

FCC ISED RF Test Report

Test Report Number GLS-20042831-LC-FCC-IC-RF-R1

FCC ID 2AH4HATD500X
ISED ID 21385-ATD500X

Applicant Mobilogix

Applicant Address 5500 Trabuco Road, Suite 150, Irvine, CA 92620

Product Name ATD500X

Model (s) BAT-X

Date of Receipt 04/28/2020

Date of Test 04/28/2020-06/03/2020

Report Issue Date 06/04/2020

Test Standards 47 CFR Part 15.247
RSS-247 Issue 2, Feb 2017
47CFR Part 22
47CFR Part 24
47CFR Part 27
47CFR Part 90
RSS-130 Issue 2: Feb 2019
RSS-132 Issue 3: Jan 2013
RSS-133 Issue 6: Jan 2018
RSS-139 Issue 3: Jul 2015

Test Result **PASS**



Issued by:

Vista Compliance Laboratories

1261 Puerta Del Sol, San Clemente, CA 92673 USA

www.vista-compliance.com



Daniel Bruno (Test Technician)



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REVISION HISTORY

Report Number	Version	Description	Issued Date
GLS-20042831-LC-FCC-IC-RF	01	Initial report	06/04/2020
GLS-20042831-LC-FCC-IC-RF-R1	R1	Update FCC and ISED ID	07/01/2020

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1 Test Summary

Test Item	Test Requirement	Test Method	Result
Radiated Spurious Emissions into Restricted Frequency Bands (intentional)	47 CFR Part 15.247 RSS-247 Issue 2, Feb 2017	ANSI C63.10: 2013 KDB 558074 D01 15.247 Meas Guidance v05r02	Pass
Field Strength of Spurious Radiation (licensed band)	2.1046 22.917 (a), 24.238 (a), 90.691, 27.53 (f), (g), (h), (c)(2) and (5) RSS-130(4.7.1) and (4.7.2) RSS-132 (5.5) RSS-133 (6.5) RSS-139 (6.6) SRSP-510(5.1.2)	ANSI C63.26: 2015 KDB 971168 D01 Power Meas License Digital Systems v03r01 KDB 412172 D01 Determining ERP and EIRP v01r01	Pass

2 General Information

2.1 Applicant

Applicant	Mobilogix, Inc.
Applicant address	5500 Trabuco Road, Suite 150, Irvine, CA 92620
Manufacturer	Mobilogix, Inc.
Manufacturer Address	5500 Trabuco Road, Suite 150, Irvine, CA 92620

2.2 Product information

Product Name	ATD500X
Product Description	LTE Asset Tracker with GSM, WLAN RX and BLE
Model Number	BAT-X
Family Models	N/A
Serial Number	866425030183745
Frequency Band	BLE: 2402-2480MHz GSM850: 824.2 - 848.8 MHz GSM1900: 1850.2 - 1909.8 MHz LTE CAT-M1/NB-IOT Band 2: 1850.7-1909.3MHz LTE CAT-M1/NB-IOT Band 4: 1710.7-1754.3MHz LTE CAT-M1/NB-IOT Band 5: 824.7-848.3MHz LTE CAT-M1/NB-IOT Band 12: 699.7-715.3MHz LTE CAT-M1/NB-IOT Band 13: 779.5-784.5 MHz LTE CAT-M1/NB-IOT Band 26: 815.5 – 847.5 MHz
Type of modulation	BLE: GFSK GSM: GMSK, 8PSK LTE CAT-M1: QPSK, 16QAM LTE NB-IOT: BPSK, QPSK
Equipment Class	DTS, PCB
Antenna Information	BLE: Internal PCB antenna, 1 dBi Gain. WCDMA/LTE: PCB antenna, -0.21 dBi for 698-803MHz; 0.77 dBi for 824-894 MHz; 3.05 dBi for 1710-1880 MHz; 2.92 dBi for 1850-1990MHz; 3.72 dBi for 2500-2690MHz
Clock Frequencies	N/A
Input Power	3.7VDC (battery powered)
Power Adapter Manufacturer/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	BT and GSM/LTE can transmit simultaneously
Additional Info	EMC Emission Class B Cat M1 NB-IOT Category – NB1

2.3 Test standard and method

Test standard	47 CFR Part 15.247 RSS-247 Issue 2, Feb 2017 47CFR Part 22 47CFR Part 24 47CFR Part 27 47CFR Part 90 RSS-130 Issue 2: Feb 2019 RSS-132 Issue 3: Jan 2013 RSS-133 Issue 6: Jan 2018 RSS-139 Issue 3: Jul 2015 SRSP-510 Issue 5: Feb 2009 RSS-Gen Issue 5: Mar 2019
Test method	ANSI C63.10: 2013 ANSI C63.26: 2015 KDB 558074 D01 15.247 Meas Guidance v05r02 KDB 971168 D01 Power Meas License Digital Systems v03r01 KDB 412172 D01 Determining ERP and EIRP v01r01

3 Test Site Information

Lab performing tests	Vista Laboratories, Inc.
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www.vista-compliance.com

Test Condition	Temperature	Humidity	Atmospheric Pressure
RF Testing	23.5°C	58.2%	996 mbar
Radiated Emission Testing	23.5°C	58.2%	996 mbar

4 Modification of EUT / Deviations from Standards

N/A

5 Test Configuration and Operation

5.1 EUT Test Configuration

EUT is powered by internal battery. The cellular radio of EUT is connected to and controlled by CMW500, the base station emulator, communicate continuously in different modulation, test channel and data rate. The radio of BLE is set to transmit continuously by using mobile application.

The following software was used for testing and to monitor EUT performance

Software	Description
EMISoft Vasona	EMC/RF Spurious emission test software used during testing

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #
-	-	-	-

6 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

7 Test Results

7.1 Radiated Spurious Emissions into Restricted Frequency Bands

7.1.1 Requirement

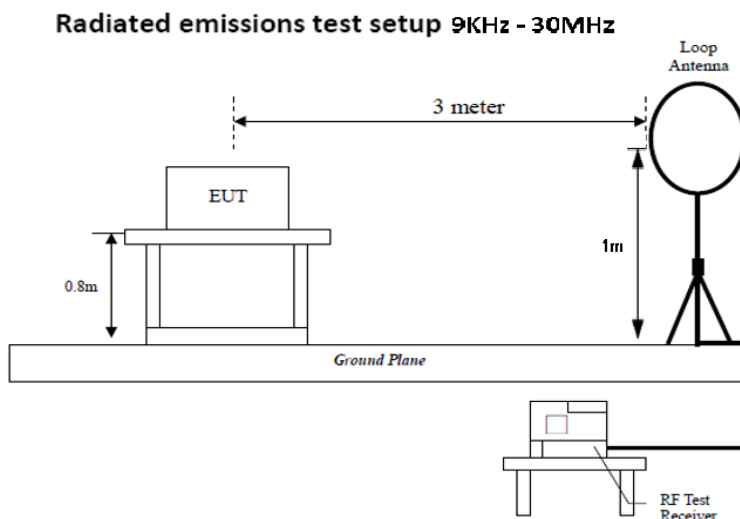
Per § 15.247 (d), RSS-247

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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

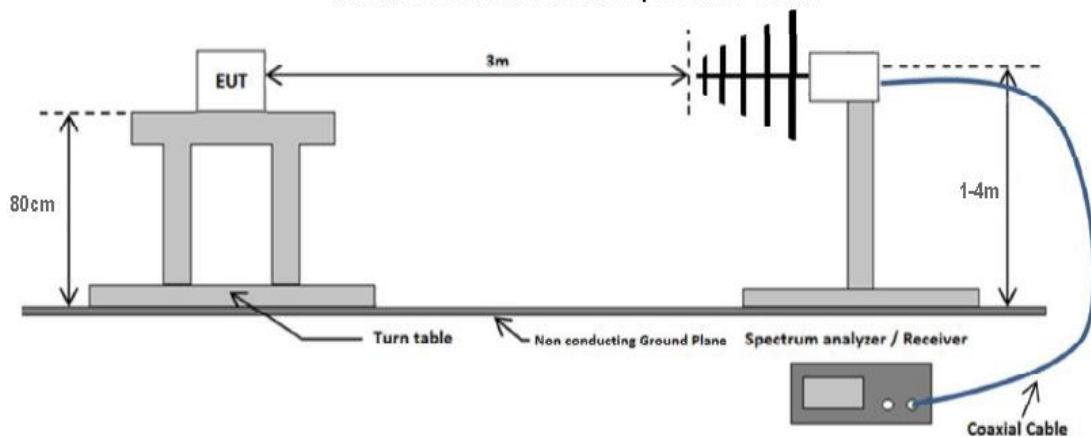
Attenuation below the general limits specified in §15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency range (MHz)	Field Strength ($\mu\text{V/m}$)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

