Radiated Spurious Emissions Radio Testing of the

IPS Group Inc.
Single Space Parking Meter Model: MK5J

In accordance with
FCC Part 15 Subpart C §15.225, 15.231 and 15.247
RSS-210 Issue 10 December 2019 Amendment April 2020
RSS-247 Issue 2 February 2017
KDB 996369 D04 Module Integration Guide V01

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IPS Group Inc.
7737 Kenamar Court
San Diego, CA 92121
USA

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Date: November 2020
Document Number: 72162499B Rev.01 Issue 01 | Version Number: 01

Authorized Signatory	Alex Chang	November 10, 2020	Alex Chang

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

EXECUTIVE SUMMARY
A sample of this product was tested and found to be in compliance with FCC Part 15 Subpart C §15.225, 15.231 and 15.247, RSS-210 Issue 10 December 2019 Amendment April 2020 and RSS-247 Issue 2 February 2017.

A2LA Cert. No. 2955.13

ACCREDITATION
Our A2LA Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our A2LA Accreditation.

TÜV SÜD America, Inc.
10040 Mesa Rim Road
San Diego, CA 92121-2912

TÜV SÜD America, Inc.
Rancho Bernardo Facility
16936 Via Del Campo
San Diego, CA 92127

Phone: 858 678 1400
www.tuv-sud-america.com

REPORT ON	Radiated Spurious Emissions Radio Testing of the IPS Group Inc. Model: MK5J Single Space Parking Meter
TEST REPORT NUMBER	72162499B Rev.01
TEST REPORT DATE	November 2020
PREPARED FOR	IPS Group Inc. 7737 Kenamar Court San Diego, CA 92121 USA
CONTACT PERSON	Gary Thomas Sr. RF Design Engineer gary.thomas@ipsgroupinc.com (858) 768-2401
PREPARED BY	Xiaoying Zhang **Name** Authorized Signatory Title: Wireless/EMC Test Engineer

Revision History

72162499B Rev.01
IPS Group Inc.
Model: MK5J Single Space Parking Meter

DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
10/21/2020	—	Initial Release			Alex Chang
11/10/2020	Initial Release	Rev.01	FCC / IC IDs correction	All	Alex Chang

CONTENTS

SECTION 1

1 REPORT SUMMARY

Radiated Spurious Emissions Radio Testing of the
IPS Group Inc.
Model: MK5J Single Space Parking Meter

1.1 Introduction

The information contained in this report is intended to show verification of the IPS Group Inc. MK5J Smart Parking Meter to the requirements of FCC Part 15 Subpart C §15.225, 15.231 and 15.247, RSS-210 Issue 10 December 2019 Amendment April 2020 and RSS-247 Issue 2 February 2017.

Objective	To perform Class II Permissive Change verification to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out. Only radiated spurious emissions testing was performed. The NFC, RFID 13.56 MHz, 430 MHz, BLE and Cellular modules imbedded in the EUT were FCC certified.
Manufacturer	IPS Group Inc.
EUT	Smart Parking Meter
Model Name	Single Space Parking Meter
Model Name	MK5J
FCC ID	SGWIPS2007SSPM
IC Number	11583A-IPS2007SSPM
FCC Classification	Low Power Communications Device Transmitter (DXX)
Serial Number(s)	0000466294
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.225, 15.231 and 15.247 (October 1, 2019). • KDB 996369 D04 Module Integration Guide V01. Modular Transmitter Integration Guide— Guidance for Host Product Manufacturers • RSS-210 Issue 10 December 2019 Amendment April 2020 – Licence-Exempt Radio Apparatus: Category I Equipment • RSS-247 Issue 2 February 2017 - Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices • RSS-Gen Issue 5 Amendment 1 March 2019 - General Requirements for Compliance of Radio Apparatus.
Start of Test	September 09, 2020
Finish of Test	October 05, 2020
Name of Engineer(s)	Xiaoying Zhang

Related Document(s)	• ANSI C63.10-2013. American National Standard of Procedures for Compliance testing of Unlicensed Wireless Devices. • Supporting documents for EUT certification are separate exhibits.

1.2 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.225, 15.231 and 15.247, RSS-210 Issue 10 December 2019 Amendment April 2020 and RSS-247 Issue 2 February 2017 with cross-reference to the corresponding ISED RSS standard are shown below.

Section	FCC Part 15 Spec Clause	RSS	Test Description	Result	Comments/ Base Standard
-	§15.203 and 204	RSS-Gen 6.8	Antenna Requirements	Compliant	See Test Note[1]
2.1	§15.225(a)(b)(c)	RSS-210 B.6(a) (i)(ii)(iii)	Emission Mask	Compliant	-
2.2	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Emissions	Compliant	-
2.3	§15.209 §15.225(d) §15.231(e) §15.247(d)	RSS-210 B.6(a)(iv) RSS-210 A1.4 RSS-247 5.5	Spurious Radiated Emissions	Compliant	-
-	§15.207(a)	RSS-Gen 7.2	Conducted Emissions	N/A	Battery powered

Test Note[1]:The EUT uses a permanently attached antenna to the intentional radiator and is considered sufficient evidence to comply with the provisions of this requirement.

1.3 Product Information

1.3.1 Technical Description

The Equipment Under Test (EUT) was an IPS Group Inc. Single Space Parking Meter Model: MK5J. The EUT is part of the Smart Metering Collection System. It uses RFID for cashbox identification, BLE for user pay by phone interface during collection process. NFC for tap and go payment by credit cards, RFID 430 MHz to relay vehicle sensor data to main processor and Cellular for web-based Data Management System (DMS). The radiated spurious emissions of NFC, RFID 13.56 MHz, 430 MHz and BLE functions of the EUT was verified under this test report.

1.3.2 EUT General Description

EUT Description	Smart Parking Meter
Model Name	Single Space Parking Meter
Model Number(s)	MK5J
Rated Voltage	• Lithium Battery (3.6V) IPS Group Inc. TL-5420/5P/IPS • Tadiran Batteries TLI-1550A 4V 330mAh (on-board battery)
NFC and RFID 13.56 MHz Module Output Power	100 mW or 200 mW (programmable)
EUT NFC and RFID 13.56 MHz Field Strength	61.2 dBµV/m @ 3 meters
Frequency Range	NFC and RFID 13.56 MHz: 13.56 MHz in the 13.110 to 14.0101 MHz band 430 MHz: 410.610 MHz to 430.400 MHz BLE: 2402 MHz to 2480 MHz
Number of Operating Frequencies	NFC and RFID 13.56 MHz: 1
NFC Antenna Type	Integral PCB Loop
NFC Antenna Connector	Pin tail soldered to PCB RF Coax
NFC Antenna Part Number	795-732-PCBA Rev-2A
RFID 13.56 MHz Antenna Type	Integral PCB Loop
RFID 13.56 MHz Antenna Connector	IPX U.FL RF Coaxial Connector (Integral)
RFID 13.56 MHz Antenna Part Number	795-773-PCBA Rev-01

1.3.3 Approved Module Installed

Technology	Model	FCC ID	Antenna Gain/Type
Cellular	Quectel BG96	XMR201707BG96	0.5 dBi, IPS LTE Batwing 795-771-PCB Rev 01
BLE	BGM13P32A	QOQ-BGM13P	0.5 dBi, Mini 2.45 GHz Antenna, Johanson Technology P/N 2450AT18A100
430 MHz	VDS-030	SGWIPS2014VDS	1.9 dBi, LINX Tech, ANT-433-HETH (helical, through-hole)

Information contained in this table were declared by the manufacturer.

1.4 EUT Test configuration

1.4.1 Test Configuration Description

Test Configuration	*Description*
Default	Transmit Mode. EUT in Diagnostic Mode and NFC, RFID 13.56 MHz, 430 MHz RFID turned on. BLE set to single channel transmit mode and the cellular radio set to active mode. A CMW500 was used to establish a call using LTE Bands 2, 4 or 13.

1.4.2 EUT Exercise Software

The EUT was running Diagnostic Software Version 52.79.9 when verified.

1.4.3 Support Equipment and I/O cables

Manufacturer	*Equipment/Cable*	*Description*
Protek	DC Power Suppy Unit	Model: 18020M Output: 0 – 18 VDC 20A

1.4.4 Simplified Test Configuration Diagrams

Not required. EUT verified on standalone configuration. EUT is battery operated, nonetheless DC power input connections were provided by the manufacturer in order for the EUT to sustain extended testing time without totally draining the battery.

