

# TEST REPORT

EMC Test for CE Conformance of SRM200A model

**APPLICANT**

SEONG JI INDUSTRIAL CO., LTD.

**REPORT NO.**

HCT-EM-1910-CE005-R1

**DATE OF ISSUE**

November 26, 2019

**HCT Co., Ltd.**

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Applicant

SEONG JI INDUSTRIAL CO., LTD.

54-33, DongtanHana 1-gil, Hwaseong-si, Gyeonggi-do, 18423, Korea

Product Name

Monarch Quad-mode module

Model Name

SRM200A

Date of Test

October 17, 2019 to October 26, 2019

Test Standard Used

ETSI EN 301 489-1 V2.2.3 (2019-11)

ETSI EN 301 489-3 V2.1.1 (2019-03)

Draft ETSI EN 301 489-17 V3.2.0 (2017-03)

ETSI EN 301 489-19 V2.1.1 (2019-04)

Test Results

Refer to the present document

Manufacturer

SEONG JI INDUSTRIAL CO., LTD.

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.

Tested by

Kyoung-Hee Yoon

(signature)

Technical Manager

Jin-Pyo Hong

(signature)

## REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	November 11, 2019	Initial Release
1	November 26, 2019	Updated the version of test standard (ETSI EN 489-1).

The above equipment has been tested by HCT Co., Ltd and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

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## 1. TEST FACILITIES AND ACCREDITATIONS

### 1.1 Test Laboratory

Company Name	HCT Co., Ltd.
Address	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383. Rep. of Korea
Telephone	+82 31 645 6300
FAX	+82 31 645 6401

### 1.2 Test Facilities

Our laboratories are accredited and designated in accordance with the provisions of Radio Waves ACT and International Standard ISO/IEC 17025.

CANADA	ISED Canada	Company Code. 5944A
JAPAN	VCCI	Member No. 264
KOREA	National Radio Research Agency	Designation No. KR0032
	KOLAS	Testing No. KT197
USA	FCC	Registration Number 90661

### 1.3 System Measurement Uncertainty

All measurement uncertainty values are shown with a coverage factor of  $k=2$  to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the  $U_{\text{CISPR}}$  measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Conducted Emission	1.8 dB
Electro-Static Discharge:	5 %
	It has been demonstrated that the ESD generator meets the specified requirements in the standard with at least a 95 % confidence.
RF Electro-Magnetic Field:	3.7 dB

## 2. REFERENCES OF TEST

### 2.1 Test Standard

ETSI EN 301 489-1 V2.2.3 (2019-11)

ETSI EN 301 489-3 V2.1.1 (2019-03)

Draft ETSI EN 301 489-17 V3.2.0 (2017-03)

ETSI EN 301 489-19 V2.1.1 (2019-04)

### 2.2 Test Method

EN 55032:2015

EN 61000-4-2:2009

EN 61000-4-3:2006+A1:2008+A2:2010

### 2.3. Additional Deviations and Exclusions from Standards

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

### 3. TEST INFORMATION OF THE EUT

#### 3.1 General Information of the EUT

Product Name	Monarch Quad-mode module
Model Name	SRM200A
H/W Version	v1.4
S/W Version	v1.0.1
Manufacturer	SEONG JI INDUSTRIAL CO., LTD.

#### 3.2 Product Specification

The SRM200A is a Monarch Quad-mode module.

Frequency	Sigfox: 868.034 MHz to 868.226 MHz for TX 869.429 MHz to 869.621 MHz for RX Bluetooth: 2 402 MHz to 2 480 MHz for TX/RX WiFi: 2 412 MHz to 2 472 MHz for TX/RX GNSS (GLONASS, GPS): 1 559 MHz to 1 610 MHz
Power rating	3.3 VDC

## 4. CONFIGURATION AND CONNECTIONS WITH THE EUT

### 4.1 Configuration of the EUT and Ancillary Equipment

Device Type	Model Name	Serial Number	Manufacturer
EUT	SRM200A	-	SEONG JI INDUSTRIAL
JIG board	-	-	SEONG JI INDUSTRIAL
Notebook PC	650 G1 5CG5520P9J	-	HP
Notebook PC adapter	PPP014H-S F1-09040230370D	-	Hipro Electronics(Suzhou)
SDR dongle	-	-	SigFox
Network AP	IpTIMEA604M	A604M87KC02653	ipTIME
Smart phone	-	-	SAMSUNG

### 4.2 Test Ports

#### [Emission Test]

Start Connection		End Connection		Cable	
Equipment	I/O Port	Equipment	I/O Port	Length(m)	Shielding Condition
EUT	Micro USB	Notebook PC	USB	1.2	Unshielded
Notebook PC	DC IN	Notebook PC adapter	-	1.4	Unshielded
Notebook PC adapter	-	Power	-	1.5	Unshielded



## [Immunity Test]

### SIGFOX mode

Start Connection		End Connection		Cable	
Equipment	I/O Port	Equipment	I/O Port	Length(m)	Shielding Condition
EUT	Micro USB	Notebook PC	USB	1.2	Unshielded
Notebook PC	DC IN	Notebook PC adapter	-	1.4	Unshielded
	USB	SDR Dongle	USB	-	-
Notebook PC adapter	-	Power	-	1.5	Unshielded

### Bluetooth/ WiFi/ GNSS mode

Start Connection		End Connection		Cable	
Equipment	I/O Port	Equipment	I/O Port	Length(m)	Shielding Condition
EUT	Micro USB1	Notebook PC	USB	1.2	Unshielded
	Micro USB2	Notebook PC	USB	1.2	Unshielded
	Micro USB3	Notebook PC	USB	1.2	Unshielded
Notebook PC	DC IN	Notebook PC adapter	-	1.4	Unshielded
Notebook PC adapter	-	Power	-	1.5	Unshielded

NOTE. USB1, USB2: WiFi 2.4 GHz, Bluetooth Connection

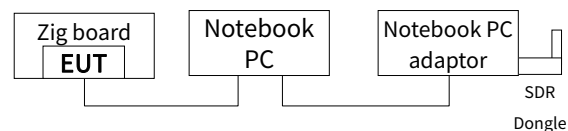
USB1, USB2, USB3: GNSS Connection

### 4.3 Connection Diagram of the EUT and Peripheral Devices

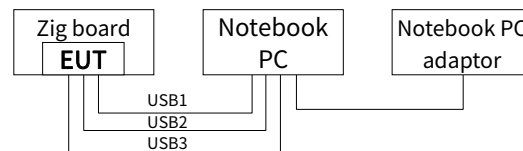
The EUT was configured in the following manner.

NOTE. At the request of the manufacturer, the configuration of the tests was arranged.

#### SIGFOX mode



#### Bluetooth/ WiFi/ GNSS mode



*Non-Conductive Table  
Power Supply: 230 VAC, 50 Hz*

### 4.4 Operating Mode

#### [Emission Test]

EUT was tested by Max. Power output condition.

#### [Immunity Test]

##### Bluetooth Mode

During the test, the operating mode of EUT was Bluetooth mode.

An RF communication link was set up between the EUT and the Notebook PC.

##### WiFi 2.4 GHz Mode

The operating mode of EUT was WLAN mode using 802.11b/g/n

Notebook PC link

##### SIGFOX Mode

During the test, the operating mode of EUT was Sigfox mode.

An RF communication link was set up between the EUT and the SDR Dongle.

##### GNSS Mode

The operating mode of EUT was GNSS receiving state

## 5. TEST RATIONALE

### 5.1 Exclusion Band

Testing shall be calculated as follows:

#### Short Range Devices (SRD)

##### Exclusion bands for emissions testing:

###### Transmitters

Where this is not so specified the exclusions bands shall be as below:

- For transmitters operating, or intended to operate, in a channelized frequency band, the exclusion band is five times (i.e.  $\pm 250\%$ ) the maximum operating channel width (OCW) allowed for that service, centred around the operating frequency.
- For wide band transmitters, i.e. transmitters in a non-channelized frequency band, the exclusion band is twice the intended operating frequency band centred around the centre frequency of the intended operating frequency band.

The exclusion band shall only apply when the EUT is in transmit mode of operation.

###### Receivers

No exclusion band applies.

##### Exclusion bands for immunity testing:

###### Transmitters

The exclusion band be as specified for emissions testing.

###### Receivers

The exclusion band is based on an extension value.

The lower limit of the exclusion band is the lower edge of the Operating Channel (OC) minus the extension value, or zero, whichever is the greater.

The upper limit is the upper edge of the OC plus the extension value.

The extension value is given in table. The OC is defined in the relevant radio standard.

Receiver operating frequency $f_0$	Extension value
< 300 kHz	300 kHz
300 kHz to < 30 MHz	3 MHz
30 MHz to < 1 GHz	15 MHz, or $5\% \times f_0$ , whichever is greater
1 GHz to < 6 GHz	100 MHz
$\geq 6$ GHz	$5\% \times f_0$

NOTE: The receiver exclusion band frequency range aligns as far as possible with the blocking test frequency range defined in ETSI EN 300 220-1.

### **WiFi / Bluetooth**

Immunity testing of equipment operating in the 2,4 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -120 MHz
- upper limit of exclusion band = highest allocated band edge frequency +120 MHz

The exclusion band for immunity testing of equipment operating in the 5 GHz Wi-Fi band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz
- upper limit of exclusion band = highest allocated band edge frequency +270 MHz

The exclusion band for immunity testing of equipment operating in the 5,8 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz,
- as the immunity requirements have an upper frequency range of 6 GHz and any upper edge exclusion band would be greater than this for the 5,8 GHz band. The above frequency shall also be regarded as the upper end of the test range.

NOTE: These receiver exclusion band ranges align with the relevant blocking test ranges.

### **GNSS Band**

The receiver exclusion band is the band of frequencies over which no tests of radiated immunity of a receiver are made.

- The lower frequency of the receiver exclusion band is the lower frequency of the complete receive band of the EUT minus 5 % of that lower frequency.
- The upper frequency of the receiver exclusion band is the upper frequency of the complete receive band of the EUT plus 5 % of that upper frequency.

## 5.2 Performance Criteria

The performance criteria are used to make an assessment whether a radio equipment passes or fails immunity tests.

The performance criteria are:

performance criteria A for immunity tests with phenomena of a continuous nature;

performance criteria B for immunity tests with phenomena of a transient nature;

### Performance Requirements

Criteria	During test	After test
A	Operate as intended No loss of function No unintentional responses	Operate as intended No loss of function No degradation of performance No loss of stored data or user programmable functions
B	May show loss of function No unintentional responses	Operate as intended Lost function(s) shall be self-recoverable No degradation of performance No loss of stored data or user programmable functions

NOTE: Whether a phenomenon is considered transient, continuous or otherwise is indicated in the test procedures for the phenomenon in ETSI EN 301 489-1, clause 9.

