



FCC RADIO TEST REPORT

FCC ID : TVE-121101A
Equipment : Wireless Network Extender
Brand Name : FORTINET
Model Name : FortiExtender 211Exxxxxx,
FORTIEXTENDER-211Exxxxxx, FEX-211Exxxxxx,
FortiExtender 212Exxxxxx,
FORTIEXTENDER-212Exxxxxx, FEX-212Exxxxxx
(Please refer to section 1.1.4 for detail information.)
Applicant : Fortinet, Inc.
899 Kifer Road, Sunnyvale, CA 94086 USA
Manufacturer : Fortinet, Inc.
899 Kifer Road, Sunnyvale, CA 94086 USA
Standard : 47 CFR FCC Part 15.247

The product was received on Apr. 09, 2019, and testing was started from Jul. 16, 2020 and completed on Jul. 16, 2020. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.


Approved by: Cliff Chang

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



Table of Contents

History of this test report.....	3
Summary of Test Result.....	4
1 General Description	5
1.1 Information.....	5
1.2 Applicable Standards	7
1.3 Testing Location Information	7
1.4 Measurement Uncertainty	7
2 Test Configuration of EUT.....	8
2.1 Test Channel Mode	8
2.2 The Worst Case Measurement Configuration.....	9
2.3 EUT Operation during Test	10
2.4 Accessories	10
2.5 Support Equipment.....	10
2.6 Test Setup Diagram	11
3 Transmitter Test Result	12
3.1 Emissions in Restricted Frequency Bands.....	12
4 Test Equipment and Calibration Data	16
Appendix A. Test Results of Emissions in Restricted Frequency Bands	
Appendix B. Test Photos	
Photographs of EUT v01	



History of this test report

TEL : 886-3-656-9065
FAX : 886-3-656-9085
Report Template No.: CB-A10_6 Ver1.2

Page Number : 3 of 16
Issued Date : Aug. 25, 2020
Report Version : 01



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	-
3.1	15.247(d)	Emissions in Restricted Frequency Bands	PASS	-

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

1. The test configuration, test mode and test software were written in this test report are declared by the manufacturer.
2. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Sam Chen

Report Producer: Vicky Huang



1 General Description

1.1 Information

1.1.1 RF General Information

Frequency Range (MHz)	Bluetooth Mode	Ch. Frequency (MHz)	Channel Number
2400-2483.5	LE	2402-2480	0-39 [40]

Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	BT-LE(1Mbps)	1.0	1
2.4-2.4835GHz	BT-LE(2Mbps)	2.0	1

Note:

- ♦ Bluetooth LE uses a GFSK modulation.
- ♦ BWch is the nominal channel bandwidth.

1.1.2 Antenna Information

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	1	-	RF11C02360S	Printing Antenna	N/A	4

Note1: The above information was declared by manufacturer.

Note2: The EUT has one antenna.

For BT function:

For IEEE 802.15.1 Bluetooth mode (1TX/1RX)

Port 1 can be used as transmitting/receiving antenna.

1.1.3 EUT Operational Condition

EUT Power Type	From AC Adapter or PoE		
Function	☒ Point-to-multipoint	☐ Point-to-point	
Test Software Version	WCN Combo tool		
Support Mode	☒ LE 1M PHY: 1 Mb/s		
	☐ LE Coded PHY (S=2): 500 Kb/s		
	☐ LE Coded PHY (S=8): 125 Kb/s		
	☒ LE 2M PHY: 2 Mb/s		

Note: The above information was declared by manufacturer.

1.1.4 Table for Multiple Listing

The model names in the following table are all refer to the identical product.

EUT	Model Name	LTE Module	BT	PCBA	Description
1	FortiExtender 211Exxxxxx	LTE module chip: EM7565*1	BT*1	Same PCBA	All three model names are the same, no difference. The purpose for these three model names are for marketing sales.
	FORTIEXTENDER-211Exxxxxx	LTE module chip: EM7565*1	BT*1	Same PCBA	
	FEX-211Exxxxxx	LTE module chip: EM7565*1	BT*1	Same PCBA	
2	FortiExtender 212Exxxxxx	LTE module chip: EM7565*2	BT*1	Same PCBA	All three model names are the same, no difference. The purpose for these three model names are for marketing sales.
	FORTIEXTENDER-212Exxxxxx	LTE module chip: EM7565*2	BT*1	Same PCBA	
	FEX-212Exxxxxx	LTE module chip: EM7565*2	BT*1	Same PCBA	
(where “x” can be “0-9”, or “A-Z”, or “-”, or blank for marketing purposes or software changes only and no HW related changes.)					

