Report Number:	14193907-E3V2
Issue Date:	2022/07/08
Product Name:	Telematics Control Unit
FCC ID:	VRBJSGM004
Model Number:	JSG-M004

Electromagnetic Compatibility Test Report

For

Sage Co.Ltd.
2F, KY Bldg.
2-24 Sumiyoshi-Cho Naka-Ku
Yokohama-City, 231-0013 Japan

ACCREDITED
CERT #0751.05

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Test Report Details

Tests Performed By:	UL VERIFICATION SERVICES INC. 47173 BENICIA STREET FREMONT, CA 94538, U.S.A.
Tests Performed For:	Sage Co.Ltd. 2F, KY Bldg. 2-24 Sumiyoshi-Cho Naka-Ku Yokohama-City, 231-0013 Japan
Issue Date:	2022/7/08
Product Name:	Telematics Control Unit
Model Number Tested:	JSG-M004
Sample Serial Number:	#153,154,#155
Applicable Standards:	FCC 47 CFR PART 15 SUBPART B
Date Test Item Received:	March 22,2022
Testing Start Date:	June 22,2022
Date Testing Complete:	July 07,2022
Overall Results:	**Compliant**

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

*This report contains data that are not covered by the A2LA accreditation. The scope of accreditation is limited to the specific tests that are listed on the A2LA websites referenced at the end of this report.

Report Directory

Report Revision History

Revision Date	Revision Version	Description	Revised By	Revision Reviewed By
06/24/2022	V1	Initial Issue		
07/08/2022	V2	Updated Cover Page, 3.1, 4.1 and added section 4.2		Kiya Kedida

1.0 TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4:2014.

1.1 Deviations from standard test methods

None

1.2 Device Modifications Necessary for Compliance

None

1.3 TEST RESULTS SUMMARY

This product is considered Class B

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

Requirement – Test	Result (Compliant / Non-Compliant)
RADIATED EMISSIONS	Complies

Approved & Released For

UL Verification Services Inc. By:

Dan Coronia
Project Engineer/Operations Leader
Consumer Technology Division
UL Verification Services Inc.

Prepared By:

Kiya Kedida
Test Engineer
Consumer Technology Division
UL Verification Services Inc.

2.0 DECISION RULES AND MEASUREMENT UNCERTAINTY

2.1 Metrological Traceability

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards

2.2 Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement).

2.3 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U_{lab}	U_{Cispr}
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.39 db	3.8 db
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.07 db	3.4 db
Worst Case Conducted Disturbance Voltage Probe, 9KHz to 30 MHz	2.8 db	2.9 db
Worst Case Conducted Power, 30 MHz to 300MHz	4.04 db	--
Worst Case Radiated Disturbance, 9KHz to 30 MHz (60cm Loop)	2.52 db	--
Worst Case Radiated Disturbance, 9KHz to 30 MHz (LLAS)	3.03	3.3
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 db	6.3 db
Worst Case Radiated Disturbance, 1000 to 6000 MHz	4.24 db	5.2 db
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 db	5.5
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 db	--
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 db	--

Uncertainty figures are valid to a confidence level of 95%.

2.4 Sample Calculation

RADIATED EMISSIONS
Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS
Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

3.0 GENERAL - Product Description

3.1 Equipment Description

Telematics Control Unit(TCU) device sends data messages (from TCU itself, BLE Sensors and BLE Tags) to the Platform(PF) and receives command messages from PF.TCU consists of LTE(Cat.M1) module, BLE module and GNSS. TCU gathers data from GNSS and other BLE devices(BLE Sensors and BLE Tags) and sends the data message to PF via LTE Cat.M1 network. The product contains BLE module with FCC ID: QQQ-GM220P and LTE module with FCC ID: XMR201910BG95M3.

3.2 Device Configuration During Test

3.2.1 Equipment Used During Test:

Use	Product Type	Manufacturer	Model	Comments
EUT	Telematics Control Unit	Sage Co.Ltd.	JSG-M004	None

Note: **EUT** - Equipment Under Test, **AE** - Auxiliary/Associated Equipment, or **SIM** - Simulator (Not Subjected to Test)

3.2.2 Input/Output Ports:

Port #	Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
0	Enclosure	N/E	—	—	None
1	DC Power Supply				None

*Note:
AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

3.2.3 EUT Highest Frequencies:

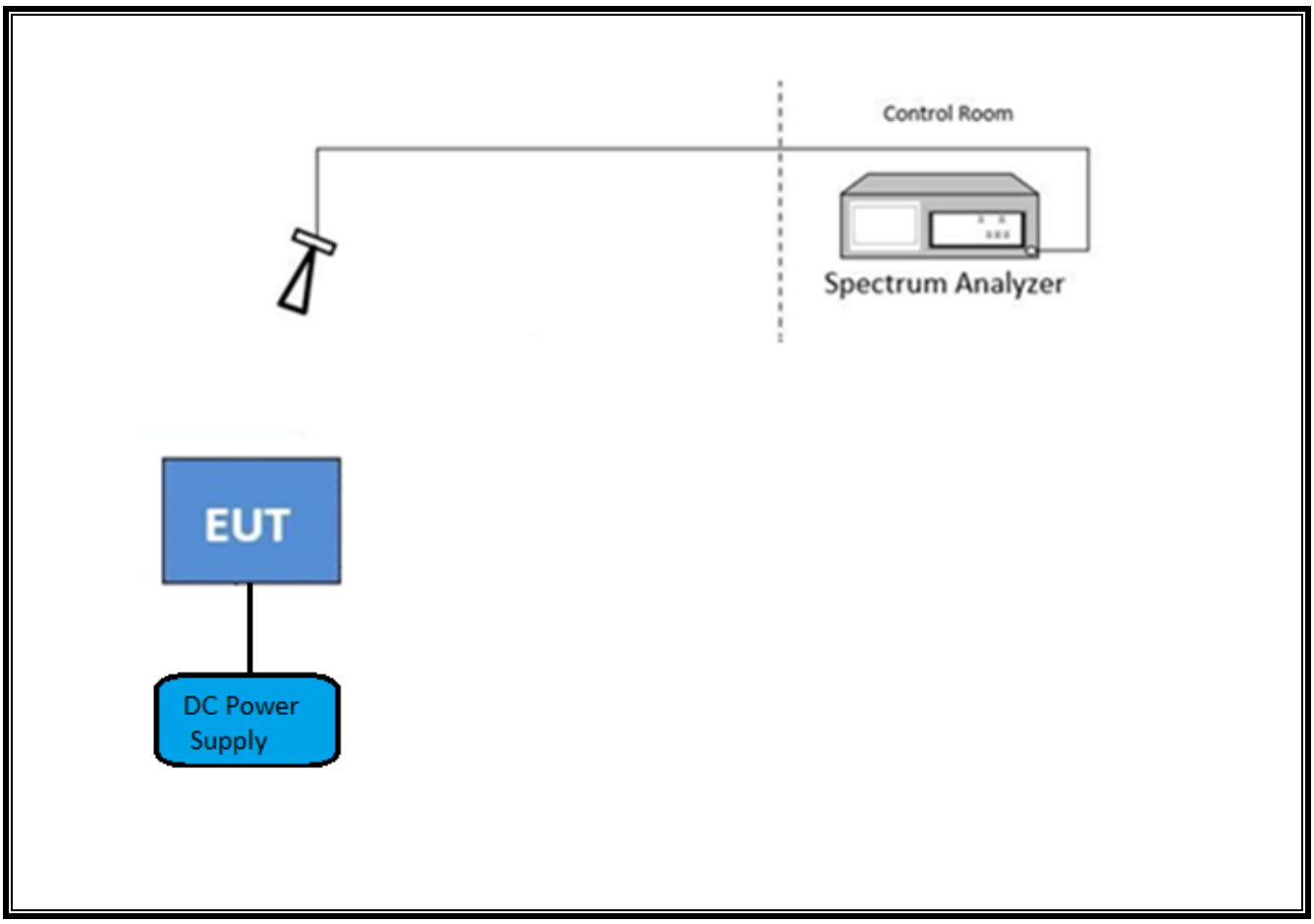
Frequency (MHz)	Description
2480 MHz	Highest frequency generated or used by the EUT

3.2.4 Power Interface:

Mode # /Rated	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated					Single	
	12 Vdc	-	-	-	-	

3.3 Block Diagram:

The diagram below illustrates the configuration of the equipment above.