## 6. TEST SUMMARY

The results in this report apply only to sample tested:

Test Date	Phenomena	Application port	Performance Criteria	Test Method
10.17.2019	Conducted Emission	AC Power	See test data	EN 55032
10.24.2019 10.25.2019	Electro-Static Discharge (ESD)	Enclosure	B	EN 61000-4-2
10.25.2019 10.26.2019	RF Electro-Magnetic Field (RS)	Enclosure	A	EN 61000-4-3

### NOTE.

1. Immunity doesn't test based on reference Section 7.2 of EN 301 489-1.  
(Fast transients, RF common mode, Voltage dips and interruptions, Surge)
2. Radiated emission is that it was not tested on the basis of Section 8.2 of EN 301 489-1.
3. The EUT does not support signal for section 4.2.2 of ETSI EN 301 489-19.

## 7. TEST EQUIPMENT

Type		Model Name	Manufacturer	Serial Number	Calibration Cycle	Next CAL. Date
Conducted Emission						
<input checked="" type="checkbox"/>	EMI Test Receiver	ESCI	Rohde & Schwarz	100584	1 year	06.18.2020
<input checked="" type="checkbox"/>	LISN	ENV216	Rohde & Schwarz	102245	1 year	12.12.2019
Electro-Static Discharge (ESD)						
<input checked="" type="checkbox"/>	ELECTROSTATIC DISCHARGE SIMULATOR	ESS-2000	NOISEKEN	ESS0230746	1 year	08.20.2020
RF Electro-Magnetic Field (RS-03)						
<input checked="" type="checkbox"/>	System Interface	SI-300-2	TDK RF SOLUTIONS	30015	-	-
<input checked="" type="checkbox"/>	System Controller PC	DM500T4Z	SAMSUNG	-	-	-
<input checked="" type="checkbox"/>	Power Meter	E4419B	Agilent	MY41291485	1 year	01.30.2020
<input checked="" type="checkbox"/>	Power Sensor	N8482A	Agilent	MY51330014	1 year	01.30.2020
<input checked="" type="checkbox"/>	Power Amplifier	30S1G6	AR	0345460	-	-
<input checked="" type="checkbox"/>	Power Amplifier	250W1000AM3	AR	306169	-	-
<input checked="" type="checkbox"/>	Vector Signal Generator	N5182A	Agilent	MY47071067	1 year	02.22.2020
<input checked="" type="checkbox"/>	Directional Coupler	DC6080A	AR	0350176	1 year	11.08.2019
<input checked="" type="checkbox"/>	Directional Coupler	DC7205A	AR	0344986	1 year	08.19.2020
<input checked="" type="checkbox"/>	Log periodic Antenna	LPDA-0803	TDK	13112	-	-
<input checked="" type="checkbox"/>	Horn Antenna	3117	ETS	00168716	-	-

## 8. EMC TEST RESULT

### 8.1 Conducted Emission

#### 8.1.1 Operating Environment

Test Date: October 17, 2019

Climatic Conditions: Temperature 22.8 °C, Relative Humidity 41.4 %

Kind of Test Site: EMI Shield room

#### 8.1.2 Test Methods and Levels

The test method shall be in accordance with EN 55032.

The equipment shall meet the class B limits given in EN 55032

#### 8.1.3 Test Condition

##### a. The Operating Mode

SIGFOX mode

Bluetooth mode

WiFi 2.4 GHz mode

GNSS mode

##### b. Testing

The following requirements and evaluation of test results shall apply.

Power supply	230 VAC, 50 Hz
Application port	AC mains input/output port
Frequency range	150 kHz to 30 MHz
LISN impedance	50 $\Omega$
EMI receiver	Bandwidth: 9 kHz Detector type: Quasi-peak / CISPR-Average



#### 8.1.4 Test Limits

Frequency Range (MHz)	Quasi-Peak (dB $\mu$ V)	CAverage (dB $\mu$ V)	Test Result
0.15 to 0.5	66 to 56	56 to 46	Pass
0.5 to 5	56	46	Pass
5 to 30	60	50	Pass

### 8.1.5 Test Setup Photo

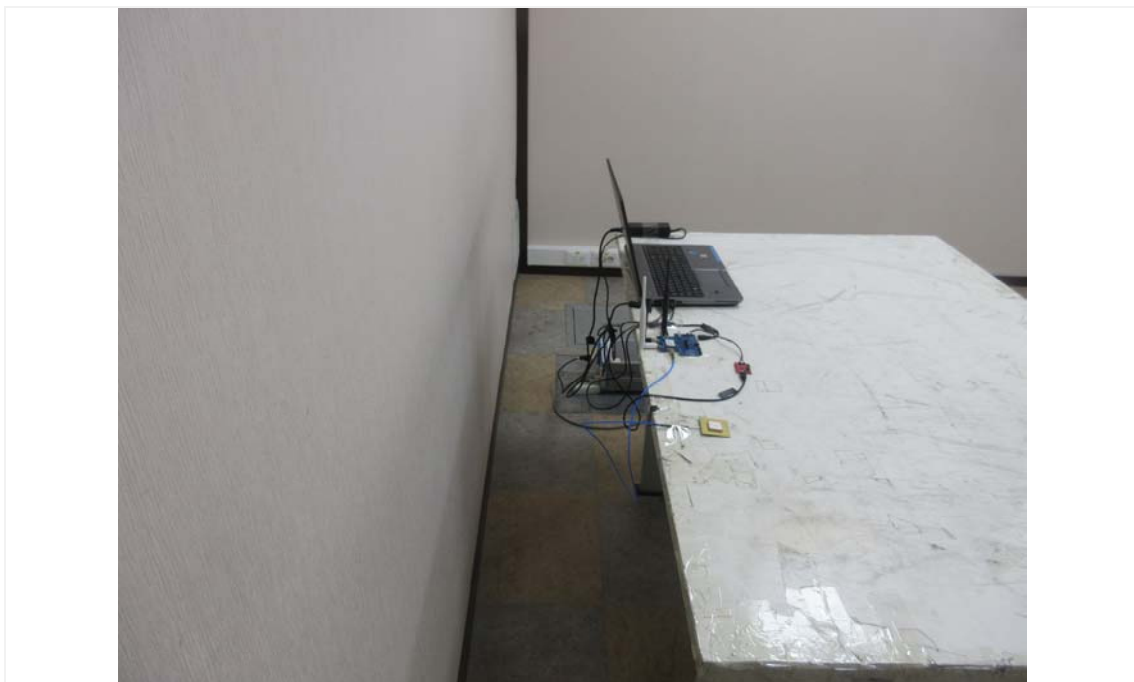
SIGFOX Mode



## WiFi Mode



## Bluetooth Mode

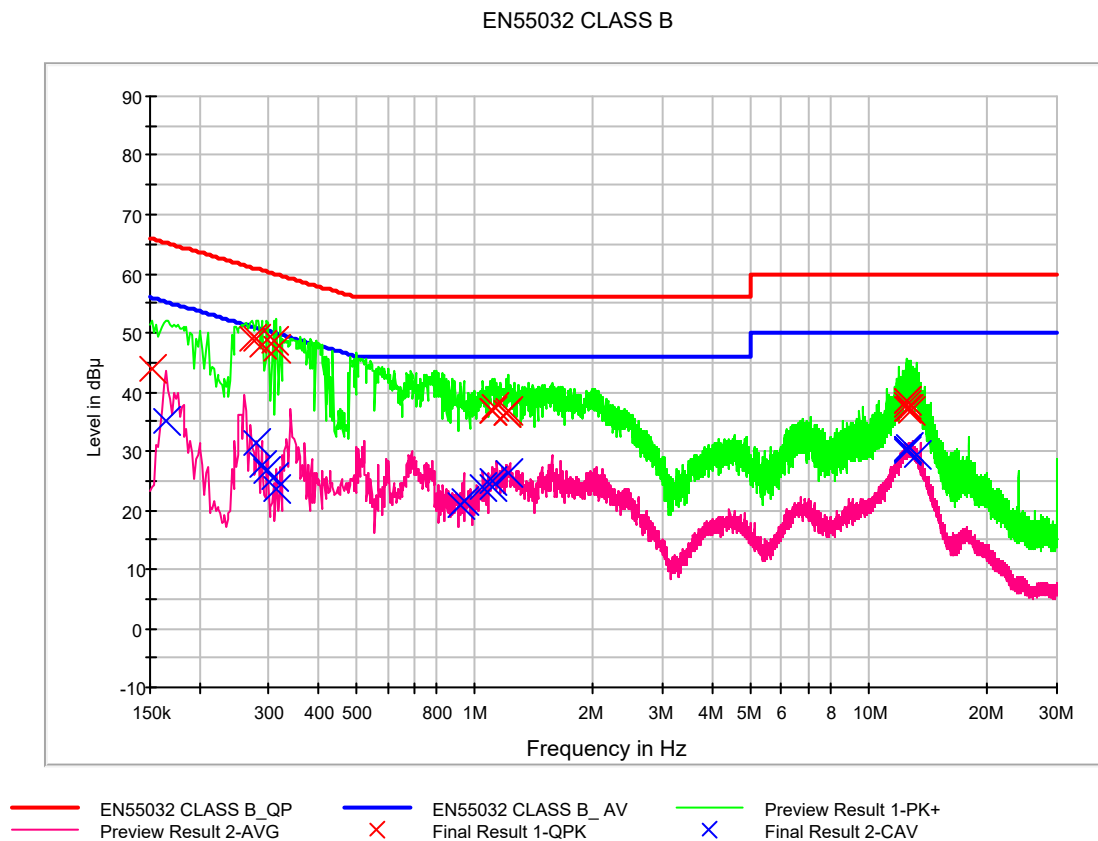


## GNSS Mode



### 8.1.6 Measuring Data

Figure 1: Conducted Emission (0.15 MHz to 30 MHz), SIGFOX mode, Line (L1)