From the above models, model: FEX-211E and FEX-212E were selected as a representative model for the test. Only FEX-212E data was recorded in this report. Please Reference to Sporton Project No.: 903129 for the FEX-211E test result.

1.1.5 Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR903129AB
Below is the table for the change of the product with respect to the original one

Modifications	Performance Checking
1. Add EUT 2(contain two LTE modules). (Please refer to section 1.1.4 for detail information.) 2. Add three model names for EUT 2. (Please refer to section 1.1.4 for detail information.)	Emissions in Restricted Frequency Bands below 1GHz



1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR FCC Part 15
- ♦ ANSI C63.10-2013

The following reference test guidance is not within the scope of accreditation of TAF.

- ♦ FCC KDB 558074 D01 v05r02
- ♦ FCC KDB 414788 D01 v01r01

1.3 Testing Location Information

Testing Location				
☐	HWA YA	ADD	: No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)	
		TEL	: 886-3-327-3456	FAX : 886-3-327-0973
☒	JHUBEI	ADD	: No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C.	
		TEL	: 886-3-656-9065	FAX : 886-3-656-9085

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
Radiated	03CH05-CB	Eason Chen	24.6~25.8°C / 59~61%	Jul. 16, 2020

Test site Designation No. TW0006 with FCC.

Test site registered number IC 4086D with Industry Canada.

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

Test Items	Uncertainty	Remark
Radiated Emission (30MHz ~ 1,000MHz)	4.8 dB	Confidence levels of 95%



2 Test Configuration of EUT

2.1 Test Channel Mode

Mode	Power Setting
BT-LE(1Mbps)	-
2402MHz	7
2440MHz	6
2480MHz	7
BT-LE(2Mbps)	-
2402MHz	7
2440MHz	6
2480MHz	7



2.2 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	Emissions in Restricted Frequency Bands
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.
Operating Mode < 1GHz	Normal Link
1	EUT 2 at Z-axis+GPS+Bluetooth+LTE Band 2(Module 1, SIM Slot 1)+WCDMA Band 2(Module 2, SIM Slot 1)+Adapter
2	EUT 2 at Y-axis+GPS+Bluetooth+LTE Band 2(Module 1, SIM Slot 1)+WCDMA Band 2(Module 2, SIM Slot 1)+Adapter
Mode 1 has been evaluated to be the worst case between Mode 1~2, thus measurement for Mode 3 will follow this same test mode.	
3	EUT 2 at Z-axis+GPS+Bluetooth+WCDMA Band 5(Module 1, SIM Slot 2)+LTE Band 2 (Module 2, SIM Slot 2)+Adapter
Mode 1 has been evaluated to be the worst case among Mode 1~3, thus measurement for Mode 4 will follow this same test mode.	
4	EUT 2 at Z-axis+GPS+Bluetooth+LTE Band 2(Module 1, SIM Slot 1)+WCDMA Band 2(Module 2, SIM Slot 1)+PoE
For operating mode 4 is the worst case and it was record in this test report.	

The Worst Case Mode for Following Conformance Tests	
Tests Item	Simultaneous Transmission Analysis - Co-location RF Exposure Evaluation
Operating Mode	
1	EUT 1-Bluetooth+WWAN(LTE)
2	EUT 1-Bluetooth+WWAN(WCDMA)
3	EUT 2-Bluetooth+Module 1-WWAN(LTE)+Module 2-WWAN(LTE)
4	EUT 2-Bluetooth+Module 1-WWAN(LTE)+Module 2-WWAN(WCDMA)
5	EUT 2-Bluetooth+Module 1-WWAN(WCDMA)+Module 2-WWAN(LTE)
6	EUT 2-Bluetooth+Module 1-WWAN(WCDMA)+Module 2-WWAN(WCDMA)
Refer to Sporton Test Report No.: FA903129-03 for Co-location RF Exposure Evaluation.	

