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FCC ISED RF Test Report

Test Report Number	CMP-20011621-LC-FCC-IC-PCB
FCC ID	APV-3640MB
ISED ID	5843C-3640MB
Applicant	CalAmp
Applicant Address	2177 Salk Ave, Suite 200, Carlsbad, CA 92008 USA
Product Name	Fleet Management and Tracking Device
Model (s)	LMU3640MB
Date of Receipt	04/20/2020
Date of Test	04/20/2020-05/08/2020
Report Issue Date	05/19/2020
Test Standards	47CFR Part 22 47CFR Part 24 47CFR Part 27 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)

David Zhang (Technical Manager)

REVISION HISTORY

Report Number	Version	Description	Issued Date
CMP-20011621-LC-FCC-IC-PCB	01	Initial report	05/19/2020

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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 C63.26: 2015 KDB 971168 D01 Power Meas License Digital Systems v03r01 KDB 412172 D01 Determining ERP and EIRP v01r01	Pass
Field Strength of Spurious Radiation (licensed band)	2.1046 22.917 (a), 24.238 (a), 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	CalAmp
Applicant address	2177 Salk Ave, Suite 200, Carlsbad, CA 92008 USA
Manufacturer	CalAmp
Manufacturer Address	2177 Salk Ave, Suite 200, Carlsbad, CA 92008 USA

2.2 Product information

Product Name	Fleet Management and Tracking Device
Product Description	Fleet Management and Tracking Device
Model Number	LMU3640MB
Family Models	N/A
Serial Number	18CE06601002-0B
Frequency Band	BLE: 2402-2480MHz GSM850: 824.2 - 848.8 MHz GSM1900: 1850.2 - 1909.8 MHz LTE CAT-M1 Band 2: 1850.7-1909.3MHz LTE CAT-M1 Band 4: 1710.7-1754.3MHz LTE CAT-M1 Band 5: 824.7-848.3MHz LTE CAT-M1 Band 12: 699.7-715.3MHz LTE CAT-M1 Band 13: 779.5-784.5 MHz LTE CAT-M1 Band 25: 1850.7 - 1914.3 MHz
Type of modulation	BLE: GFSK GSM: GMSK, 8PSK LTE CAT-M1: QPSK, 16QAM
Equipment Class	DTS, PCB
Antenna Information	Bluetooth ceramic antenna, peak Gain: 1.88dBi; P/N: 1001312 Cellular LPWA antenna: peak gain: 3.1dBi; P/N: 1004795
Clock Frequencies	N/A
Input Power	Vehicle Battery powered: 12-24VDC
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

2.3 Test standard and method

Test standard	47CFR Part 15 Subpart B: 2019 ICES-003 Issue 6: April 2019 47CFR Part 22: 2019 47CFR Part 24: 2019 47CFR Part 27: 2019 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 C63.26: 2015 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

The EUT is an engineering test sample loaded with RF testing firmware specifically designed to support the RF TX/RX measurement in different aspects.

5 Test Configuration and Operation

5.1 EUT Test Configuration

EUT is powered by external DC power supply for testing purpose. 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. For BLE, the test software is used to set EUT to different transmission mode in terms of radio mode, test channel, data rate, etc.

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
Teraterm.exe	To set EUT into continuous TX and RX mode under different modulation, data rate and channel, etc.

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #
12VDC Battery	EverStart	526CCA	JCH20011619127

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

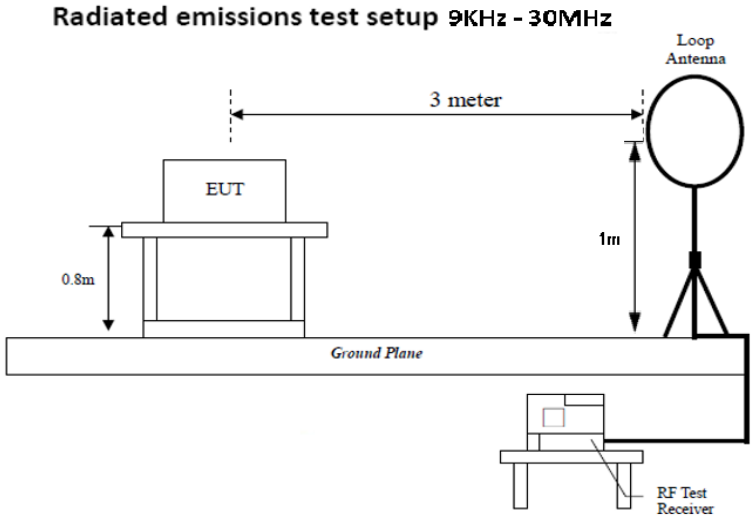
Per § 15.247 (d)

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.

