

FCC - TEST REPORT

Report Number	60.790.20.083.01R0	3 Date of Issue	: February 24, 2021				
Model	FB100						
Product Type	Bluetooth, ANT, NF	C wireless module					
Applicant	4iiii Innovations Inc.						
Address	141 2 Ave E, Cochra	ine, Alberta, Canada					
Production Facility	Gwan Kuen Technol	ogy Co., LTD					
Address	No 105, Liye Rd., Zhonghe Dist., New Taipei City, 235 Taiwan (R.O.C)						
Test Result	■Positive	□Negative					
Total pages including Appendices	25	-					

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2 Description of Equipment Under Test

Description of the Equipment Under Test

Product: Bluetooth, ANT, NFC wireless module

Model no.: FB100

FCC ID: ZZN-FB100

Rating: 3.6V DC

Frequency: 13.56MHz

Antenna gain: 0.0dBi

Number of operated channel: 1

Modulation: ASK

Auxiliary Equipment and Software Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Computer	Lenovo	X220	0A72168
AC/DC adapter	Apple	A1537	1

Auxiliary Software Used during Test:

DESCRIPTION	SOFTWARE NAME	VERSION	REMARK
RF Test Mode	FlexBridgeCertificati	0.0.4	Provided by applicant
Software	on.exe		



3 Summary of Test Standards

Test Standards

FCC Part 15 Subpart C 10-1-20 Edition

Federal Communications Commission, PART 15 — Radio Frequency Devices,

Subpart C — Intentional Radiators

All the tests were performed using the procedures from ANSI C63.4(2014) and ANSI C63.10 (2013).



4 Details about the Test Laboratory

Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch

Building 12&13 Zhiheng Wisdomland Business Park,

Nantou Checkpoint Road 2, Shenzhen 518052, P.R.China FCC Registration Number: 514049 ISED test site number: 10320A

Emission Tests			
Test Item	Test Site		
FCC Part 15 Subpart C			
FCC Title 47 Part 15.209 & 15.225(a to d) Fundamental and Radiated Emission	Site 1		
FCC Title 47 Part 15.207 Conduct Emission	Site 1		
FCC Title 47 Part 15.215(c) 20dB & 99% Bandwidth	Site 1		
FCC Title 47 Part 15.225(e) Frequency Tolerance	Site 1		
FCC Title 47 Part 15.203 Antenna Requirement	Site 1		



4.1 Test Equipment Site List

Radiated emission Test - Site 1

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2021-6-29
Signal Analyzer	Rohde & Schwarz	FSV40	101031	2021-6-22
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100398	2021-7-7
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2021-8-4
Horn Antenna	Rohde & Schwarz	HF907	102294	2021-7-5
Wideband Horn Antenna	Q-PAR	QWH-SL-18- 40-K-SG	12827	2021-6-21
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2021-6-21
Pre-amplifier	Rohde & Schwarz	SCU 40A	100432	2021-7-30
Attenuator	Agilent	8491A	MY39264334	2021-6-21
3m Semi-anechoic chamber	TDK	9X6X6		2022-10-28
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

Conducted Emission Test - Site 1

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2021-6-29
LISN	Rohde & Schwarz	ENV4200	100249	2021-6-12
LISN	Rohde & Schwarz	ENV432	101318	2021-6-12
LISN	Rohde & Schwarz	ENV216	100326	2021-6-12
LISN	Rohde & Schwarz	ENV216	102472	2021-6-12
ISN	Rohde & Schwarz	ENY81	100177	2021-6-12
ISN	Rohde & Schwarz	ENY81-CA6	101664	2021-6-12
High Voltage Probe	Schwarzbeck	TK9420(VT9420)	9420-584	2021-6-23
RF Current Probe	Rohde & Schwarz	EZ-17	100816	2021-6-28
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2021-6-21
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A
Shielding Room	TDK	CSR #1		2020-11-07

20dB & 99% Bandwidth, Frequency tolerance - Site 1

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2021-6-21
RF Switch Module	Rohde & Schwarz	OSP120/OSP- B157	101226/100851	2021-6-21
DC Power supplier	GW INSTEK	GEO	891477	2021-9-17