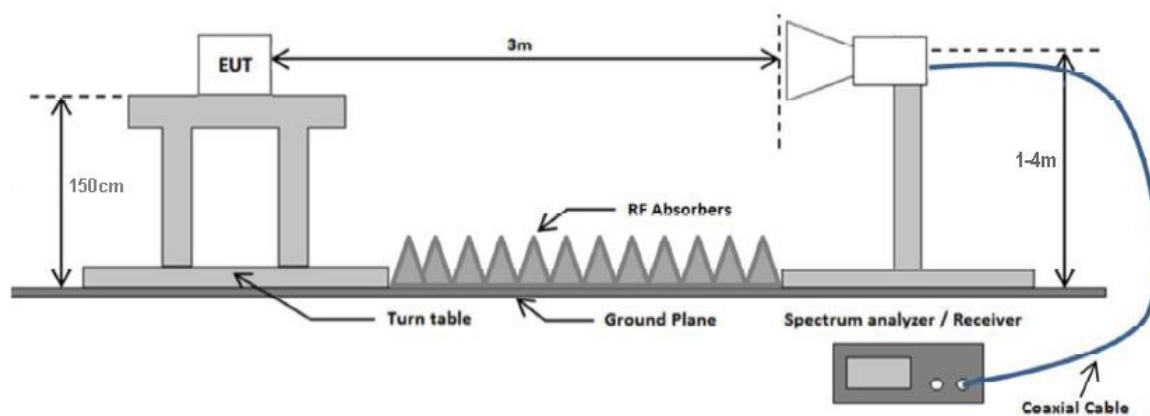
7.1.2 Test setup



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



7.1.3 Test Procedure

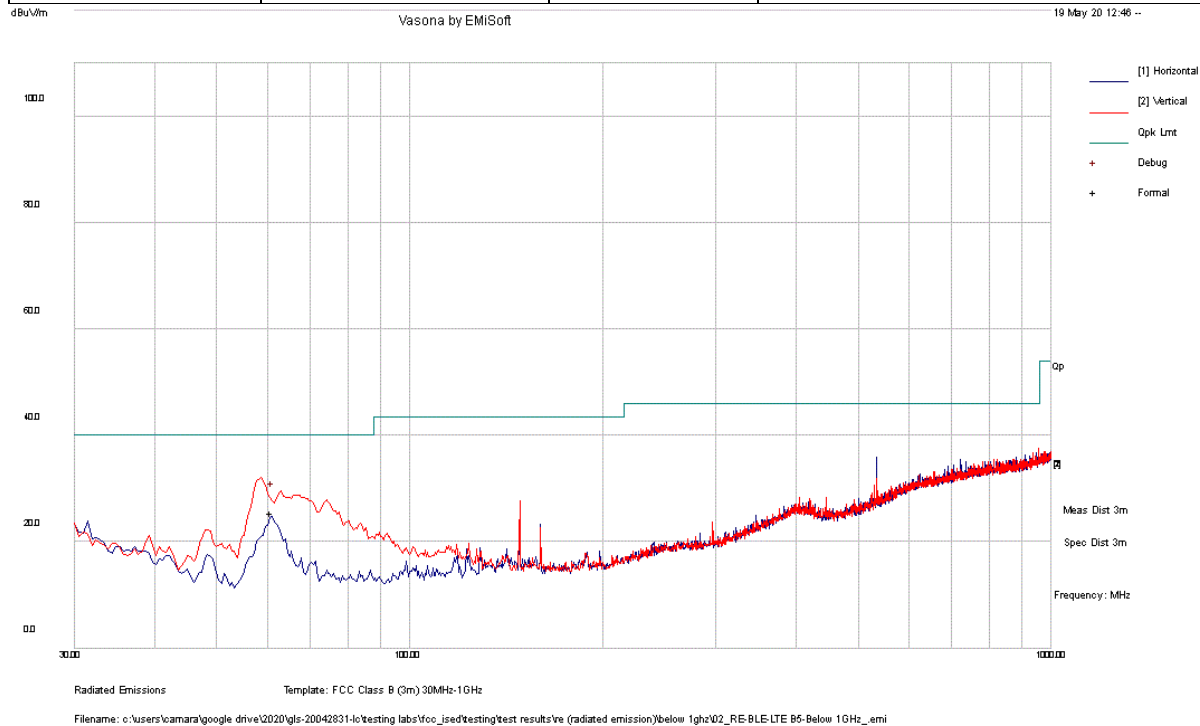
According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r01 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C63.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

7.1.4 Test Result

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	15.247, RSS-247	Mode:	BLE+LTE B2
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
60.957	47.4	3	-24.9	25.5	Quasi Max	V	102	114	40	-14.5	Pass

Note: Frequency at around 835MHz is EUT fundamental emission.

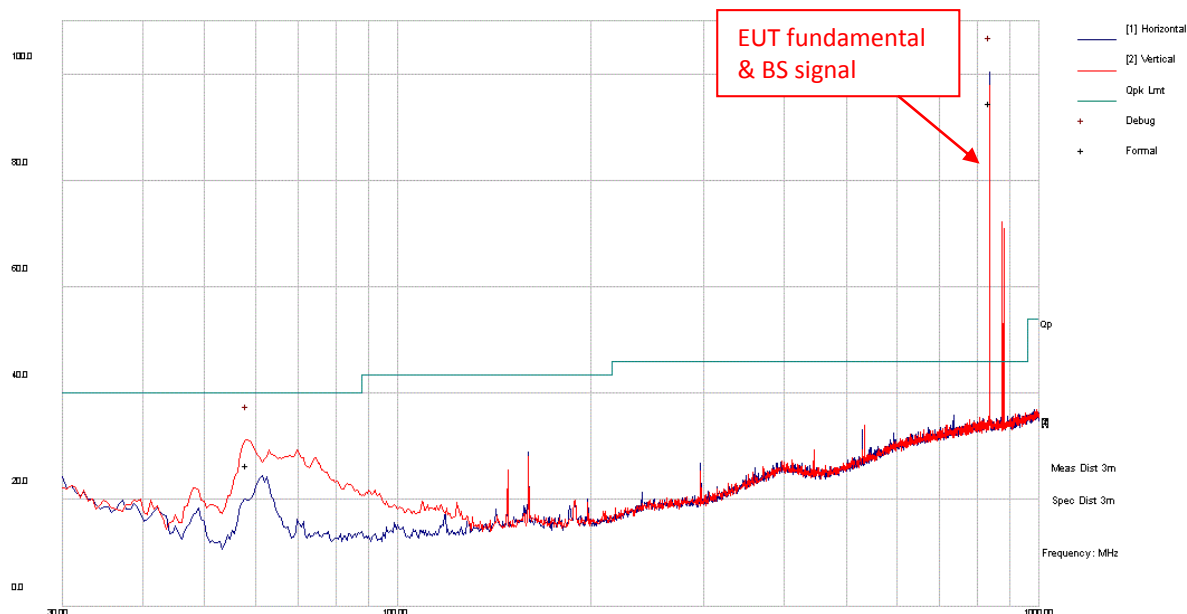
RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	15.247, RSS-247	Mode:	BLE+GSM B5
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

dBuV/m

Vasona by EMIsoft

19 May 20 11:34 --



Radiated Emissions

Template: FCC Class B (3m) 30MHz-1GHz

Filename: c:\users\camara\google drive\2020\gl-20042831-lc-testing labs\foe\sed\testing\test results\re (radiated emission)\below 1ghz\01_RE-BLE-GSM B2-Below 1GHz_emi

120

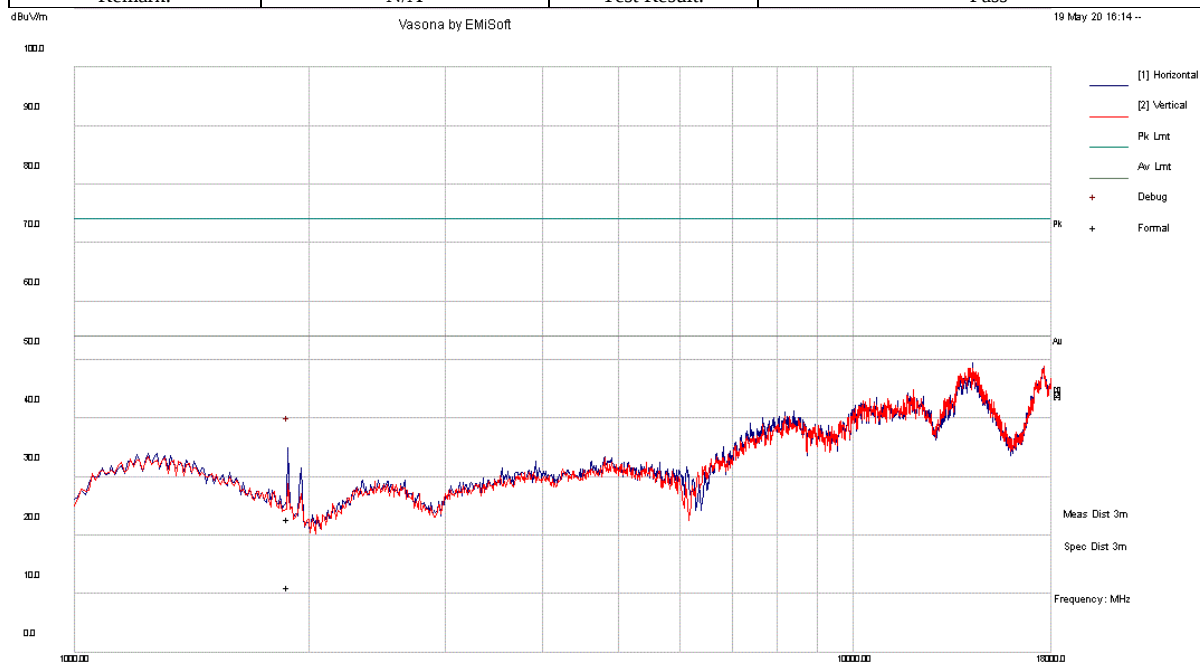
Res BW 1Hz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
836.929	94.2	7.4	-6.9	94.7	Quasi Max	H	106	145	46	48.7	N/A
58.34	48.6	3	-25	26.5	Quasi Max	V	100	261	40	-13.5	Pass

Note: Frequency at around 835MHz is EUT fundamental emission.

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, RSS-247	Mode:	BLE+GSM B2
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz

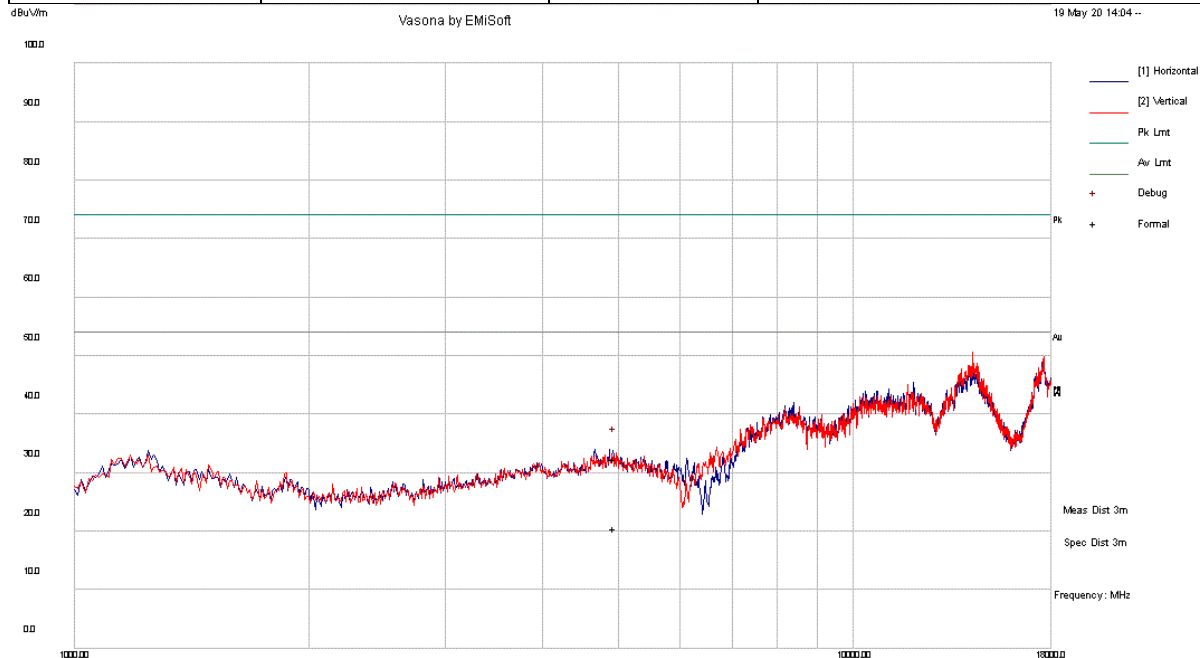
Filename: c:\users\camara\google drive\2020\glis-20042831-lc-testing labs\foosjed\testing\test results\re (radiated emission)\above 1ghz\02_RE-BLE-GSM B5-Above 1GHz_emi

Res BW 1Hz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1882.749	29.9	14.4	-21.5	22.7	Peak Max	V	353	52	74	-51.3	Pass
1882.749	18.2	14.4	-21.5	11.1	Average Max	V	353	52	54	-42.9	Pass

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, RSS-247	Mode:	BLE+LTE B2
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz

Filename: c:\users\camara\google drive\2020\glis-20042831-lc\testing labs\foosjed\testing\test results\re (radiated emission)\above 1ghz\03_RE-BLE-LTE B2-Above 1GHz_emi

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
4936.532	28.3	17.4	-13.3	32.4	Peak Max	V	392	334	74	-41.6	Pass
4936.532	16.4	17.4	-13.3	20.5	Average Max	V	392	334	54	-33.5	Pass

18GHz – 25GHz test result

Note: no substantial emission is found other than the noise floor.
Different modes have been verified.