### QuasiPeak Final Result

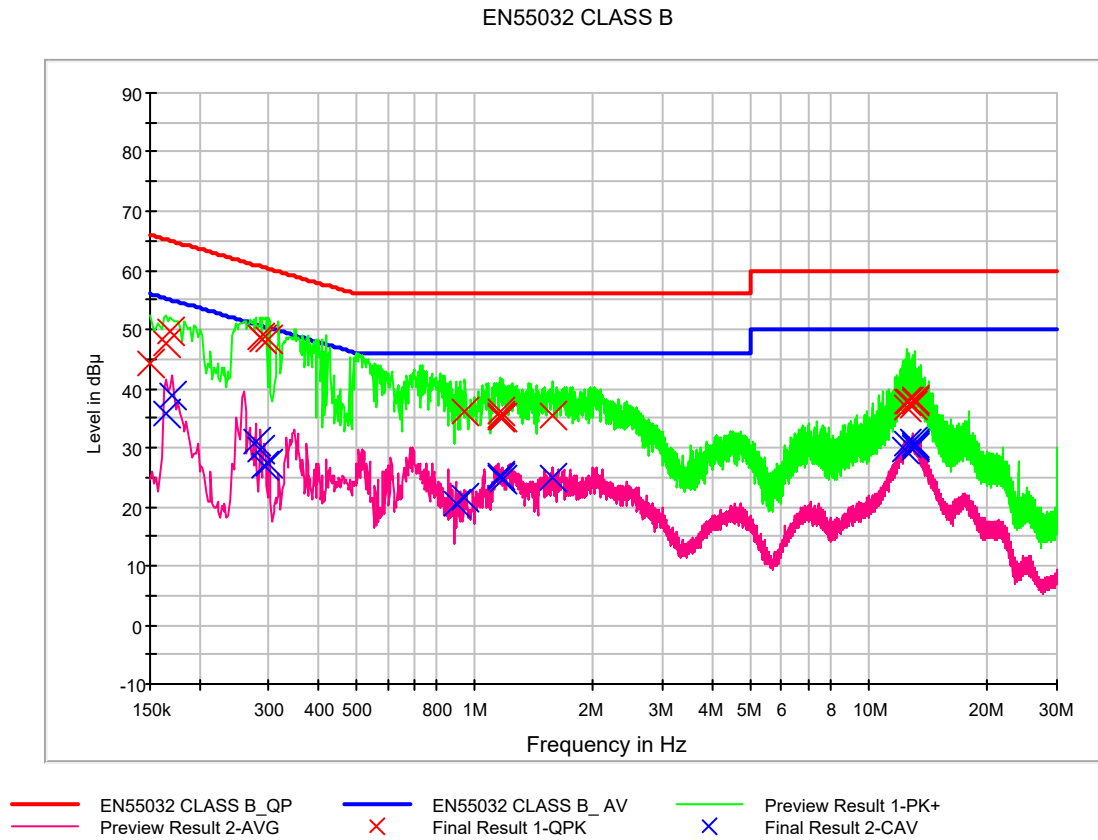
Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.152000	43.8	9.000	L1	9.7	22.1	65.9
0.272000	49.1	9.000	L1	9.7	12.0	61.1
0.280000	48.9	9.000	L1	9.7	11.9	60.8
0.288000	47.8	9.000	L1	9.7	12.7	60.6
0.308000	48.5	9.000	L1	9.7	11.5	60.0
0.312000	47.3	9.000	L1	9.7	12.6	59.9
1.102000	36.8	9.000	L1	9.8	19.2	56.0
1.108000	36.8	9.000	L1	9.8	19.2	56.0
1.122000	37.3	9.000	L1	9.8	18.7	56.0
1.202000	36.6	9.000	L1	9.8	19.4	56.0
1.208000	36.6	9.000	L1	9.8	19.4	56.0
1.214000	36.7	9.000	L1	9.8	19.3	56.0
12.418000	37.1	9.000	L1	10.1	22.9	60.0
12.506000	37.9	9.000	L1	10.1	22.1	60.0
12.514000	38.3	9.000	L1	10.1	21.7	60.0
12.518000	38.5	9.000	L1	10.1	21.5	60.0
12.652000	37.2	9.000	L1	10.1	22.8	60.0
12.710000	36.9	9.000	L1	10.1	23.1	60.0

### CAverage Final Result

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.164000	35.0	9.000	L1	9.7	20.3	55.3
0.280000	31.3	9.000	L1	9.7	19.5	50.8
0.288000	27.6	9.000	L1	9.7	23.0	50.6
0.296000	26.7	9.000	L1	9.7	23.6	50.4
0.308000	25.6	9.000	L1	9.7	24.4	50.0
0.314000	23.5	9.000	L1	9.7	26.3	49.9
0.922000	21.0	9.000	L1	9.8	25.0	46.0
0.936000	21.6	9.000	L1	9.8	24.4	46.0
1.050000	23.9	9.000	L1	9.8	22.1	46.0
1.102000	23.9	9.000	L1	9.8	22.1	46.0
1.108000	25.0	9.000	L1	9.8	21.0	46.0
1.214000	26.4	9.000	L1	9.8	19.6	46.0
12.418000	30.2	9.000	L1	10.1	19.8	50.0
12.502000	30.2	9.000	L1	10.1	19.8	50.0
12.514000	30.4	9.000	L1	10.1	19.6	50.0
12.518000	30.3	9.000	L1	10.1	19.7	50.0
12.638000	30.6	9.000	L1	10.1	19.4	50.0
13.244000	29.3	9.000	L1	10.1	20.7	50.0



Figure 2: Conducted Emission (0.15 MHz to 30 MHz), SIGFOX mode, Line (N)



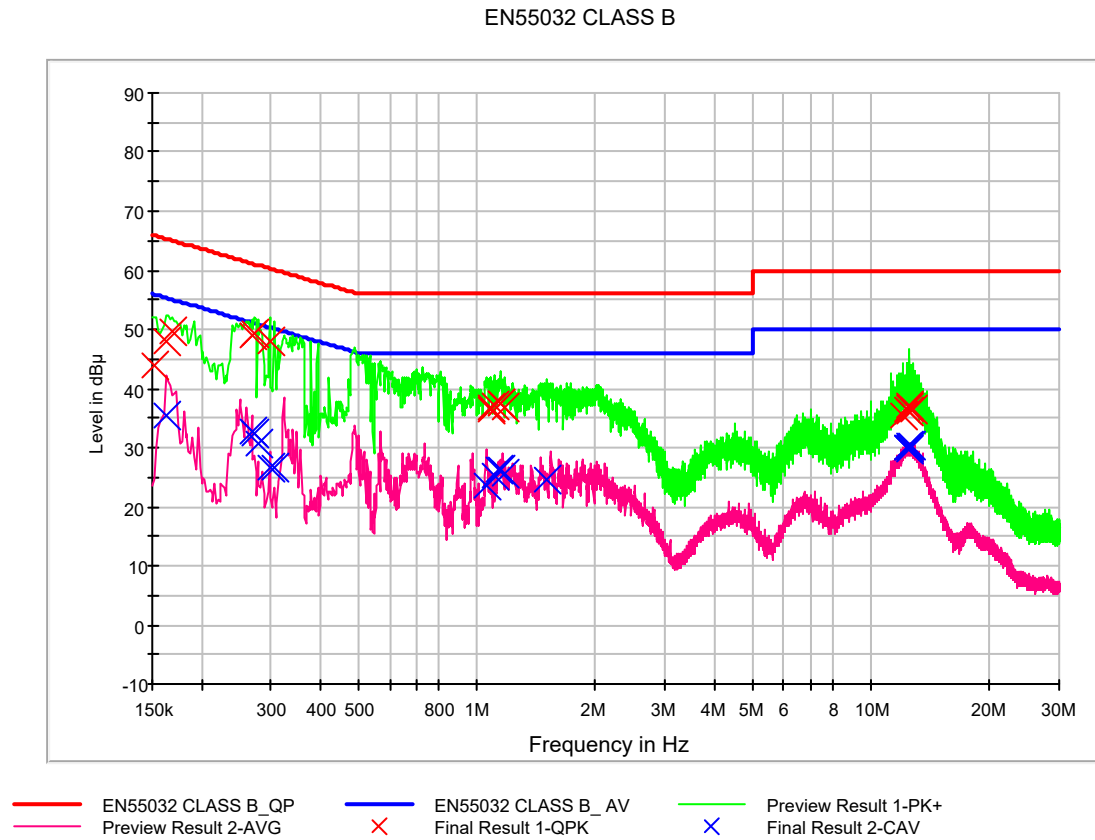
### QuasiPeak Final Result

Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.150000	44.1	9.000	N	9.7	21.9	66.0
0.164000	47.6	9.000	N	9.7	17.6	65.3
0.168000	49.5	9.000	N	9.7	15.5	65.1
0.286000	48.6	9.000	N	9.7	12.1	60.6
0.290000	48.2	9.000	N	9.7	12.3	60.5
0.300000	48.3	9.000	N	9.7	12.0	60.2
0.946000	36.2	9.000	N	9.8	19.8	56.0
1.156000	36.1	9.000	N	9.8	19.9	56.0
1.160000	35.2	9.000	N	9.8	20.8	56.0
1.164000	35.6	9.000	N	9.8	20.4	56.0
1.172000	35.1	9.000	N	9.8	20.9	56.0
1.572000	35.6	9.000	N	9.8	20.4	56.0
12.450000	36.7	9.000	N	10.1	23.3	60.0
12.526000	38.0	9.000	N	10.1	22.0	60.0
12.644000	37.8	9.000	N	10.1	22.2	60.0
12.886000	37.0	9.000	N	10.1	23.0	60.0
13.024000	38.1	9.000	N	10.1	21.9	60.0
13.148000	37.8	9.000	N	10.1	22.2	60.0

### CAverage Final Result

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.164000	35.9	9.000	N	9.7	19.3	55.3
0.170000	38.9	9.000	N	9.7	16.0	55.0
0.278000	30.9	9.000	N	9.7	20.0	50.9
0.286000	29.8	9.000	N	9.7	20.8	50.6
0.292000	27.0	9.000	N	9.7	23.4	50.5
0.300000	27.3	9.000	N	9.7	22.9	50.2
0.894000	20.4	9.000	N	9.7	25.6	46.0
0.946000	21.5	9.000	N	9.8	24.5	46.0
1.156000	25.3	9.000	N	9.8	20.7	46.0
1.164000	24.8	9.000	N	9.8	21.2	46.0
1.172000	24.6	9.000	N	9.8	21.4	46.0
1.572000	24.7	9.000	N	9.8	21.3	46.0
12.262000	29.8	9.000	N	10.1	20.2	50.0
12.526000	30.6	9.000	N	10.1	19.4	50.0
12.940000	30.9	9.000	N	10.1	19.1	50.0
13.024000	30.6	9.000	N	10.1	19.4	50.0
13.144000	30.1	9.000	N	10.1	19.9	50.0
13.148000	30.3	9.000	N	10.1	19.7	50.0

Figure 3: Conducted Emission (0.15 MHz to 30 MHz), Bluetooth mode, Line (L1)