1.5 Deviations from the Standard

No deviations from the applicable test standards or test plan were made during testing.

1.6 Modification Record

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number: 0000466294		
N/A	—	—

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.10-2013. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 Test Facility Location

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: (858) 678 1400 Fax: (858) 546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: (858) 6781400 Fax: (858) 546 0364.

1.9 test facility Registration

1.9.1 FCC – Designation No.: US1146

TÜV SÜD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Designation is US1146.

1.9.2 Innovation, Science and Economic Development Canada (ISED) Registration No.: 3067A-1 & 22806-1

The 10m Semi-anechoic chamber of TÜV SÜD America Inc. (San Diego Rancho Bernardo) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A-1.

The 3m Semi-anechoic chamber of TÜV SÜD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 22806-1.

1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TÜV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.9.4 NCC (National Communications Commission - US0102)

TÜV SÜD America Inc. (San Diego) is listed as a Foreign Recognized Telecommunication Equipment Testing Laboratory and is accredited to ISO/IEC 17025 (A2LA Certificate No.2955.13) which under APEC TEL MRA Phase 1 was designated as a Conformity Assessment Body competent to perform testing of equipment subject to the Technical Regulations covered under its scope of accreditation including RTTE01, PLMN01 and PLMN08 for TTE type of testing and LP0002 for Low-Power RF Device type of testing.

1.9.5 VCCI – Registration No. A-0280 and A-0281

TÜV SÜD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.

1.9.6 RRA – Identification No. US0102

TÜV SÜD America Inc. (San Diego) is National Radio Research Agency (RRA) recognized laboratory under Phase I of the APEC Tel MRA.

1.9.7 OFCA – U.S. Identification No. US0102

TÜV SÜD America Inc. (San Diego) is recognized by Office of the Communications Authority (OFCA) under Appendix B, Phase I of the APEC Tel MRA.

SECTION 2

2 TEST DETAILS

Radio Testing of the
IPS Group Inc.
Model: MK5J Single Space Parking Meter

2.1 Emission Mask

2.1.1 Specification Reference

Part 15 Subpart C §15.225 (a)(b)(c) and RSS-210 B.6 (a)(i)(ii)(iii)

2.1.2 Standard Applicable

(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

2.1.3 Equipment Under Test and Modification State

Serial No: 0000466294 / Default Test Configuration

2.1.4 Date of Test/Initial of test personnel who performed the test

September 11 and Ocotber 05, 2020 / XYZ

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions (Rancho Bernardo Satellite Facility)

Ambient Temperature	23.6 - 24.6 °C
Relative Humidity	30.7 - 46.7 %
ATM Pressure	98.9 - 99.0 kPa

2.1.7 Additional Observations

- This is a radiated test for NFC and RFID 13.56 MHz emission mask.
- The spectrum was searched from 9kHz to 30MHz. Only 13.110 MHz to 14.010 MHz presented. There are no significant emissions observed other than the fundamental frequency (13.56 MHz) measured at 3 meters.
- Limits were converted from 30 meters to 3 meters using 40 dB/decade extrapolation rules.
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.1.8 for sample computation.

2.1.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dBµV) @ 13.56MHz			15.0
Correction Factor (dB)	Asset# 1026 (cable)	0.6	21.5
	Asset# 1057 3m (cable)	0.7	
	Asset# 6628 (antenna)	19.9	
	Asset# 1187(cable)	0.3	
Reported QuasiPeak Final Measurement (dBµV/m) @ 30MHz			**36.5**

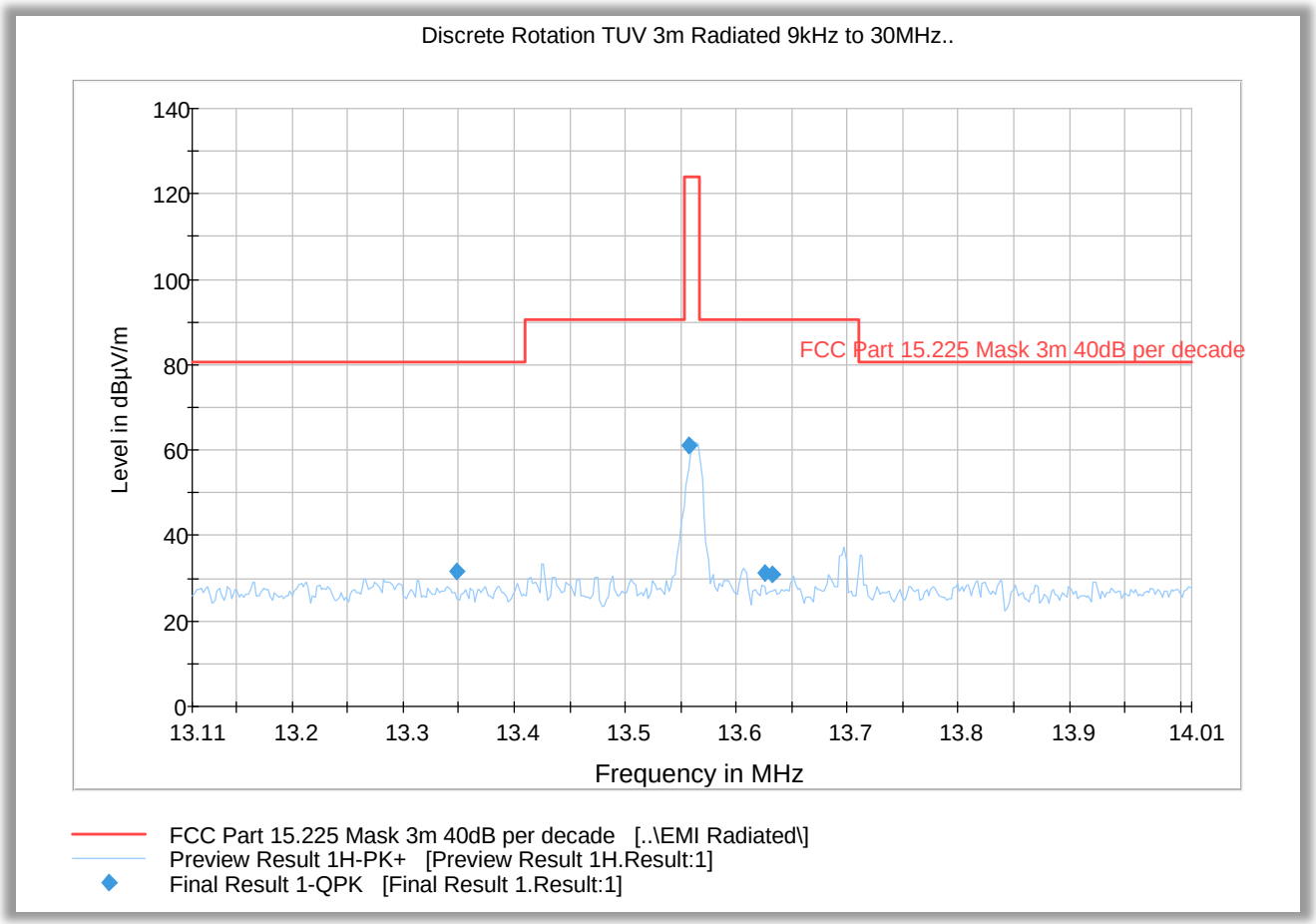
2.1.9 Sample Computation (Limits)

Limit @ 13.553–13.567 MHz:	= 15,848 µV/m @30 meters
	= 20 log(15,848 µV/m)
	= 84 dB µV/m @30 meters
Using 20dB/decade extrapolation rule:	= 40 log (30m/3m)
Measuring distance correction factor:	= 40 dB
Calculated limit @ 3 meters:	= 84 dB µV/m + 40 dB
	= 124 dB µV/m

2.1.10 Test Results

See attached plots.