7.2 Strength of Spurious Radiation

7.2.1 Requirement

§ 2.1051, 22.917(a), 24.238(a), 27.53 (f), (g), (h) and (c)(2) and (5)

RSS-130(4.7.1) and (4.7.2), RSS-132(5.5), RSS-133(6.5), RSS-139(6.6)

FCC 47 CFR Part 22, Clause 22.917 (a) and FCC 47 CFR Part 24, Clause 24.238 (a)

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

FCC 47 CFR Part 27, Clause 27.53 (c)(2) and (5)

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

FCC 47 CFR Part 27, Clause 27.53 (f)

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

FCC 47 CFR Part 27, Clause 27.53 (g)

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

FCC 47 CFR Part 27, Clause 27.53 (h)

(h) AWS emission limits — (1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

FCC 47 CFR Part 90, Clause 90.691

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

RSS-130, Clause 4.7.1 and 4.7.2

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746- 756 MHz and 777-787 MHz shall also comply with the following restrictions:

a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

- (i) $76 + 10 \log_{10} p$ (watts), dB, for base and fixed equipment, and
- (ii) $65 + 10 \log_{10} p$ (watts), dB, for mobile and portable equipment.

b) The e.i.r.p. in the band 1559-1610 MHz shall not exceed -70 dBW/MHz for wideband signal and 80 dBW for discrete emission with bandwidth less than 700 Hz.

RSS-132, Clause 5.5

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

- (i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).
- (ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

RSS-133, Clause 6.5.1

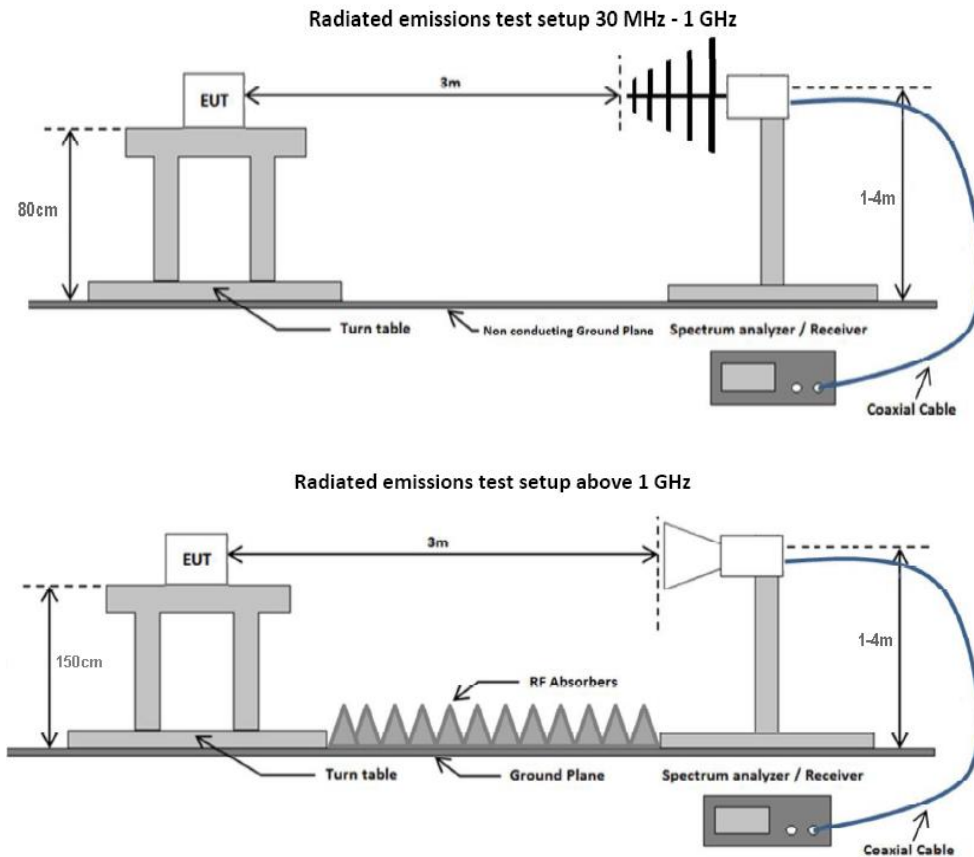
Equipment shall comply with the limits in (i) and (ii) below.

- (i) In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts).
- (ii) After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} p$ (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

RSS-139, Clause 6.6

- (i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.
- (ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

7.2.2 Test setup



7.2.3 Test Procedure

ANSI C63.26: 2015 section 5.5

KDB 971168 D01 Power Meas License Digital Systems v03r01 section 7

Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

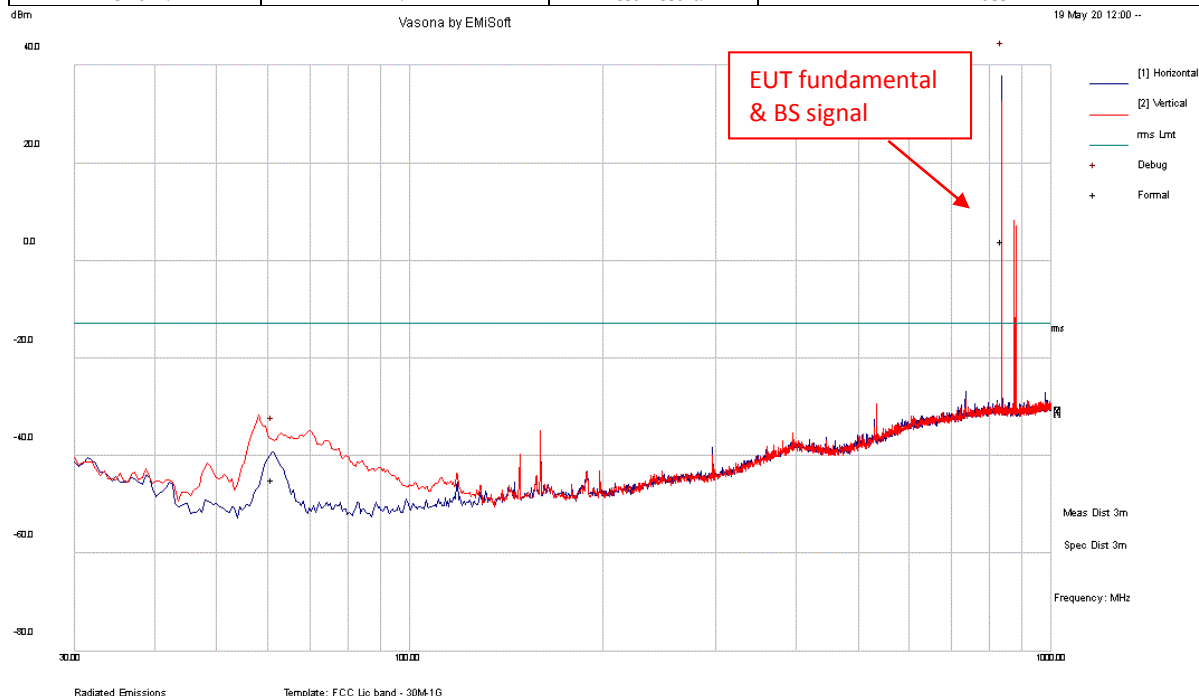
1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.

5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

7.2.4 Test Result

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 22 & RSS 132	Mode:	BLE+GSM B5
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

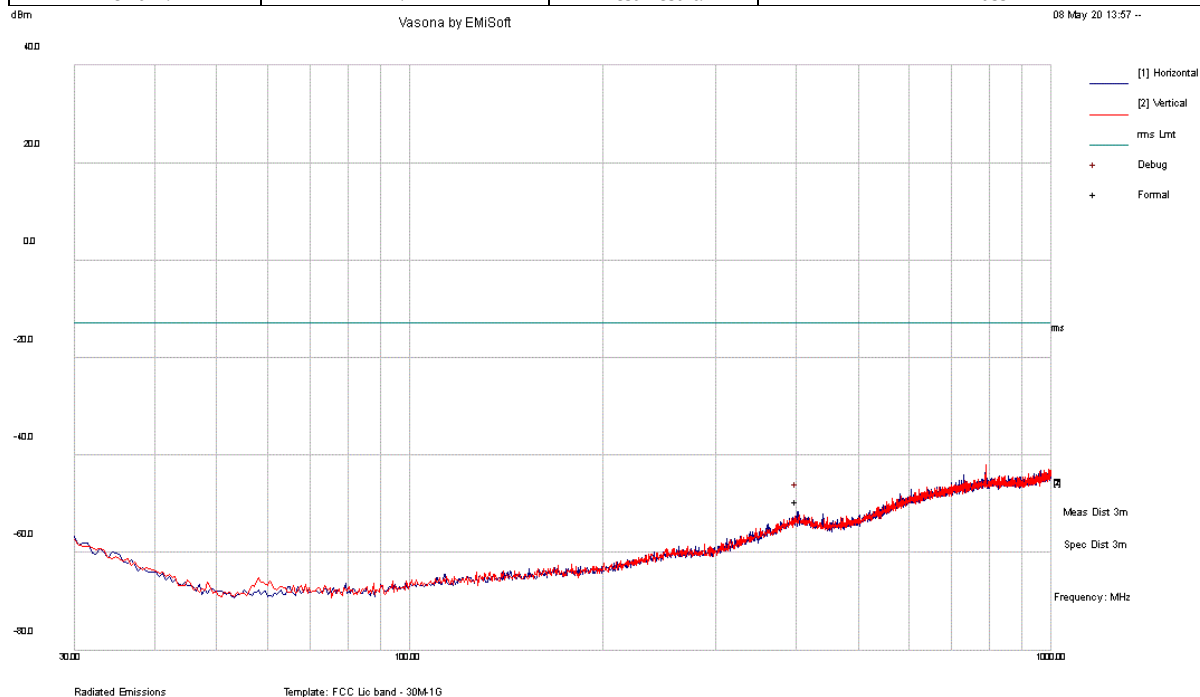


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
837.067	-38.7	19.2	23.6	4	RMS Max	H	182	332	-13	17	N/A
61.071	-66.1	14.8	6.6	-44.8	RMS Max	V	124	113	-13	-31.8	Pass

Note: Frequency at around 835MHz is EUT fundamental emission.