3.4 Worst- Case Configuration and Mode

The fundamental of the EUT was investigated in three orthogonal orientations X, Y, & Z. It was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

3.5 EUT Configurations

Configuration #	Description
1	The EUT was powered by AC/DC power adapter.

3.6 EUT Operation Modes

Mode of Operation#	Description
1	The EUT was powered on and stand alone.

3.7 Rationale for EUT Configurations

Configuration #	Description
1	The selected EUT configuration was chosen to maximize emissions.

3.8 Rationale for EUT Mode of Operation

Mode of Operation #	Description
1	The mode of operations was determined by the manufacturer.

4.0 APPLICABLE EMISSIONS LIMITS AND TEST RESULTS

4.1 Test Conditions and Results - RADIATED EMISSIONS

Test Engineer	45256 JB	
Test Date	6/22/2022	
Laboratory Parameters	Required prior to the test	During the test
Ambient Temperature	15 to 35 °C	21°C
Humidity	30 % to 60 %	48%
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30MHz – 18GHz	3 meter

Limits - Class B		
Frequency (MHz)	Limit (dBµV/m)	
CISPR Limits for radiated disturbance of Class B ITE at measuring distance of 3 m		
30-230	40	NA
230-1000	47	NA
FCC/ICES Limits for radiated disturbance of Class B ITE at measuring distance of 3 m		
30-88	40	NA
88-216	43.5	NA
216-230	46	NA
230-960	46/47	NA
Above 960	54	NA
	Peak	Average
Above 1 GHz	74	54

Supplementary information: None

Radiated Emissions EUT Configuration Settings

Power Interface #	EUT Configurations #	EUT Mode of Operation#
1	1	1
Supplementary information: None		

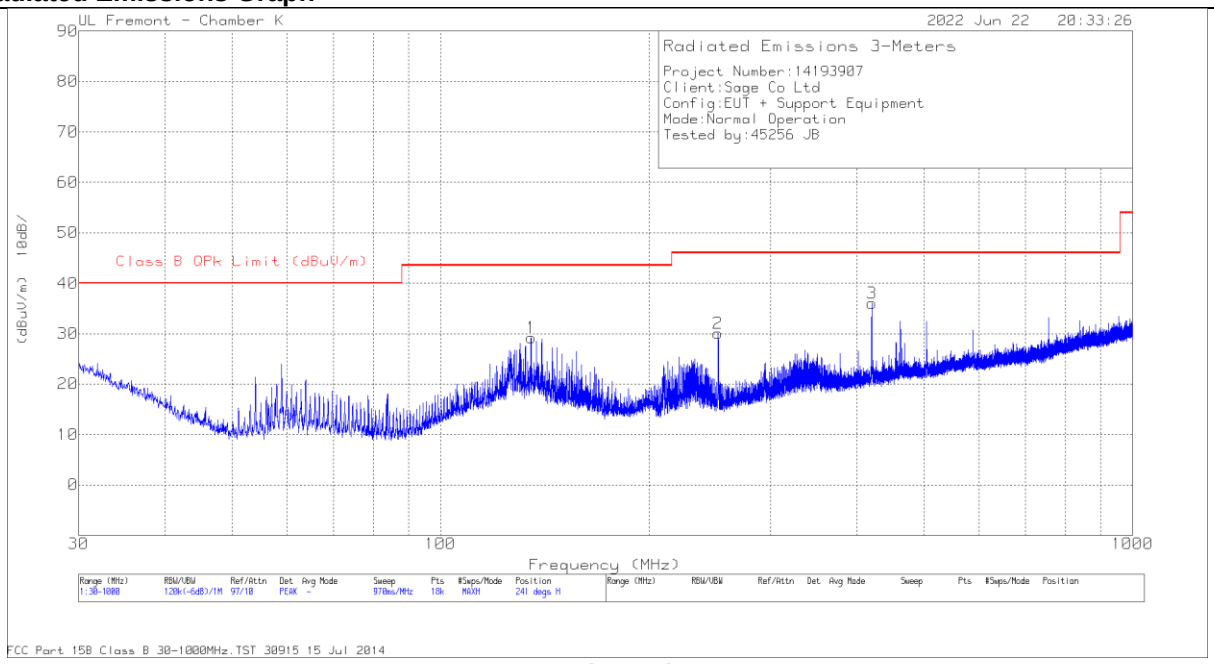
Radiated Emissions Test Equipment

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**ID Num**	**Cal Due**	**Last Cal**
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T119	05/07/2022	05/07/2021
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	80404	08/04/2022	08/04/2021
Amplifier 1-8GHz 30dB gain	L3 Narda	AMF-4D-01000800-30-29P	167495	03/09/2023	03/09/2022
RF Filter Box, 1-18GHz	FREMONT	SAC-L1	171013	03/09/2023	03/09/2022
Amplifier, 1 - 18GHz	MITEQ	AFS42-00101800-25-S-42	T1568	03/09/2023	03/09/2022
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310N	T300	04/09/2023	04/09/2022
Amplifier, 1-7GHz, 24dB	AMPLICAL	AMP1G7-24-27	T1607	03/09/2023	03/09/2022
Antenna, BroadBand Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	171862	09/28/2022	09/28/2021
EMI TEST RECEIVER, with B8 option	Rohde & Schwarz	ESW44	PRE0179377	02/20/2023	02/20/2022
NSA, Test Site Validation	TDK RF SOLUTIONS INC.	ANSI C63.4 & CISPR 16-1-4	210613	09/18/2022	09/18/2021
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight Technologies Inc	8449B	80671	04/19/2023	04/19/2022

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	Rev 9.5, April 30, 2020, Oct 21, 2019

RADIATED EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)

Radiated Emissions Graph



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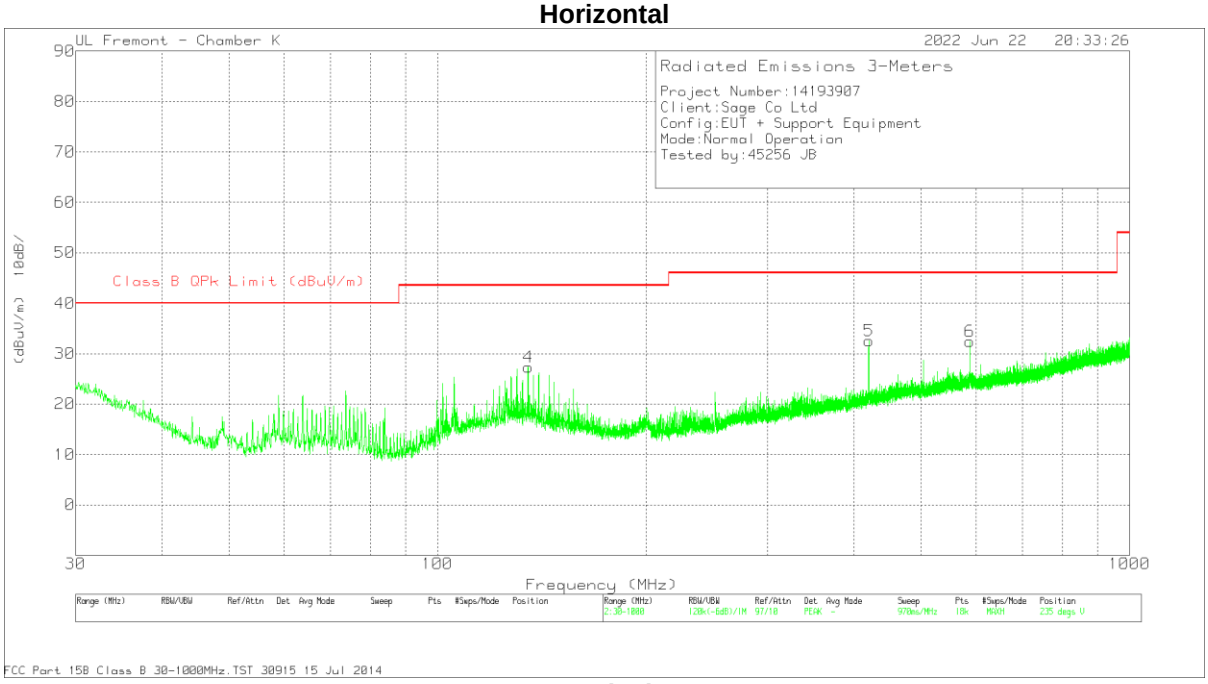