Note:

1. The EUT contains a certified WWAN module (FCC ID: N7NEM75)
2. The EUT was powered by Adapter or PoE, and the Adapter and PoE was for measurement only, would not be marketed.



The Adapter and PoE information as below:

Support Unit	Brand Name	Model Name
Adapter	APD	WA-30J12R
PoE	Fortinet	Fortiswitch 224E

2.3 EUT Operation during Test

During the test, the EUT operation to normal function.

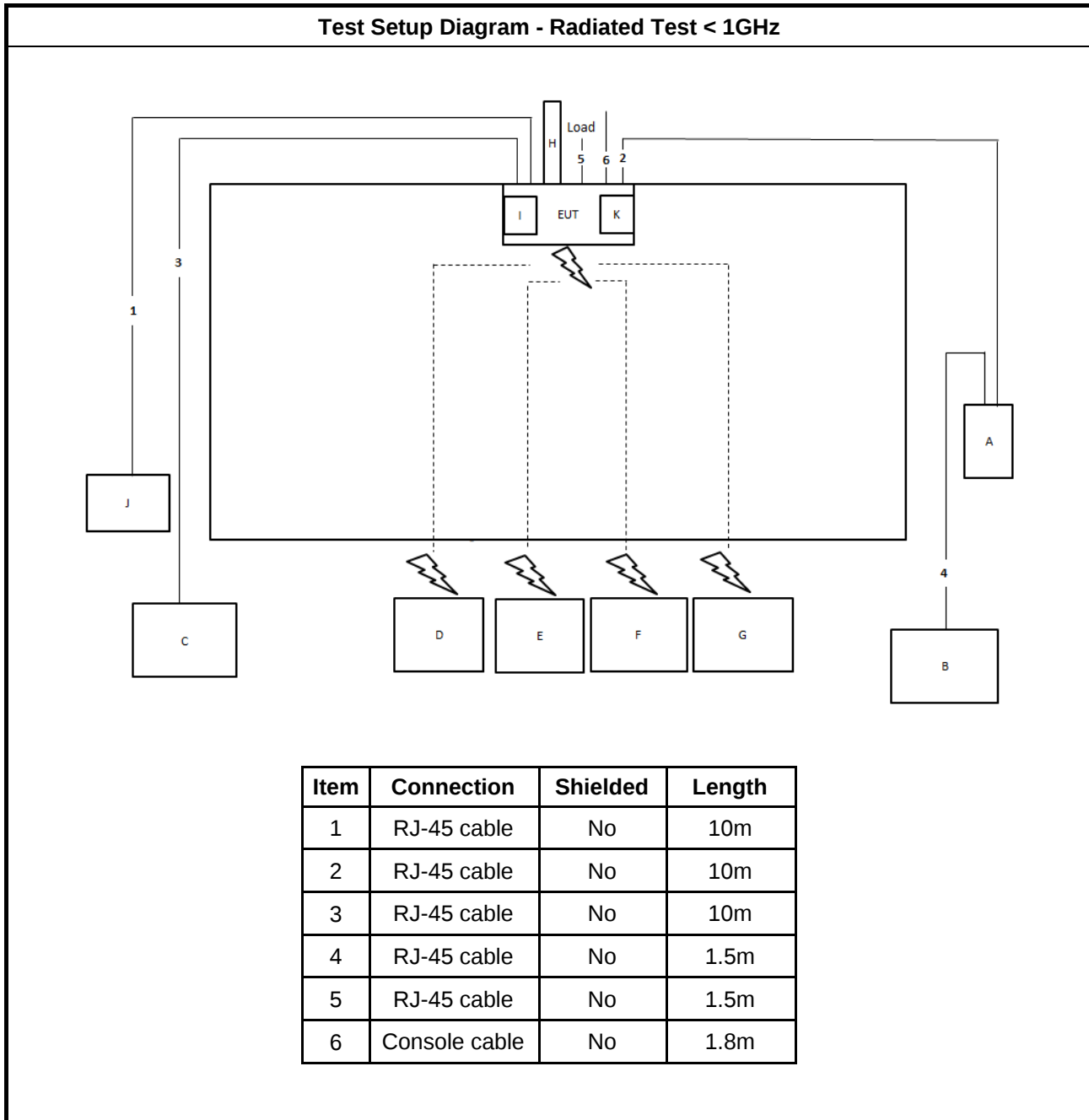
2.4 Accessories

N/A

2.5 Support Equipment

Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
A	PoE	Fortinet	Fortiswitch 224E	N/A
B	LAN NB	DELL	E4300	N/A
C	WAN NB	DELL	E4300	N/A
D	iPad	Apple	A1430	N/A
E	LTE base station	Anritsu	MT8820C	N/A
F	GPS Simulator	WELNAVIGATE	GS-100	N/A
G	3G base station	R&S	CMU200	N/A
H	Flash disk3.0	Silicon Power	B06	N/A
I	SIM Card	N/A	N/A	N/A
J	LAN NB	DELL	E4300	N/A

