

EMC Test Report

Report No.: AGC08501171201EE01

PRODUCT DESIGNATION : Open-Source Sensor Beacon
BRAND NAME : Ruuvi
MODEL NAME : RuuviTag
MANUFACTURER : Ruuvi Innovations Ltd.
DATE OF ISSUE : Dec. 22, 2017
STANDARD(S) : EN 301 489-1 V2.2.0: 2017-03 (draft)
: EN 301 489-17 V3.2.0: 2017-03 (draft)
REPORT VERSION : V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Dec. 22, 2017	Valid	Initial release

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1. TEST REPORT CERTIFICATION

Manufacturer	Ruuvi Innovations Ltd.
Address	c/o Solventia Rauhankatu 20B20, 06100 Porvoo, Finland
Factory	Ruuvi Innovations Ltd.
Address	c/o Solventia Rauhankatu 20B20, 06100 Porvoo, Finland
Product Designation	Open-Source Sensor Beacon
Brand Name	Ruuvi
Test Model	RuuviTag
Date of test	Dec. 15, 2017 to Dec. 20, 2017
Deviation	None
Condition of Test Sample	Normal
Report Template	AGCRT-EC-BLE/EMC (2013-03-01)

We, Attestation of Global Compliance (Shenzhen) Co., Ltd., hereby certify that the submitted samples of the above item, as detailed in chapter 2.1 of this report, has been tested in our facility. The test record, data evaluation and test configuration represented herein are true and accurate accounts of measurements of the sample's EMC characteristics under the conditions herein specified. The test results of this report relate only to the tested sample identified in this report.


 Tested By _____
 Henry Zhang(Zhang Zhuorui) Dec. 20, 2017


 Reviewed By _____
 Cool Cheng(Cheng Mengguo) Dec. 22, 2017


 Approved By _____
 Forrest Lei(Lei Yonggang)
 Authorized Officer Dec. 22, 2017

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2. GENERAL INFORMATION

2.1. DESCRIPTION OF EUT

The EUT is a short range, lower power, Bluetooth device.

It is designed by way of FHSS modulation achieves the system operating.

Details of technical specification refer to the description in follows:

Transmitter/Receiver (TX/RX)

Operating Frequency	2.402 GHz to 2.480GHz
Bluetooth Version	V4.2
Modulation	GFSK for BLE
Hardware Version	B6
Software Version	V1.0
Antenna Type	PCB Antenna
Number of channels	40 for BLE
Antenna Gain	0dBi
Power Supply	DC 3V by battery

Note: The EUT didn't support BR/EDR.

2.2. OBJECTIVE

Perform Electro Magnetic Interference (EMI) and Electro Magnetic Susceptibility (EMS) tests for CE Marking.

2.3. TEST STANDARDS AND RESULTS

The EUT has been tested according to ETSI EN 301 489-1 V2.2.0 (2017-03) and ETSI EN 301 489-17 V3.2.0 (2017-03).

ETSI EN 301 489-1	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements
ETSI EN 301 489-17	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems;

Note: The standards applied in test are draft.

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2.4. TEST ITEMS AND THE RESULTS

No.	Basic Standard	Test Type	Result
EMISSION (EN 301 489-1 §7.1)			
1	EN 55032	Radiated emission	PASS
2	EN 55032	Conducted emission, AC ports	N/A
3	EN 55032	Conducted emission, Telecom ports	N/A
4	EN 61000-3-2	Harmonic current emissions	N/A
5	EN 61000-3-3	Voltage fluctuations & flicker	N/A
IMMUNITY (EN 301 489-1 §7.2)			
6	EN 61000-4-2	Electrostatic discharge immunity	PASS
7	EN 61000-4-3	Radiated RF electromagnetic field immunity	PASS
8	EN 61000-4-4	Electrical fast transient/burst immunity	N/A
9	ISO 7637-1, -2	Transients and surges, DC ports	N/A
10	EN 61000-4-5	Surge immunity, AC ports, Telecom ports	N/A
11	EN 61000-4-6	Immunity to conducted disturbances induced by RF fields	N/A
12	EN 61000-4-11	Voltage dips and short interruptions immunity	N/A

Note:

1. N/A- Not Applicable.
2. The latest versions of basic standards are applied.

2.5. ENVIRONMENTAL CONDITIONS

During the measurement the environmental conditions were within the listed ranges:

- Temperature: 15°C-35°C
- Humidity: 30-60 %
- Atmospheric pressure: 86-106 kPa

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3. TEST MODE DESCRIPTION

TEST MODE DESCRIPTION		
NO.	EMI TEST MODE DESCRIPTION	WORST
1	BT Link	V
2	Standby	
NO.	EMS TEST MODE DESCRIPTION	
1	BT Link	
2	Standby	

Note:

1. V means EMI worst mode
2. All modes have been tested and only the worst mode test data recorded in the test report.

I/O Port Information (☐ Applicable ☒ Not Applicable)

I/O Port of EUT			
I/O Port Type	Number	Cable Description	Tested With
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4. MEASUREMENT UNCERTAINTY