Vertical

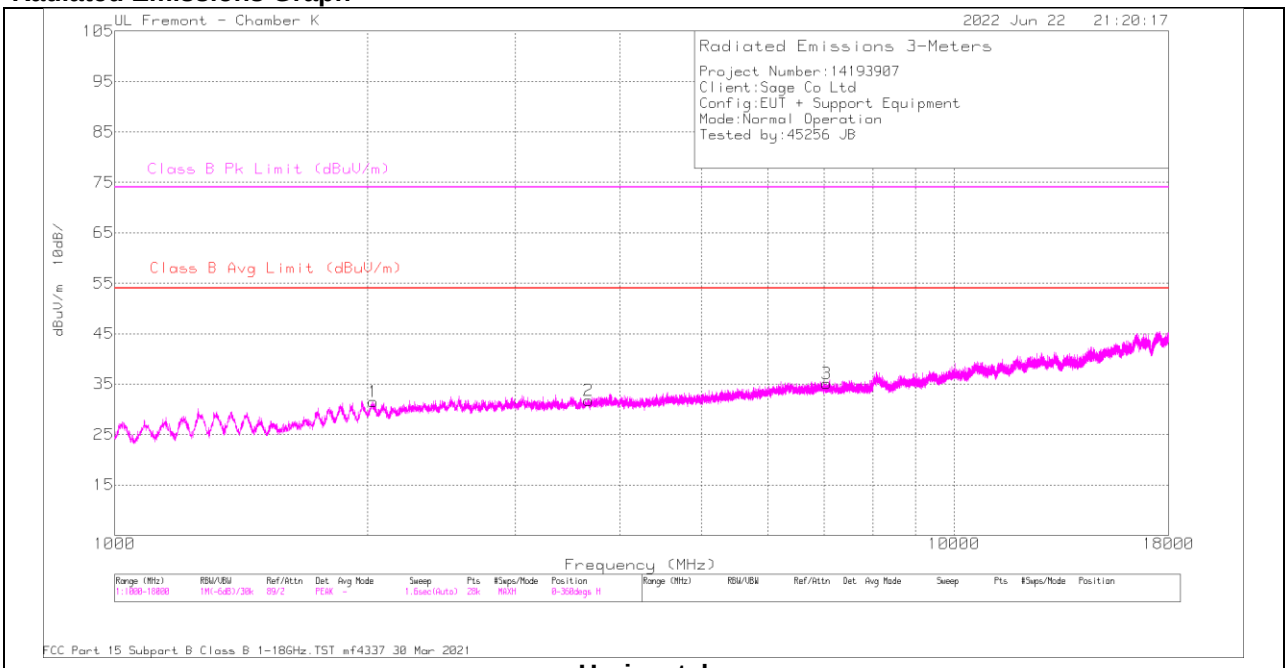
Radiated Emissions Data Points

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	82258 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	135.191	39.98	Pk	19.9	-30.7	29.18	43.52	-14.34	114	197	H
2	251.969	42.08	Pk	18	-30	30.08	46.02	-15.94	355	99	H
3	419.941	42.78	Pk	22.6	-29.4	35.98	46.02	-10.04	156	197	H
	419.933	42.47	Qp	22.6	-29.4	35.67	46.02	-10.35	159	221	H
4	135.191	38.11	Pk	19.9	-30.7	27.31	43.52	-16.21	356	99	V
5	419.995	39.29	Pk	22.6	-29.4	32.49	46.02	-13.53	193	197	V
6	588.021	35.73	Pk	25.3	-28.6	32.43	46.02	-13.59	151	99	V

Pk - Peak detector
Qp - Quasi-Peak detector

RADIATED EMISSIONS 1000 TO 18,000 MHz – FCC

Radiated Emissions Graph



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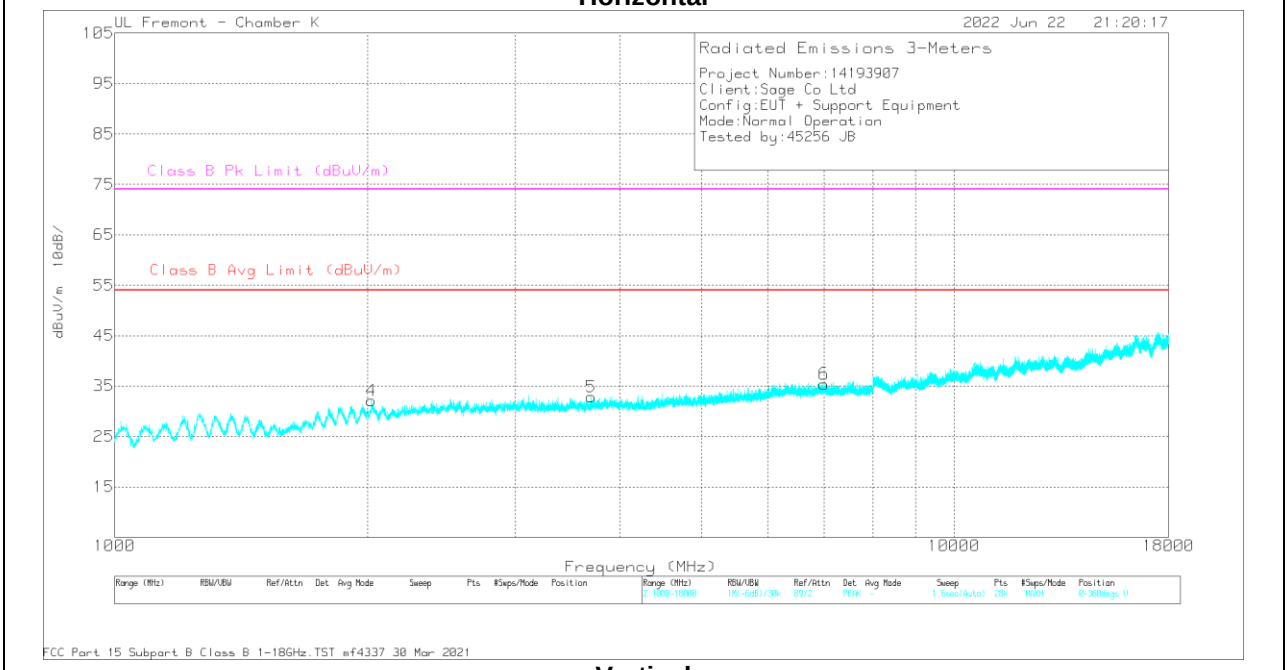