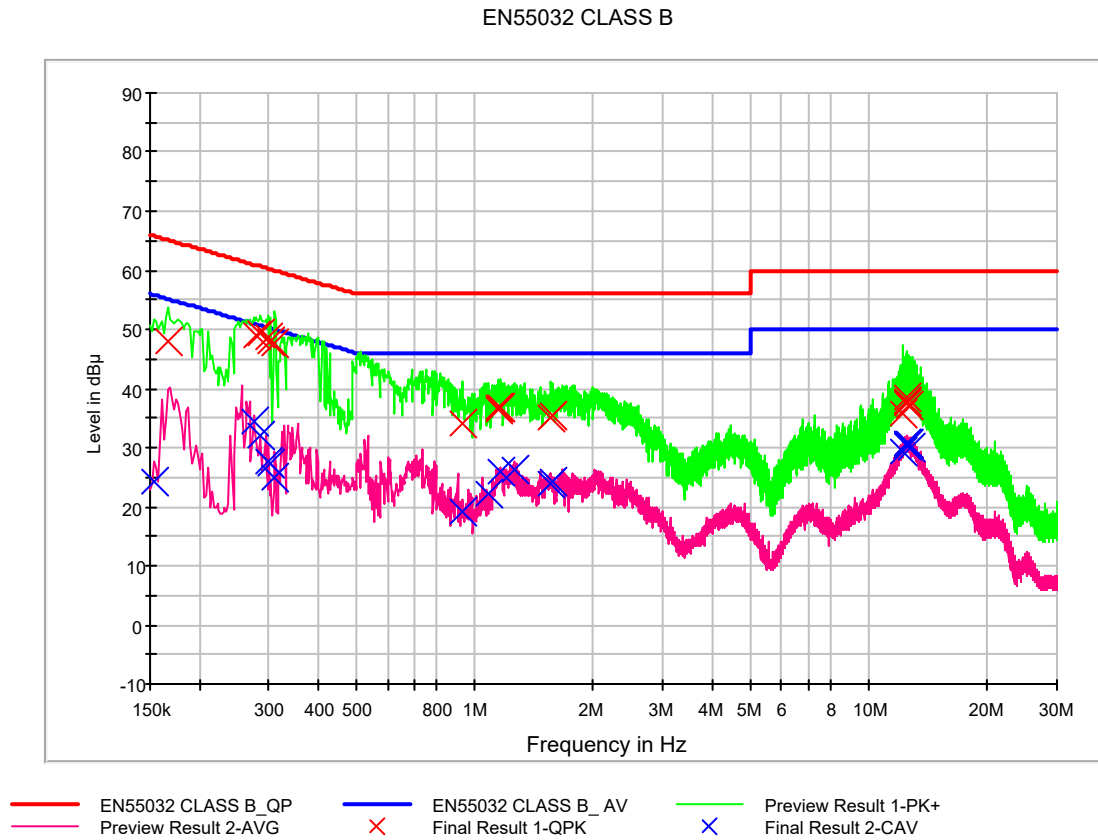
### QuasiPeak Final Result

Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.152000	43.9	9.000	L1	9.7	22.0	65.9
0.162000	47.9	9.000	L1	9.7	17.5	65.4
0.168000	49.7	9.000	L1	9.7	15.4	65.1
0.268000	48.8	9.000	L1	9.7	12.4	61.2
0.272000	49.3	9.000	L1	9.7	11.8	61.1
0.298000	48.0	9.000	L1	9.7	12.3	60.3
1.080000	36.4	9.000	L1	9.8	19.6	56.0
1.086000	36.6	9.000	L1	9.8	19.4	56.0
1.104000	37.2	9.000	L1	9.8	18.8	56.0
1.142000	37.4	9.000	L1	9.8	18.6	56.0
1.148000	37.5	9.000	L1	9.8	18.5	56.0
1.174000	36.9	9.000	L1	9.8	19.1	56.0
12.048000	35.3	9.000	L1	10.1	24.7	60.0
12.364000	36.4	9.000	L1	10.1	23.6	60.0
12.472000	36.2	9.000	L1	10.1	23.8	60.0
12.530000	36.9	9.000	L1	10.1	23.1	60.0
12.534000	37.0	9.000	L1	10.1	23.0	60.0
12.710000	36.3	9.000	L1	10.1	23.7	60.0

### CAverage Final Result

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.162000	35.3	9.000	L1	9.7	20.0	55.4
0.268000	32.7	9.000	L1	9.7	18.5	51.2
0.272000	32.4	9.000	L1	9.7	18.6	51.1
0.278000	30.7	9.000	L1	9.7	20.2	50.9
0.298000	26.5	9.000	L1	9.7	23.8	50.3
0.306000	26.5	9.000	L1	9.7	23.6	50.1
1.060000	23.7	9.000	L1	9.8	22.3	46.0
1.104000	25.4	9.000	L1	9.8	20.6	46.0
1.132000	26.2	9.000	L1	9.8	19.8	46.0
1.142000	26.2	9.000	L1	9.8	19.8	46.0
1.174000	25.4	9.000	L1	9.8	20.6	46.0
1.496000	24.6	9.000	L1	9.8	21.4	46.0
12.334000	30.0	9.000	L1	10.1	20.0	50.0
12.364000	30.0	9.000	L1	10.1	20.0	50.0
12.472000	29.8	9.000	L1	10.1	20.2	50.0
12.530000	30.1	9.000	L1	10.1	19.9	50.0
12.534000	30.2	9.000	L1	10.1	19.8	50.0
12.610000	30.3	9.000	L1	10.1	19.7	50.0

Figure 4: Conducted Emission (0.15 MHz to 30 MHz), Bluetooth mode, Line (N)



### QuasiPeak Final Result

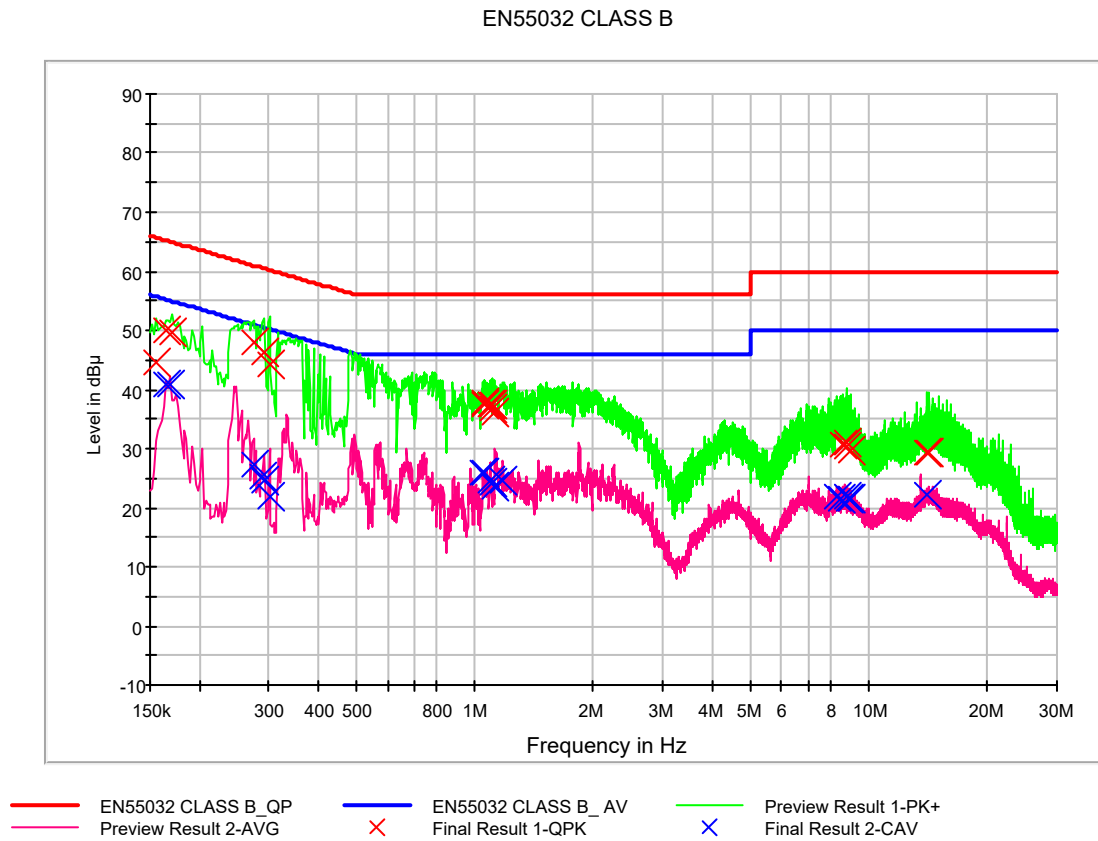
Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.166000	48.0	9.000	N	9.7	17.1	65.2
0.278000	48.9	9.000	N	9.7	12.0	60.9
0.286000	49.4	9.000	N	9.7	11.3	60.6
0.300000	48.6	9.000	N	9.7	11.7	60.2
0.304000	48.0	9.000	N	9.7	12.1	60.1
0.310000	47.8	9.000	N	9.7	12.2	60.0
0.932000	34.0	9.000	N	9.8	22.0	56.0
1.146000	36.9	9.000	N	9.8	19.1	56.0
1.154000	36.4	9.000	N	9.8	19.6	56.0
1.158000	36.7	9.000	N	9.8	19.3	56.0
1.564000	35.0	9.000	N	9.8	21.0	56.0
1.570000	35.3	9.000	N	9.8	20.7	56.0
12.168000	35.7	9.000	N	10.1	24.3	60.0
12.510000	37.6	9.000	N	10.1	22.4	60.0
12.520000	38.5	9.000	N	10.1	21.5	60.0
12.524000	38.0	9.000	N	10.1	22.0	60.0
12.544000	37.9	9.000	N	10.1	22.1	60.0
12.664000	37.2	9.000	N	10.1	22.8	60.0



### CAverage Final Result

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.154000	24.4	9.000	N	9.7	31.4	55.8
0.274000	34.3	9.000	N	9.7	16.7	51.0
0.286000	32.1	9.000	N	9.7	18.5	50.6
0.300000	27.6	9.000	N	9.7	22.6	50.2
0.304000	27.4	9.000	N	9.7	22.7	50.1
0.310000	24.8	9.000	N	9.7	25.2	50.0
0.932000	19.3	9.000	N	9.8	26.7	46.0
1.082000	22.2	9.000	N	9.8	23.8	46.0
1.158000	25.8	9.000	N	9.8	20.2	46.0
1.254000	26.4	9.000	N	9.8	19.6	46.0
1.564000	24.1	9.000	N	9.8	21.9	46.0
1.570000	24.2	9.000	N	9.8	21.8	46.0
12.168000	29.4	9.000	N	10.1	20.6	50.0
12.510000	30.4	9.000	N	10.1	19.6	50.0
12.524000	30.7	9.000	N	10.1	19.3	50.0
12.544000	30.5	9.000	N	10.1	19.5	50.0
12.664000	30.7	9.000	N	10.1	19.4	50.0
12.786000	30.1	9.000	N	10.1	19.9	50.0

Figure 5: Conducted Emission (0.15 MHz to 30 MHz), WiFi (2.4 GHz) mode, Line (L1)