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

- Uncertainty of Radiated Emission, $U_c = \pm 3.2\text{dB}$

5. SUPPORT EQUIPMENT

Device Type	Manufacturer	Model Name	S/N	Data Cable
IPOD	APPLE	A1367	N/A	0

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6. IDENTIFICATION OF THE RESPONSIBLE TESTING LOCATION

Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location 1	2/F., Building 2, No.1-No.4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang, Bao'an District, Shenzhen, Guangdong, China
Location 2	B112-B113, Building 12, Baoan Building Materials Center, No.1 of Xixiang Inner Ring Road, Baoan District, Shenzhen, Guangdong, P.R.China
Note: The test item ESD was tested in the laboratory of the location 2, the others were tested in the laboratory of the location 1.	

7. TEST EQUIPMENT LIST

TEST EQUIPMENT OF RADIATED EMISSION TEST

Description	Manufacturer	Model No.	S/N	Calibration Date	Calibration Due.
Spectrum Analyzer	AGILENT	E4440A	US41421290	July 13, 2017	July 12, 2018
EMI Test Receiver	R&S	ESCI	100694	July 02, 2017	July 01, 2018
Wideband Frequency Antenna	SCHWARZBECK	VULB9168	VULB9168-494	Mar.12, 2017	Mar.11, 2018
Horn Antenna	EM	EM-AH-10180	67	Mar.01, 2017	Feb.28, 2018
Amplifier	EM	EM30180	060552	Mar.01, 2017	Feb.28, 2018

TEST EQUIPMENT OF ESD TEST

Equipment	Manufacturer	Model	S/N	Calibration Date	Calibration Due.
ESD Simulator	SCHAFFNER	NSG 438	782	Sep. 20, 2017	Sep. 19, 2018

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TEST EQUIPMENT OF RS IMMUNITY TEST

Description	Manufacturer	Model No.	S/N	Calibration Date	Calibration Due.
Signal Generator	R&S	SML03	102525	July 23,2017	July 22,2018
Wideband Frequency Antenna	SCHWARZBECK	VULB9168	VULB9168-494	Mar.12,2017	Mar.11, 2018
Horn Antenna	EM	EM-AH-10180	67	Mar.01,2017	Feb.28,2018
Power Probe	R&S	URV5-Z4	100124	July 29,2017	July 28,2018
Power Meter	R&S	NRVD	8323781027	July 29,2017	July 28,2018
Power Amplifier	KALMUS	7100LC	04-02/17-06-001	July 01,2017	Jun.30,2018
RF Amplifier	MILMEGA	AS0104-55_55	1004793	July 01,2017	Jun.30,2018
RF Amplifier	MILMEGA	AS1860-50	1465421	July 01,2017	Jun.30,2018
RF Amplifier	MILMEGA	AS0102-55	1531879	July 01,2017	Jun.30,2018
Directional Couple	WERLATONE	C5571-10	99463	July 16,2017	July 15,2018
Directional Couple	WERLATONE	C6026-10	99482	July 16,2017	July 15,2018

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8. EMISSION TEST

8.1. RADIATED DISTURBANCE MEASUREMENT

8.1.1. LIMITS OF RADIATED DISTURBANCES

Limits for radiated disturbance 30M to1 GHz at a measurement distance of 3 m

Frequency range (MHz)	Quasi peak limits(dBuV/m), for Class B ITE, at 3m measurement distance
30 - 230	40
230 - 1000	47

Limits for radiated disturbance above 1 GHz at a measurement distance of 3 m

Frequency range (MHz)	Limits (dBuV/m), Class B ITE	
	Peak	Average
1000-3000MHz	70	50
3000-6000MHz	74	54

Notes:

1. The lower limit shall apply at the transition frequency.
2. Additional provisions may be required for cases where interference occurs.