Vertical

Radiated Emissions Data Points

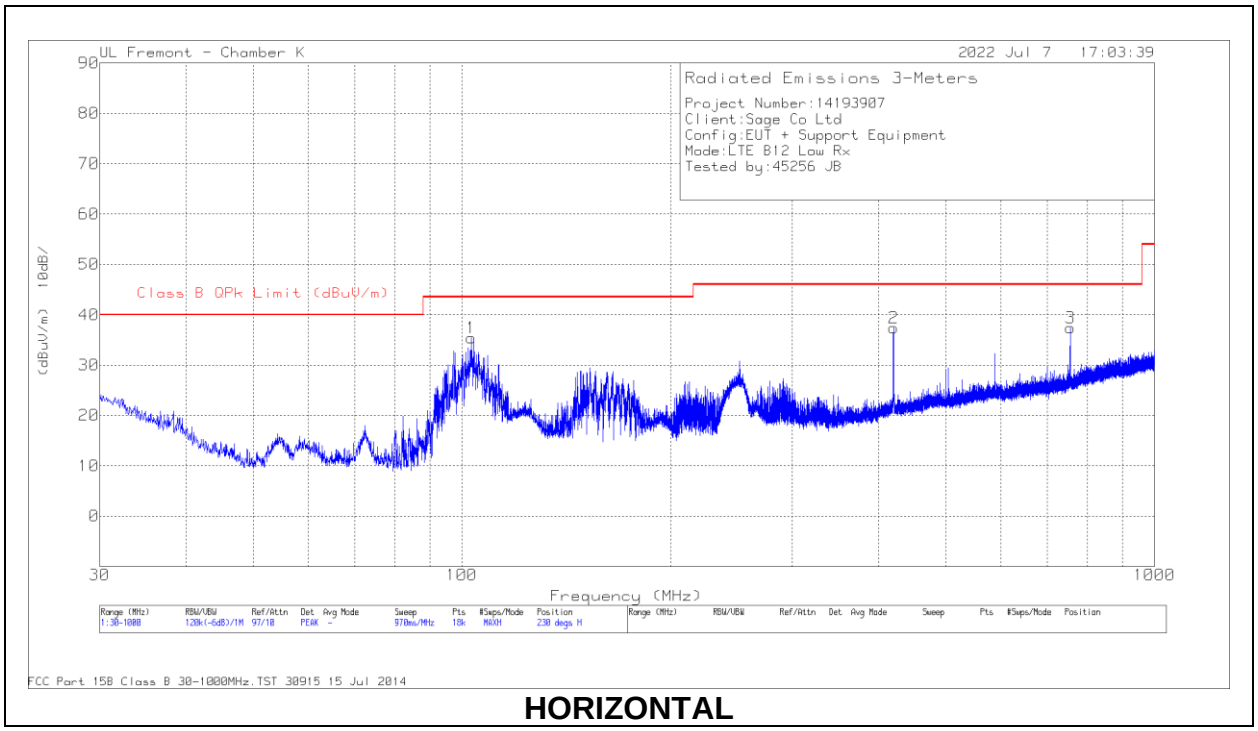
Frequency (MHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2032.787	54.72	Pk	31.7	-45.8	40.62	-	-	74	-33.38	115	230	H
2032.787	41.76	Av	31.7	-45.8	27.66	54	-26.34	-	-	115	230	H
3668.502	51.03	Pk	33.4	-42.4	42.03	-	-	74	-31.97	71	145	H
3668.502	37.12	Av	33.4	-42.4	28.12	54	-25.88	-	-	71	145	H
7050.791	47.54	Pk	35.9	-38.9	44.54	-	-	74	-29.46	250	331	H
7050.791	34.18	Av	35.9	-38.9	31.18	54	-22.82	-	-	250	331	H
2023.715	54.65	Pk	31.8	-45.5	40.95	-	-	74	-33.05	115	309	V
2023.715	41.61	Av	31.8	-45.5	27.91	54	-26.09	-	-	115	309	V
3697.005	50.39	Pk	33.4	-42.2	41.59	-	-	74	-32.41	109	310	V
3697.005	37.15	Av	33.4	-42.2	28.35	54	-25.65	-	-	109	310	V
7002.623	47.72	Pk	35.9	-38.7	44.92	-	-	74	-29.08	195	298	V
7002.623	34.27	Av	35.9	-38.7	31.47	54	-22.53	-	-	195	298	V

Pk - Peak detector
Av - Average detection

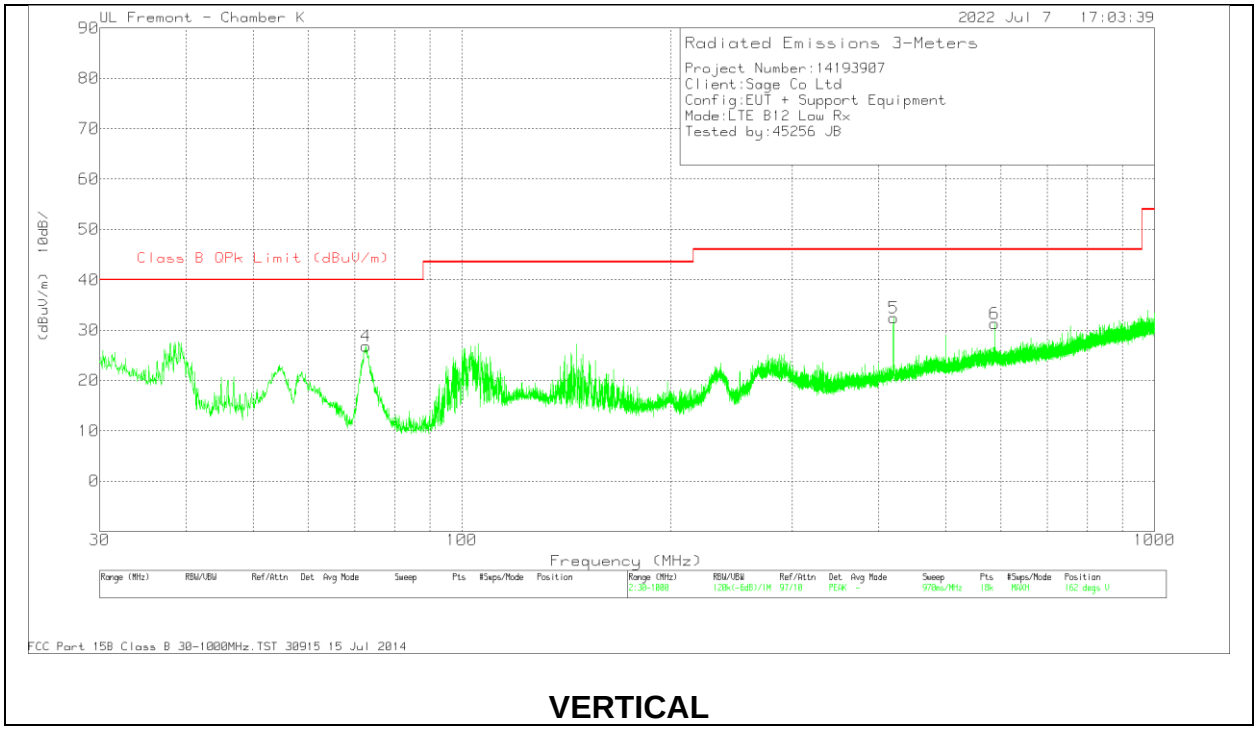
4.2 15B Receiver Mode - RADIATED EMISSIONS

LTE BAND 12 Below 1GHz

LOW CHANNEL



HORIZONTAL



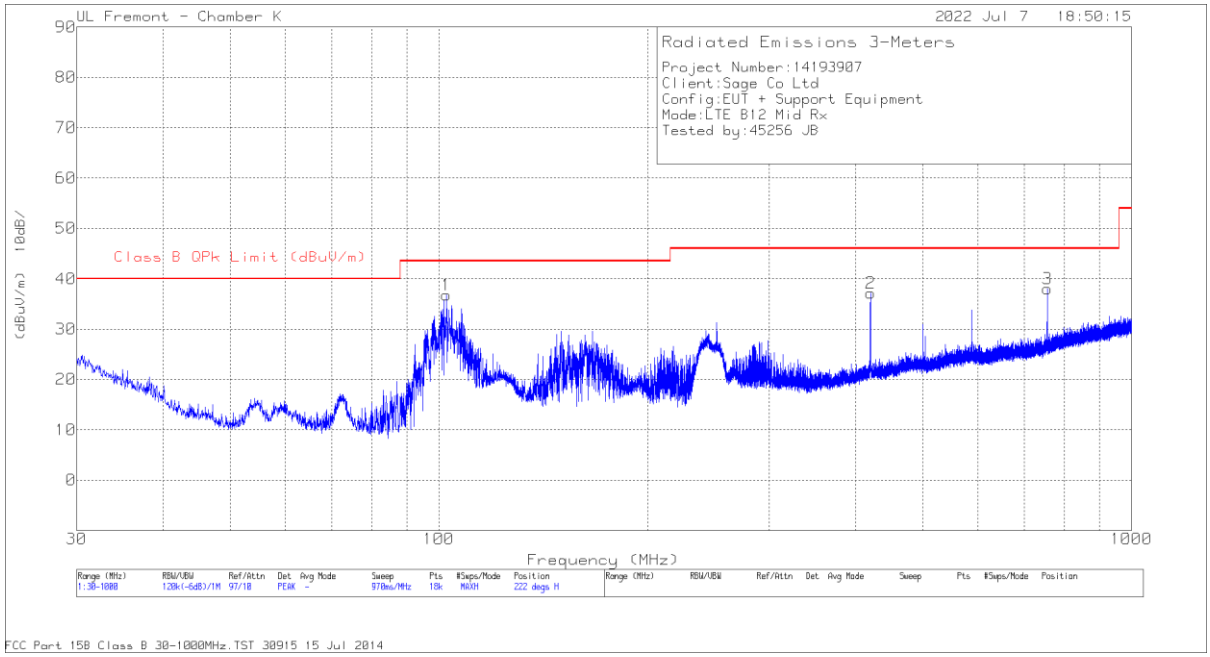
VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	82258 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	103.235	48.83	Pk	17.5	-30.9	35.43	43.52	-8.09	5	295	H
2	419.941	44.17	Pk	22.6	-29.4	37.37	46.02	-8.65	109	99	H
3	756.047	38.21	Pk	27.3	-28.1	37.41	46.02	-8.61	208	99	H
4	72.6801	43.77	Pk	14.2	-31.1	26.87	40	-13.13	33	99	V
5	419.887	39.27	Pk	22.6	-29.4	32.47	46.02	-13.55	279	99	V
6	588.021	34.59	Pk	25.3	-28.6	31.29	46.02	-14.73	312	99	V