2.1.11 Test Results



Quasi Peak Data (§15.225 Limits)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
13.347633	31.5	1500.0	9.000	100.0	H	147.0	21.8	49.0	80.5
13.557910	61.2	1500.0	9.000	100.0	H	-1.0	21.8	62.8	124.0
13.626174	31.3	1500.0	9.000	100.0	H	359.0	21.8	59.1	90.5
13.632202	31.0	1500.0	9.000	100.0	H	-15.0	21.8	59.5	90.5

2.2 Band-edge Compliance of RF Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
FCC 47 CFR Part 15, Clause 15.205
RSS-247, Clause 5.5

2.2.2 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.2.3 Equipment Under Test and Modification State

Serial No: 0000466294 / Default Test Configuration

2.2.4 Date of Test/Initial of test personnel who performed the test

September 10, 2020 / XYZ

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

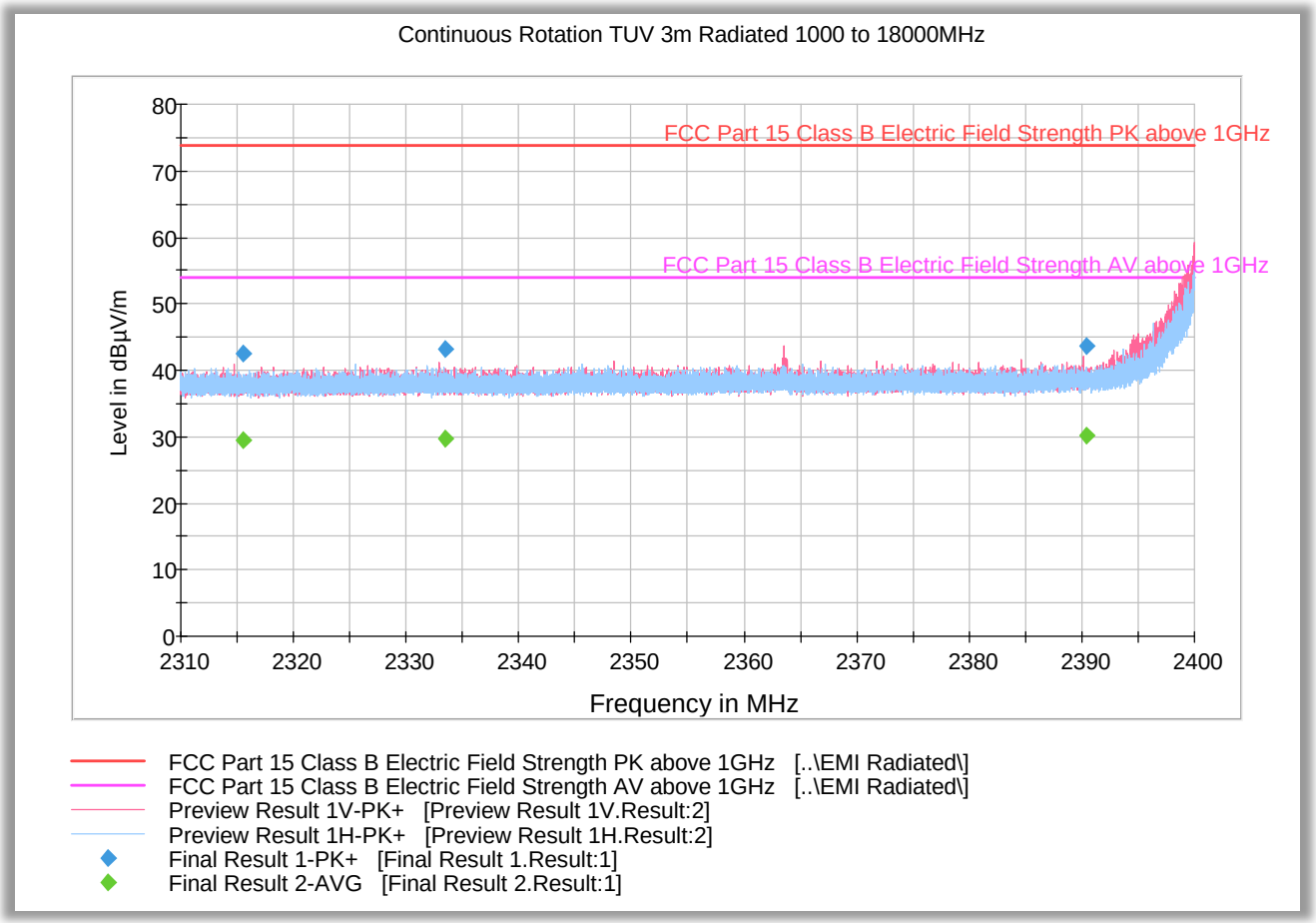
2.2.6 Environmental Conditions

Ambient Temperature	23.1 °C
Relative Humidity	38.0 %
ATM Pressure	98.9 kPa

2.2.7 Additional Observations

- This is radiated test for BLE Low Channel (2402 MHz) and High Channel (2480 MHz).
- The spectrum was searched from 2310MHz to 2390MHz for lower immediate restricted band and 2483MHz to 2500MHz for the upper immediate restricted band.

2.2.8 Test Results Restricted Band 2310MHz to 2390MHz (BLE Low Channel)



Peak Data

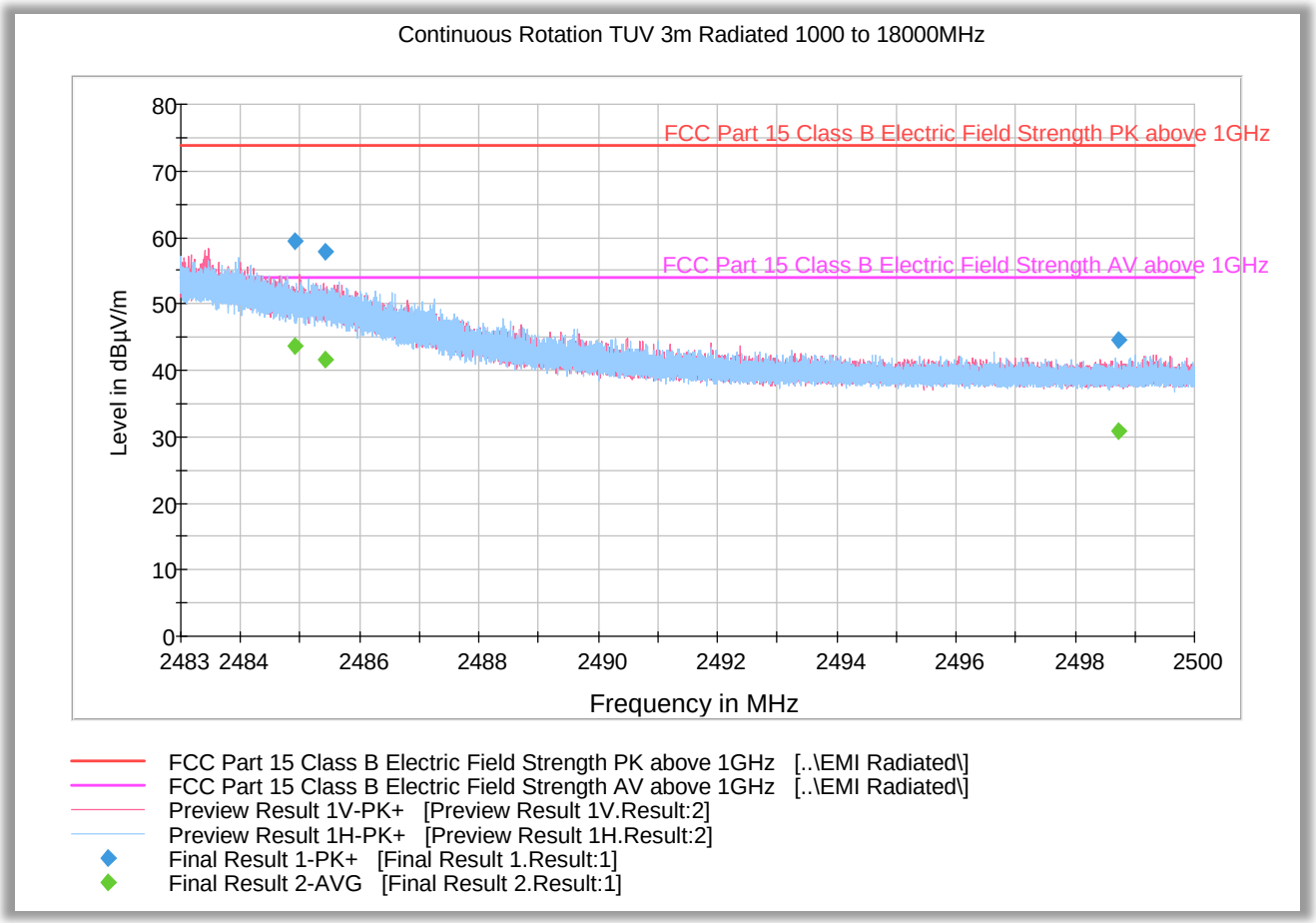
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2315.53400	42.5	1000.	1000.000	250.5	V	148.0	-0.7	31.4	73.9
2333.52000	43.2	1000.	1000.000	200.5	V	-4.0	-0.6	30.7	73.9
2390.43400	43.6	1000.	1000.000	119.7	H	37.0	-0.3	30.3	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2315.53400	29.4	1000.	1000.000	250.5	V	148.0	-0.7	24.5	53.9
2333.52000	29.6	1000.	1000.000	200.5	V	-4.0	-0.6	24.3	53.9
2390.43400	30.1	1000.	1000.000	119.7	H	37.0	-0.3	23.8	53.9

Test Notes: 2.4GHz notch filter removed for this test.