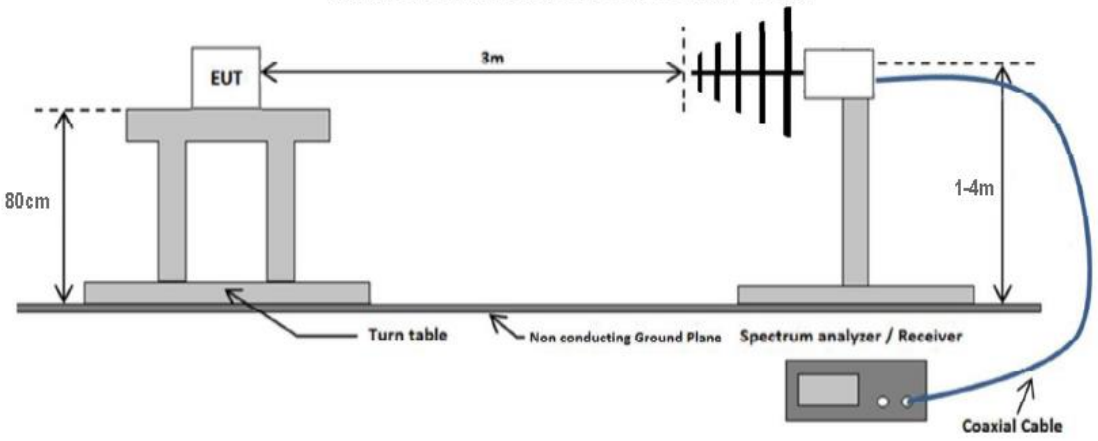
Attenuation below the general limits specified in §15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency range (MHz)	Field Strength (μV/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