Pk - Peak detector
Qp - Quasi-Peak detector

MID CHANNEL



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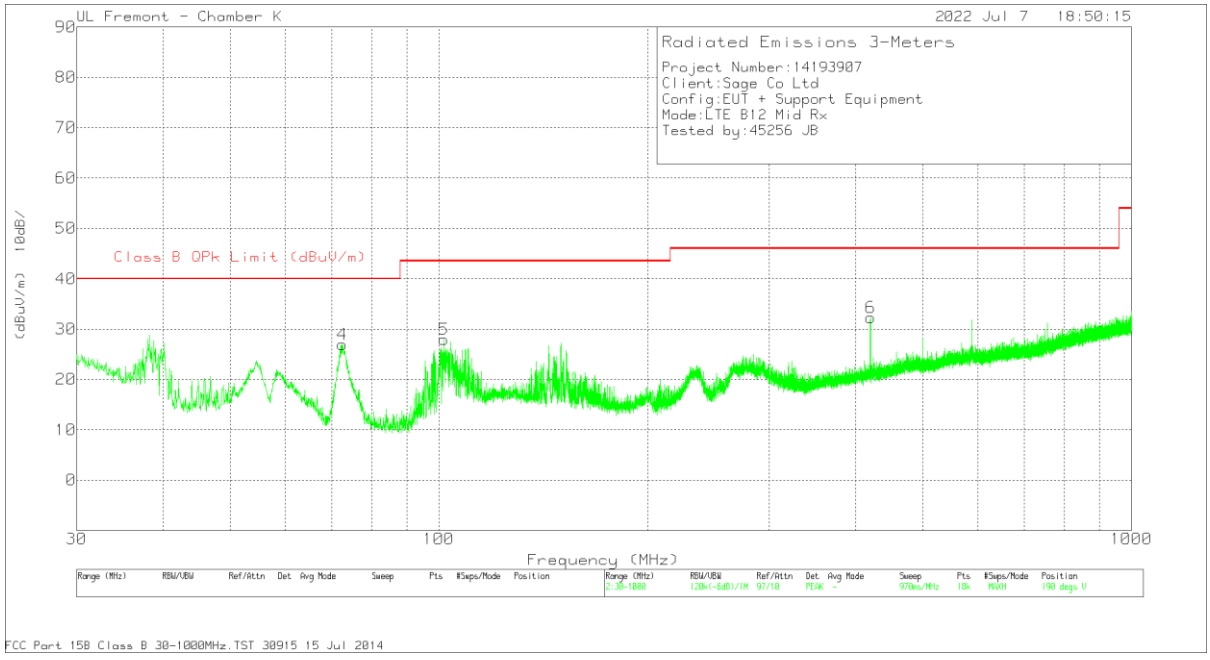