2.2.9 Test Results Restricted Band 2483MHz to 2500MHz (BLE High Channel)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.91833	59.3	1000.	1000.000	199.5	V	38.0	0.2	14.6	73.9
2485.41833	57.9	1000.	1000.000	194.5	V	25.0	0.2	16.0	73.9
2498.71660	44.6	1000.	1000.000	127.7	V	8.0	0.3	29.3	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.91833	43.7	1000.	1000.000	199.5	V	38.0	0.2	10.2	53.9
2485.41833	41.7	1000.	1000.000	194.5	V	25.0	0.2	12.2	53.9
2498.71660	30.8	1000.	1000.000	127.7	V	8.0	0.3	23.1	53.9

Test Notes: 2.4GHz notch filter removed for this test.

2.3 Spurious Radiated Emissions

2.3.1 Specification Reference

FCC Part 15 Subpart C §15.225(d) and RSS-210 B.6 (a)(iv)
FCC Part 15 Subpart C §15.231(e) and RSS-210 A1.4
FCC Part 15 Subpart C §15.247 and RSS-247 5.5

2.3.2 Standard Applicable

FCC Part 15 Subpart C §15.225
(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.

FCC Part 15 Subpart C §15.231
(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	1,000	100
70-130	500	50
130-174	[1] 500 to 1,500	[1] 50 to 150
174-260	1,500	150
260-470	[1] 1,500 to 5,000	[1] 150 to 500
Above 470	5,000	500

[1]Linear Interpolations

FCC Part 15 Subpart C §15.247
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.3.3 Equipment Under Test and Modification State

Serial No: 0000466294 / Default Test Configuration

2.3.4 Date of Test/Initial of test personnel who performed the test

September 11 and October 05, 2020 / XYZ

2.3.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.6 Environmental Conditions (Rancho Bernardo Satellite Facility)

Ambient Temperature	23.6 - 24.6 °C
Relative Humidity	30.7 - 46.7 %
ATM Pressure	98.9 - 99.0 kPa

2.3.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9 kHz to 18 GHz (to satisfy intentional emitter composite emissions requirement KDB996369 D04 Module Integration Guide V01, e.g. inclusion of NFC, RFID 13.56 MHz, 430 MHz, BLE and Cellular RF module).
- Only noise floor observed after 18GHz. Data presented is up to 18GHz only.
- Initial prescan indicates similar spurious response between LTE Bands. BW and Modulations also does not impact the test results. LTE verification was performed using 5MHz BW and QPSK modulation.
- There are no emissions found that do not comply with the restricted bands defined in FCC Part 15 Subpart C, 15.205.
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.3.8 for sample computation.

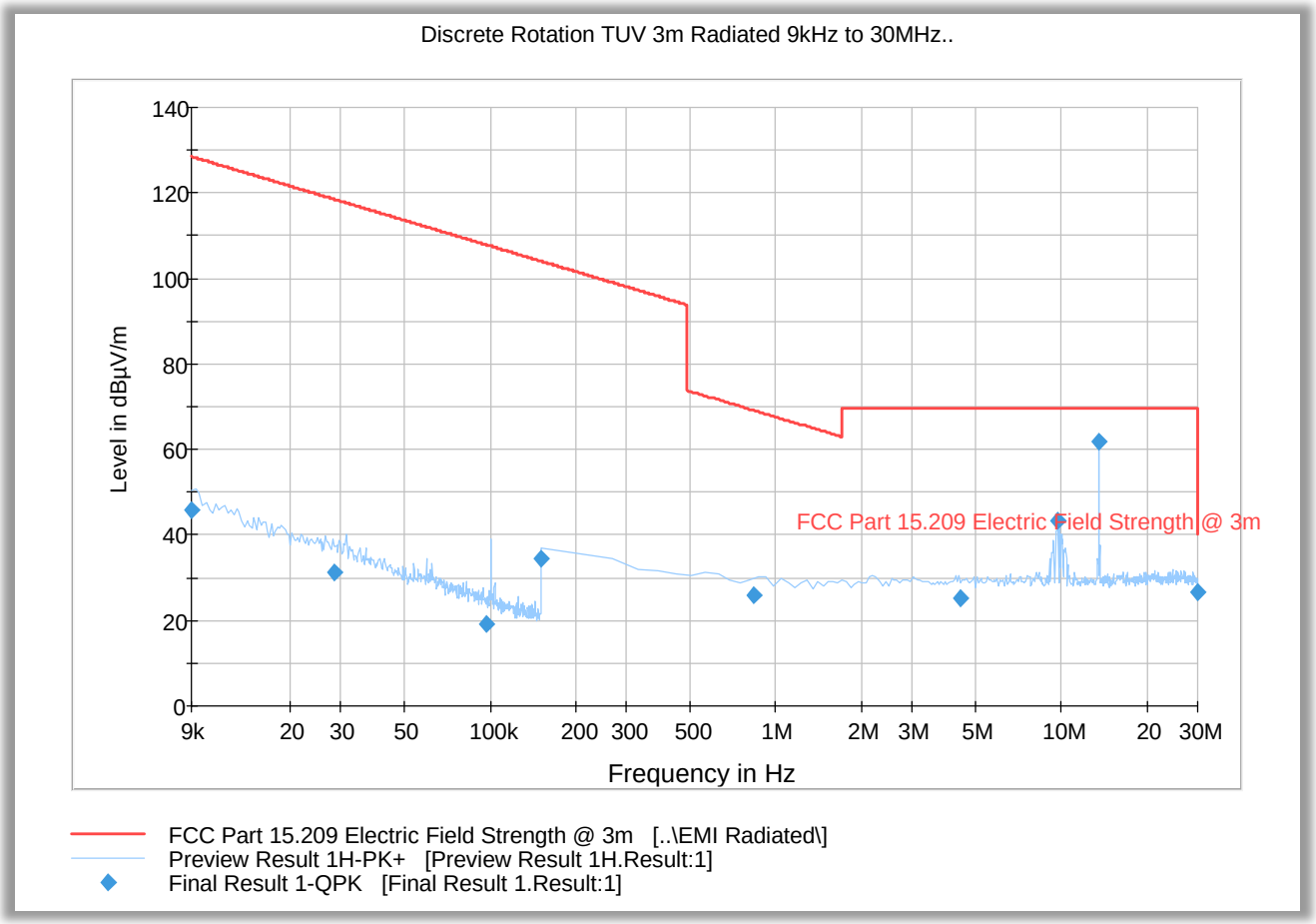
2.3.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dBµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dBµV/m) @ 30MHz			**11.8**

2.3.9 Test Results

See attached plots.