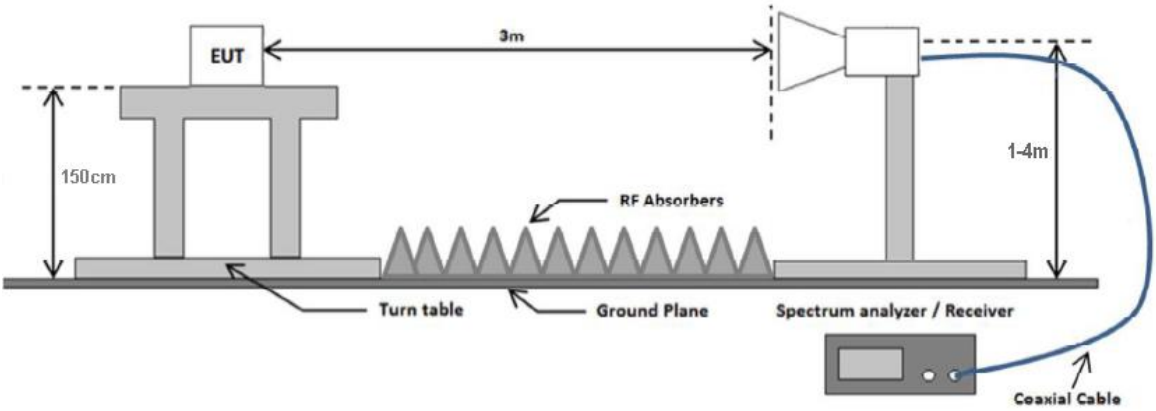
7.1.2 Test setup



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



7.1.3 Test Procedure

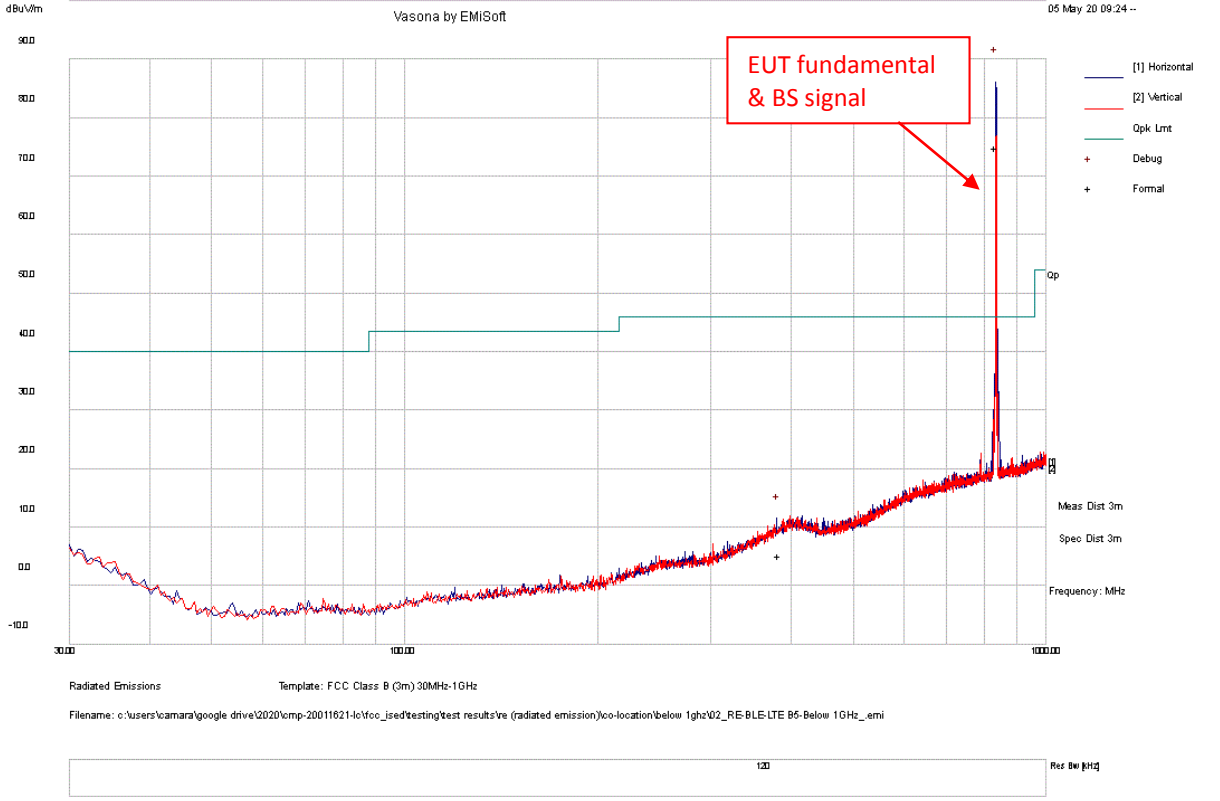
According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r01 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C62.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was 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
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