2.6 Test Setup Diagram





3 Transmitter Test Result

3.1 Emissions in Restricted Frequency Bands

3.1.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB / decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Note 3: Using the distance of 1m during the test for above 18 GHz, and the test value to correct for the distance factor at 3m.

3.1.2 Measuring Instruments

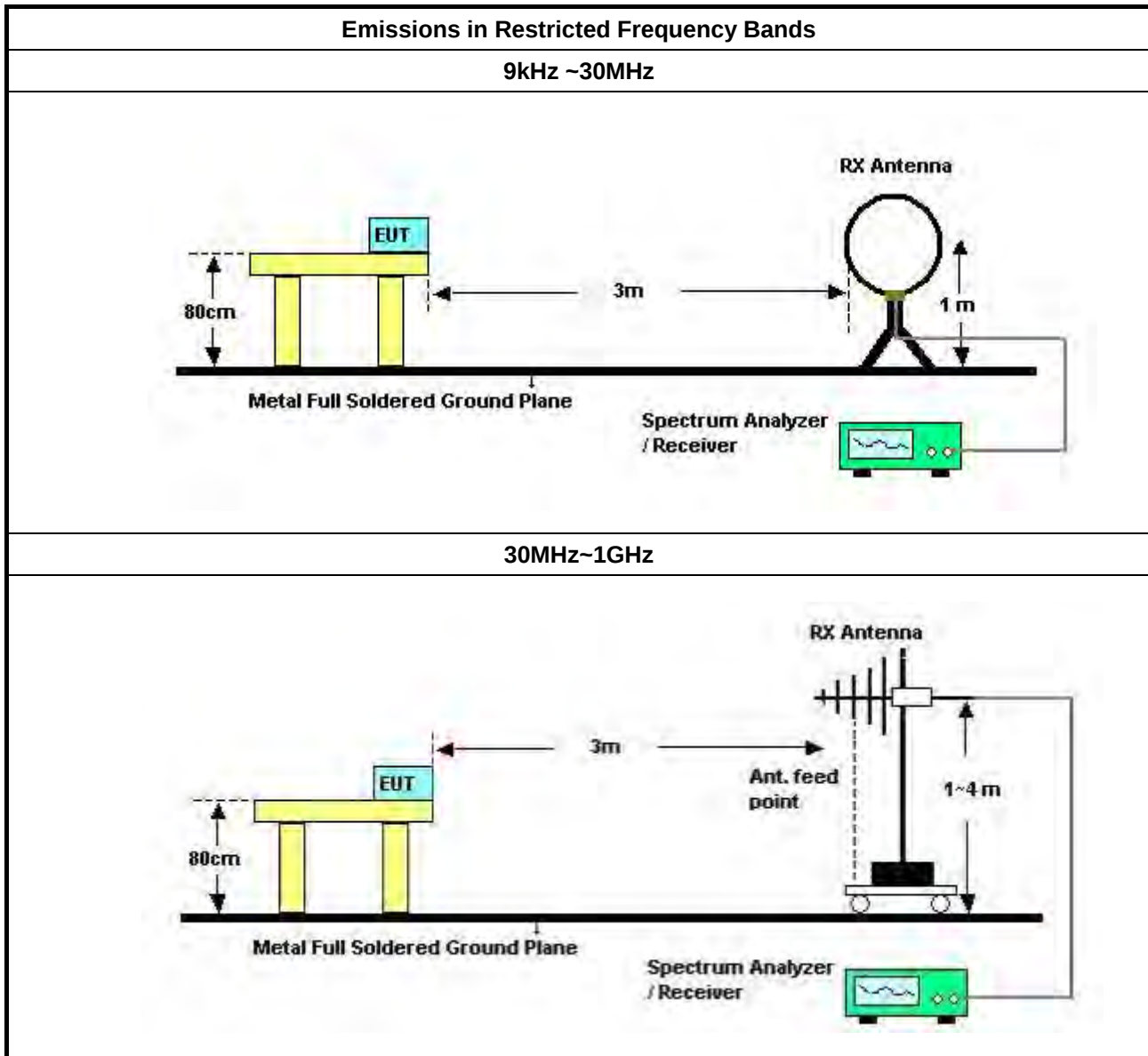
Refer a test equipment and calibration data table in this test report.