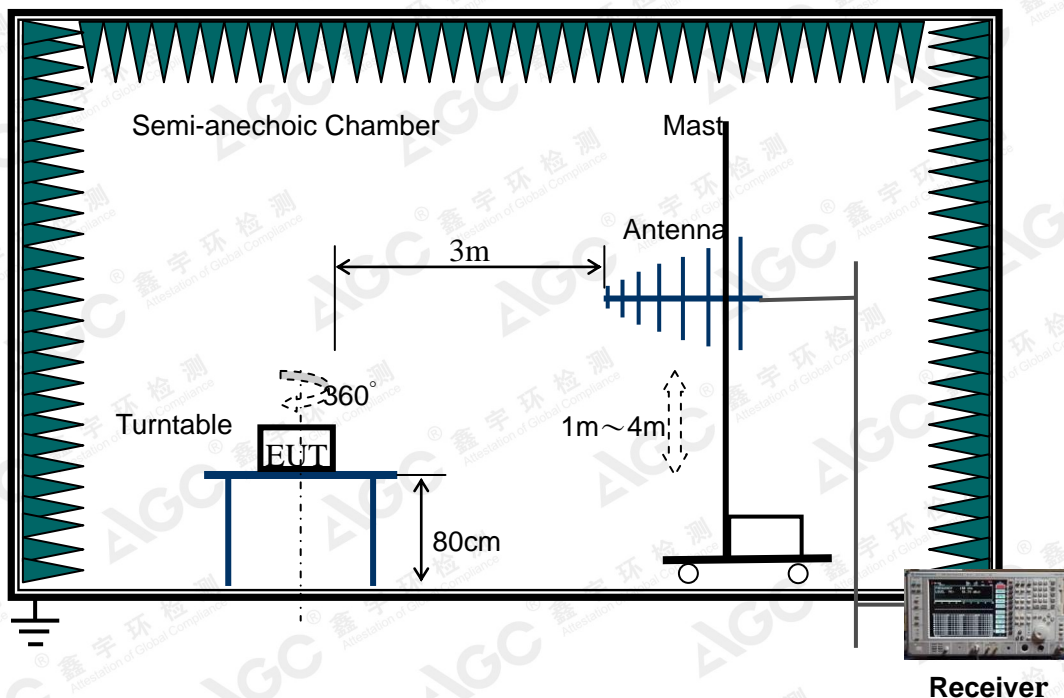
8.1.2. TEST PROCEDURE

- (1). The EUT was placed on the top of an insulating table 0.8 meters above the ground at a semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- (2). The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- (3).The antenna is a broadband antenna, and its height is varied from 1 to 4 meter above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- (4). For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to the heights from 1 to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

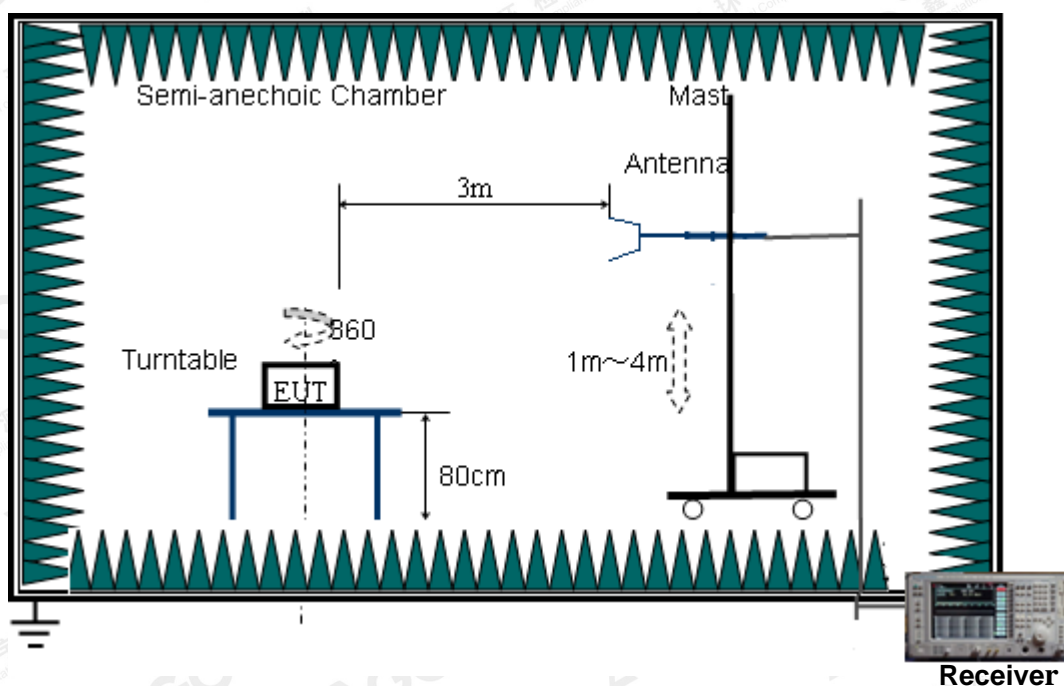
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8.1.3. BLOCK DIAGRAM OF TEST SETUP