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 24E & RSS 133	Mode:	BLE+LTE CAT-M1 B2
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



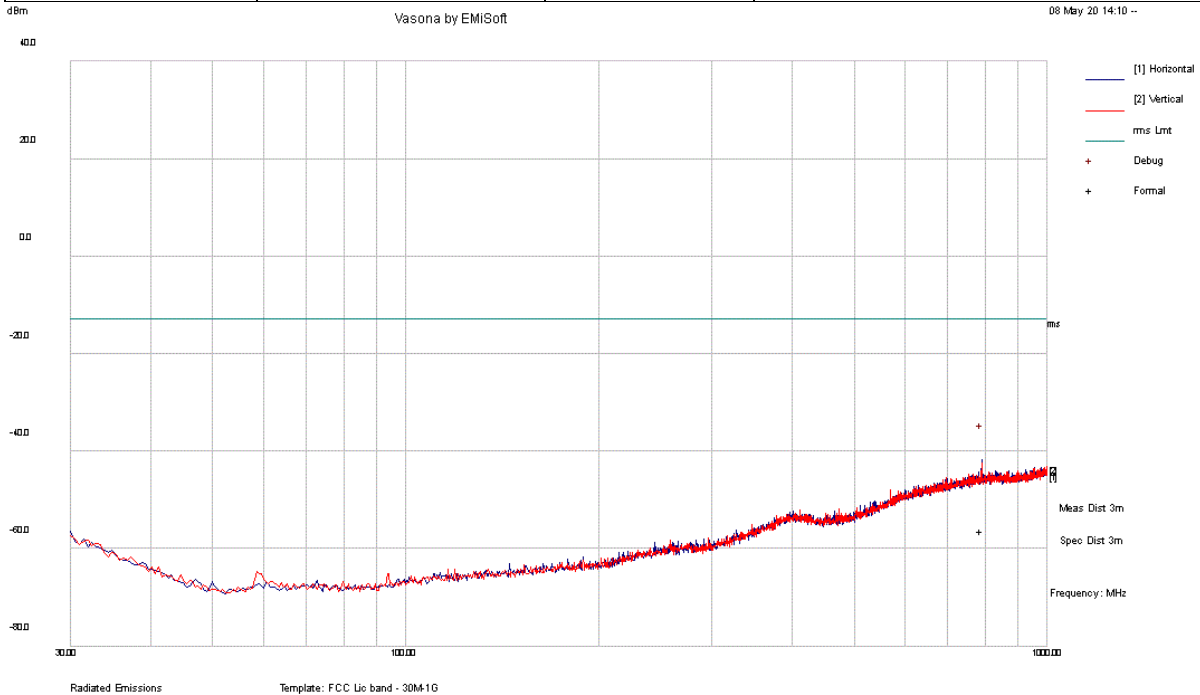
Radiated Emissions Template: FCC Uic band - 30M-1G

100	Res BW [Hz]
-----	-------------

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
400.531	-85.7	18.1	18.1	-49.5	RMS Max	V	264	106	-13	-36.5	Pass

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 27 & RSS 139	Mode:	BLE+LTE CAT-M1 B4
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Radiated Emissions

Template: FCC Uic band - 30M-1G

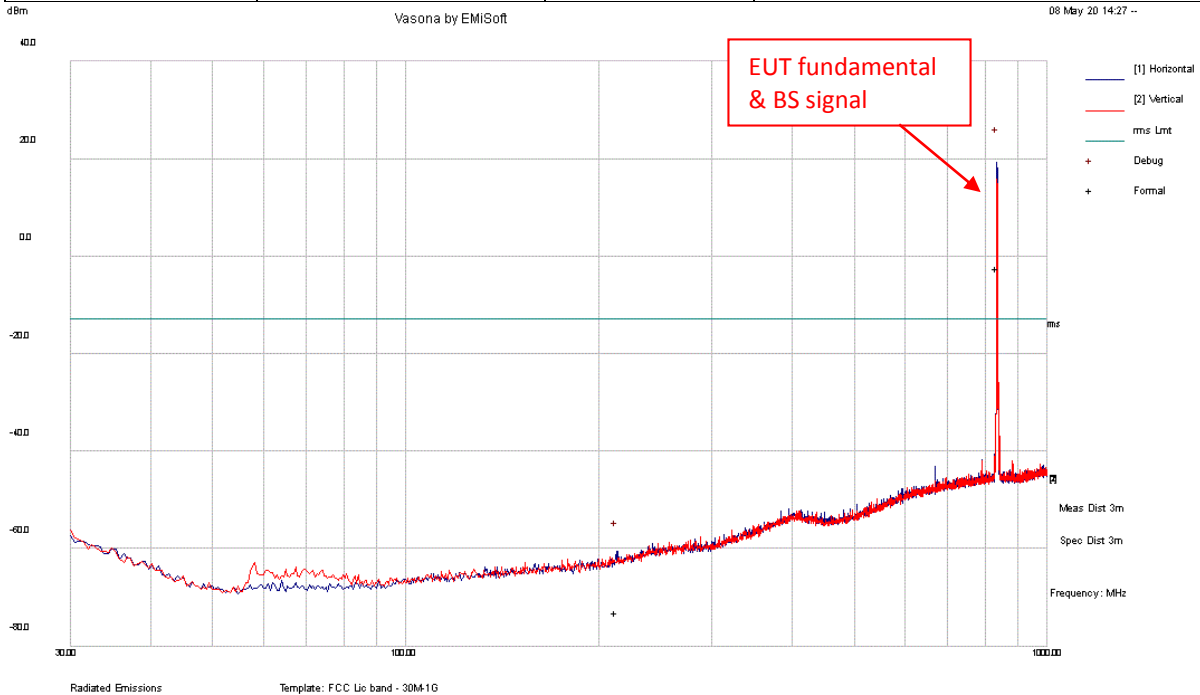
100

Res BW 10Hz

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
790.139	-98.9	19	23.7	-56.2	RMS Max	H	161	212	-13	-43.2	Pass

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 22 & RSS 132	Mode:	BLE+LTE CAT-M1 B5
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

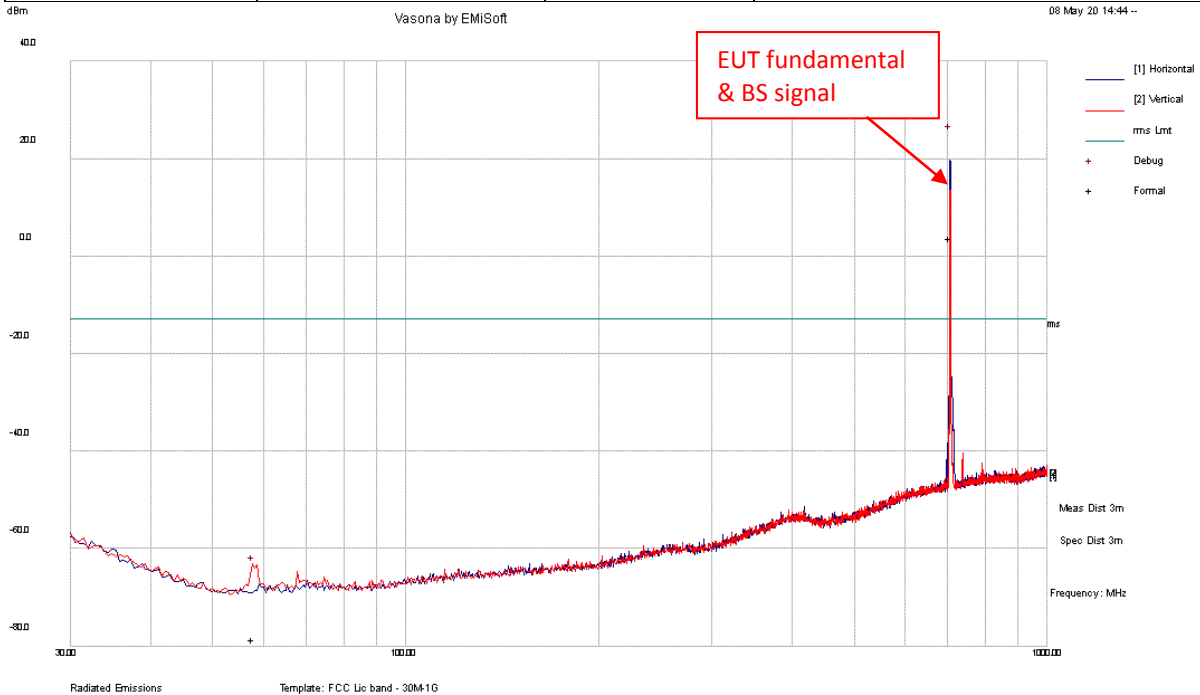


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
835.186	-45.2	19.1	23.6	-2.5	RMS Max	H	153	153	-13	10.5	N/A
212.317	-100.3	16.6	10.6	-73	RMS Max	H	108	315	-13	-60	Pass

Note: Frequency at around 835MHz is EUT fundamental emission.

