189.857	26.5	16	16.0	26.5	43.5	-17.0
H	203.402	26.7	16	16.0	26.7	43.5	-16.8
H	366.291	25.3	16	24.0	33.3	46.0	-12.7
H	420.390	23.6	16	25.0	32.6	46.0	-13.4
H	474.589	23.8	16	26.0	33.8	46.0	-12.2
V	583.148	23.5	16	28.0	35.5	46.0	-10.5
V	868.114	23.3	16	31.0	38.3	46.0	-7.7

NOTES: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative sign in the column shows value below limit.

4. Horn antenna is used for the emission over 1000MHz.

5. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 Section 2.2.

6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

3.4 Frequency Stability

FCC Part 15 Section 15.225 / RSS-210 Section A2.6

Data Table
Frequency Deviation with Voltage Variation

Operating frequency		13.562531MHz		
Test Voltage (V)	Temperature (°C)	Measured frequency (MHz)	Frequency error (%)	Limit (%)
4.5	+ 50	13.562519	-0.00009	±0.01
	+ 40	13.562524	-0.00005	±0.01
	+ 30	13.562527	-0.00003	±0.01
	+ 20	13.562531	0	±0.01
	+ 10	13.562534	+0.00002	±0.01
	0	13.562535	+0.00003	±0.01
	- 10	13.562542	+0.00008	±0.01
	- 20	13.562566	+0.00258	±0.01

Nominal frequency Temperature (°C) Humidity (%)	Voltage	Frequency (MHz)	Frequency error (ppm)	Limite (ppm)	Result
25°C 50%	3.85	13.562533	-0.221	100	Pass
25°C 50%	4.5	13.562536	0	100	Pass
25°C 50%	4.95	13.562541	+0.369	100	Pass
Min -30C 0%	3.85	13.562563	+1.991	100	Pass
Min -30C 0%	4.5	13.562569	+2.433	100	Pass
Min -30C 0%	4.95	13.562577	+3.023	100	Pass
Max 50C 50%	3.85	13.562526	-0.737	100	Pass
Max 50C 50%	4.5	13.562529	-0.516	100	Pass
Max 50C 50%	4.95	13.562525	-0.811	100	Pass

Measurement Uncertainty is ±1.141Hz (13.56MHz) at a level of confidence of 95%.

4.0 Equipment Photographs

For electronic filing, the photographs are saved with filename: external photos.pdf and internal photos.pdf.

5.0 Product Labelling

For electronics filing, the FCC ID & IC label artwork and the label location are saved with filename: label.pdf.

6.0 Technical Specifications

For electronic filing, the block diagram and schematic of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

7.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

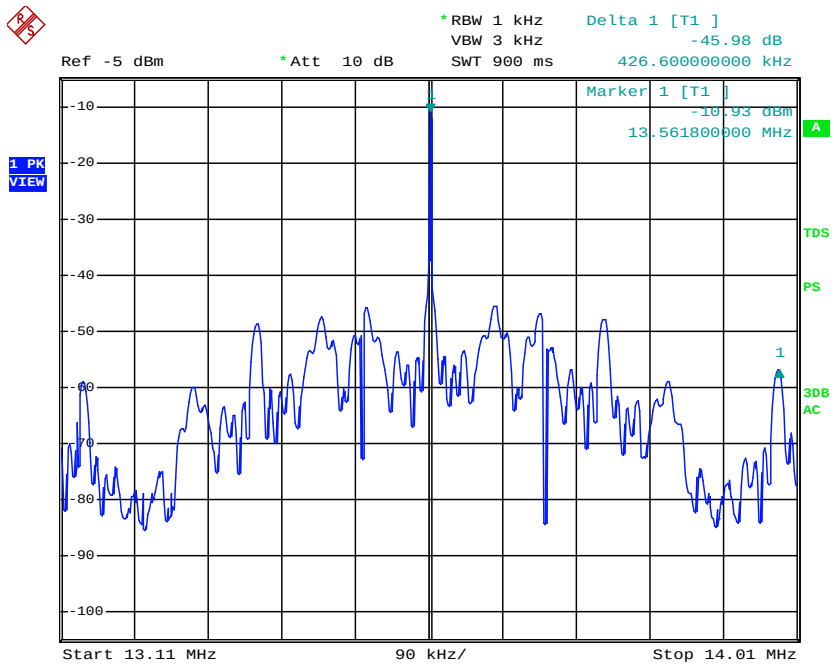
This manual will be provided to the end-user with each unit sold/leased in the United States and Canada.