4.2 Measurement System Uncertainty

Measurement System Uncertainty Emissions

System Measurement Uncertainty				
Items	Extended Uncertainty			
Uncertainty for Radiated Emission in 3m chamber 9kHz-30MHz	4.76dB			
Uncertainty for Radiated Emission in 3m chamber	Horizontal: 5.12dB;			
30MHz-1000MHz	Vertical: 5.10dB;			
Uncertainty for Radiated Emission in 3m chamber	Horizontal: 5.01dB;			
1000MHz-25000MHz	Vertical: 5.00dB;			
Uncertainty for Conducted Emission at AC Power Line 150kHz-30MHz	3.21dB			
Uncertainty for conducted power test	1.16dB			
Uncertainty for frequency test	0.6×10 ⁻⁷			



5 Summary of Test Results

Emission Tests							
FCC Part 15 Subpart C							
Test Condition	Pages	Те	st Res	ult			
		Pass	Fail	N/A			
FCC Title 47 Part 15.209 & 15.225(a-d) Fundamental and Radiated Emission	12-13						
FCC Title 47 Part 15.207 Conduct Emission	14-15						
FCC Title 47 Part 15.215(c) 20dB & 99% Bandwidth	16						
FCC Title 47 Part 15.225(e) Frequency Tolerance	17						
FCC Title 47 Part 15.203 Antenna Requirement	18						



6 General Remarks

Remarks

This submittal(s) (test report) is intended for **FCC ID: ZZN-FB100**, complies with Section 15.203, 15.205, 15.207, 15.209, 15.225 of the FCC Part 15, Subpart C rules.

The TX and RX range is 13.56MHz.

SUMMARY:

- All tests according to the regulations cited on page 8 were
 - - Performed
 - ☐ Not Performed
- The Equipment Under Test
 - - Fulfills the general approval requirements.
 - ☐ **Does not** fulfill the general approval requirements.

Sample Received Date: December 1, 2020

Testing Start Date: December 3, 2020

Testing End Date: December 28, 2020

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

Reviewed by: Prepared by: Tested by:

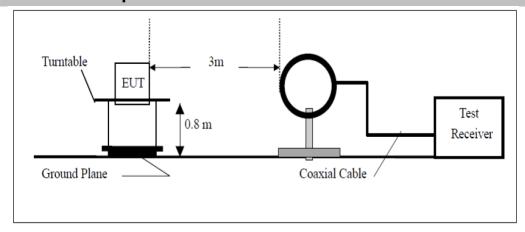
Eric LI EMC Project Manager Hosea CHAN EMC Project Engineer