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE CAT-M1 B12
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

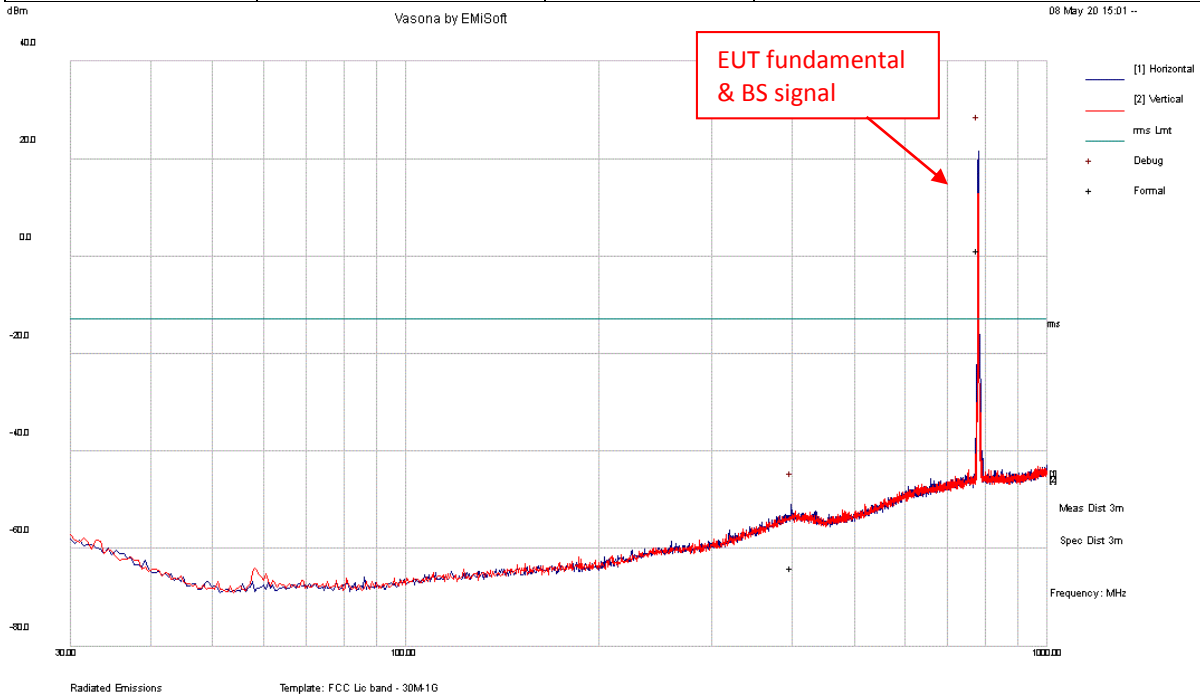


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
705.61	-37.9	19.1	22.7	3.9	RMS Max	H	128	212	-13	16.9	N/A
57.774	-99.6	14.7	6.4	-78.4	RMS Max	V	283	56	-13	-65.4	Pass

Note: Frequency at around 700 MHz is EUT fundamental emission.

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE CAT-M1 B13
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

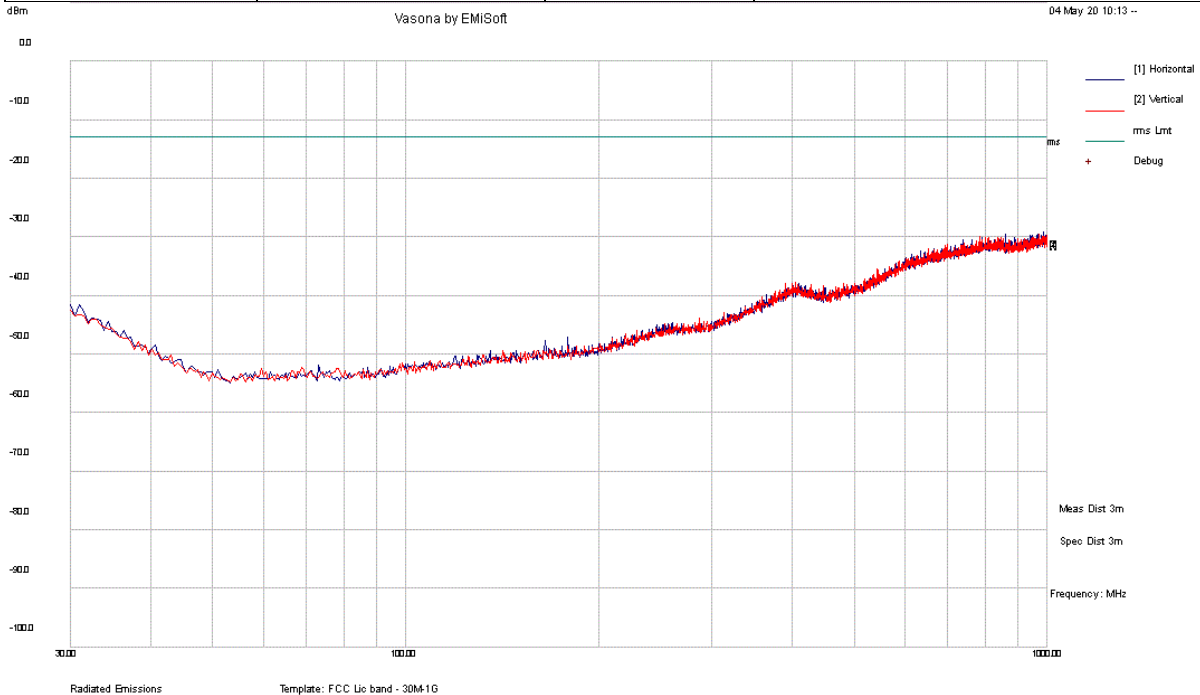


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
780.65	-41.3	19	23.6	1.3	RMS Max	H	340	108	-13	14.3	N/A
399.04	-100.1	18.1	18.1	-63.9	RMS Max	H	231	0	-13	-50.9	Pass

Note: Frequency at around 780 MHz is EUT fundamental emission.

RADIATED EMISSIONS BELOW 1 GHZ

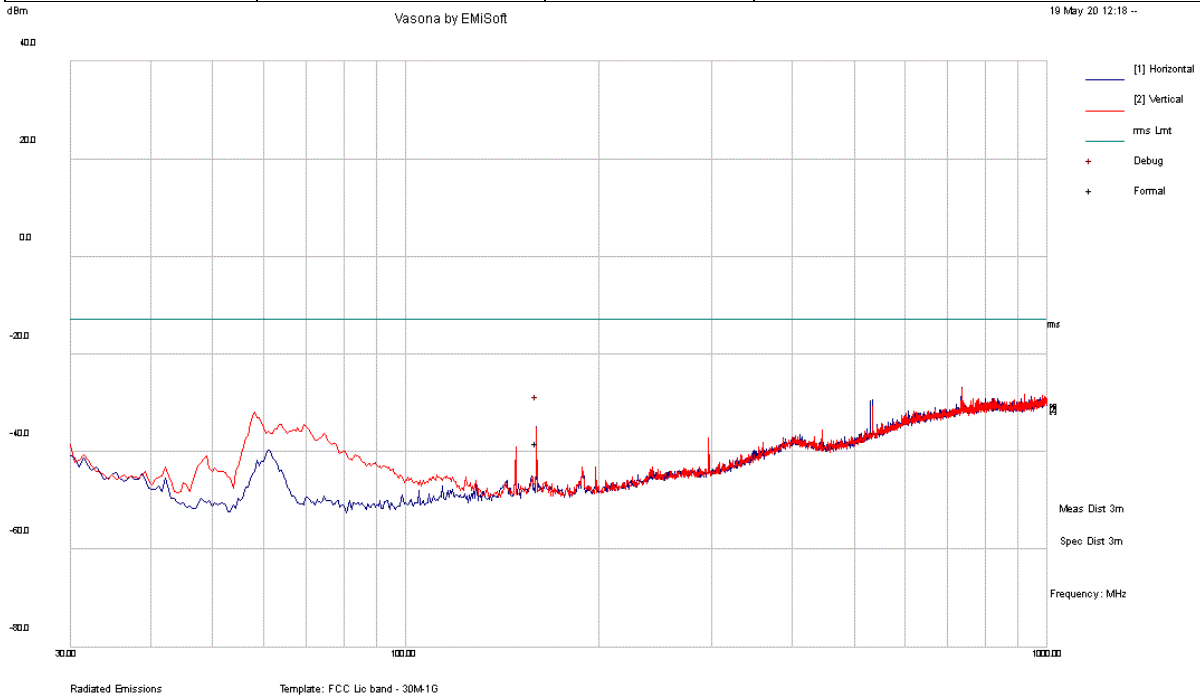
Test Standard:	Part 90	Mode:	BLE+LTE CAT-M1 B26
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
708.21	-80.3	19	23.6	-37.7	RMS Max	H	340	108	-13	-24.7	N/A

RADIATED EMISSIONS BELOW 1 GHZ

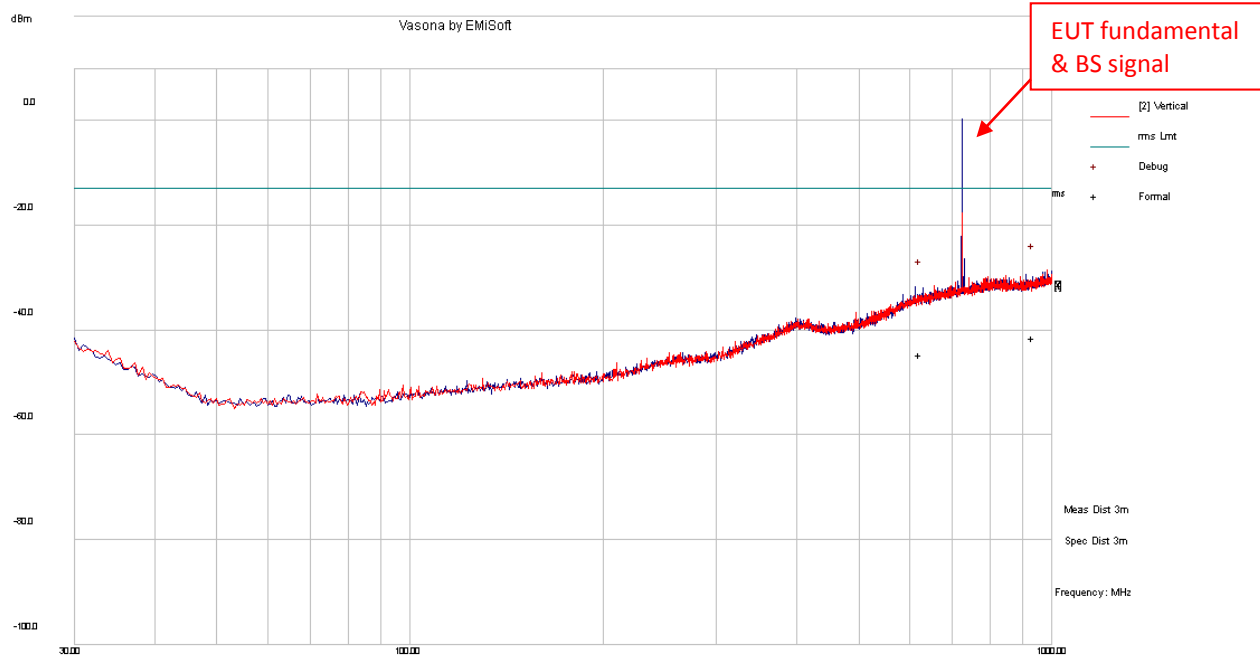
Test Standard:	Part 24E & RSS 133	Mode:	BLE+LTE NB-IOT B2
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
159.993	-63.7	16.1	9.4	-38.2	RMS Max	V	258	311	-13	-25.2	Pass