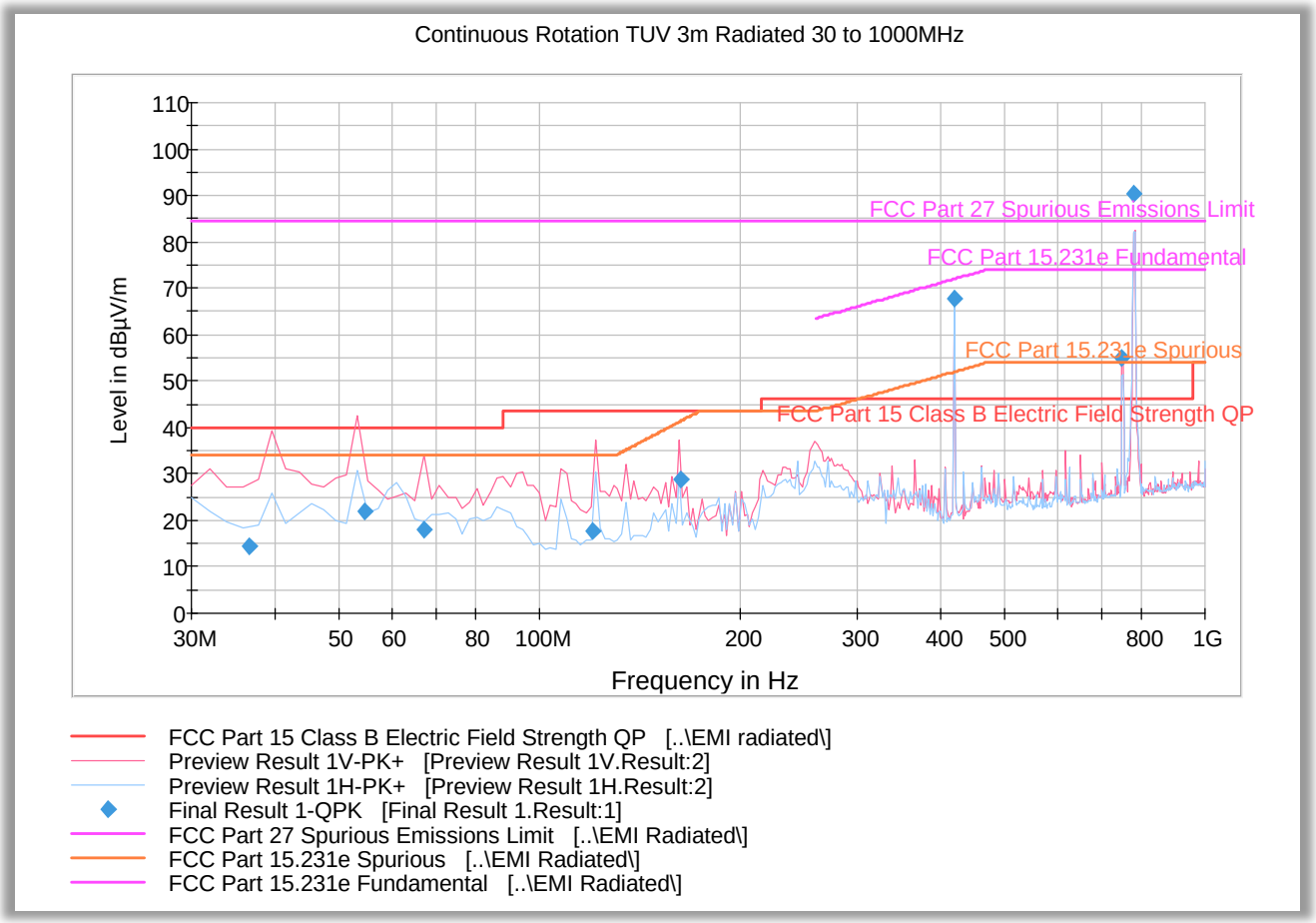
2.3.10 Test Results Below 30MHz (NFC and RFID 13.56 MHz Active)



Quasi Peak Data (§15.209 Limits)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
0.009000	45.8	1000.0	0.200	100.0	H	163.0	25.0	82.7	128.5
0.028323	31.2	1000.0	0.200	100.0	H	31.0	21.5	87.3	118.6
0.097269	19.4	1000.0	0.200	100.0	H	315.0	19.7	88.5	107.8
0.150000	34.5	1000.0	0.200	100.0	H	10.0	19.6	69.6	104.1
0.836655	25.9	1500.0	9.000	100.0	H	191.0	19.7	43.3	69.1
4.434194	25.4	1500.0	9.000	100.0	H	-9.0	20.5	44.2	69.5
9.738142	43.2	1500.0	9.000	100.0	H	-15.0	21.0	26.3	69.5
13.558599	61.7	1500.0	9.000	100.0	H	359.0	21.8	7.8	69.5
29.965000	26.6	1500.0	9.000	100.0	H	6.0	25.3	43.0	69.5

2.3.11 Test Results 30MHz to 1GHz (NFC, RFID 13.56 MHz with 420 MHz, BLE and LTE Band 13 Active)

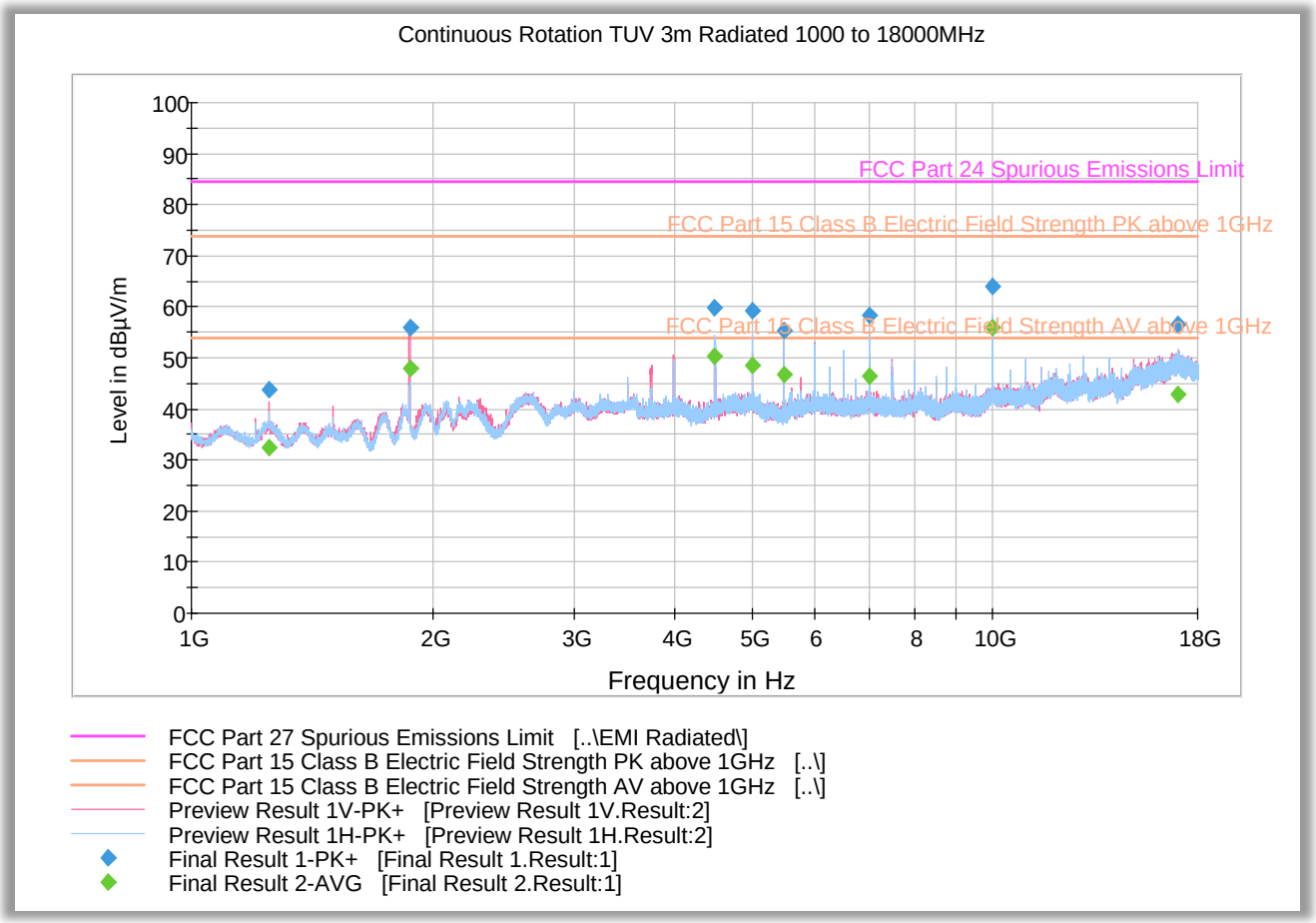


Quasi Peak Data (§15.209 Limits)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
36.639439	14.3	1000.0	120.000	116.0	V	325.0	-13.1	25.7	40.0
54.726653	22.0	1000.0	120.000	150.0	V	19.0	-16.0	18.0	40.0
67.213868	18.1	1000.0	120.000	155.0	V	232.0	-18.0	21.9	40.0
120.082725	17.8	1000.0	120.000	100.0	V	73.0	-15.4	25.7	43.5
162.704369	28.7	1000.0	120.000	100.0	V	194.0	-12.9	14.8	43.5
420.481443	67.8	1000.0	120.000	109.0	H	355.0	-5.2	3.7	71.5*
749.982365	55.1	1000.0	120.000	129.0	V	314.0	1.7	Call Box Signal	
782.788457	90.4	1000.0	120.000	150.0	V	175.0	2.5	LTE B13 Fundamental	

* 420 MHz Fundamental, 15.231(e) fundamental limit applies.
For NFC, RFID 13.56 MHz and BLE, the field strength of the spurious emissions shall comply with general limits shown in §15.209.
For 420 MHz, the field strength of the spurious emissions shall comply with 15.231(e) or general limits shown in §15.209, whichever limit permits a higher field strength.