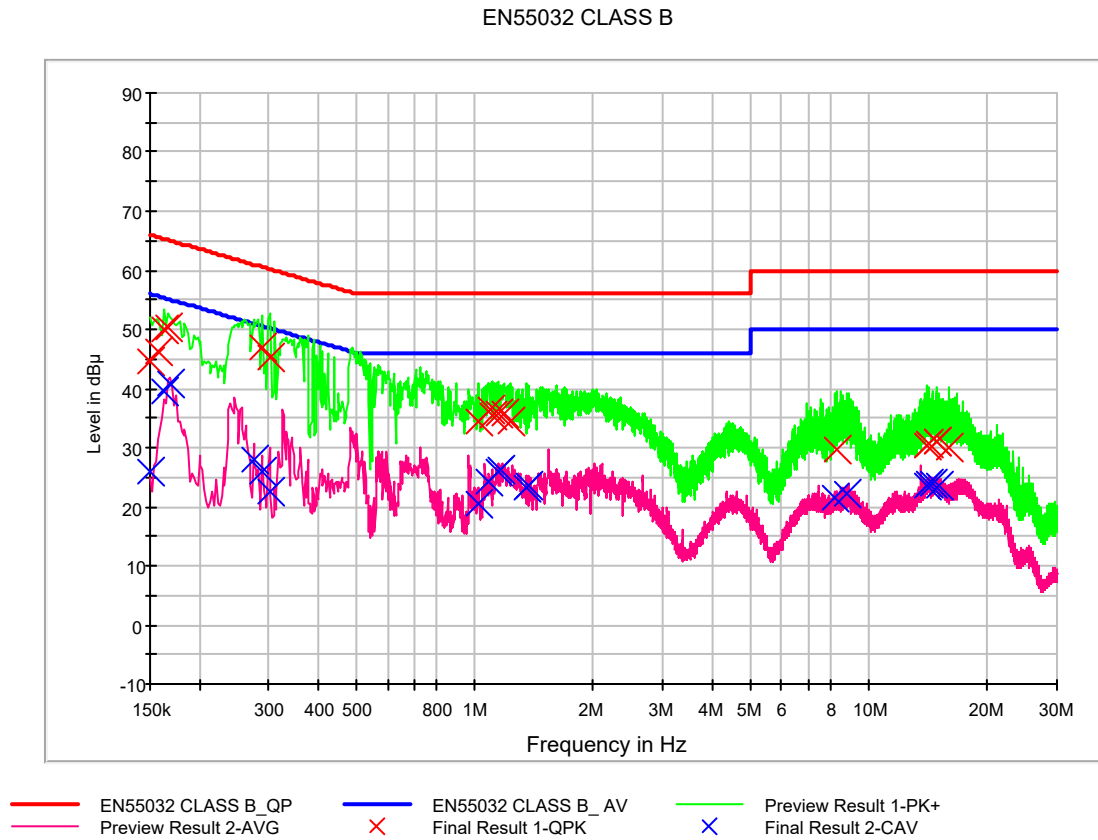
### QuasiPeak Final Result

Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.156000	44.6	9.000	L1	9.7	21.0	65.7
0.164000	50.2	9.000	L1	9.7	15.1	65.3
0.170000	49.8	9.000	L1	9.7	15.2	65.0
0.274000	48.1	9.000	L1	9.7	12.9	61.0
0.292000	46.2	9.000	L1	9.7	14.2	60.5
0.302000	44.2	9.000	L1	9.7	16.0	60.2
1.052000	37.6	9.000	L1	9.8	18.4	56.0
1.058000	37.7	9.000	L1	9.8	18.3	56.0
1.094000	37.3	9.000	L1	9.8	18.7	56.0
1.102000	37.3	9.000	L1	9.8	18.7	56.0
1.106000	36.9	9.000	L1	9.8	19.1	56.0
1.118000	36.0	9.000	L1	9.8	20.0	56.0
8.624000	30.8	9.000	L1	10.0	29.2	60.0
8.814000	31.0	9.000	L1	10.0	29.0	60.0
8.820000	30.4	9.000	L1	10.0	29.6	60.0
8.980000	29.6	9.000	L1	10.0	30.4	60.0
14.030000	29.3	9.000	L1	10.1	30.7	60.0
14.274000	29.3	9.000	L1	10.1	30.7	60.0

### CAverage Final Result

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.164000	40.8	9.000	L1	9.7	14.4	55.3
0.168000	40.8	9.000	L1	9.7	14.3	55.1
0.274000	27.2	9.000	L1	9.7	23.8	51.0
0.288000	25.1	9.000	L1	9.7	25.5	50.6
0.292000	24.7	9.000	L1	9.7	25.8	50.5
0.302000	21.9	9.000	L1	9.7	28.3	50.2
1.050000	26.0	9.000	L1	9.8	20.0	46.0
1.058000	25.9	9.000	L1	9.8	20.1	46.0
1.094000	24.5	9.000	L1	9.8	21.5	46.0
1.102000	24.1	9.000	L1	9.8	21.9	46.0
1.118000	23.7	9.000	L1	9.8	22.3	46.0
1.182000	24.7	9.000	L1	9.8	21.3	46.0
8.308000	21.7	9.000	L1	10.0	28.3	50.0
8.484000	21.5	9.000	L1	10.0	28.5	50.0
8.814000	21.8	9.000	L1	10.0	28.2	50.0
8.902000	21.6	9.000	L1	10.0	28.4	50.0
8.980000	21.4	9.000	L1	10.0	28.6	50.0
14.030000	22.3	9.000	L1	10.1	27.7	50.0

Figure 6: Conducted Emission (0.15 MHz to 30 MHz), WiFi (2.4 GHz) mode, Line (N)



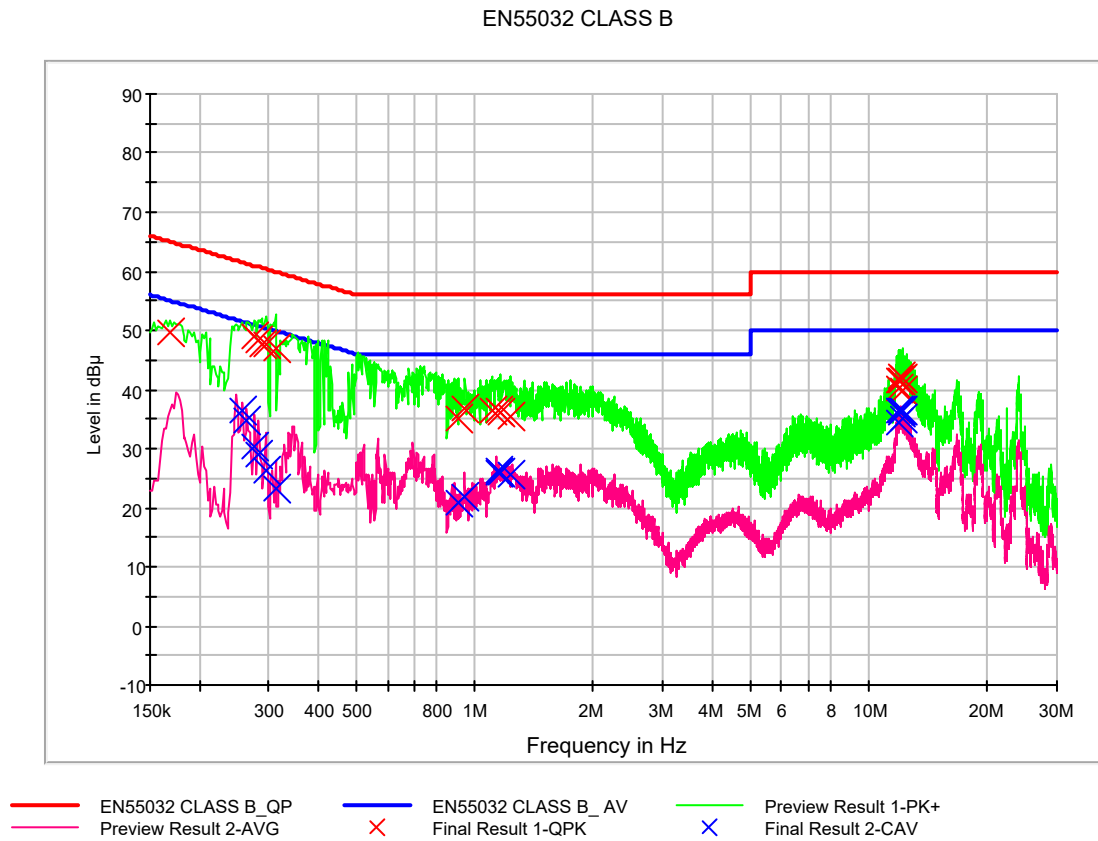
### QuasiPeak Final Result

Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.150000	44.7	9.000	N	9.7	21.3	66.0
0.158000	46.1	9.000	N	9.7	19.4	65.6
0.162000	50.1	9.000	N	9.7	15.3	65.4
0.166000	50.4	9.000	N	9.7	14.8	65.2
0.288000	47.0	9.000	N	9.7	13.5	60.6
0.302000	45.2	9.000	N	9.7	15.0	60.2
1.022000	34.2	9.000	N	9.8	21.8	56.0
1.100000	36.3	9.000	N	9.8	19.7	56.0
1.106000	35.5	9.000	N	9.8	20.5	56.0
1.142000	35.8	9.000	N	9.8	20.2	56.0
1.184000	35.6	9.000	N	9.8	20.4	56.0
1.236000	34.3	9.000	N	9.8	21.7	56.0
8.314000	29.6	9.000	N	10.0	30.4	60.0
13.948000	30.4	9.000	N	10.1	29.6	60.0
14.216000	30.6	9.000	N	10.1	29.4	60.0
14.800000	31.0	9.000	N	10.1	29.0	60.0
14.832000	30.9	9.000	N	10.1	29.1	60.0
15.870000	29.8	9.000	N	10.1	30.2	60.0

### CAverage Final Result

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.150000	25.9	9.000	N	9.7	30.1	56.0
0.162000	39.5	9.000	N	9.7	15.9	55.4
0.168000	41.0	9.000	N	9.7	14.1	55.1
0.274000	28.1	9.000	N	9.7	22.9	51.0
0.288000	25.9	9.000	N	9.7	24.7	50.6
0.302000	22.6	9.000	N	9.7	27.6	50.2
1.022000	20.5	9.000	N	9.8	25.5	46.0
1.080000	24.2	9.000	N	9.8	21.8	46.0
1.142000	26.0	9.000	N	9.8	20.0	46.0
1.162000	26.1	9.000	N	9.8	19.9	46.0
1.354000	23.3	9.000	N	9.8	22.7	46.0
1.364000	23.6	9.000	N	9.8	22.4	46.0
8.234000	21.4	9.000	N	10.0	28.6	50.0
8.832000	22.1	9.000	N	10.0	27.9	50.0
13.948000	23.5	9.000	N	10.1	26.5	50.0
14.216000	24.0	9.000	N	10.1	26.0	50.0
14.546000	24.0	9.000	N	10.1	26.0	50.0
14.978000	23.7	9.000	N	10.1	26.3	50.0