RADIATED EMISSIONS BELOW 1 GHz

Test Standard:	Part 27& RSS 130	Mode:	BLE+LTE NB-IOT B12
Frequency Range:	30 MHz - 1 GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



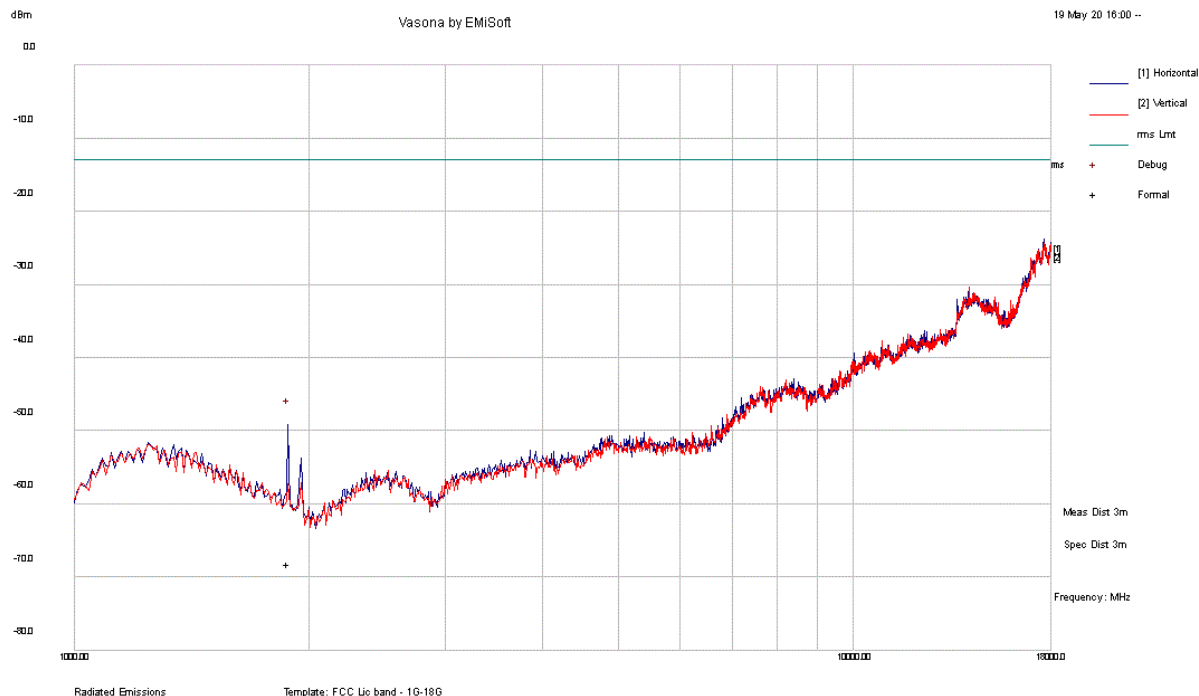
Filename: c:\program files (x86)\emisoft - vasona\19110409.emi

Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
932.28	-84.61	19.51	23.63	-41.47	RMS	V	187	136	-13.00	-28.47	Pass
621.82	-84.90	18.97	21.45	-44.48	RMS	V	286	160	-13.00	-31.48	Pass

Note: Frequency at around 700 MHz is EUT fundamental emission.

RADIATED EMISSIONS 1 - 18 GHZ

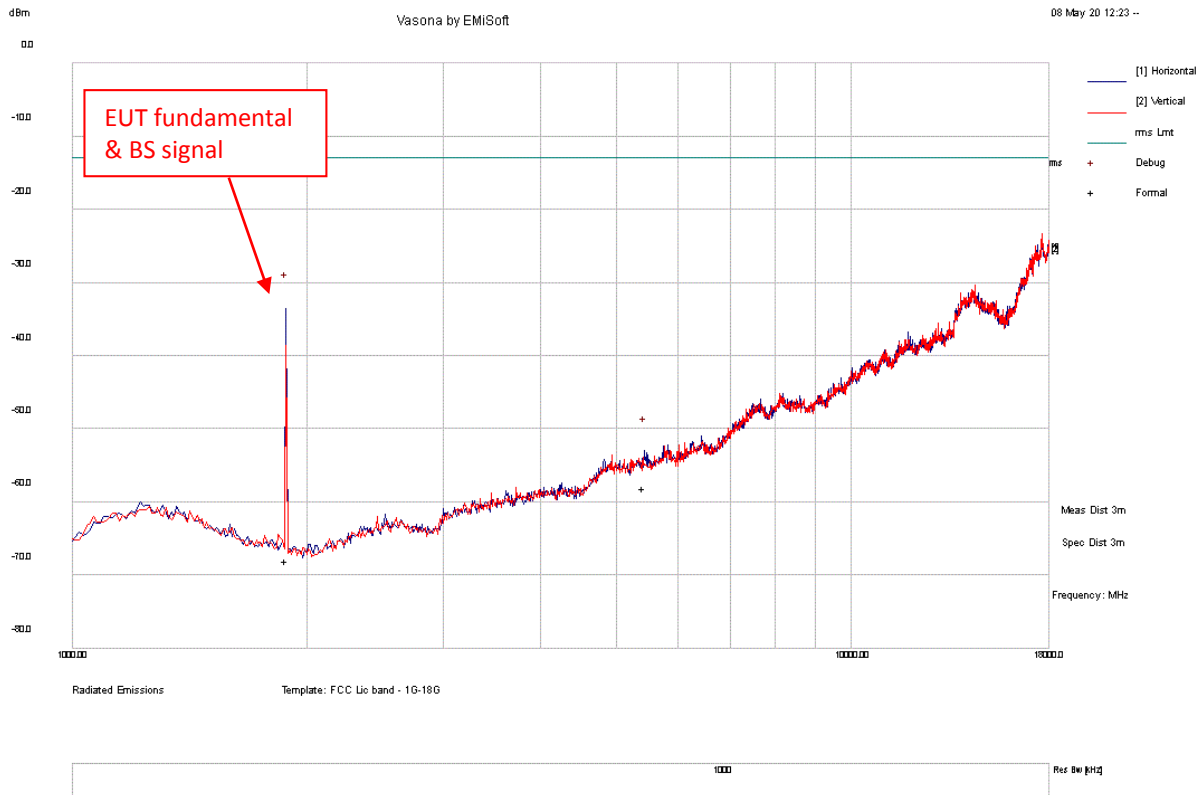
Test Standard:	Part 22 & RSS 132	Mode:	BLE+GSM B5
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
1883.869	-82.8	16.2	-1.6	-68.2	RMS Max	H	329	289	-13	-55.2	Pass

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	Part 24E & RSS 133	Mode:	BLE+LTE CAT-M1 B2
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

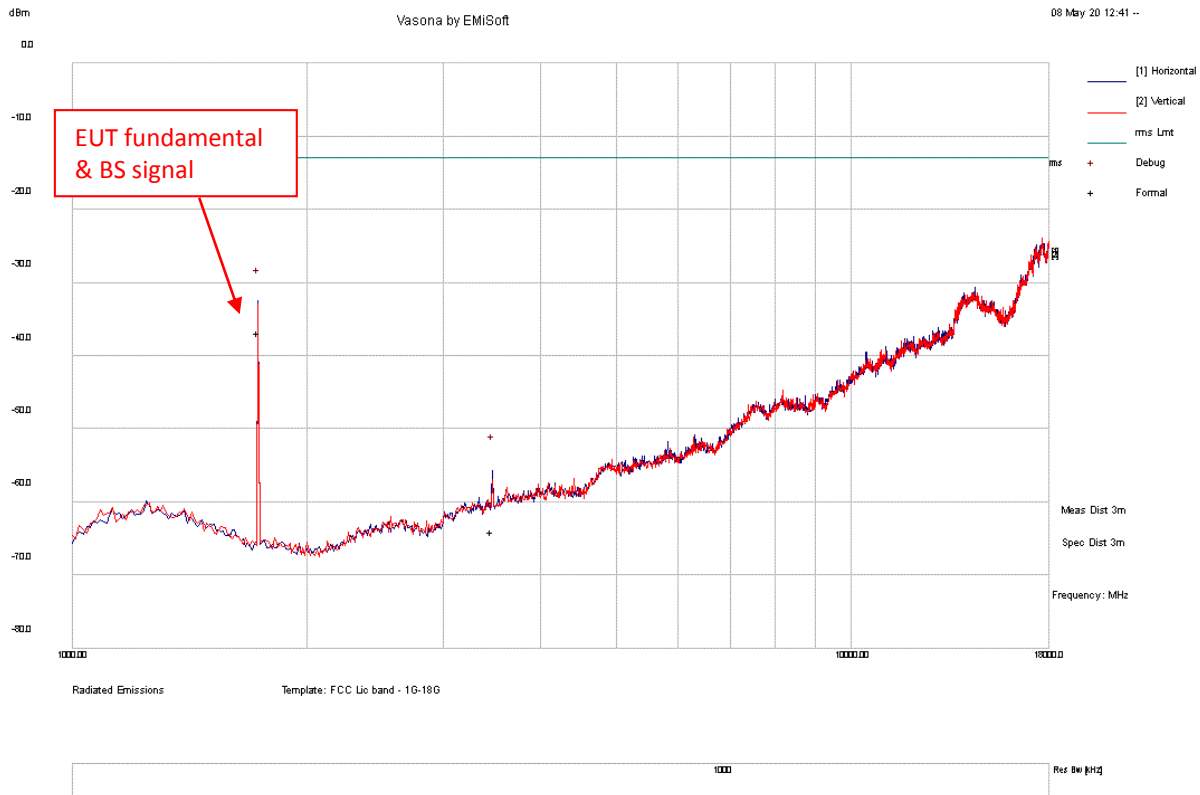


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
1879.917	-82.8	16.2	-1.5	-68.1	RMS Max	H	100	0	-13	-55.1	N/A
5430.079	-84.3	18.6	7.6	-58	RMS Max	H	185	146	-13	-45	Pass

Note: Frequency at around 1900 MHz is EUT fundamental emission.