2.3.12 Test Results above 1GHz (NFC, RFID 13.56 MHz with 420 MHz, BT Low Energy and LTE Band 2 Active)



Peak Data

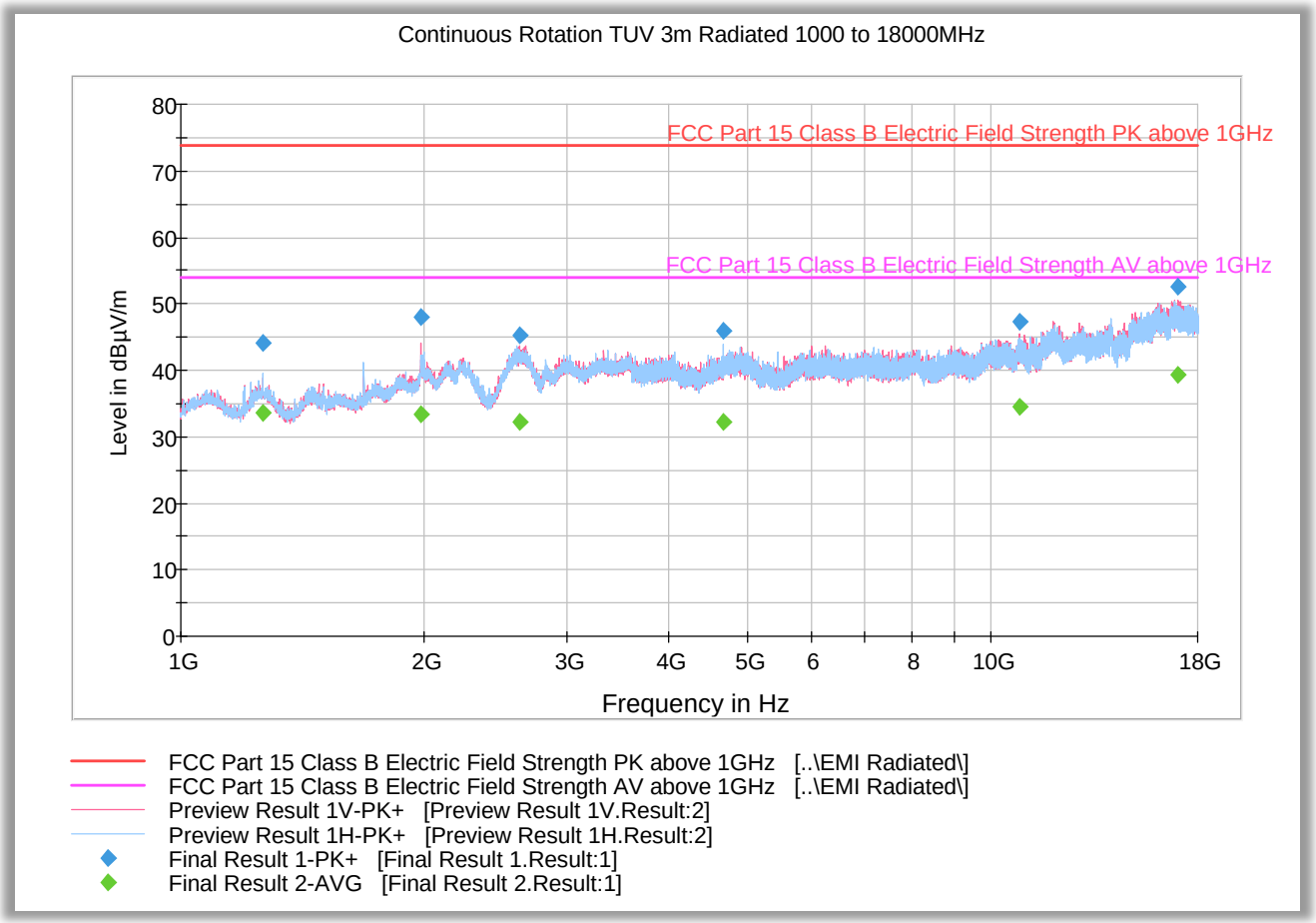
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1249.73333	43.8	1000.0	1000.000	103.7	V	161.0	-5.9	30.1	73.9
1871.33333	56.0	1000.0	1000.000	152.6	V	34.0	-2.8	17.9	73.9
4499.93333	59.9	1000.0	1000.000	152.6	H	57.0	4.4	14.0	73.9
4999.93333	59.3	1000.0	1000.000	152.6	H	54.0	4.9	14.6	73.9
5500.10000	55.4	1000.0	1000.000	325.1	H	5.0	5.8	18.5	73.9
7000.10000	58.4	1000.0	1000.000	251.3	H	-2.0	7.5	15.5	73.9
10000.0000	64.1	1000.0	1000.000	204.5	H	13.0	9.7	9.8	73.9
16999.8000	56.5	1000.0	1000.000	269.3	H	12.0	18.4	17.4	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1249.73333	32.5	1000.0	1000.000	103.7	V	161.0	-5.9	21.4	53.9
1871.33333	48.0	1000.0	1000.000	152.6	V	34.0	-2.8	5.9	53.9
4499.93333	50.4	1000.0	1000.000	152.6	H	57.0	4.4	3.5	53.9
4999.93333	48.4	1000.0	1000.000	152.6	H	54.0	4.9	5.5	53.9
5500.10000	46.6	1000.0	1000.000	325.1	H	5.0	5.8	7.3	53.9
7000.10000	46.5	1000.0	1000.000	251.3	H	-2.0	7.5	7.4	53.9
10000.0000	55.8	1000.0	1000.000	204.5	H	13.0	9.7	-1.9	53.9
16999.8000	42.7	1000.0	1000.000	269.3	H	12.0	18.4	11.2	53.9

Test Notes: A 2.4GHz Notch and 1.8 GHz Notch were used during the testing. 10GHz spurious is verified not from BT low energy and the highest limit FCC Part 24 limit applies. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures. BLE operation will be ignored for this test.