Figure 7: Conducted Emission (0.15 MHz to 30 MHz), GNSS mode, Line (L1)





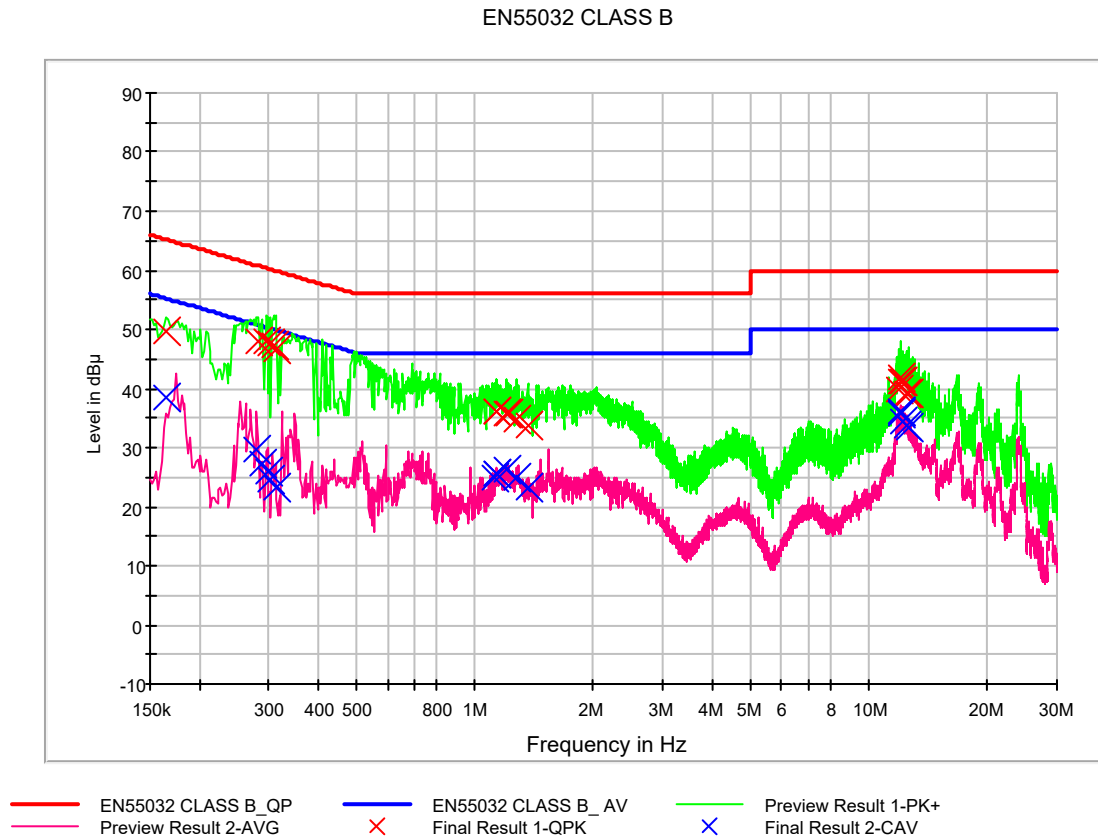
### QuasiPeak Final Result

Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.168000	49.6	9.000	L1	9.7	15.4	65.1
0.276000	49.1	9.000	L1	9.7	11.9	60.9
0.282000	48.3	9.000	L1	9.7	12.5	60.8
0.288000	47.7	9.000	L1	9.7	12.9	60.6
0.296000	47.8	9.000	L1	9.7	12.6	60.4
0.312000	46.8	9.000	L1	9.7	13.1	59.9
0.908000	35.1	9.000	L1	9.8	20.9	56.0
0.946000	36.7	9.000	L1	9.8	19.3	56.0
1.102000	36.5	9.000	L1	9.8	19.5	56.0
1.142000	36.6	9.000	L1	9.8	19.4	56.0
1.164000	36.1	9.000	L1	9.8	19.9	56.0
1.236000	35.4	9.000	L1	9.8	20.6	56.0
11.934000	41.7	9.000	L1	10.1	18.3	60.0
11.966000	40.0	9.000	L1	10.1	20.0	60.0
12.020000	41.5	9.000	L1	10.1	18.5	60.0
12.030000	42.0	9.000	L1	10.1	18.0	60.0
12.128000	42.0	9.000	L1	10.1	18.0	60.0
12.186000	39.9	9.000	L1	10.1	20.1	60.0

### CAverage Final Result

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.258000	36.5	9.000	L1	9.7	15.0	51.5
0.264000	34.6	9.000	L1	9.7	16.7	51.3
0.276000	30.4	9.000	L1	9.7	20.6	50.9
0.282000	29.1	9.000	L1	9.7	21.6	50.8
0.294000	26.4	9.000	L1	9.7	24.0	50.4
0.312000	23.4	9.000	L1	9.7	26.5	49.9
0.908000	20.9	9.000	L1	9.8	25.1	46.0
0.944000	22.0	9.000	L1	9.8	24.0	46.0
1.142000	26.3	9.000	L1	9.8	19.7	46.0
1.152000	25.8	9.000	L1	9.8	20.2	46.0
1.164000	25.8	9.000	L1	9.8	20.2	46.0
1.236000	25.6	9.000	L1	9.8	20.4	46.0
11.934000	36.5	9.000	L1	10.1	13.5	50.0
11.966000	34.5	9.000	L1	10.1	15.5	50.0
12.002000	36.1	9.000	L1	10.1	13.9	50.0
12.022000	36.3	9.000	L1	10.1	13.7	50.0
12.126000	36.5	9.000	L1	10.1	13.5	50.0
12.198000	34.9	9.000	L1	10.1	15.1	50.0

Figure 8: Conducted Emission (0.15 MHz to 30 MHz), GNSS mode, Line (N)



### QuasiPeak Final Result

Frequency (MHz)	QuasiPeak (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.164000	49.5	9.000	N	9.7	15.7	65.3
0.282000	48.1	9.000	N	9.7	12.7	60.8
0.296000	47.9	9.000	N	9.7	12.5	60.4
0.302000	47.6	9.000	N	9.7	12.5	60.2
0.308000	47.2	9.000	N	9.7	12.8	60.0
0.312000	46.6	9.000	N	9.7	13.4	59.9
1.136000	36.0	9.000	N	9.8	20.0	56.0
1.140000	36.2	9.000	N	9.8	19.8	56.0
1.208000	35.9	9.000	N	9.8	20.1	56.0
1.218000	35.8	9.000	N	9.8	20.2	56.0
1.280000	34.7	9.000	N	9.8	21.3	56.0
1.362000	33.6	9.000	N	9.8	22.4	56.0
11.970000	39.7	9.000	N	10.1	20.3	60.0
12.020000	41.0	9.000	N	10.1	19.0	60.0
12.028000	41.8	9.000	N	10.1	18.2	60.0
12.234000	41.2	9.000	N	10.1	18.8	60.0
12.496000	39.3	9.000	N	10.1	20.7	60.0
12.632000	39.3	9.000	N	10.1	20.7	60.0

### CAverage Final Result

Frequency (MHz)	CAverage (dB V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB V)
0.164000	38.4	9.000	N	9.7	16.9	55.3
0.280000	29.6	9.000	N	9.7	21.2	50.8
0.288000	27.3	9.000	N	9.7	23.3	50.6
0.298000	25.9	9.000	N	9.7	24.4	50.3
0.302000	24.5	9.000	N	9.7	25.7	50.2
0.312000	23.1	9.000	N	9.7	26.8	49.9
1.124000	25.0	9.000	N	9.8	21.0	46.0
1.136000	25.6	9.000	N	9.8	20.4	46.0
1.140000	25.6	9.000	N	9.8	20.4	46.0
1.208000	26.2	9.000	N	9.8	19.8	46.0
1.280000	24.9	9.000	N	9.8	21.1	46.0
1.362000	23.3	9.000	N	9.8	22.7	46.0
12.000000	36.1	9.000	N	10.1	13.9	50.0
12.020000	35.9	9.000	N	10.1	14.1	50.0
12.038000	36.2	9.000	N	10.1	13.8	50.0
12.250000	34.5	9.000	N	10.1	15.5	50.0
12.496000	33.7	9.000	N	10.1	16.3	50.0
12.632000	33.5	9.000	N	10.1	16.5	50.0

## 8.2 Electro-Static Discharge

### 8.2.1 Operating Environment

Test Date: October 24 / October 25, 2019

Climatic Conditions: Temperature 23.8 / 21.9 °C, Relative Humidity 41.6 / 40.6 %,

Atmospheric Pressure 100.4 / 100.2 kPa

Kind of Test Site: RF Shield Room

### 8.2.2 Test Methods and Levels

The test method shall be in accordance with EN 61000-4-2.

### 8.2.3 Test Condition

#### a. The Operating Mode

SIGFOX mode

Bluetooth mode

WiFi 2.4 GHz mode

GNSS mode

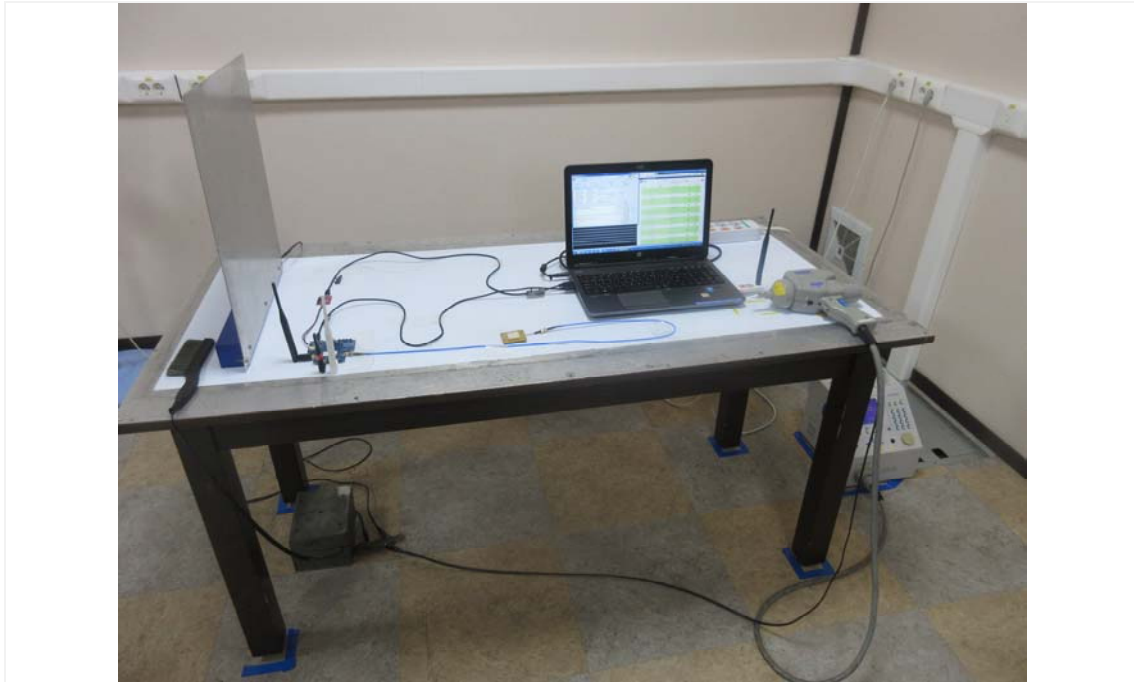
#### b. Testing

The following requirements and evaluation of test results shall apply.