Louise Liu EMC Test Engineer

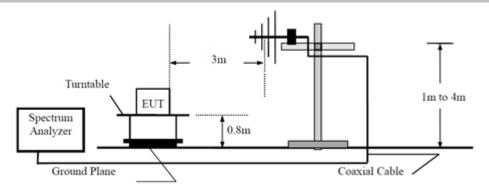


7 Test Setups

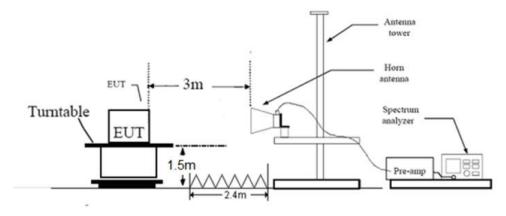
7.1 Radiated test setups 9kHz-30MHz



7.1 Radiated test setups Below 1GHz

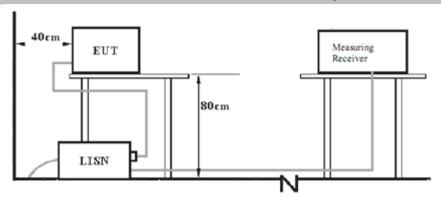


7.2 Radiated test setups Above 1GHz

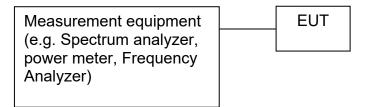




7.3 AC Power Line Conducted Emission test setups



7.4 Conducted RF test setups





8 Emission Test Results

8.1 Fundamental Radiated Emission

EUT: FB100

Op Condition: Operated, TX Mode Test Specification: FCC 15.209 & 15.225

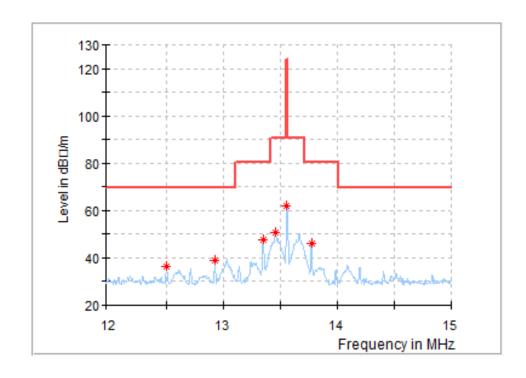
Comment: 3.6V DC

Remark: Below 30MHz

Test Result				
□ Passed				
Not Passed				

Band	Frequency	Amplitude	Limit	Over Limit	Detector	Ant. Pol.	Corr.
MHz	MHz	dBµV/m	dBµV/m	dB	Peak/Ave.	X/Y/Z	dB/m
0.000.12.110	1.209675	41.78	65.96	-24.18	Peak	Х	19.69
0.009-13.110	12.925800	38.93	69.50	-30.57	Peak	X	19.86
13.110-13.410	13.348675	47.64	80.50	-32.86	Peak	Х	19.84
13.410-13.553	13.453150	50.70	90.50	-39.80	Peak	X	19.83
13.553-13.567	13.560000	61.72	124.00	-62.28	Peak	Х	19.83
13.567-13.710	13.665500	48.89	90.50	-41.61	Peak	Х	19.82
13.710-14.010	13.776525	46.24	80.50	-34.26	Peak	X	19.81
14.010-30	14.194000	35.90	69.50	-33.60	Peak	Х	19.79

Remark: Test was performed at 3m distance, it already has been transferred to 3m limit.





Radiated Emission

EUT: FB100

Op Condition: Operated, TX Mode Test Specification: FCC 15.209 & 15.225

Comment: 3.6V DC

Remark: 30MHz to 1GHz

Test Result	
⊠ Passed	
☐ Not Passed	

Frequency	Result	Limit	Over Limit	Detector	Ant. Polarity	Corr.
MHz	dBµV/m	dBµV/m	dB	PK/QP/AV	H/V	dB
63.161875	26.51	40.00	-13.49	Peak	Н	16.04
68.860625	26.24	40.00	-13.76	Peak	Н	14.30
167.982500	30.41	43.50	-13.09	Peak	Н	13.51
288.080625	31.57	46.00	-14.43	Peak	Н	18.41
407.996875	38.54	46.00	−7.46	Peak	Н	21.48
432.004375	36.11	46.00	-9.89	Peak	Н	22.06
57.160000	28.12	40.00	-11.88	Peak	V	17.27
63.343750	28.68	40.00	-11.32	Peak	V	15.99
143.975000	31.02	43.50	-12.48	Peak	V	12.82
168.103750	27.39	43.50	-16.11	Peak	V	13.52
407.996875	34.65	46.00	-11.35	Peak	V	21.48
923.188125	40.45	46.00	-5.55	Peak	V	29.65

Remark:

- 1. As the measured peak value not exceeded the Quasi-peak limit, Quasi-peak value no need to be measured
- Result Level=Reading Level + Correction Factor
 Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
 Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
- (The Reading Level is recorded by software which is not shown in the sheet)
 3. As the fundamental wave of EUT is 13.56MHz, according to FCC part 15.33, should perform the test from 9kHz to tenth harmonic 135.6MHz. We completed the test form 9kHz to 1GHz, which is sufficient to comply with the requirement.