3.1.3 Test Procedures

Test Method	
▪ The average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].	
▪ Refer as ANSI C63.10, clause 6.10.3 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.	
▪ For the transmitter unwanted emissions shall be measured using following options below:	
	▪ Refer as FCC KDB 558074, clause 8.6 for unwanted emissions into restricted bands.
	☐ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.1(trace averaging for duty cycle $\geq 98\%$).
	☐ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.2(trace averaging + duty factor).
	☒ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.5.3(Reduced VBW $\geq 1/T$).
	☐ Refer as ANSI C63.10, clause 11.12.2.5.3 (Reduced VBW). VBW $\geq 1/T$, where T is pulse time.
	☐ Refer as ANSI C63.10, clause 7.5 average value of pulsed emissions.
	☒ Refer as FCC KDB 558074, clause 8.6 & C63.10 clause 11.12.2.4 measurement procedure peak limit.
▪ For the transmitter band-edge emissions shall be measured using following options below:	
	▪ Refer as FCC KDB 558074 clause 8.7 & c63.10 clause 11.13.1, When the performing peak or average radiated measurements, emissions within 2 MHz of the authorized band edge may be measured using the marker-delta method described below.
	▪ Refer as FCC KDB 558074, clause 8.7 (ANSI C63.10, clause 6.10.6) for marker-delta method for band-edge measurements.
	▪ Refer as FCC KDB 558074, clause 8.7 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz).
	▪ For conducted unwanted emissions into restricted bands (absolute emission limits). Devices with multiple transmit chains using options given below: (1) Measure and sum the spectra across the outputs or (2) Measure and add 10 log(N) dB
	▪ For FCC KDB 662911 The methodology described here may overestimate array gain, thereby resulting in apparent failures to satisfy the out-of-band limits even if the device is actually compliant. In such cases, compliance may be demonstrated by performing radiated tests around the frequencies at which the apparent failures occurred.

3.1.4 Test Setup



3.1.5 Measurement Results Calculation

The measured Level is calculated using:

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamplifier Factor (if applicable) = Level.

3.1.6 Emissions in Restricted Frequency Bands (Below 30MHz)

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to KDB414788 Radiated Test Site, and the result came out very similar.

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10th harmonic or 40 GHz, whichever is appropriate.



3.1.7 Test Result of Emissions in Restricted Frequency Bands

Refer as Appendix A



4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
Bilog Antenna with 6dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-06	35236 & AT-N0610	30MHz ~ 2GHz	Mar. 27, 2020	Mar. 26, 2021	Radiation (03CH05-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Apr. 13, 2020	Apr. 12, 2021	Radiation (03CH05-CB)
Pre-Amplifier	EMCI	EMC330N	980331	20MHz ~ 3GHz	Apr. 28, 2020	Apr. 27, 2021	Radiation (03CH05-CB)
Spectrum Analyzer	R&S	FSP40	100304	9kHz ~ 40GHz	Aug. 15, 2019	Aug. 14, 2020	Radiation (03CH05-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	May 13, 2020	May 12, 2021	Radiation (03CH05-CB)
RF Cable-low	Woken	RG402	LOW Cable-04+23	30MHz~1GHz	Oct. 07, 2019	Oct. 06, 2020	Radiation (03CH05-CB)

Note: Calibration Interval of instruments listed above is one year.