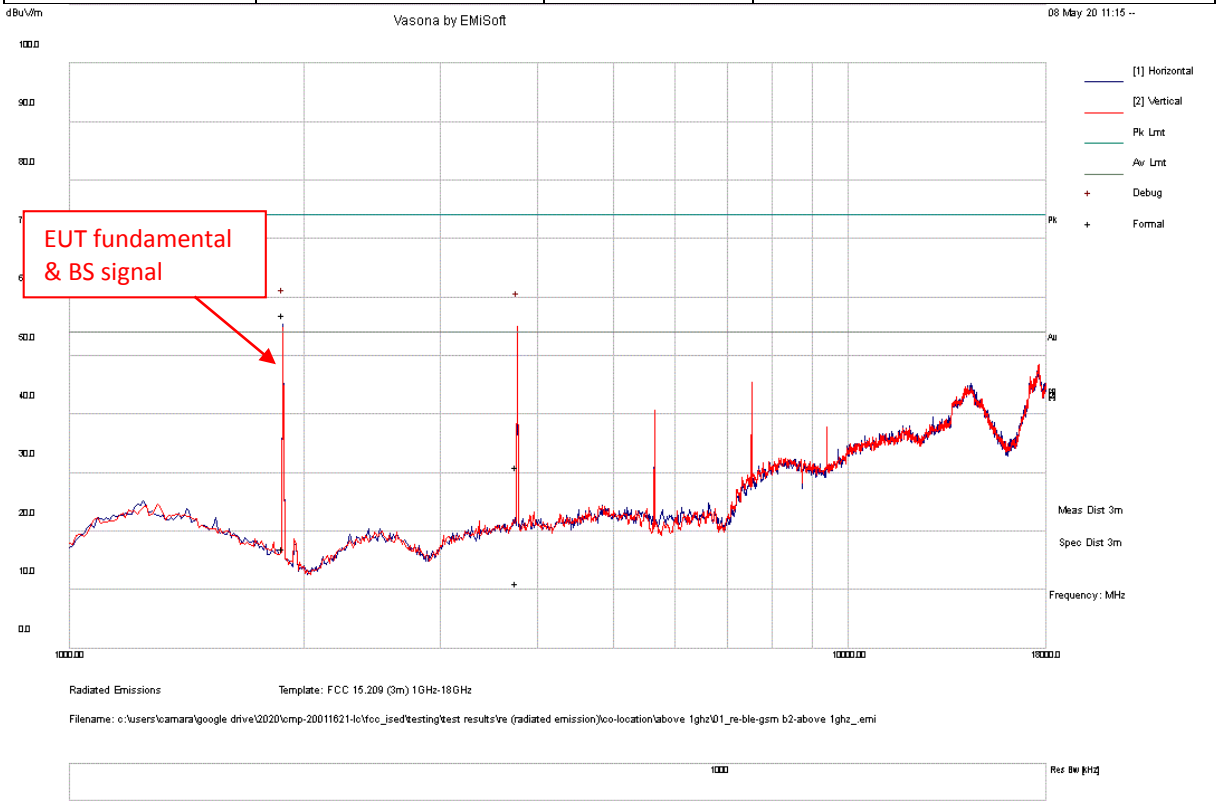


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
834.781	74.4	7.4	-6.9	74.9	Quasi Max	H	342	139	46	28.9	N/A
382.695	12.8	6.3	-14	5.1	Quasi Max	H	100	255	46	-40.9	Pass

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

RADIATED EMISSIONS 1 - 18 GHZ

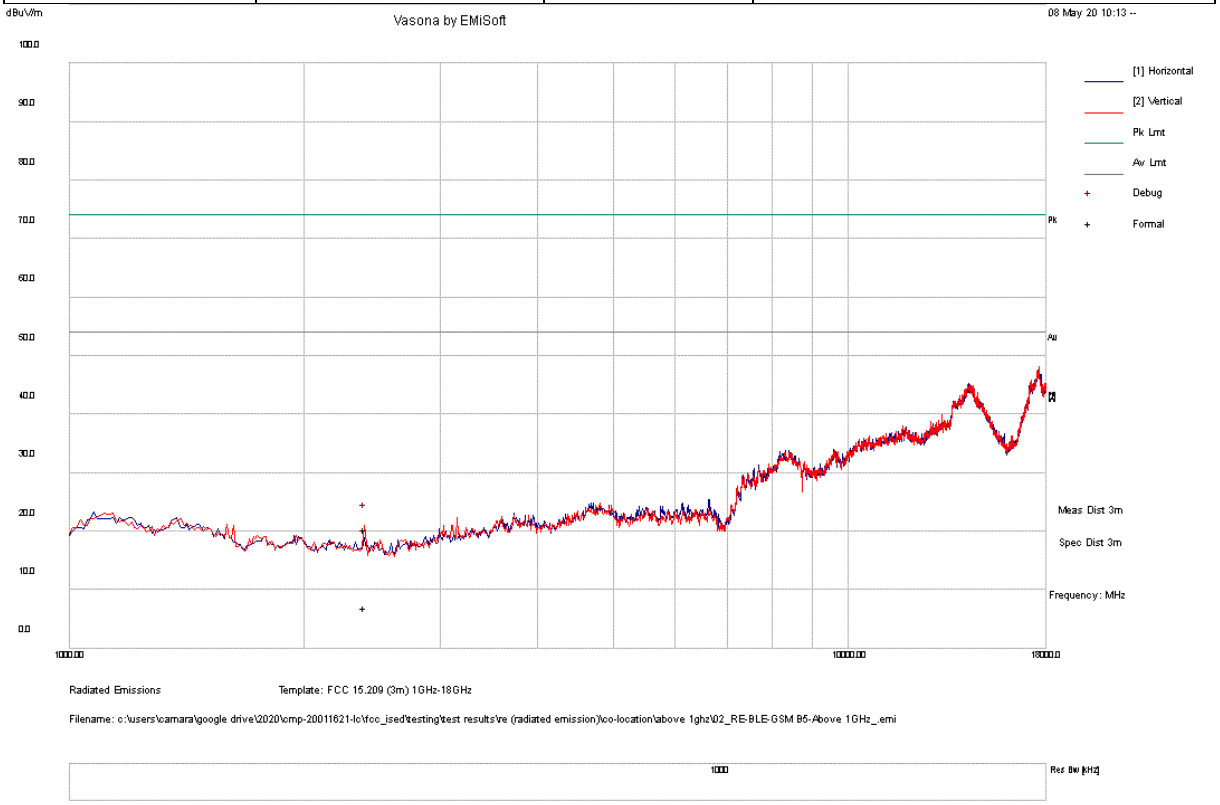
Test Standard:	15.247, RSS-247	Mode:	BLE+GSM B2
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