Radiated Disturbance below 1 GHz



Radiated Disturbance above 1 GHz

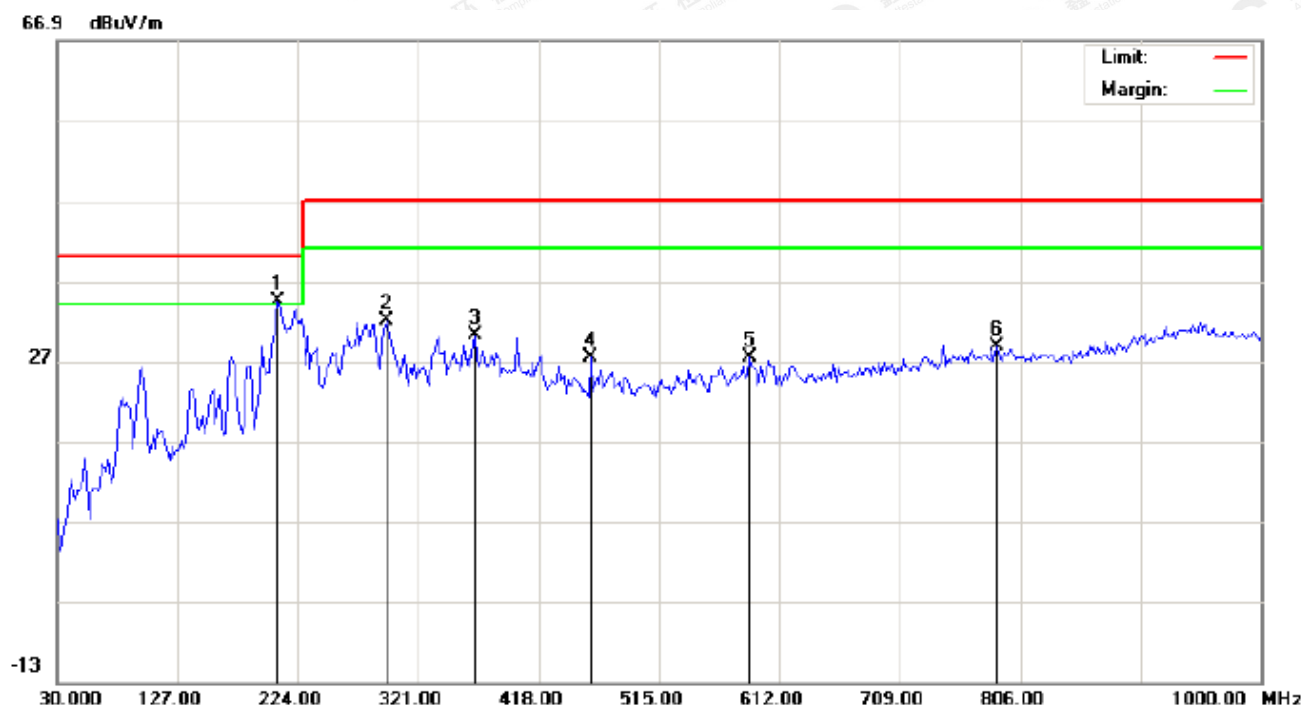


For the actual test configuration, please refer to the related item-Photographs of the Test Configuration.

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8.1.4 TEST RESULT

RADIATED EMISSION BELOW 1GHz- HORIZONTAL



Site: site #1
Limit: EN55032 ClassB 3M Radiation
EUT: Open-Source Sensor Beacon
M/N: RuuviTag
Mode: BT Link
Note:

Polarization: **Horizontal**
Power:
Distance:

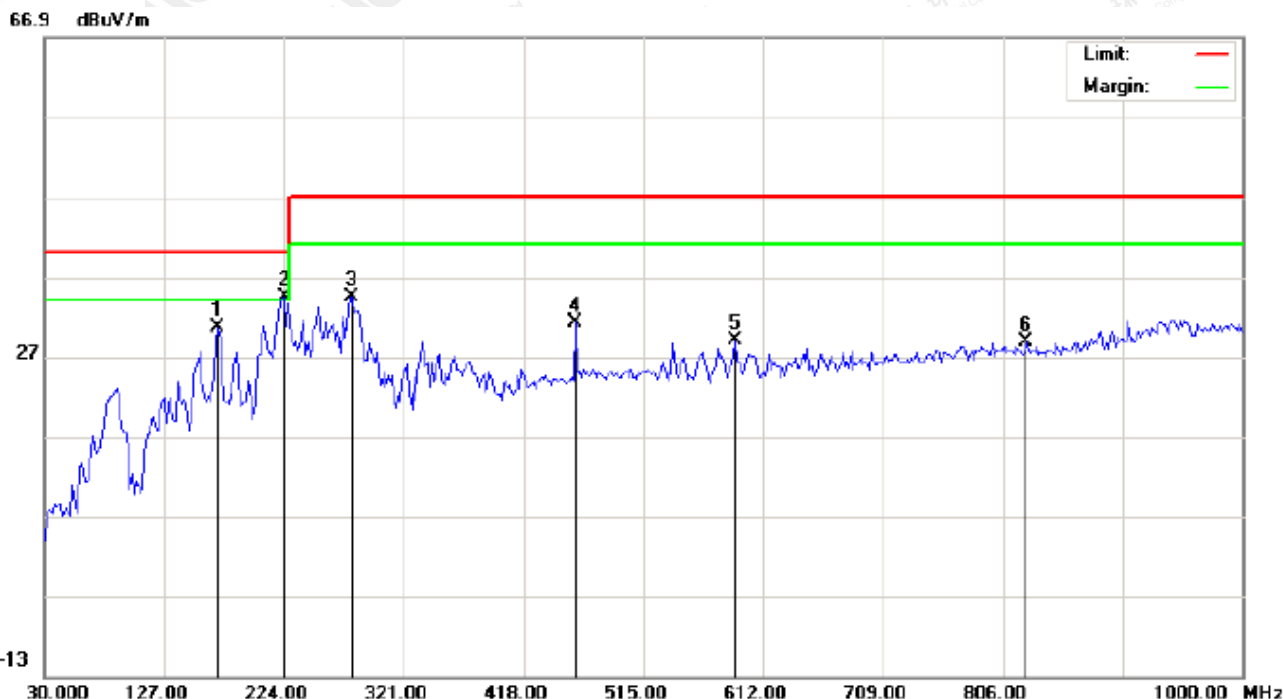
Temperature: 22.4
Humidity: 52.5 %

No.	Mk	Freq. MHz	Reading dBuV	Factor dB/m	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1	*	207.8333	23.23	11.20	34.43	40.00	-5.57	peak			
2		295.1333	17.42	14.58	32.00	47.00	-15.00	peak			
3		366.2667	11.30	18.85	30.15	47.00	-16.85	peak			
4		460.0332	6.73	20.70	27.43	47.00	-19.57	peak			
5		587.7500	4.02	23.42	27.44	47.00	-19.56	peak			
6		786.6000	1.69	27.14	28.83	47.00	-18.17	peak			

RESULT: PASS

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RADIATED EMISSION BELOW 1GHz- VERTICAL



Site: site #1
Limit: EN55032 ClassB 3M Radiation
EUT: Open-Source Sensor Beacon
M/N: RuuviTag
Mode: BT Link
Note:

Polarization: **Vertical**
Power:
Distance:

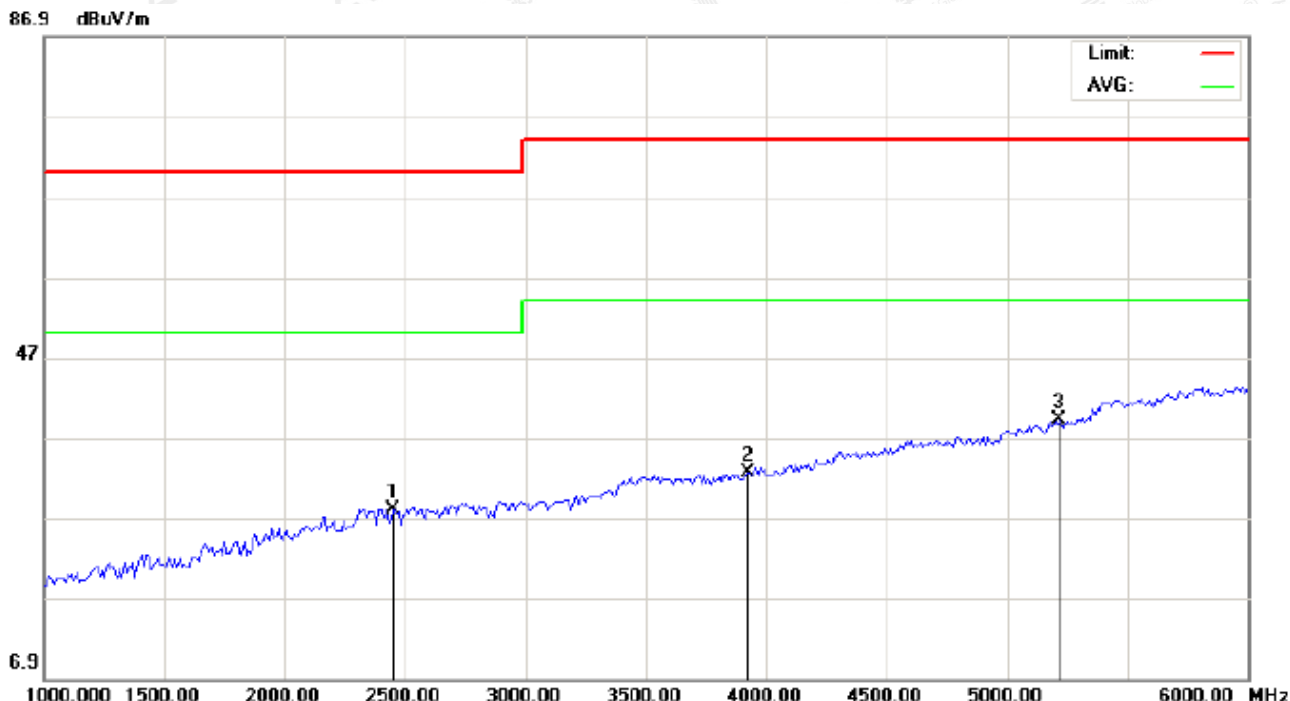
Temperature: 22.4
Humidity: 52.5 %

No.	Mk	Freq. MHz	Reading dBuV	Factor dB/m	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1		170.6500	15.93	14.66	30.59	40.00	-9.41	peak			
2	*	224.0000	23.03	11.35	34.38	40.00	-5.62	peak			
3		278.9667	19.69	14.77	34.46	47.00	-12.54	peak			
4		460.0332	10.59	20.70	31.29	47.00	-15.71	peak			
5		589.3667	6.41	22.68	29.09	47.00	-17.91	peak			
6		825.3999	1.41	27.31	28.72	47.00	-18.28	peak			

RESULT: PASS

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RADIATED EMISSION ABOVE 1GHz – HORIZONTAL