Radiated Emissions below 1GHz

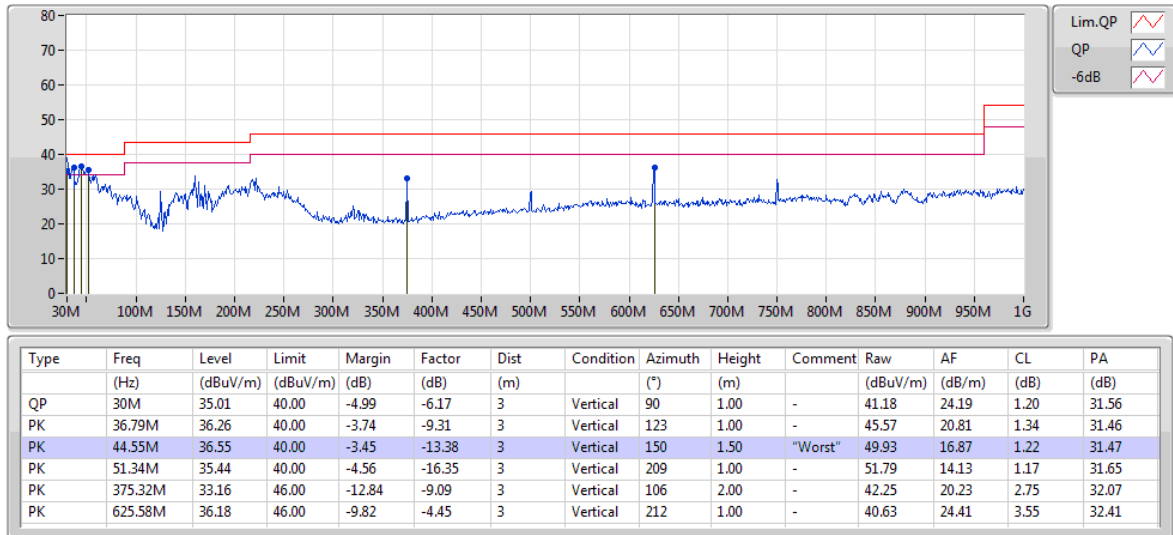
Appendix A

Summary

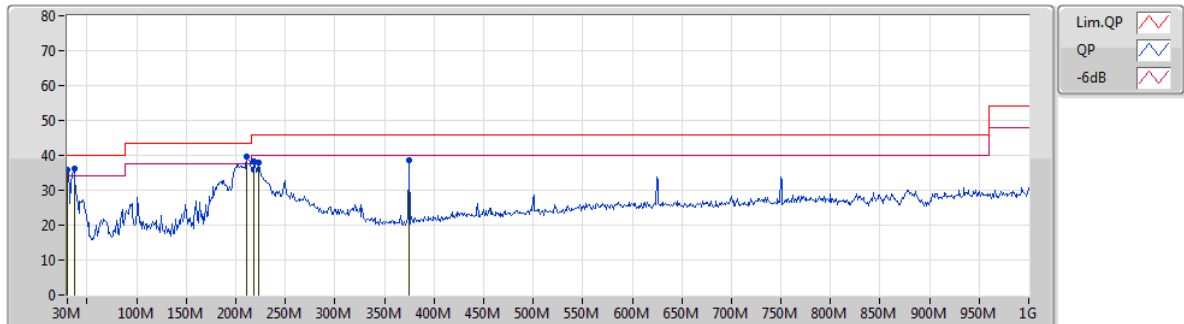
Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Condition
Mode 4	Pass	PK	44.55M	36.55	40.00	-3.45	Vertical

Test Mode: Mode 4

16/07/2020



16/07/2020



Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment	Raw (dBuV/m)	AF (dB/m)	CL (dB)	PA (dB)
PK	30M	35.81	40.00	-4.19	-6.17	3	Horizontal	274	2.00	-	41.98	24.19	1.20	31.56
PK	36.79M	36.10	40.00	-3.90	-9.31	3	Horizontal	268	2.00	"Worst"	45.41	20.81	1.34	31.46
PK	210.42M	39.50	43.50	-4.00	-15.08	3	Horizontal	169	1.00	-	54.58	14.70	2.04	31.82
PK	218.18M	38.19	46.00	-7.81	-15.12	3	Horizontal	360	1.50	-	53.31	14.65	2.07	31.84
PK	223.03M	37.78	46.00	-8.22	-14.85	3	Horizontal	183	1.50	-	52.63	14.91	2.10	31.86
PK	375.32M	38.60	46.00	-7.40	-9.09	3	Horizontal	246	1.00	-	47.69	20.23	2.75	32.07