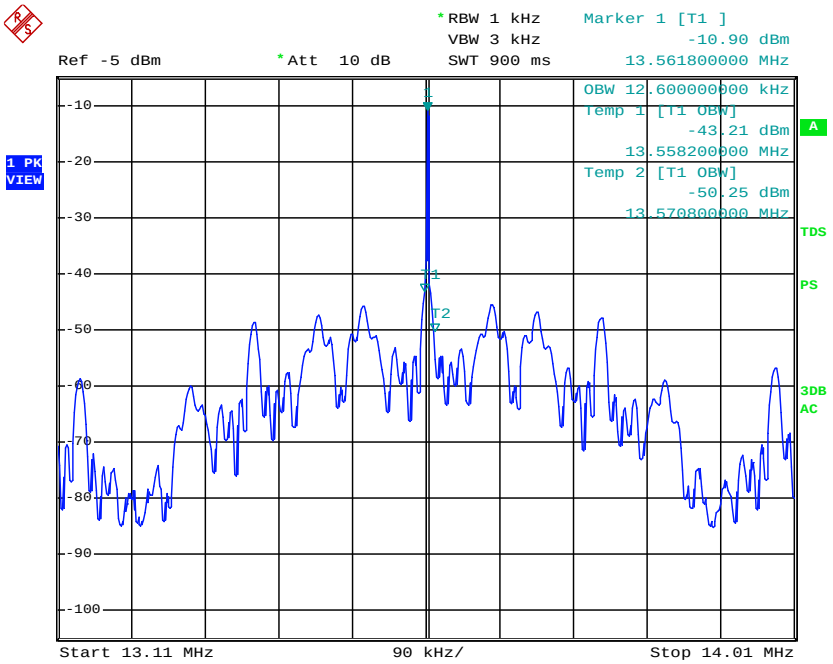
8.0 Miscellaneous Information

The miscellaneous information includes details of the test procedure and measured bandwidth.

8.1 Measured Bandwidth

The plot saved in bw.pdf which shows the fundamental emission is confined in the specified band. The emission of the fundamental is 19.7dBµV/m and it is below the limit of 50.5 dBµV/m in the range of (13.410-13.553MHz) and (13.710-14.010MHz) and the limit of 40.5 dBµV/m in the frequency range of (13.110-14.410MHz) and (13.710-14.010MHz). In the frequency range from 13.110-14.010MHz, we can not find any emission higher than the fundamental emission. Therefore they meet the requirement of Section 15.225(a), (b), (c), & (d).




*RBW 1 kHz
VBW 3 kHz
SWT 900 ms
Marker 1 [T1]
-10.90 dBm
13.561800000 MHz
Ref -5 dBm
*Att 10 dB
OBW 12.600000000 kHz
Temp 1 [T1 OBW]
-43.21 dBm
13.558200000 MHz
Temp 2 [T1 OBW]
-50.25 dBm
13.570800000 MHz
1 PK
VIEW
A
TDS
PS
3DB
AC
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
T1
T2
Start 13.11 MHz
90 kHz/
Stop 14.01 MHz

8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. Since the transmitter transmits the RF signal continuously.

8.3 Calculation of Average Factor

The average factor is not applicable for this device as the transmitted signal is a continuously signal.

8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services Hong Kong Ltd. in the measurements of transmitter operating under the Part 15, Subpart C rules.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately 0.8m in height above the ground plane for emission measurement at or below 1GHz and 1.5m in height above the ground plane for emission measurement above 1GHz. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axis to obtain maximum emission levels. The antenna height and polarization are also varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

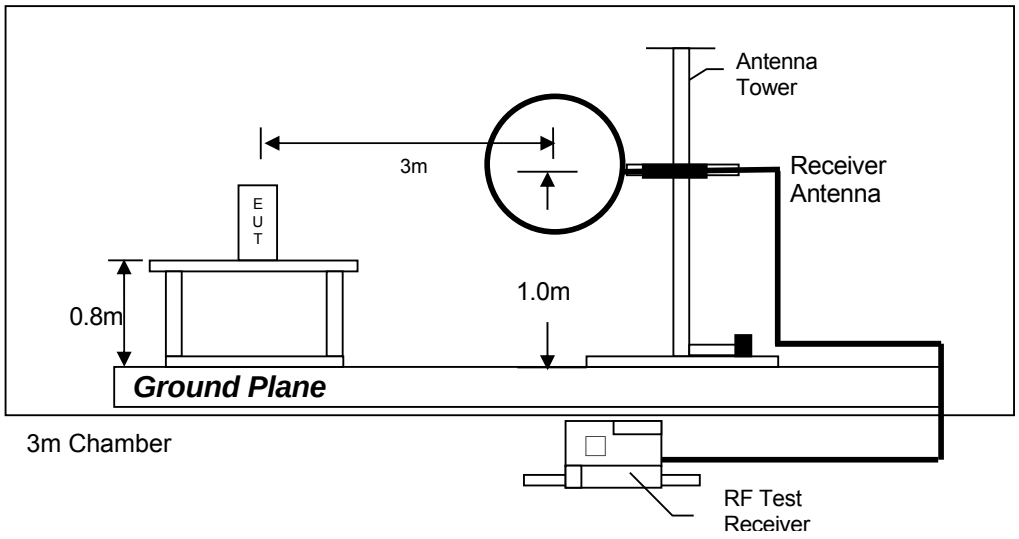
Conducted measurements were made as described in ANSI C63.10 (2013).