Site: site #1
Limit: EN55032 Class B Above 1G(Peak)
EUT: Open-Source Sensor Beacon
M/N: RuuviTag
Mode: BT Link
Note:

Polarization: **Horizontal**
Power:
Distance: 3m

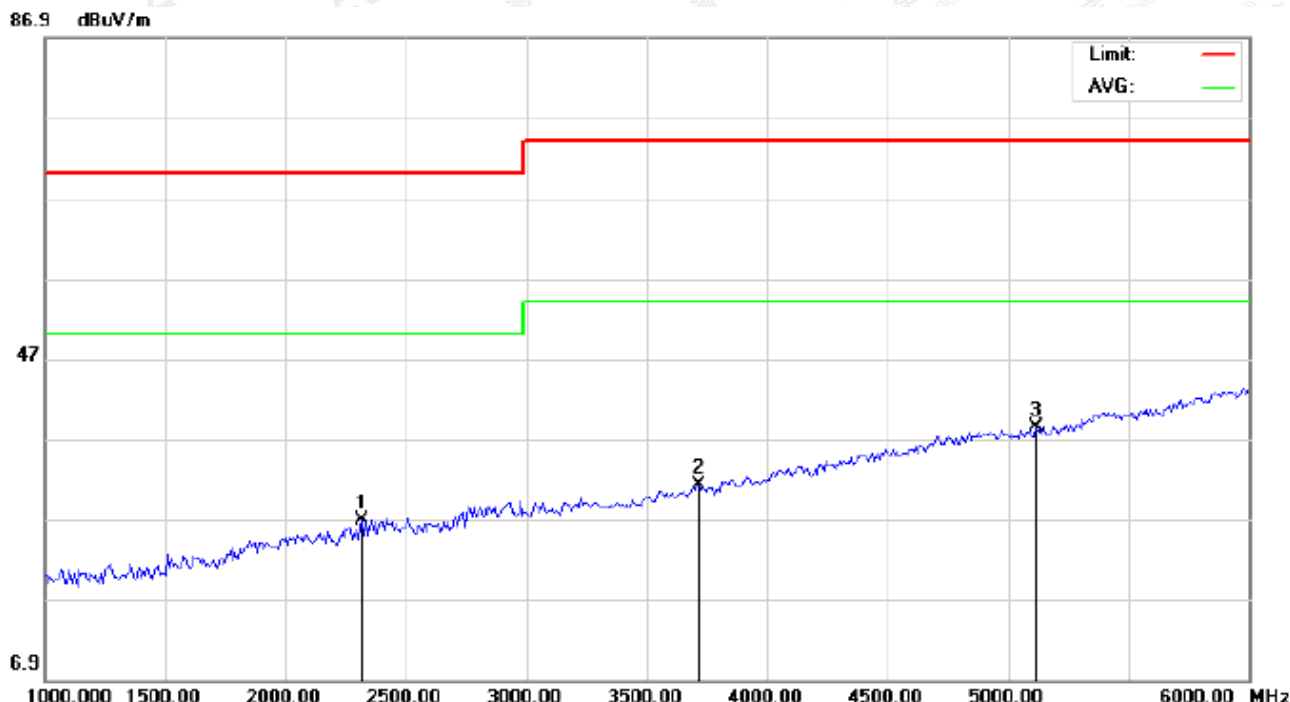
Temperature: 24.6
Humidity: 54.6 %

No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		2450.000	37.69	-9.62	28.07	70.00	-41.93	peak			
2		3925.000	37.78	-5.27	32.51	74.00	-41.49	peak			
3	*	5216.667	40.91	-1.80	39.11	74.00	-34.89	peak			

RESULT: PASS

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RADIATED EMISSION ABOVE 1GHz - VERTICAL



Site: site #1
Limit: EN55032 Class B Above 1G(Peak)
EUT: Open-Source Sensor Beacon
M/N: RuuviTag
Mode: BT Link
Note:

Polarization: **Vertical**
Power:
Distance: 3m

Temperature: 24.6
Humidity: 54.6 %

No.	Mk	Freq. MHz	Reading dBuV	Factor dB/m	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1		2316.667	36.53	-9.77	26.76	70.00	-43.24	peak			
2		3716.667	37.69	-6.56	31.13	74.00	-42.87	peak			
3	*	5116.667	40.11	-1.80	38.31	74.00	-35.69	peak			

RESULT: PASS

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9. IMMUNITY TEST

9.1. GENERAL PERFORMANCE CRITERIA

1. Performance criteria for Continuous phenomena applied to Transmitter (CT)

The performance criteria A shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

2. Performance criteria for Transient phenomena applied to Transmitter (TT)

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

3. Performance criteria for Continuous phenomena applied to Receiver (CR)

The performance criteria A shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

4. Performance criteria for Transient phenomena applied to Receiver (TR)

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration for which performance criteria C shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

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9.2. ELECTROSTATIC DISCHARGE IMMUNITY TEST