2.3.13 Test Results above 1GHz (BT Low Energy with NFC, RFID 13.56 MHz, 420 MHz active)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1261.43333	44.1	1000.0	1000.000	190.5	H	86.0	-5.8	29.8	73.9
1976.56666	47.9	1000.0	1000.000	147.7	V	193.0	-2.2	26.0	73.9
2624.30000	45.3	1000.0	1000.000	352.7	V	275.0	0.3	28.6	73.9
4669.96666	45.8	1000.0	1000.000	152.2	H	343.0	4.8	28.1	73.9
10835.1000	47.3	1000.0	1000.000	404.0	V	224.0	11.1	26.6	73.9
16985.0666	52.6	1000.0	1000.000	311.2	V	93.0	18.4	21.3	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1261.43333	33.7	1000.0	1000.000	190.5	H	86.0	-5.8	20.2	53.9
1976.56666	33.3	1000.0	1000.000	147.7	V	193.0	-2.2	20.6	53.9
2624.30000	32.2	1000.0	1000.000	352.7	V	275.0	0.3	21.7	53.9
4669.96666	32.1	1000.0	1000.000	152.2	H	343.0	4.8	21.8	53.9
10835.1000	34.5	1000.0	1000.000	404.0	V	224.0	11.1	19.4	53.9
16985.0666	39.3	1000.0	1000.000	311.2	V	93.0	18.4	14.6	53.9

Test Notes: A 2.4GHz Notch was used during the testing. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

SECTION 3

3 TEST EQUIPMENT USED

3.1 Test Equipment Used

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Radiated Emission						
1033	Bilog Antenna	3142C	00044556	EMCO	11/06/18	11/06/20
7575	Double-ridged waveguide horn	3117	00155511	EMCO	06/22/20	06/22/22
8628	Pre-amplifier	QLI-01182835-JO	8986002	Quinstar	02/26/20	02/26/21
6628	Loop Antenna	HFH 2 –Z2	880 458/25	Rhode & Schwarz	05/22/20	05/22/22
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/11/19	10/11/20
7620	EMI Test Receiver	ESU 40	100399	Rhode & Schwarz	10/18/19	10/18/20
1016	Pre-amplifier	PAM-0202	187	A.H. Systems, Inc.	02/26/20	02/26/21
7562	Wideband Radio Communication	CMW 500	1201.0002k50 /103829	Rhode & Schwarz	For Signalling	
Miscellaneous						
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	05/22/20	05/22/21
-	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 Measurement Uncertainty

Calculation of Measurement Uncertainty per CISPR 16-4-2:2011 with Corr. 1

3.2.1 Radiated Measurements (Below 1GHz)

	Input Quantity (Contribution) X_i	Value		Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10	dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.20	dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.75	dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	1.10	dB	Normal, k=2	2.000	0.55	0.30
5	Receiver pulse amplitude	1.50	dB	Rectangular	1.732	0.87	0.75
6	Receiver pulse repetition rate	1.50	dB	Rectangular	1.732	0.87	0.75
7	Noise floor proximity	0.50	dB	Rectangular	1.732	0.29	0.08
8	Mismatch: antenna-receiver	0.95	dB	U-shaped	1.414	0.67	0.45
9	AF frequency interpolation	0.30	dB	Rectangular	1.732	0.17	0.03
10	AF height deviations	0.10	dB	Rectangular	1.732	0.06	0.00
11	Directivity difference at 3 m	3.12	dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 3 m	1.00	dB	Rectangular	1.732	0.58	0.33
13	Cross-polarisation	0.90	dB	Rectangular	1.732	0.52	0.27
14	Balance	0.00	dB	Rectangular	1.732	0.00	0.00
15	Site imperfections	3.91	dB	Triangular	2.449	1.60	2.55
16	Separation distance at 3 m	0.30	dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.40	dB	Rectangular	1.732	0.23	0.05
18	Table height at 3 m	0.10	dB	Normal, k=2	2.000	0.05	0.00
19	Near-field effects	0.00	dB	Triangular	2.449	0.00	0.00
20	Effect of ambient noise on OATS	0.00	dB				0.00
	Combined standard uncertainty			Normal	3.00	dB	
	Expanded uncertainty			**Normal, k=2**	**6.00**	**dB**	

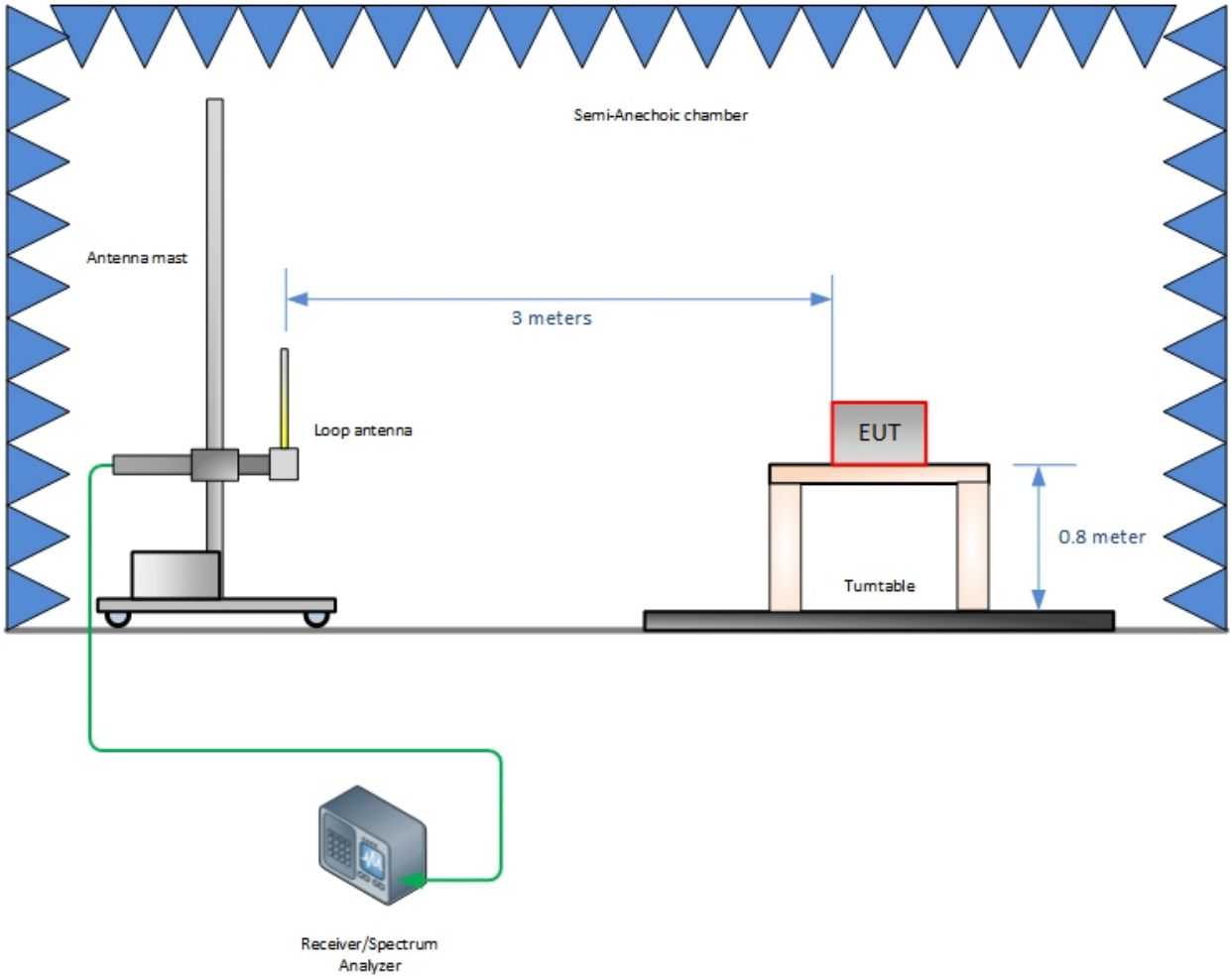
3.2.2 Radiated Emission Measurements (Above 1GHz)

	Input Quantity (Contribution) X_i	Value		Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10	dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.30	dB	Normal, k=2	2.000	0.15	0.02
3	Antenna factor AF	0.20	dB	Normal, k=2	2.000	0.10	0.01
4	Receiver sinewave accuracy	0.37	dB	Normal, k=2	2.000	0.19	0.03
5	Receiver pulse amplitude	0.57	dB	Rectangular	2.000	0.29	0.08
6	Receiver pulse repetition rate	1.21	dB	Rectangular	1.732	0.70	0.49
7	Noise floor proximity	0.70	dB	Rectangular	1.732	0.40	0.16
8	Mismatch: antenna-receiver	1.41	dB	U-shaped	1.414	1.00	0.99
9	AF frequency interpolation	1.30	dB	Rectangular	1.414	0.92	0.85
10	AF height deviations	0.30	dB	Rectangular	1.732	0.17	0.03
11	Directivity difference at 3 m	1.50	dB	Rectangular	1.732	0.87	0.75
12	Phase center location at 3 m	0.30	dB	Rectangular	1.732	0.17	0.03
13	Cross-polarisation	0.90	dB	Rectangular	1.732	0.52	0.27
14	Balance	5.30	dB	Rectangular	2.449	2.16	4.68
15	Site imperfections	1.15	dB	Triangular	1.732	0.66	0.44
16	Separation distance at 3 m	0.30	dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.00	dB	Rectangular	2.000	0.00	0.00
18	Table height at 3 m	0.10	dB	Normal, k=2	1.000	0.10	0.01
19	Near-field effects	0.30	dB	Triangular	2.000	0.15	0.02
20	Effect of ambient noise on OATS	0.20	dB		2.000	0.10	0.01
	Combined standard uncertainty			Normal	2.98	dB	
	Expanded uncertainty			**Normal, k=2**	**5.96**	**dB**	