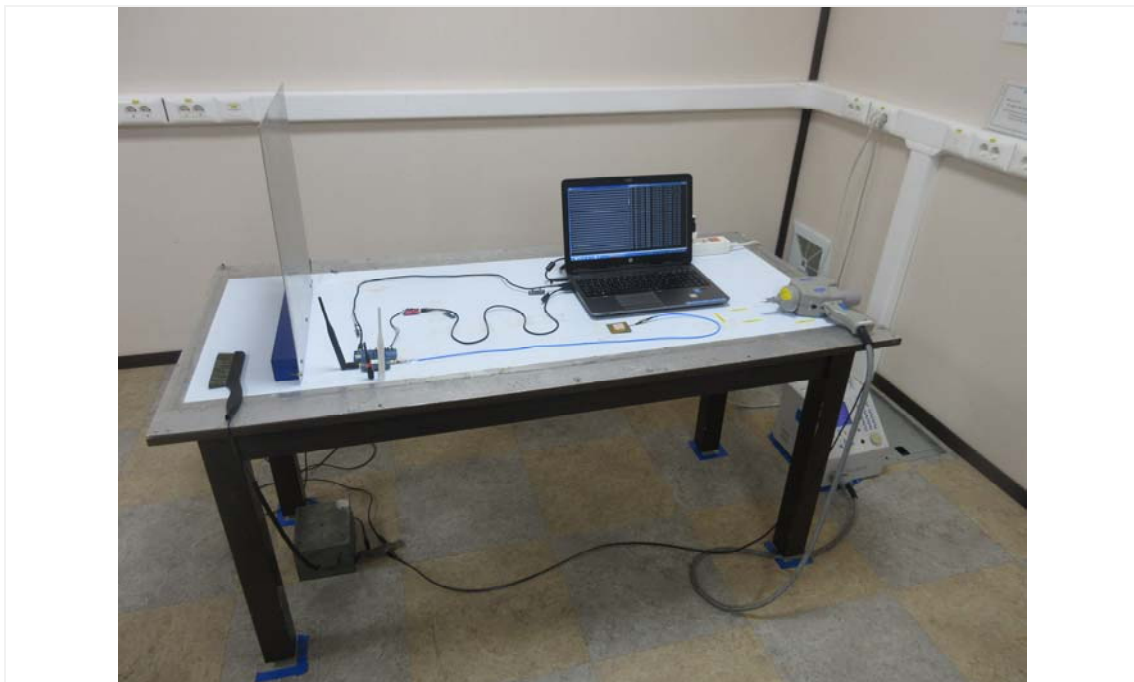
Power supply	230 VAC, 50 Hz
Application Port	Enclosure
Test Voltage	Indirect Discharge Contact Discharge: $\pm 2$ kV, $\pm 4$ kV
Discharge Impedance of ESD Generator	330 $\Omega$ / 150 pF
Polarity of Output Voltage	Positive and Negative
Discharge Mode of Operation	Single discharge
Time interval of discharge	1 s
Each Pre-Selected Point	Contact Discharge: 25 at each test point