9.2.1 TEST SPECIFICATION

Basic Standard	EN 61000-4-2
Discharge Impedance	330Ω / 150 pF
Discharge Voltage	Air Discharge -8 kV , Contact Discharge - 4 kV
Polarity	Positive / Negative
Number of Discharge	Minimum 20 times at each test point
Discharge Mode	Single discharge
Discharge Period	1-second minimum

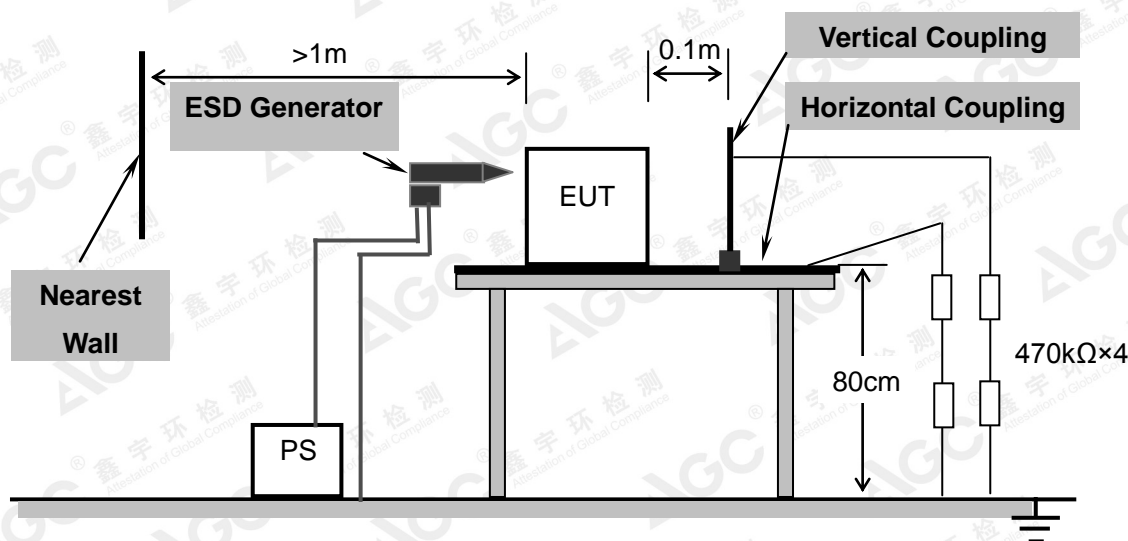
9.2.2 TEST PROCEDURE

The test procedure was in accordance with EN 61000-4-2:

- Electrostatic discharges were applied only to those points and surfaces of the EUT that are accessible to users during normal operation.
- The test was performed with at least ten single discharges on the pre-selected points in the most sensitive polarity.
- The time interval between two successive single discharges was at least 1 second.
- The ESD generator was held perpendicularly to the surface to which the discharge was applied and the return cable was at least 0.2 meters from the EUT.
- Contact discharges were applied to the non-insulating coating, with the pointed tip of the generator penetrating the coating and contacting the conducting substrate.
- Air discharges were applied with the round discharge tip of the discharge electrode approaching the EUT as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator was removed from the EUT and re-triggered for a new single discharge. The test was repeated until all discharges were completed.
- At least ten single discharges (in the most sensitive polarity) were applied to the Horizontal Coupling Plane at points on each side of the EUT. The ESD generator was positioned vertically at a distance of 0.1 meters from the EUT with the discharge electrode touching the HCP.
- At least ten single discharges (in the most sensitive polarity) were applied to the center of one vertical edge of the Vertical Coupling Plane in sufficiently different positions that the four faces of the EUT were completely illuminated. The VCP (dimensions 0.5m×0.5m) was placed vertically to and 0.1 meters from the EUT.

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9.2.3 TEST SETUP



For the actual test configuration, please refer to Appendix A : Photographs of the Test Configuration.

9.2.4 TEST RESULT TEST PROCEDURE

Please refer to ETSI EN 301 489-1 Clause 9.3.2 and EN 61000-4-2 for the measurement methods.

TEST RESULTS

Criteria	During Test	After Test
A	Shall operate as intended. May show degradation of performance (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 2). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 1). No unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2). Shall be no loss of stored data or user programmable functions.

NOTE 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

DESCRIPTION OF THE ELECTROSTATIC DISCHARGES (ESD)

Amount of Discharges	Voltage	Coupling	Observation	performance	Result (Pass/Fail)
Mini 20 / Point	±2KV, ±4kV	Contact Discharge	No Contact Discharge Point	N/A	N/A
Mini 20 / Point	±2KV, ±4kV, ±8kV	Air Discharge	No Air Discharge Point	N/A	N/A
Mini 20 / Point	±2KV, ±4kV	Indirect Discharge HCP	No Function Loss	A	Pass
Mini 20 / Point	±2KV, ±4kV	Indirect Discharge VCP	No Function Loss	A	Pass