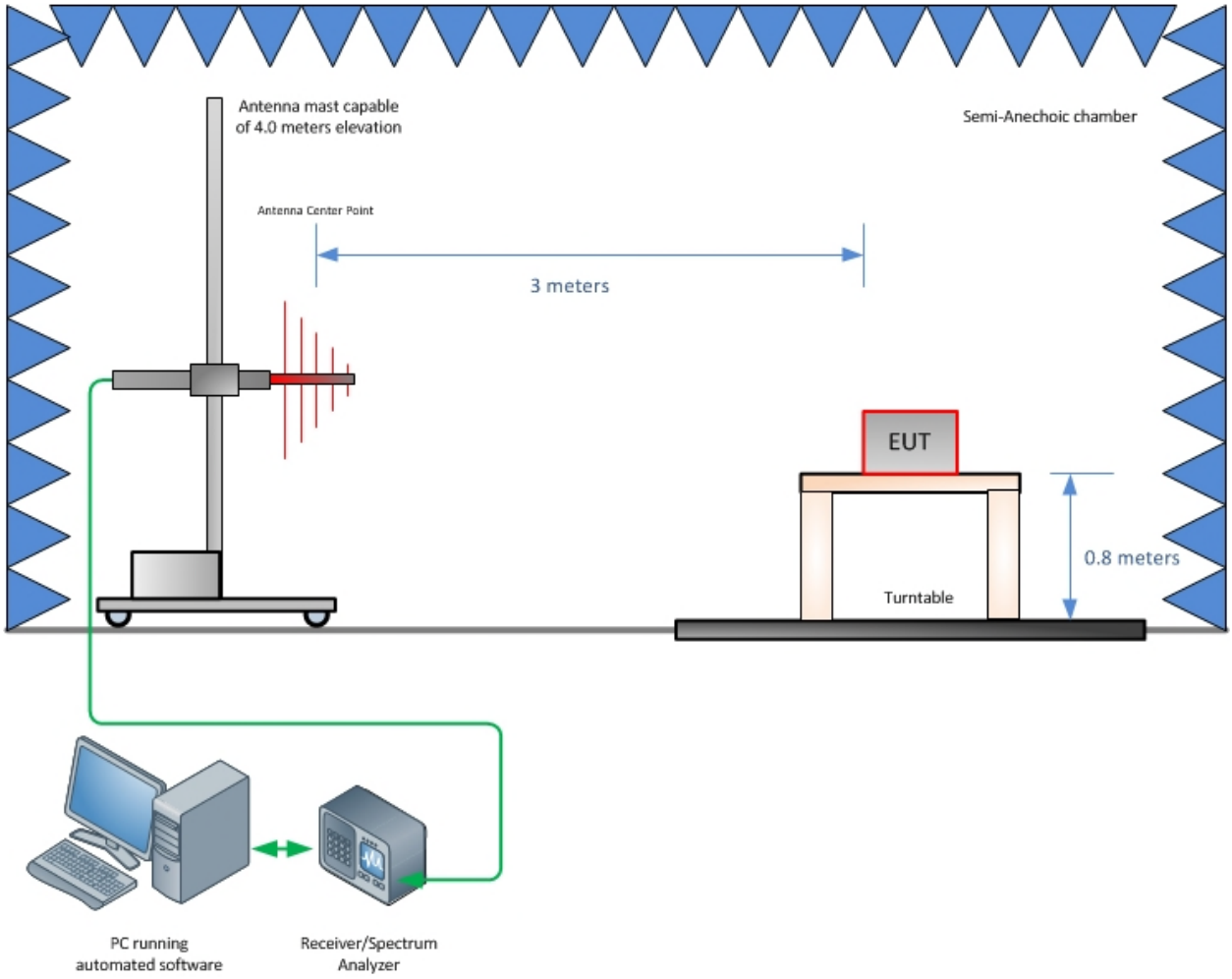
SECTION 4

4 Diagram of Test Setup

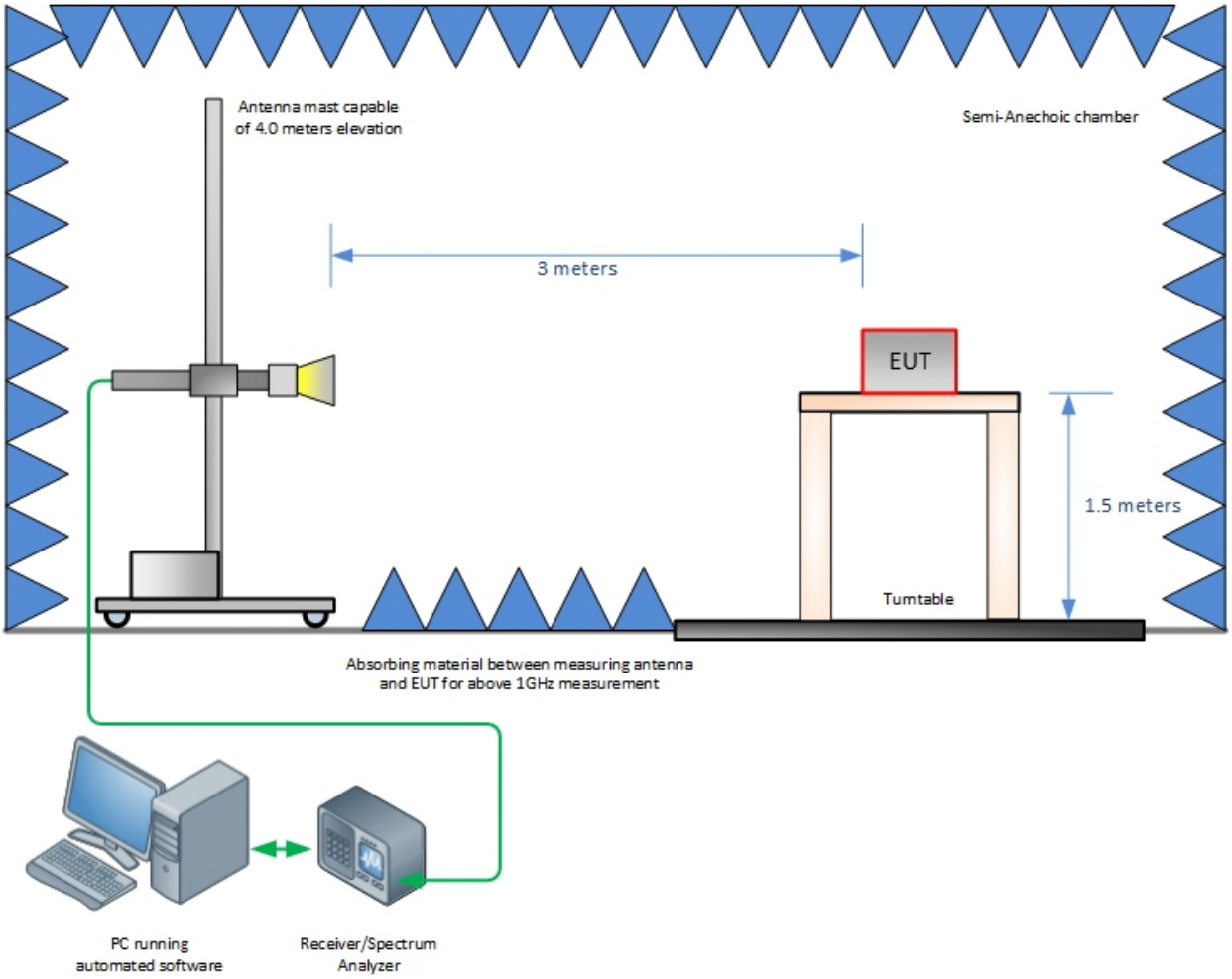
4.1 Test Setup Diagrams



Radiated Emission Test Setup (Below 30MHz)



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)

SECTION 5

5 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 Accreditation, Disclaimers and Copyright

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