### 8.2.4 Test Setup Photo

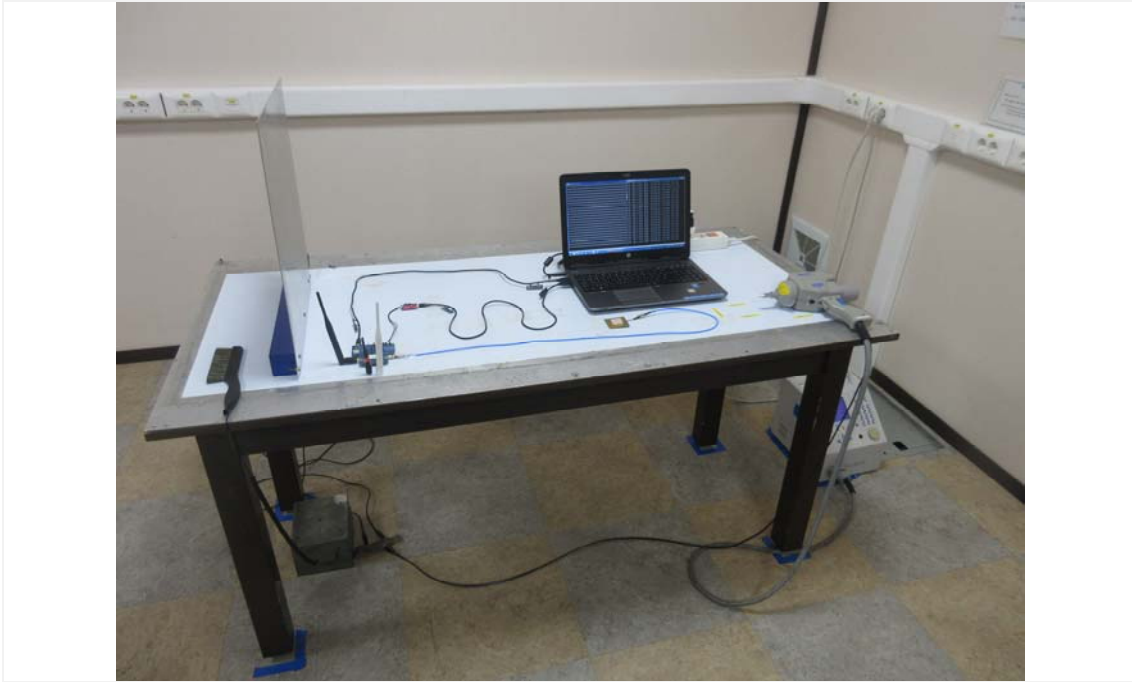
SIGFOX Mode



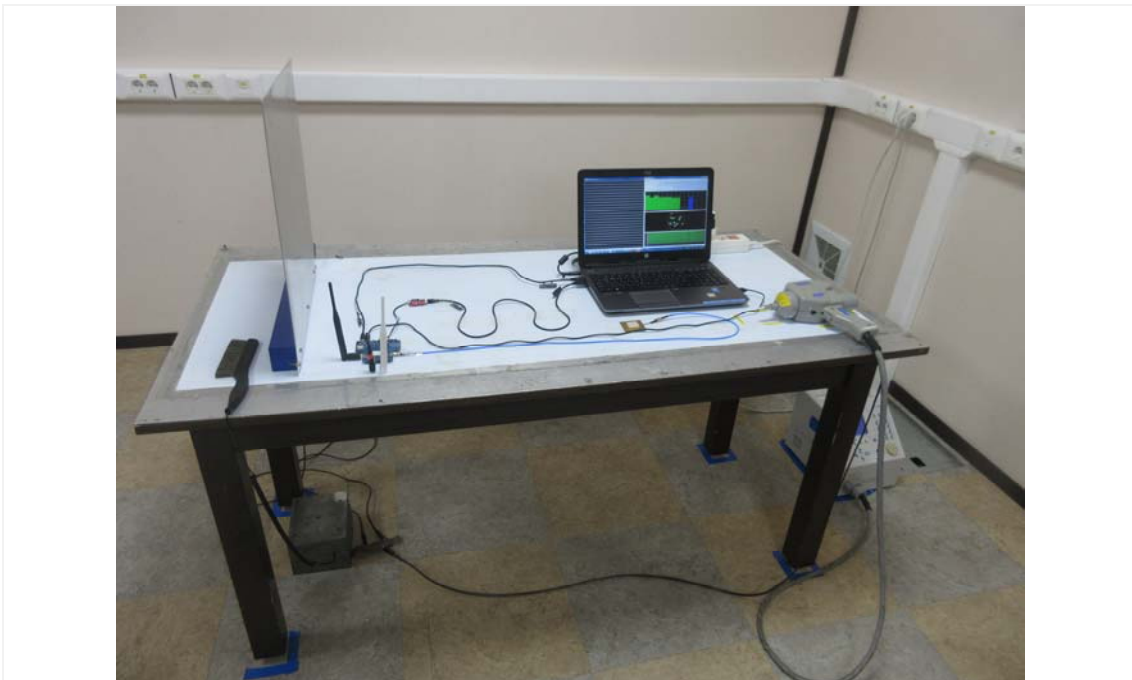
Bluetooth Mode



WiFi Mode



GNSS Mode

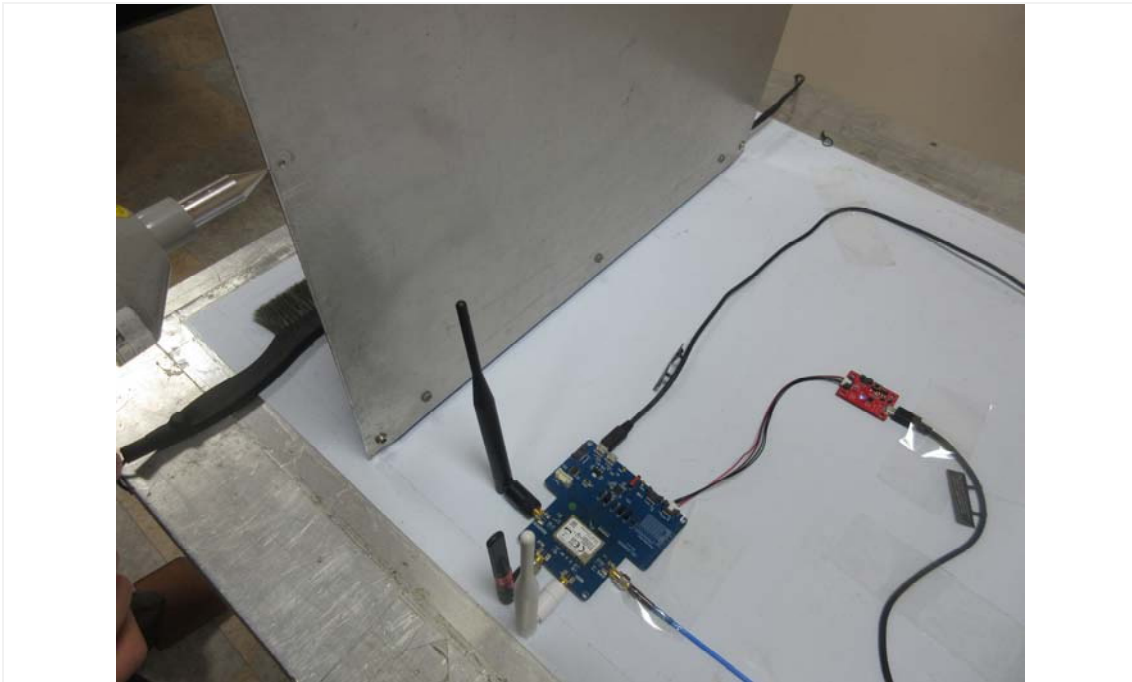




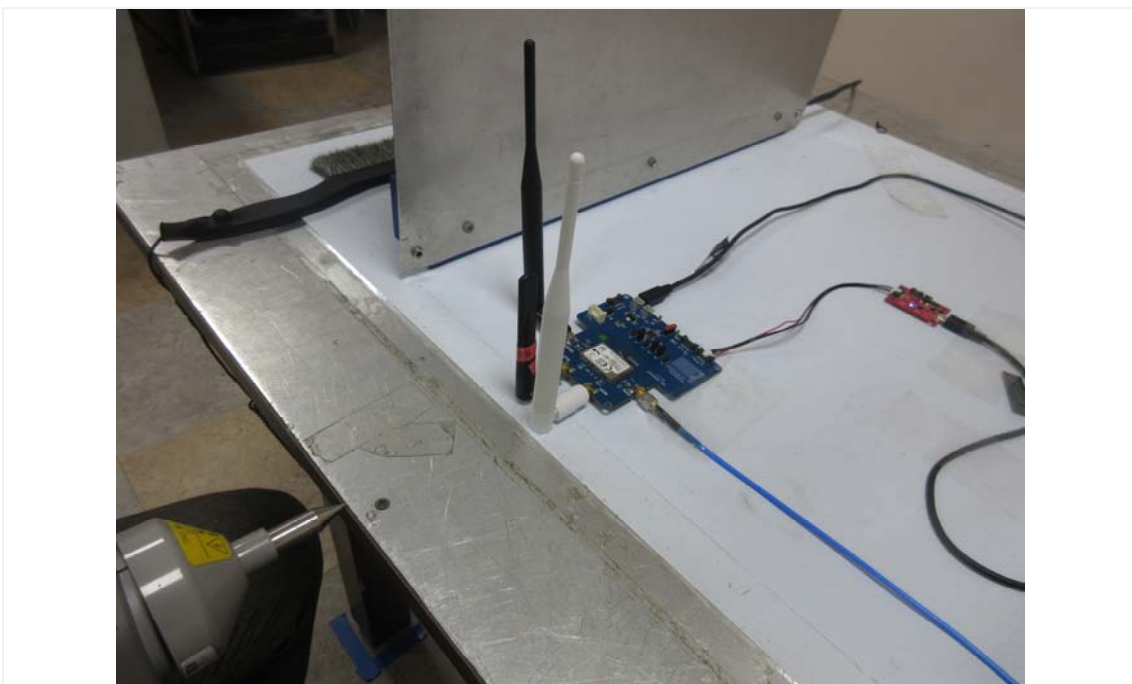
### 8.2.5 Test Points

This equipment is a module, thus indirect discharge was conducted.

Vertical Coupling Plane



Horizontal Coupling Plane



### 8.2.6 Measuring Data

#### Indirect Discharge

Discharge Points	Type of Discharge	Performance Criterion	Test Result		
			$\pm 2$ kV	$\pm 4$ kV	$\pm 8$ kV
VCP	CD	B	A	A	-
HCP	CD	B	A	A	-

NOTE.

1. “VCP” means Vertical Coupling Plane, “HCP” means Horizontal Coupling Plane
2. “CD” means Contact Discharge, “AD” means Air Discharge

### 8.2.7 Test Results

Operating Mode	Observation
SIGFOX	No unintentional operation No loss of function
Bluetooth	No unintentional operation No loss of function
WiFi	No unintentional operation No loss of function
GNSS	No loss of function

## 8.3 RF Electromagnetic Field

### 8.3.1 Operating Environment

Test Date: October 25 / October 26, 2019

Climatic Conditions: Temperature 23.1 / 21.4 °C, Relative Humidity 43.4 / 40.7 %

Kind of Test Site: Fully Anechoic Chamber Room (FACR).

### 8.3.2 Test Methods and Levels

The test method shall be in accordance with EN 61000-4-3.

### 8.3.3 Test Condition

#### a. The Operating Mode

SIGFOX mode

Bluetooth mode

WiFi 2.4 GHz mode

GNSS mode

#### b. Testing

The following requirements and evaluation of test results shall apply.

Power supply	230 VAC, 50 Hz
Applicable port	Enclosure
Frequency range	80 MHz to 6 000 MHz
Test Level	3 V/m
Modulation	AM, Depth of 80 %
Modulation of Test Signal	1 kHz Audio sine wave
Frequency Step	1 %
Dwell time	3 s
Polarization of antenna	Horizontal, Vertical
Field strength method	Substitution method

### 8.3.4 Test Setup Photo

SIGFOX Mode



Bluetooth Mode



WiFi Mode



GNSS Mode



### 8.3.5 Measuring Data

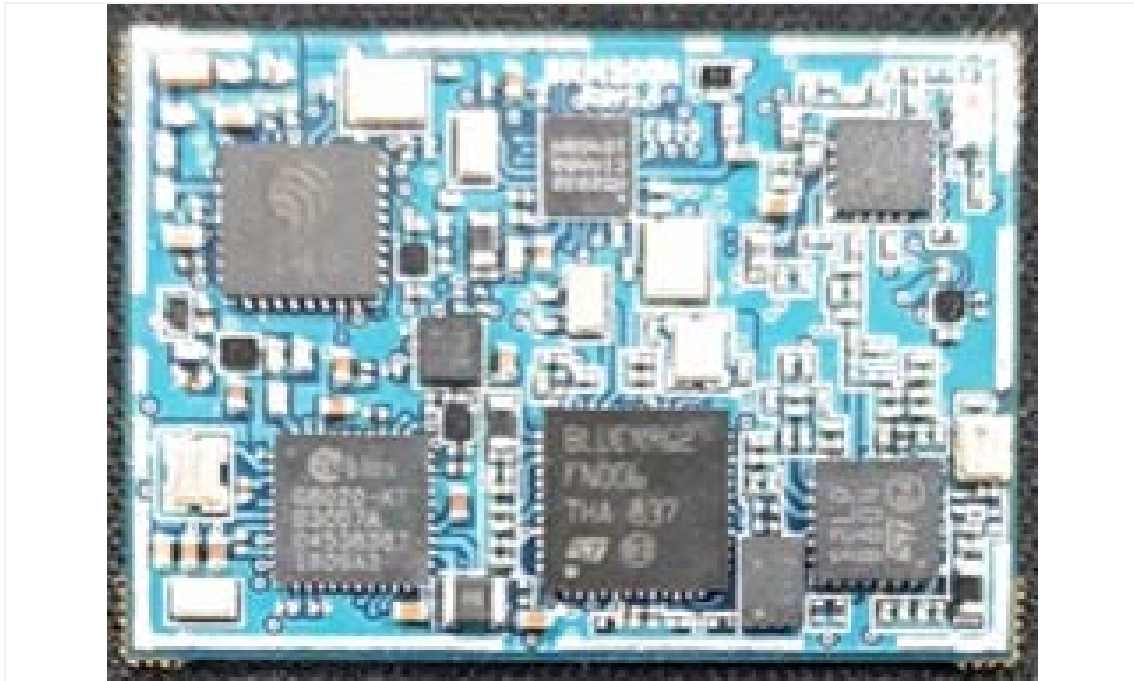
Applied Side	Antenna Polarity	Performance Criteria	Test Result
Front Side	Horizontal, Vertical	A	Pass (A)
Rear Side	Horizontal, Vertical	A	Pass (A)
Left Side	Horizontal, Vertical	A	Pass (A)
Right Side	Horizontal, Vertical	A	Pass (A)

### 8.3.6 Test Results

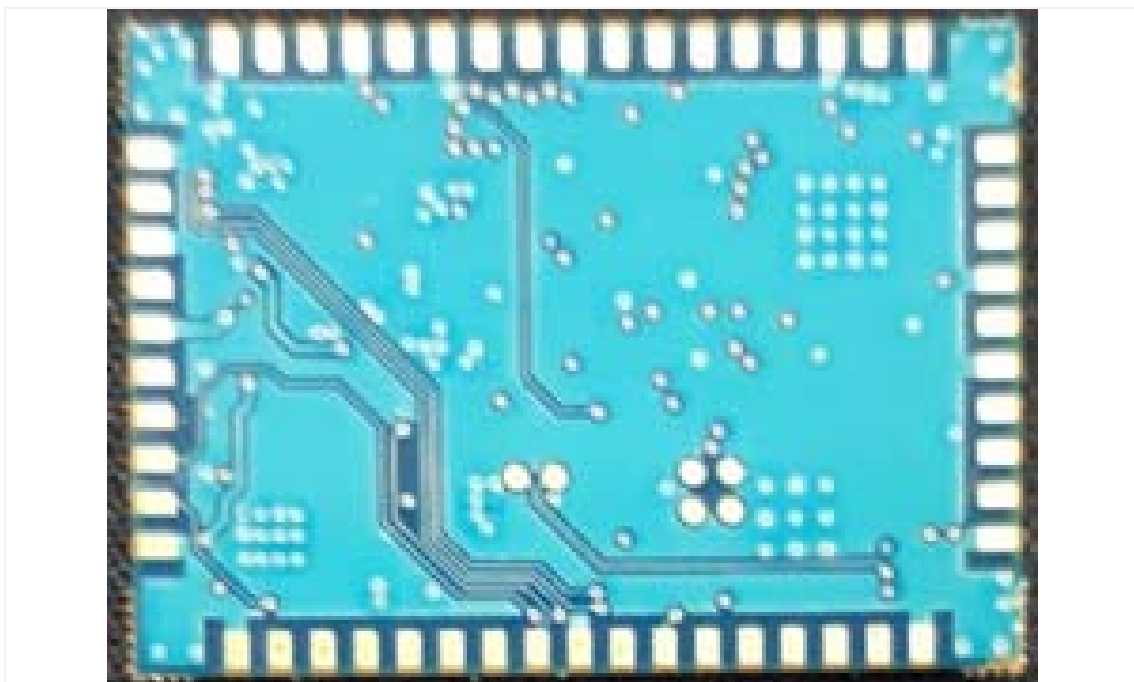
Operating Mode	Observation
SIGFOX	No unintentional operation No loss of function
Bluetooth	No unintentional operation No loss of function
WiFi	No unintentional operation No loss of function
GNSS	No loss of function

## 9. PHOTOGRAPHS OF EUT

Front View



Rear View



End of report