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	Part 27 & RSS 139	Mode:	BLE+LTE CAT-M1 B4
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

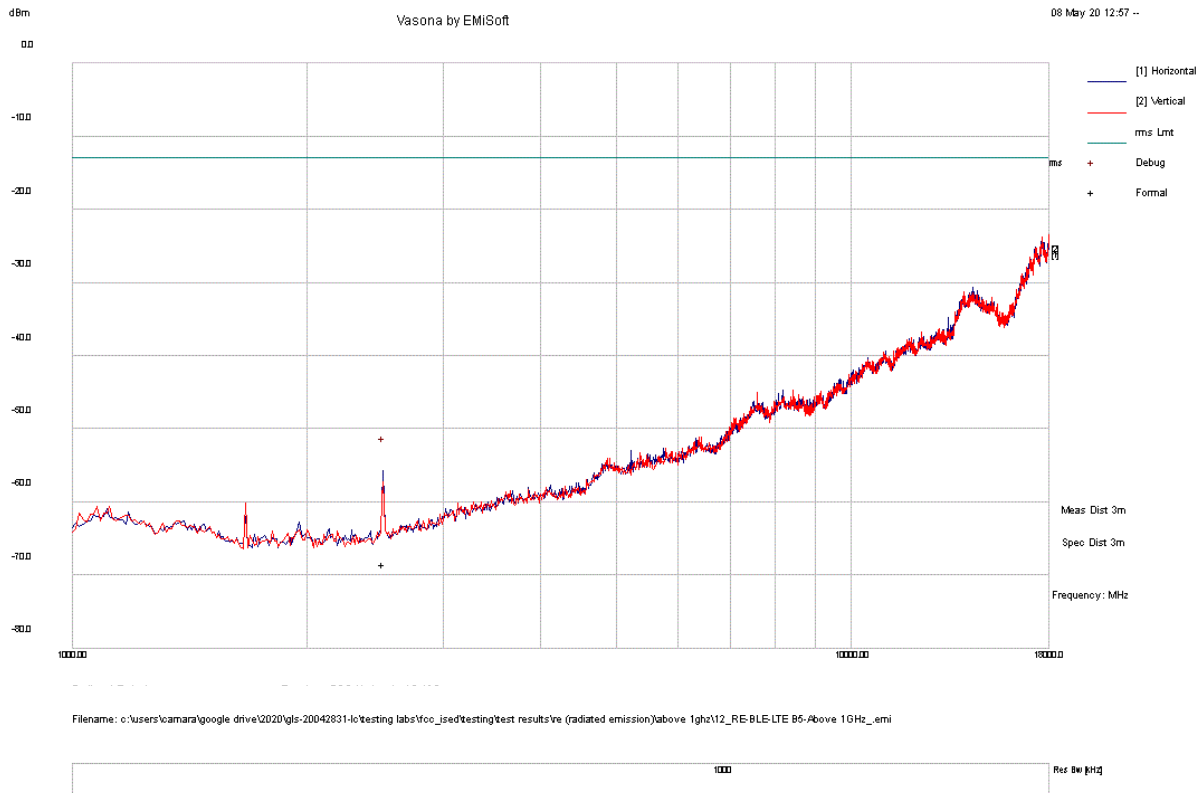


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
1731.275	-50.6	16.2	-2.4	-36.7	RMS Max	H	171	188	-13	-23.7	N/A
3463.409	-83.6	17.6	2	-64	RMS Max	H	172	74	-13	-51	Pass

Note: Frequency at around 1700 MHz is EUT fundamental emission.

RADIATED EMISSIONS 1 - 18 GHZ

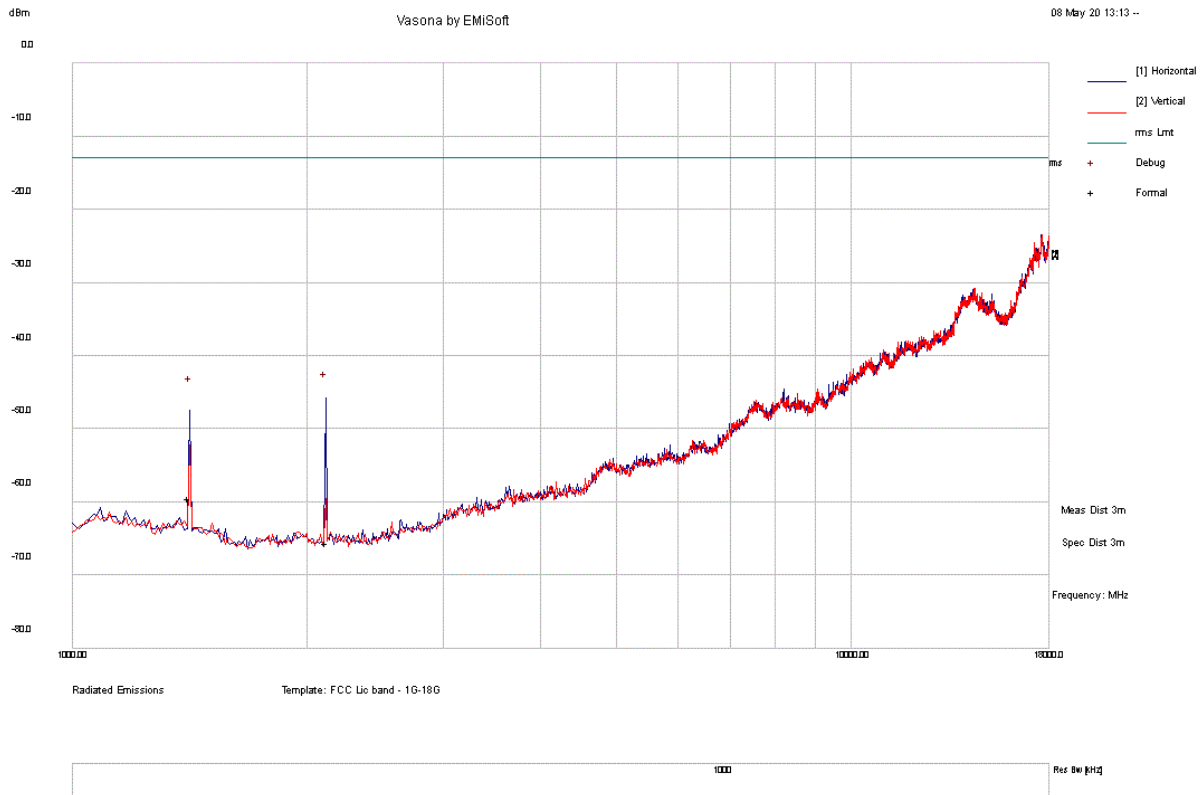
Test Standard:	Part 22 & RSS 132	Mode:	BLE+LTE CAT-M1 B5
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
2506.047	-83.3	16.7	-1.8	-68.4	RMS Max	H	364	304	-13	-55.4	Pass

RADIATED EMISSIONS 1 - 18 GHZ

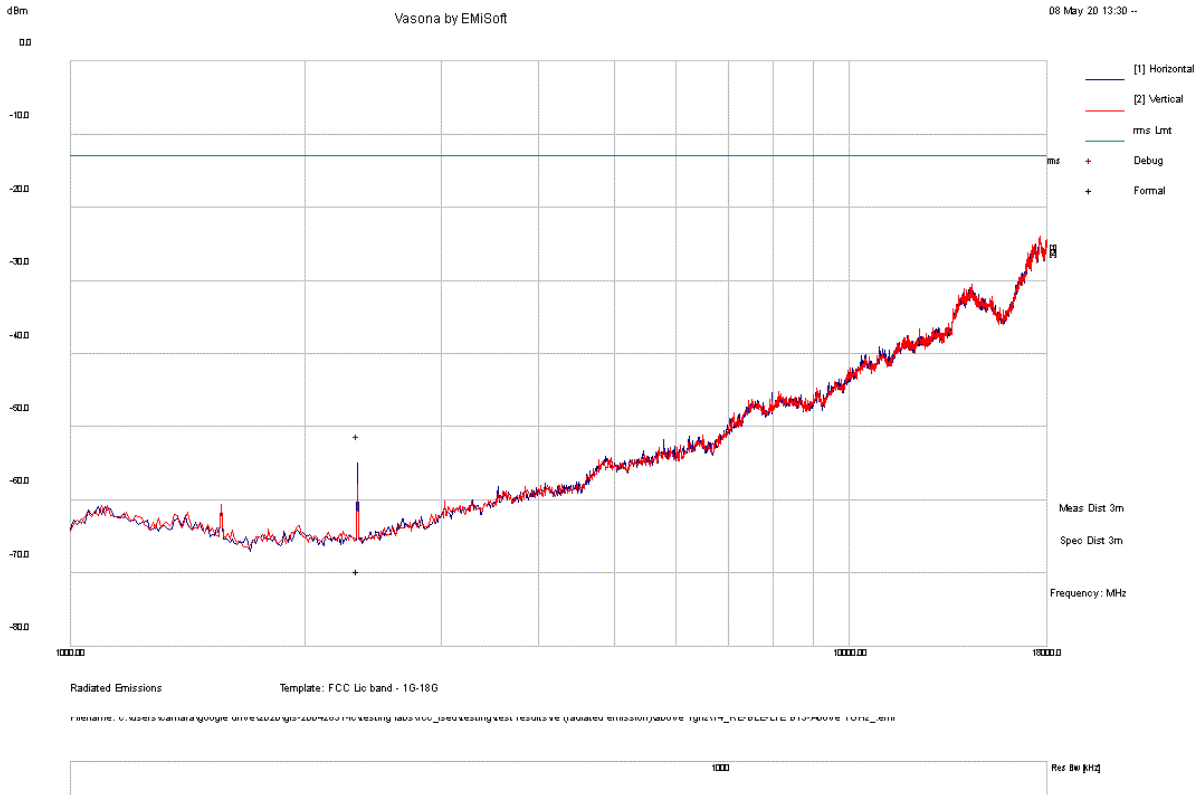
Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE CAT-M1 B12
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
2116.767	-79.5	16.3	-2.4	-65.5	RMS Max	H	190	48	-13	-52.5	Pass
1412.568	-74.8	16.1	-0.8	-59.5	RMS Max	H	158	0	-13	-46.5	Pass