Note: operating mode include all modes of EMS in page 7

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9.3. RADIATED, RADIO FREQUENCY ELECTROMAGNETIC FIELD IMMUNITY TEST

9.3.1 TEST SPECIFICATION

Basic Standard	EN 61000-4-3
Frequency Range	80 MHz – 6000MHz
Field Strength	3V/m
Modulation	1 kHz sine wave, 80%, AM modulation
Frequency Step	1% of fundamental
Polarity of Antenna	Horizontal and Vertical
Test Distance	3m
Antenna Height	1.5m
Dwell Time	3 seconds

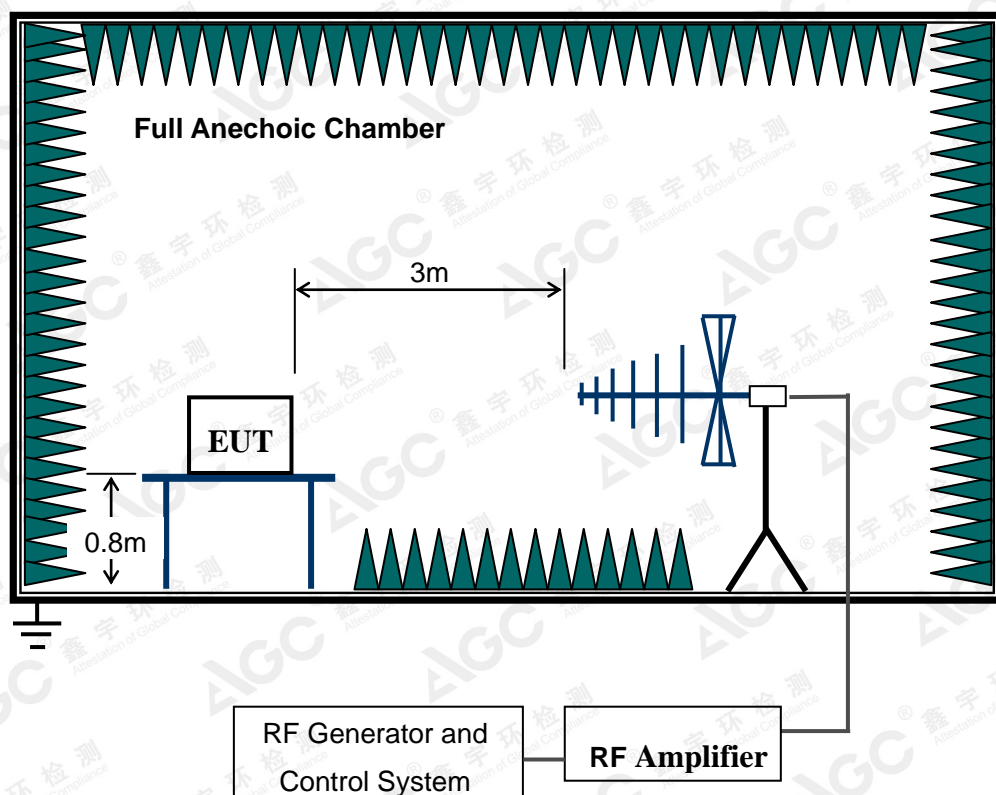
9.3.2 TEST PROCEDURE

The test procedure was in accordance with EN 61000-4-3.

- The testing was performed in a fully anechoic chamber. The transmit antenna was located at a distance of 3 meters from the EUT.
- The test signal was 80% amplitude modulated with a 1 kHz sine wave.
- The frequency range was swept from 80 MHz to 6000MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers. The rate of sweep did not exceed 1.5×10^{-3} decade/s. Where the frequency range is swept incrementally, the step size was 1% of fundamental.
- The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
- The field strength level was 3V/m.
- The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.

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9.3.3 TEST SETUP



For the actual test configuration, please refer to Appendix A : Photographs of the Test Configuration.

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9.3.4 TEST RESULT

TEST PROCEDURE

Please refer to ETSI EN 301 489-1 Clause 9.2.2, ETSI EN 301 489-17 and EN 61000-4-3 for the measurement methods.

TEST RESULTS

Criteria	During Test	After Test
A	Shall operate as intended. May show degradation of performance (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 2). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.

NOTE 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 2: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

Freq. Range (MHz)	Field	Modulation	Polarity	Position	Observation	performance	Result (Pass/Fail)
80-6000	3V/m	Yes	H / V	Front	No Function Loss	A	PASS
80-6000	3V/m	Yes	H / V	Back	No Function Loss	A	PASS
80-6000	3V/m	Yes	H / V	Left	No Function Loss	A	PASS
80-6000	3V/m	Yes	H / V	Right	No Function Loss	A	PASS
80-6000	3V/m	Yes	H / V	Top	No Function Loss	A	PASS
80-6000	3V/m	Yes	H / V	Bottom	No Function Loss	A	PASS

Note: operating mode include all modes of EMS in page 7

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APPENDIX A: PHOTOGRAPHS OF TEST SETUP

Refer to Attached file (APPENDIX I).

APPENDIX B: PHOTOGRAPHS OF EUT

Refer to Attached file (APPENDIX I).

-----END OF REPORT-----

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