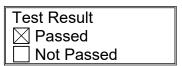


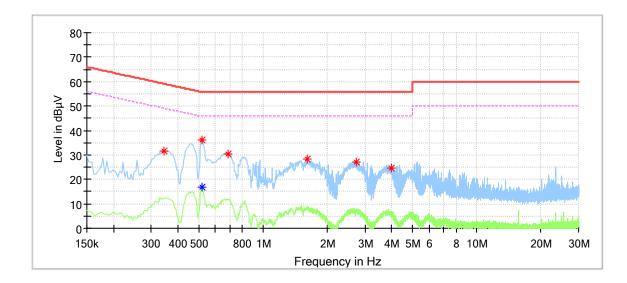
8.2 Conducted Emission at AC Power line

EUT: FB100 Op Condition: Normal link

Test Specification: FCC15.207, AC Mains, L Line

Comment: 120V AC, 60Hz (supporting adapter input)





Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Over Limit (dB)
0.346000	31.63		59.06	-27.43
0.518000		16.87	46.00	-29.13
0.518000	36.28		56.00	-19.72
0.686000	30.35		56.00	-25.65
1.606000	28.29		56.00	-27.71
2.730000	26.90		56.00	-29.10
3.986000	24.42		56.00	-31.58

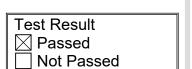


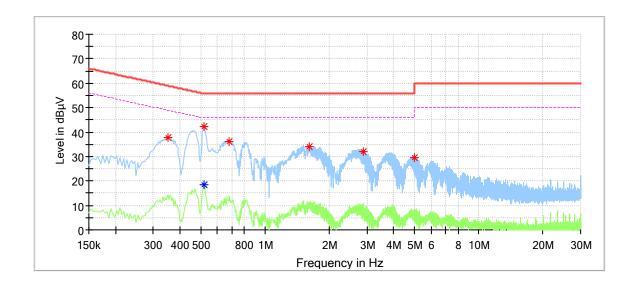
Conducted Emission Test

EUT: FB100 Op Condition: Normal link

Test Specification: FCC15.207, AC Mains, N Line

Comment: 120V AC, 60Hz (supporting adapter input)





Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Over Limit (dB)
0.350000	37.70		58.96	-21.27
0.518000		18.64	46.00	-27.36
0.518000	42.44		56.00	-13.56
0.678000	36.25		56.00	-19.75
1.610000	33.98		56.00	-22.02
2.874000	32.02		56.00	-23.98
4.978000	29.38		56.00	-26.62

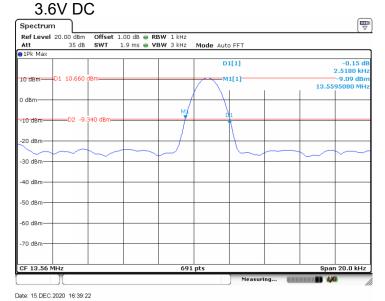


8.3 20dB & 99% Bandwidth

EUT: FB100
Op Condition: Operated, TX Mode
Test Specification: FCC15.215(c)
Comment: 3.6V DC

Test Result

☐ Passed
☐ Not Passed





Date:	15.DEC.2020	16:48:24

Bandwidth	Measured Value
20dB bandwidth	2.518 kHz
99% OCB	2.228 kHz



8.4 Frequency tolerance

EUT: FB100

Op Condition: Operated, TX Mode

Test Specification: FCC15.225(e)

Comment: 3.6V DC

Test Result
⊠ Passed
☐ Not Passed

Voltage	Temperature	Frequency	Deviation in	Limit
Vdc	°C	MHz	Hz	Hz
3.6	+50	13.560759	+759	+/-1356
3.6	+40	13.560755	+755	+/-1356
3.6	+30	13.560762	+762	+/-1356
3.6	+20	13.560753	+753	+/-1356
3.6	+10	13.560751	+751	+/-1356
3.6	0	13.560747	+741	+/-1356
3.6	-10	13.560758	+758	+/-1356
3.6	-20	13.560764	+764	+/-1356
3.06	+20	13.560761	+761	+/-1356

Remark: 1. Limit = \pm - (0.01% x 13.56MHz) = \pm -1356Hz.

^{2.} For 4.14V (115% of the rated supply voltage), as the module maximum supply voltage is 3.6V, so 4.14V is not applicable.



8.5 Antenna Requirement

EUT: FB100

Op Condition: Operated, TX Mode Test Specification: FCC15.203 (b)

Comment: 3.6V DC

Test Result	
⊠ Passed	
Not Passed	

Limit

For intentional device, according to FCC Title 47 Part 15.203, An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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.