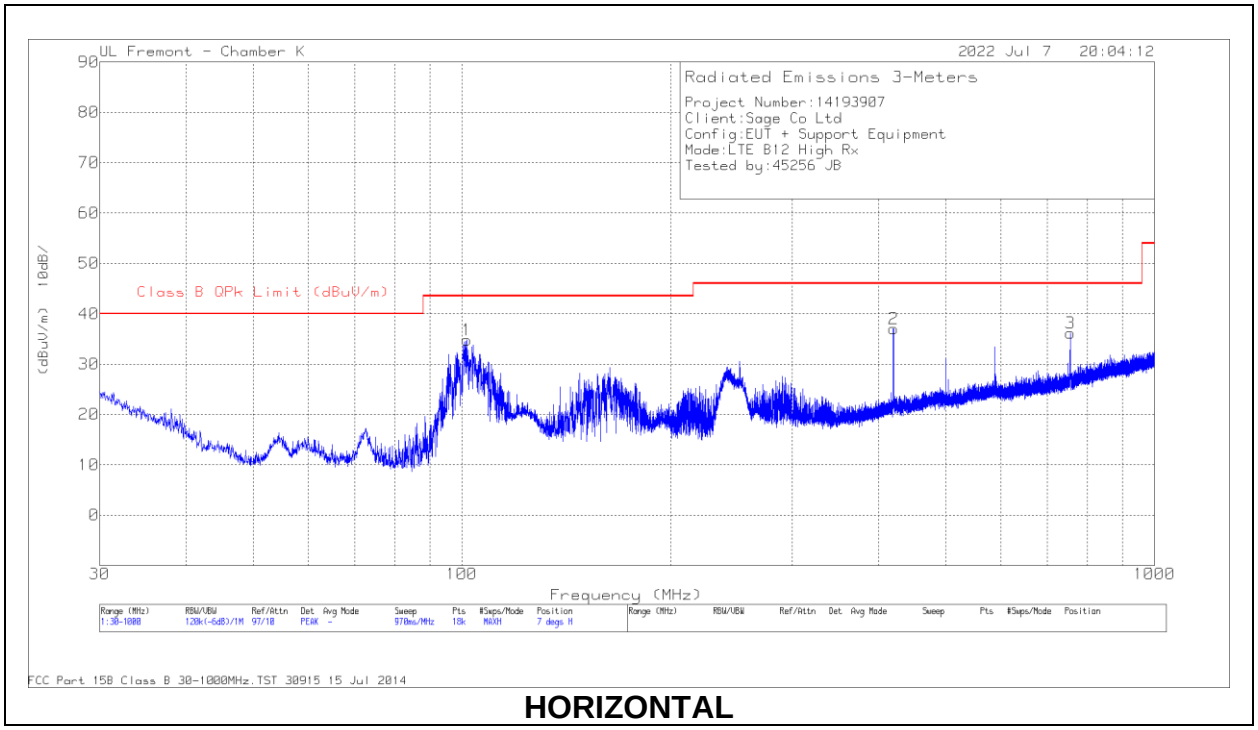
VERTICAL

RADIATED EMISSIONS

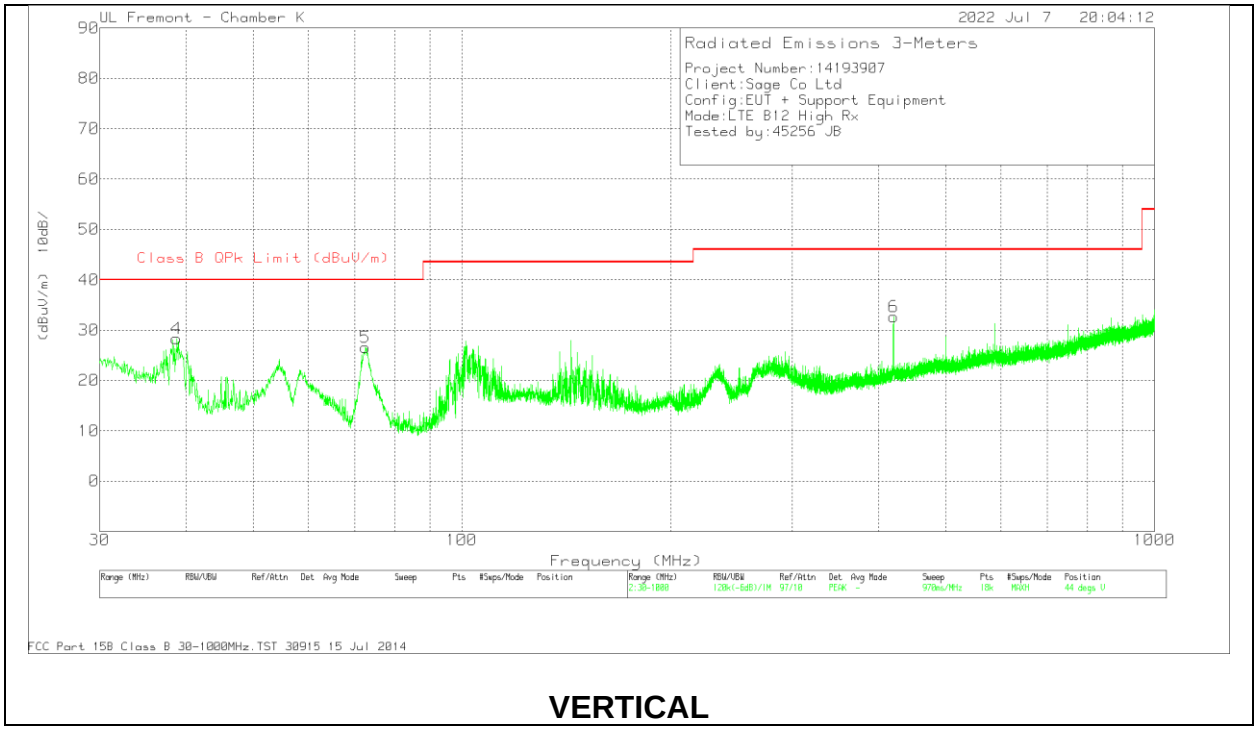
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	82258 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	102.642	50.28	Pk	17.4	-30.9	36.78	43.52	-6.74	3	295	H
	102.744	40.35	Qp	17.4	-30.9	26.85	43.52	-16.67	345	295	H
2	419.995	43.94	Pk	22.6	-29.4	37.14	46.02	-8.88	213	101	H
3	756.047	38.79	Pk	27.3	-28.1	37.99	46.02	-8.03	192	101	H
4	72.5184	43.82	Pk	14.2	-31.1	26.92	40	-13.08	347	99	V
5	101.78	41.77	Pk	17.1	-30.9	27.97	43.52	-15.55	295	197	V
6	420.049	39.16	Pk	22.6	-29.4	32.36	46.02	-13.66	283	99	V

Pk - Peak detector
Qp - Quasi-Peak detector

HIGH CHANNEL



HORIZONTAL



VERTICAL

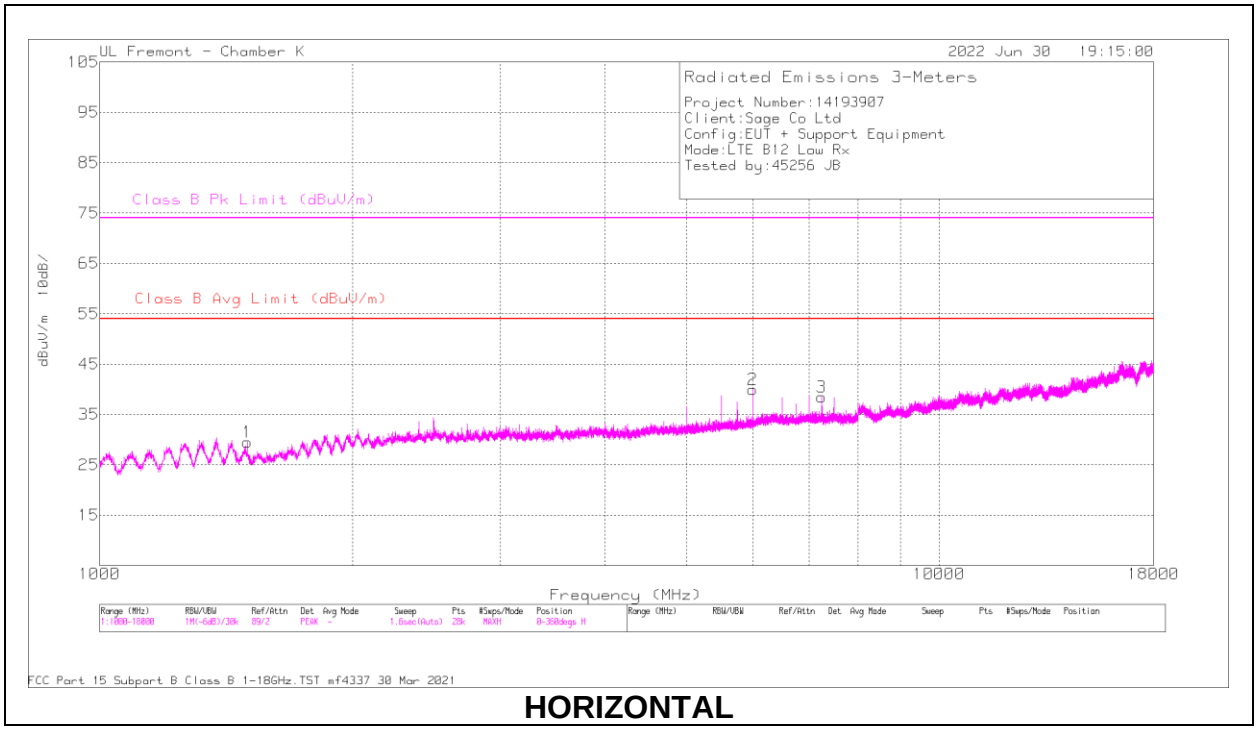
RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	82258 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	101.726	48.59	Pk	17.1	-30.9	34.79	43.52	-8.73	326	295	H
2	420.049	43.88	Pk	22.6	-29.4	37.08	46.02	-8.94	317	101	H
3	756.047	36.91	Pk	27.3	-28.1	36.11	46.02	-9.91	200	101	H
4	38.73	38.68	Pk	21.1	-31.4	28.38	40	-11.62	305	101	V
5	72.6262	43.43	Pk	14.2	-31.1	26.53	40	-13.47	348	101	V
6	420.049	39.5	Pk	22.6	-29.4	32.7	46.02	-13.32	233	101	V

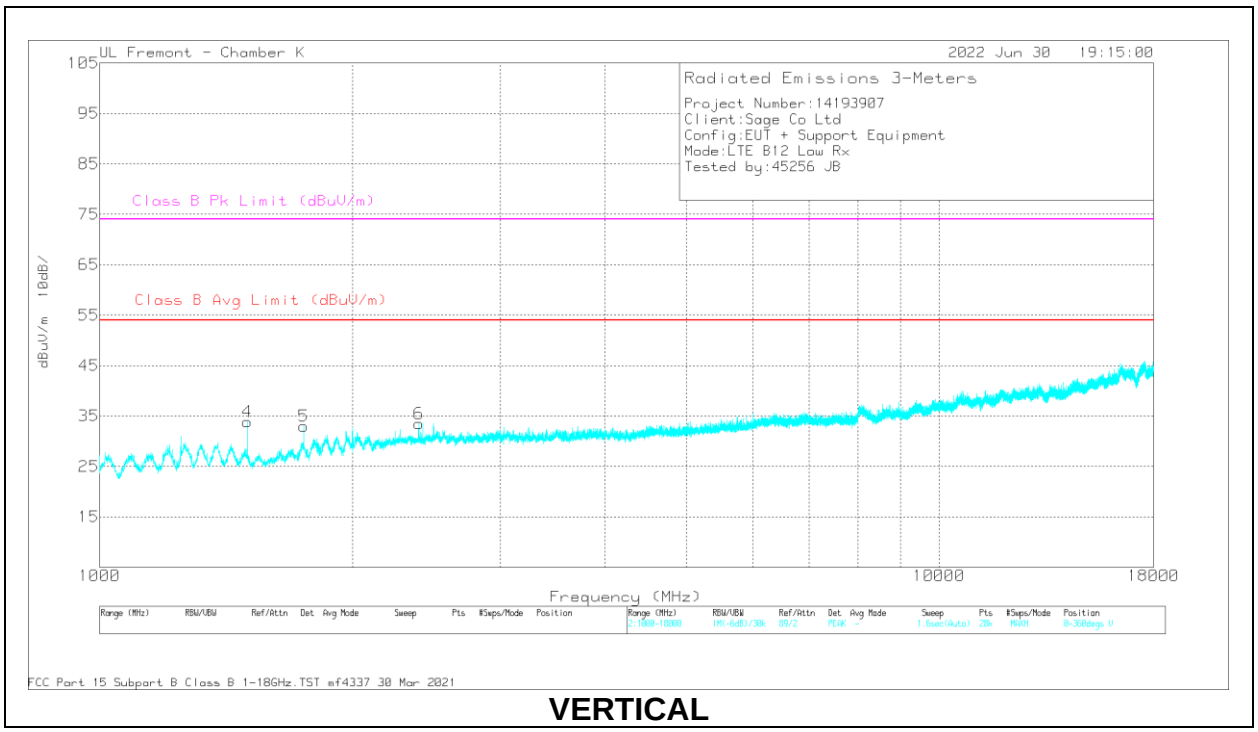
Pk - Peak detector
Qp - Quasi-Peak detector