RADIATED EMISSIONS 1 - 18 GHZ

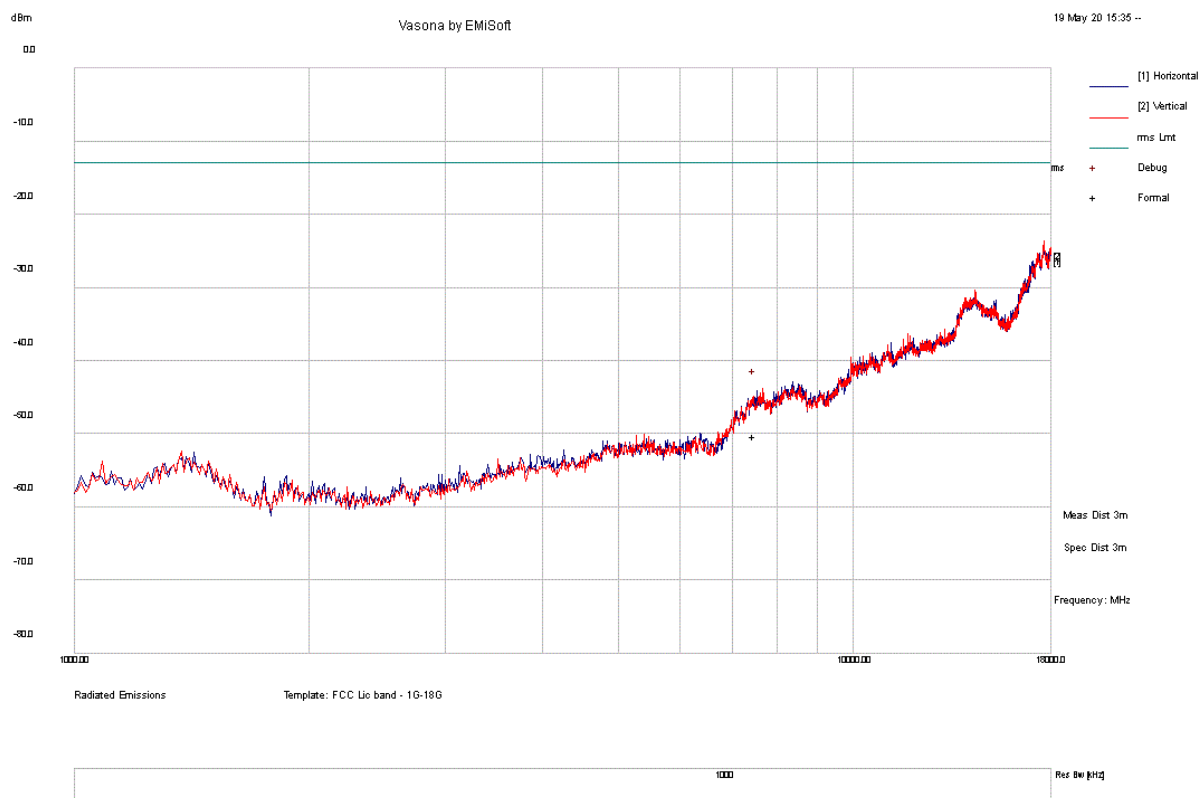
Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE CAT-M1 B13
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
2339.66	-83.9	16.5	-2.2	-69.6	RMS Max	H	366	14	-13	-56.6	Pass

RADIATED EMISSIONS 1 - 18 GHZ

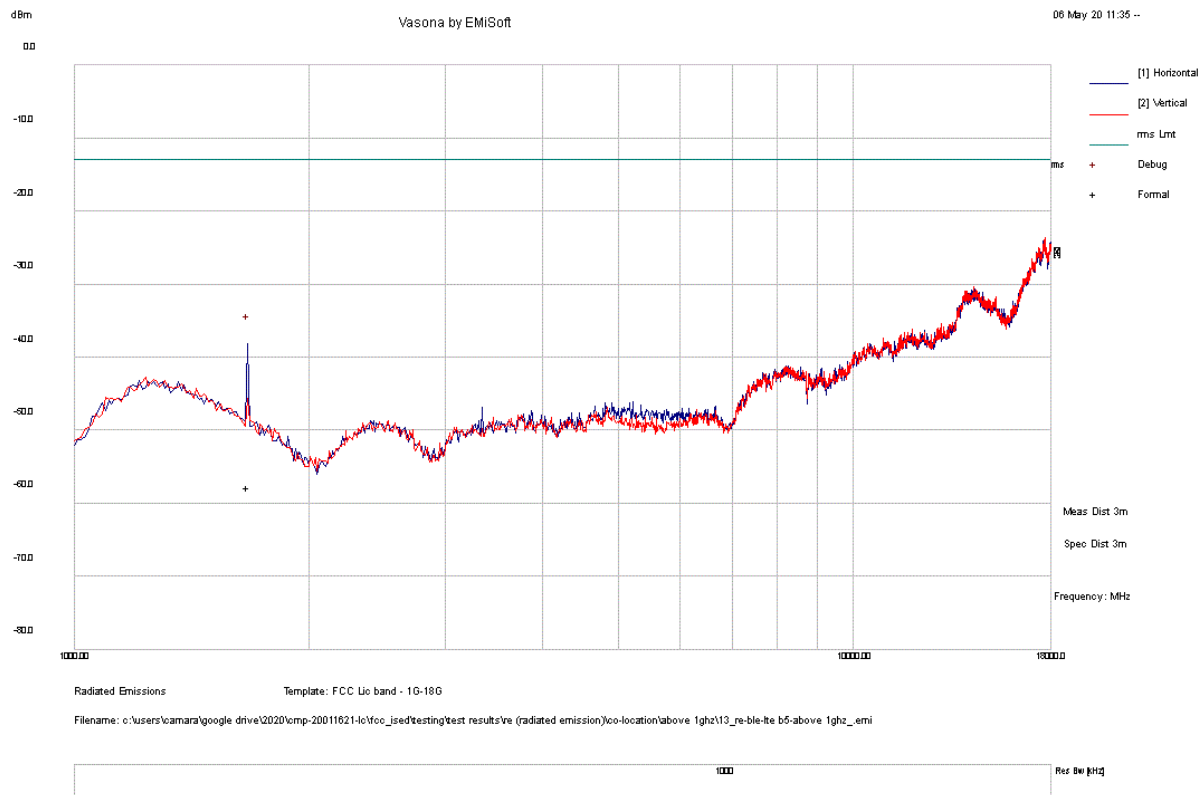
Test Standard:	Part 90	Mode:	BLE+LTE CAT-M1 B26
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
7463.595	-84.1	21.5	12.4	-50.2	RMS Max	V	209	256	-13	-37.2	Pass

RADIATED EMISSIONS 1 - 18 GHZ

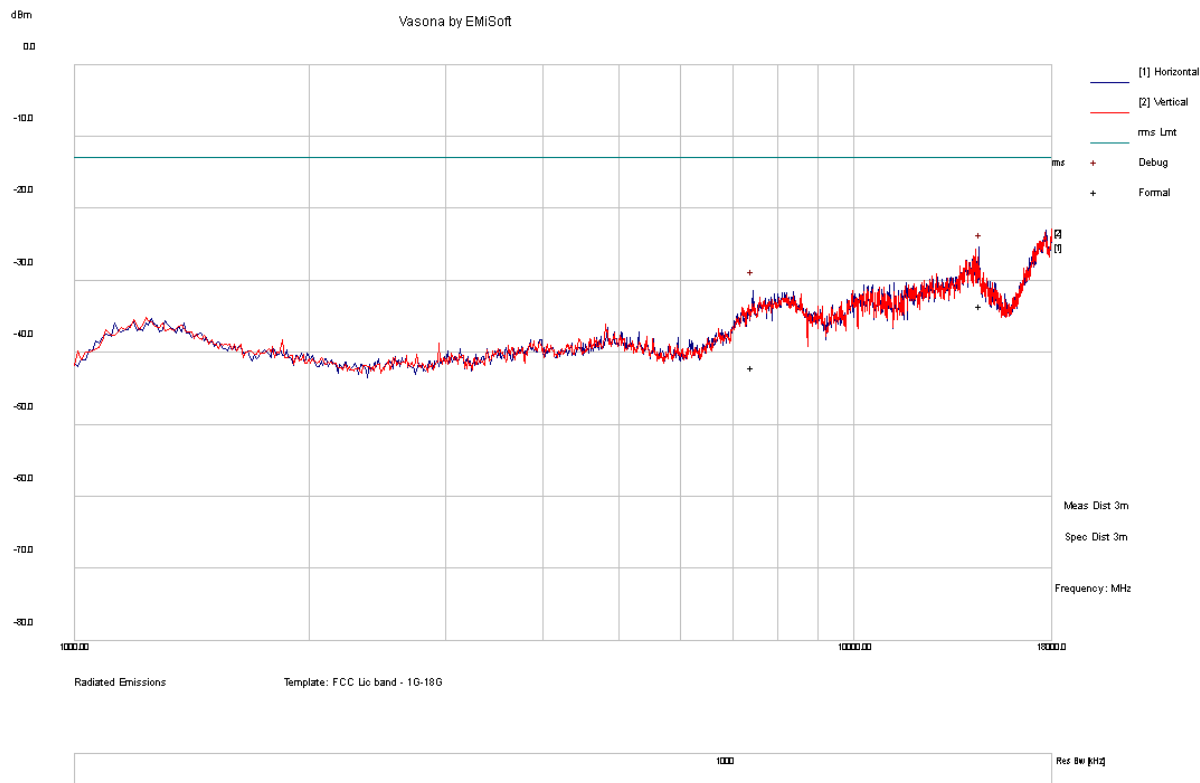
Test Standard:	Part 22 & RSS 132	Mode:	BLE+LTE NB-IOT B5
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
1669.281	-71.4	16.2	-2.5	-57.7	RMS Max	V	400	229	-13	-44.7	Pass

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE NB-IOT B12
Frequency Range:	1 GHz – 18GHz	Test Date:	04/28/2020-06/03/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
14556.53	-81.19	26.79	20.88	-33.52	RMS Max	V	218	242	-13.00	-20.52	Pass
7411.30	-75.71	21.38	12.32	-42.01	RMS Max	V	285	164	-13.00	-29.01	Pass

18GHz – 40GHz test result

Note: no substantial emission is found other than the noise floor.
Different modes have been verified.

8 EUT and Test Setup Photos

See FCC exhibits

9 Test Instrument List

Equipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/19	10/18/20
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	6/17/19	6/17/20
EMC Test Receiver	R&S	ESL6	100230	6/14/19	6/14/20
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	5/4/20	5/4/21
Bi-Log Antenna	ETS-Lindgren	3142E	217921	11/15/2019	11/15/2020
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	5/14/2020	5/14/2021
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	6/24/19	6/24/20
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	7/15/2019	7/15/2020
True RMS Multi-meter	UNI-T	UT181A	C173014829	5/5/2020	5/5/2021
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	5/15/2020	5/15/2021
RF Attenuator	Pasternack	PE7005-3	VL061	7/16/2019	7/16/2020
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	7/16/2019	7/16/2020
EM Center Control	ETS-Lindgren	7006-001	160136	N/A	N/A
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A	N/A
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	5/16/20	5/16/21
RE test cable(below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	7/16/2019	7/16/2020
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	7/16/2019	7/16/2020
RE test cable (>18GHz)	Sucoflex	104	344903/4	7/16/2019	7/16/2020
Pulse limiter	Com-Power	LIT-930A	531727	7/16/2019	7/16/2020
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	7/16/2019	7/16/2020
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	7/16/2019	7/16/2020
Wideband Communication	ANRITSU	MT8821C	6262010316	10/23/2019	10/23/2020
Wideband Communication	R&S	CMW500	147508	5/8/2020	5/8/2021