Antenna Connector Construction

The antenna used is private for the device, and it is permanently attached. A special interface is designed to make sure only the private antenna can be installed and used.



9 Test setup procedure

9.1 Field strength of emissions and Restricted bands

Test Method

- 1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3-meter chamber room for test. 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 height of antenna is varied from one meter to four meters 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 heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5: Use the following spectrum analyzer settings According to C63.10:

For Above 1GHz

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥3RBW, Sweep = auto, Detector function = peak and average, Trace = max hold.

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 120KHz, VBW≥3RBW, Sweep = auto, Detector function = QP,

Trace = max hold.



Field strength of emissions and Restricted bands

Limits

According to §15.225 (a to d), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

According to §15.209, Unwanted emissions shall comply with the limits specified.

Frequency	Field Strength	Field Strength	Detector
MHz	uV/m	dBμV/m	
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK



9.2 Conducted Emission at AC Power line

Test Method

- 1. The EUT was placed on a table, which is 0.8m above ground plane
- 2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
- 3. Maximum procedure was performed to ensure EUT compliance
- 4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

Frequency MHz	QP Limit dBµV	AV Limit dΒμV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

^{*}Decreasing linearly with logarithm of the frequency.



9.3 20dB & 99% Bandwidth

Test Method

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Position the EUT without connection to spectrum analyser. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- 3. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.

Limits:

According to 15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.



9.4 Frequency tolerance

Test Method

- 1. Connect the EUT via an RF cable to a spectrum analyzer with the EUT placed inside environment chamber.
- 2. Power on the EUT by a DC power supplier.
- 3. Adjust the voltage and the temperature according to the requirements.
- 4. Measure and record the fundamental wave frequency of each conditions.

Limits:

According to 15.225 (e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to + 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.



10 Appendix A - General Product Information

Radiofrequency radiation exposure evaluation

This exposure evaluation is intended for FCC ID: ZZN-FB100

According to KDB 447498 D01v06 section 4.3.1, For frequencies below 100 MHz and test separation distances ≤ 50 mm, the Numeric threshold is determined as:

Step a

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] $\cdot [\sqrt{f(GHz)}] \le 3.0$ for 1-g SAR

Step b)

{[Power allowed at numeric threshold for 50mm in step a)] + [(test separation distance – 50mm) \cdot (f(MHz)/150)]} mW

Step c) 1)

For test separation distances > 50mm and < 200mm, the power threshold at the corresponding test separation distance at 100MHz in step b) is multiplied by $[1 + \log(100/f(MHz))]$

Step c) 2)

For test separation distances \leq 50mm, the power threshold determined by the equation in c) 1) for 50mm and 100MHz is multiplied by $\frac{1}{2}$.

>> The fundamental frequency of the EUT is 13.56MHz, the test separation distance is ≤ 50mm. (Here calculated it as the worst-case, define the distance is 5mm)

Step a)

>> Numeric threshold, mW / 50mm * √0.1GHz ≤ 3.0 Numeric threshold ≤ 474.3mW

Step b)

>> Numeric threshold ≤ 474.3mW + (50mm-50mm) * 100MHz/150) Numeric threshold ≤ 474.3mW

Step c) 1) & c) 2)

- >> Numeric threshold ≤ 474.3mW * [1 + log 100/100MHz] * ½
 Numeric threshold ≤ 237.15mW
- >> The power (calculated power + tune up tolerance) of EUT at 13.56MHz is: 0.0005mW Which is smaller than the Numeric threshold.

Therefore, the device is exempt from stand-alone SAR test requirements.



Appendix A

Power calculation (According to C63.10 chapter 9.5)

	Value	Unit
Field Strength Measured (E)	61.72	dBµV/m
Measurement Distance (D)	3	m
Equivalent Isotropically Radiated Power (E.I.R.P in dBm)	-33.44	dBm
Equivalent Isotropically Radiated Power (E.I.R.P in mW)	0.0005	mW

Remark: EIRP = E + $20\log(D) - 104.7$

(EIRP is in dBm, E is in dBµV/m, D is in meters)

Reviewed by:

Prepared by:

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