LTE BAND 12ABOVE 1GHz

LOW CHANNEL



HORIZONTAL



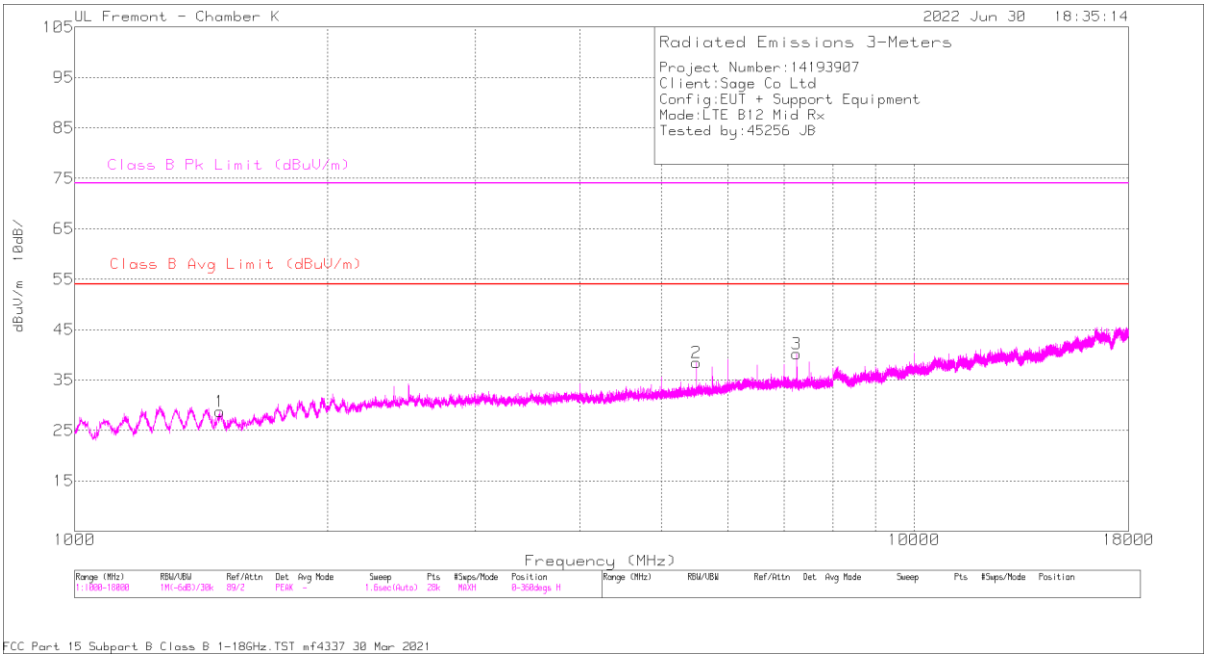
VERTICAL

RADIATED EMISSIONS

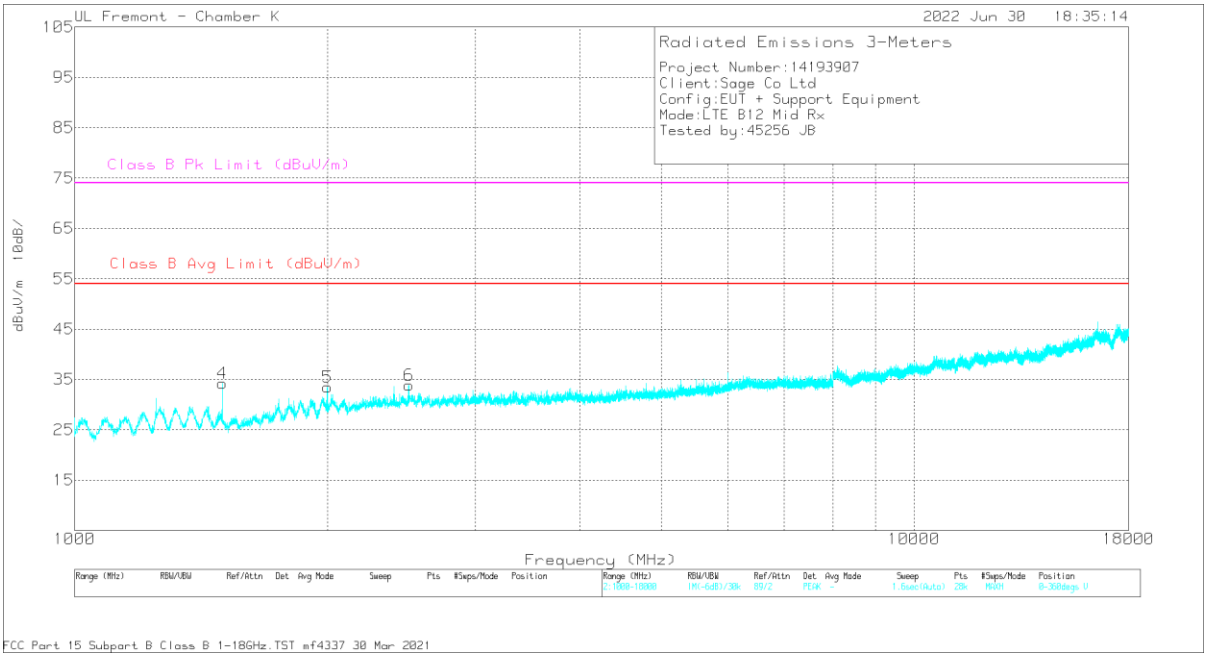
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1499.915	56.1	Pk	28.1	-46.1	38.1	-	-	74	-35.9	360	200	H
	1499.915	43.58	Av	28.1	-46.1	25.58	54	-28.42	-	-	360	200	H
2	5999.864	51.92	Pk	35.4	-39.7	47.62	-	-	74	-26.38	360	99	H
	5999.864	40.06	Av	35.4	-39.7	35.76	54	-18.24	-	-	360	99	H
3	7249.748	49.92	Pk	35.9	-38.6	47.22	-	-	74	-26.78	360	99	H
	7249.748	37.83	Av	35.9	-38.6	35.13	54	-18.87	-	-	360	99	H
4	1499.952	60.57	Pk	28.1	-46.1	42.57	-	-	74	-31.43	360	99	V
	1499.952	48.13	Av	28.1	-46.1	30.13	54	-23.87	-	-	360	99	V
5	1750.058	58.15	Pk	29.6	-46.2	41.55	-	-	74	-32.45	360	99	V
	1750.058	44.85	Av	29.6	-46.2	28.25	54	-25.75	-	-	360	99	V
6	2399.987	55.82	Pk	32	-44.7	43.12	-	-	74	-30.88	360	99	V
	2399.987	43.8	Av	32	-44.7	31.1	54	-22.9	-	-	360	99	V