The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater when frequency is below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.1). Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

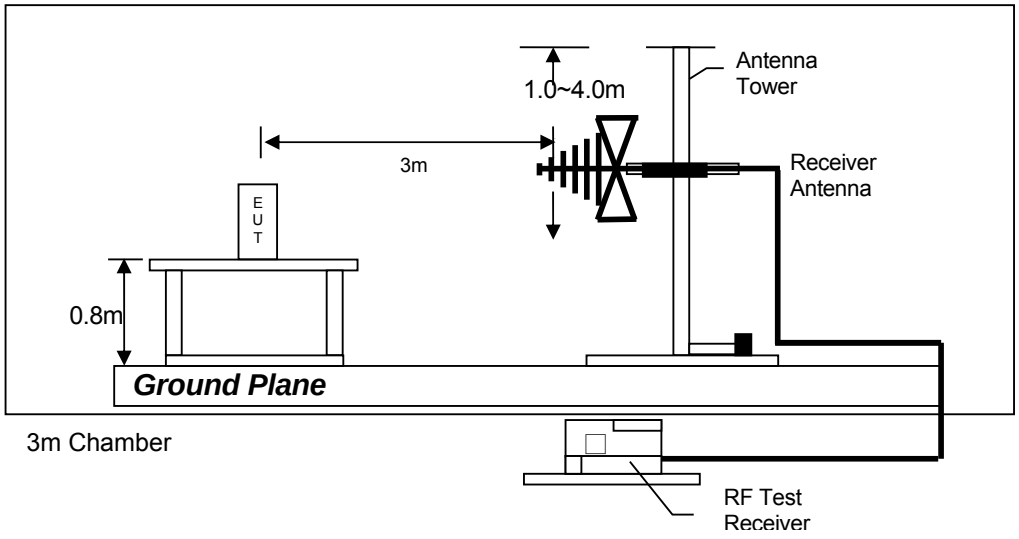
Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, unless otherwise reported. Measurements taken at a closer distance are so marked.

8.4.1 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 30MHz



Test setup of radiated emissions up to 1GHz

9.0 **Equipment List**

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Spectrum Analyzer	Biconical Antenna
Registration No.	EW-3156	EW-2253	EW-0571
Manufacturer	R&S	R&S	EMCO
Model No.	ESR26	FSP40	3104C
Calibration Date	Nov. 03, 2015	Jun. 15, 2016	Jun. 23, 2015
Calibration Due Date	Nov. 03, 2016	Jun. 15, 2017	Dec. 23, 2016

Equipment	Log Periodic Antenna	Double Ridged Guide Antenna	Active Loop H-field
Registration No.	EW-0447	EW-1133	EW-2313
Manufacturer	EMCO	EMCO	ELETROMETRIC
Model No.	3146	3115	EM-6876
Calibration Date	May. 18, 2016	Nov. 05, 2015	Jun. 27, 2016
Calibration Due Date	Nov. 18, 2017	May 05, 2017	Dec. 27, 2017

2) Bandedge Measurement

Equipment	Spectrum Analyzer
Registration No.	EW-3016
Manufacturer	R&S
Model No.	FSV40
Calibration Date	Jun.15, 2016
Calibration Due Date	Jun.15, 2017

3) Frequency Stability Measurement

Equipment	Spectrum Analyzer	Temperature & Humidity Chamber	Frequency Counter (up to 3GHz)
Registration No.	EW-3016	EW-2134	EW-2287
Manufacturer	R&S	GIANT FORCE	AGILENTTECH
Model No.	FSV40	GTH-750-40-CP-SD	53181A
Calibration Date	Jun.15, 2016	Sep. 26, 2016	Dec. 04, 2015
Calibration Due Date	Jun.15, 2017	Sep. 04, 2017	Nov. 17, 2016

END OF TEST REPORT