Pk - Peak detector
Av - Average detection

MID CHANNEL



HORIZONTAL



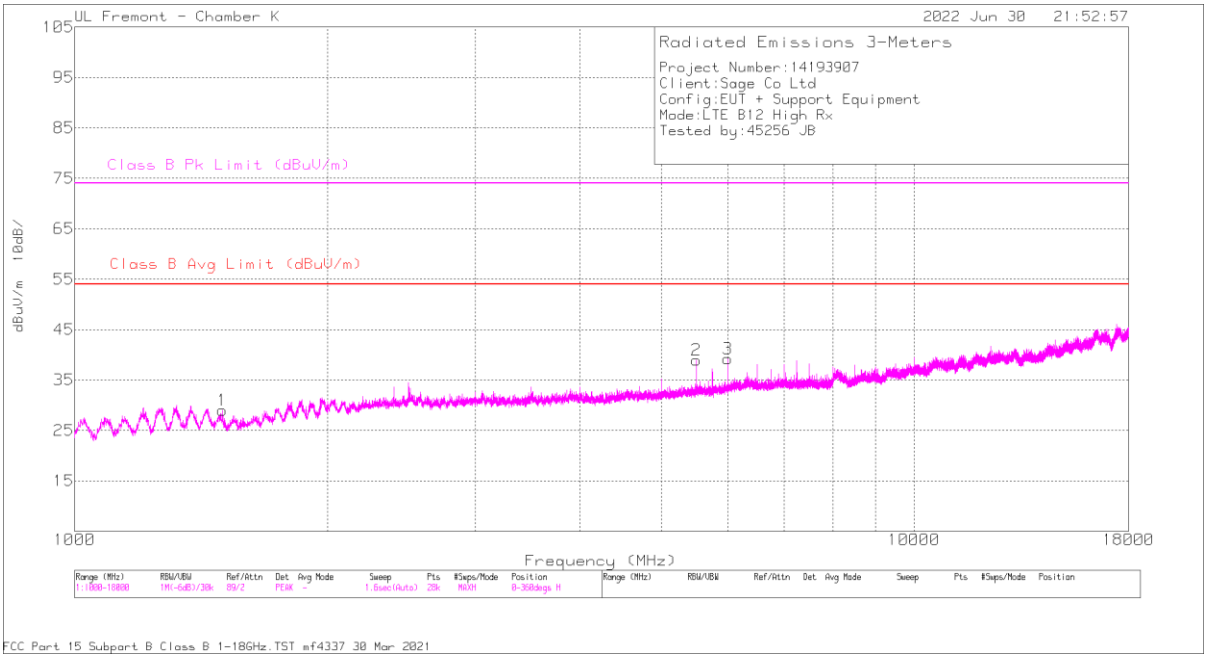
VERTICAL

RADIATED EMISSIONS

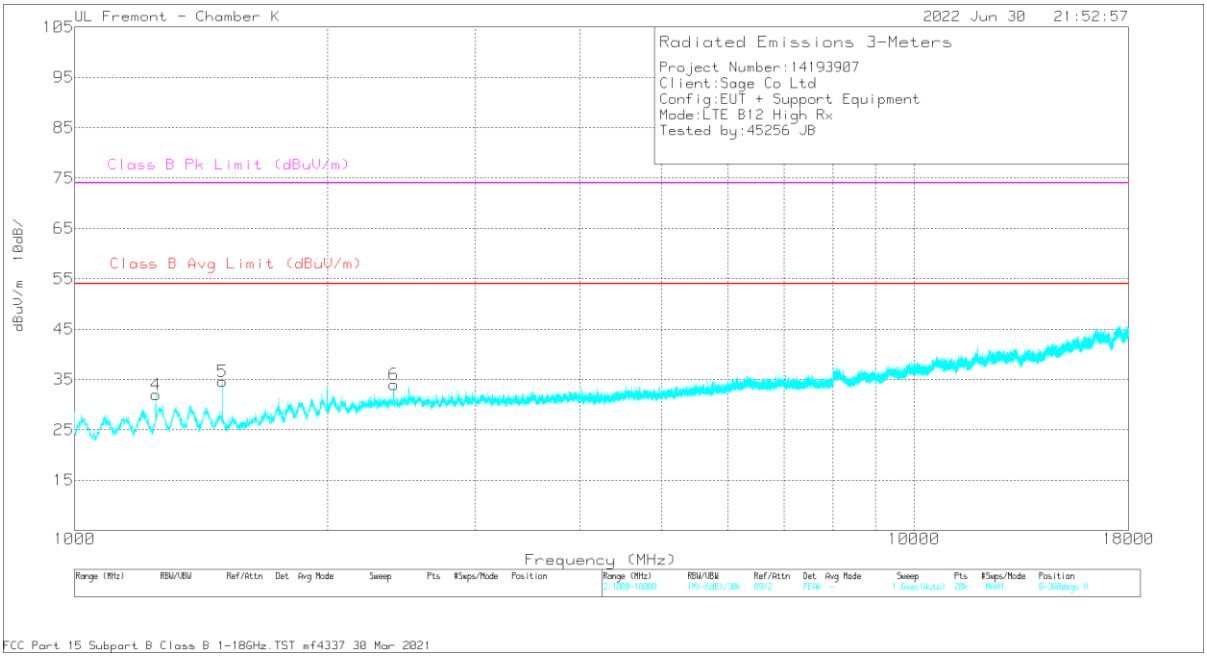
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1490.739	56.19	Pk	28.2	-46.3	38.09	-	-	74	-35.91	360	99	H
	1490.739	42.72	Av	28.2	-46.3	24.62	54	-29.38	-	-	360	99	H
2	5499.919	52.73	Pk	34.9	-40.5	47.13	-	-	74	-26.87	360	199	H
	5499.919	42.29	Av	34.9	-40.5	36.69	54	-17.31	-	-	360	199	H
3	7249.92	43.78	Pk	35.8	-38.6	40.98	54	-	74	-33.02	360	99	H
	7249.92	37.94	Av	35.8	-38.6	35.14	54	-18.86	-	-	360	99	H
4	1500.042	55.26	Pk	28.1	-46.1	37.26	54	-	74	-36.74	360	99	V
	1500.042	47.93	Av	28.1	-46.1	29.93	54	-24.07	-	-	360	99	V
5	1999.958	49.75	Pk	31.7	-45.7	35.75	54	-	74	-38.25	360	99	V
	1999.958	43.67	Av	31.7	-45.7	29.67	54	-24.33	-	-	360	99	V
6	2499.965	47.99	Pk	32.7	-44.5	36.19	54	-	74	-37.81	360	99	V
	2499.965	43.39	Av	32.7	-44.5	31.59	54	-22.41	-	-	360	99	V

Pk - Peak detector
Av - Average detection

HIGH CHANNEL



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF 80404 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1499.39	57.57	Pk	28.1	-46.2	39.47	-	-	74	-34.53	360	200	H
	1499.39	42.53	Av	28.1	-46.2	24.43	54	-29.57	-	-	360	200	H
2	5500.21	53.13	Pk	34.9	-40.5	47.53	-	-	74	-26.47	360	200	H
	5500.21	41.59	Av	34.9	-40.5	35.99	54	-18.01	-	-	360	200	H
3	5999.969	51.58	Pk	35.4	-39.7	47.28	-	-	74	-26.72	360	99	H
	5999.969	40.23	Av	35.4	-39.7	35.93	54	-18.07	-	-	360	99	H
4	1250.224	57.15	Pk	28.8	-46.7	39.25	-	-	74	-34.75	360	200	V
	1250.224	44.3	Av	28.8	-46.7	26.4	54	-27.6	-	-	360	200	V
5	1499.944	60.09	Pk	28.1	-46.1	42.09	-	-	74	-31.91	360	101	V
	1499.944	48.29	Av	28.1	-46.1	30.29	54	-23.71	-	-	360	101	V
6	2399.803	55.72	Pk	32	-44.7	43.02	-	-	74	-30.98	360	101	V
	2399.803	43.17	Av	32	-44.7	30.47	54	-23.53	-	-	360	101	V

Pk - Peak detector
Av - Average detection

Appendix A

Facilities, Accreditations and Authorizations

UL Verification Services Inc. is accredited by A2LA, Certificate Number #0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☐	Building 1: 47173 Benicia Street Fremont, CA 94538, U.S.A	US0104	2324A	208313
☐	Building 2: 47266 Benicia Street Fremont, CA 94538, U.S.A	US0104	22541	208313
☒	Building 4: 47658 Kato Rd Fremont, CA 94538, U.S.A	US0104	2324B	208313

END OF TEST REPORT