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
3760.5	31.3	16.4	-16.5	31.1	Peak Max	V	232	32	74	-42.9	Pass
3760.5	11.3	16.4	-16.5	11.1	Average Max	V	232	32	54	-42.9	Pass

RADIATED EMISSIONS 1 - 18 GHZ

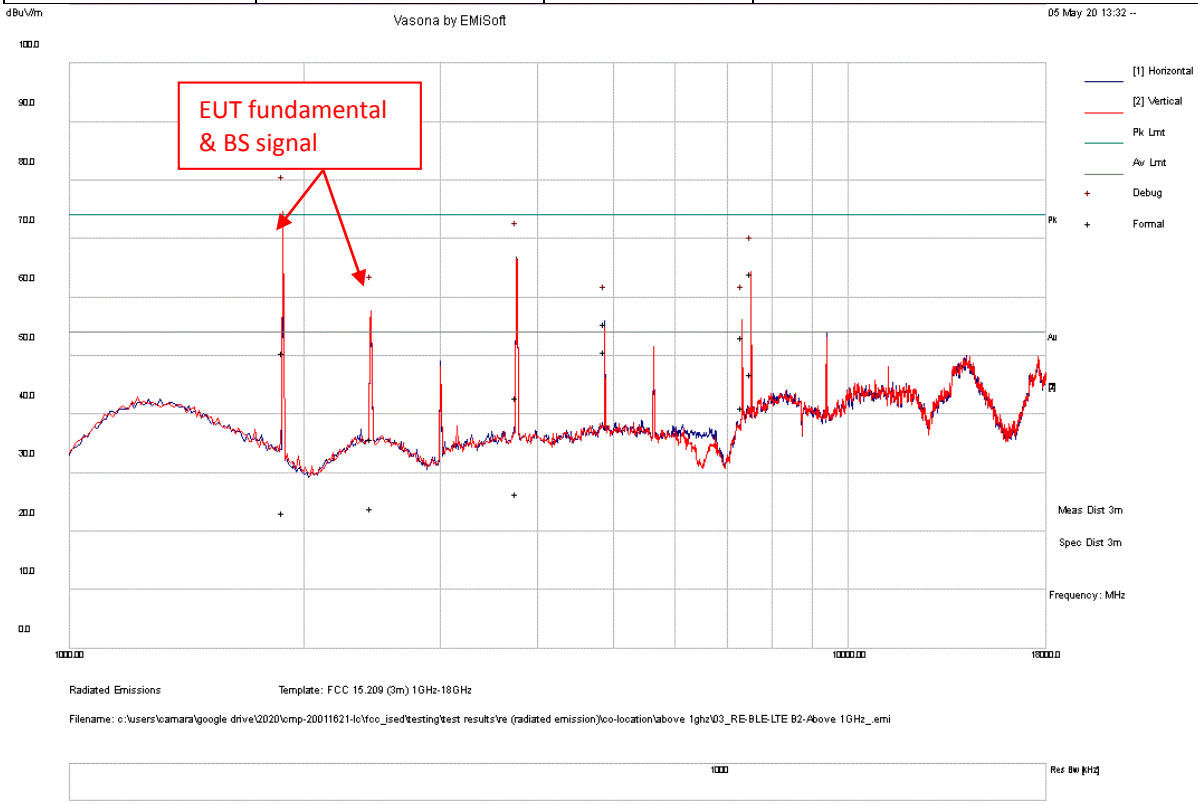
Test Standard:	15.247, RSS-247	Mode:	BLE+GSM B5
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



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
2393.704	27.9	14.7	-22.2	20.4	Peak Max	V	107	236	74	-53.6	Pass
2393.704	14.4	14.7	-22.2	6.9	Average Max	V	107	236	54	-47.1	Pass

RADIATED EMISSIONS 1 - 18 GHZ

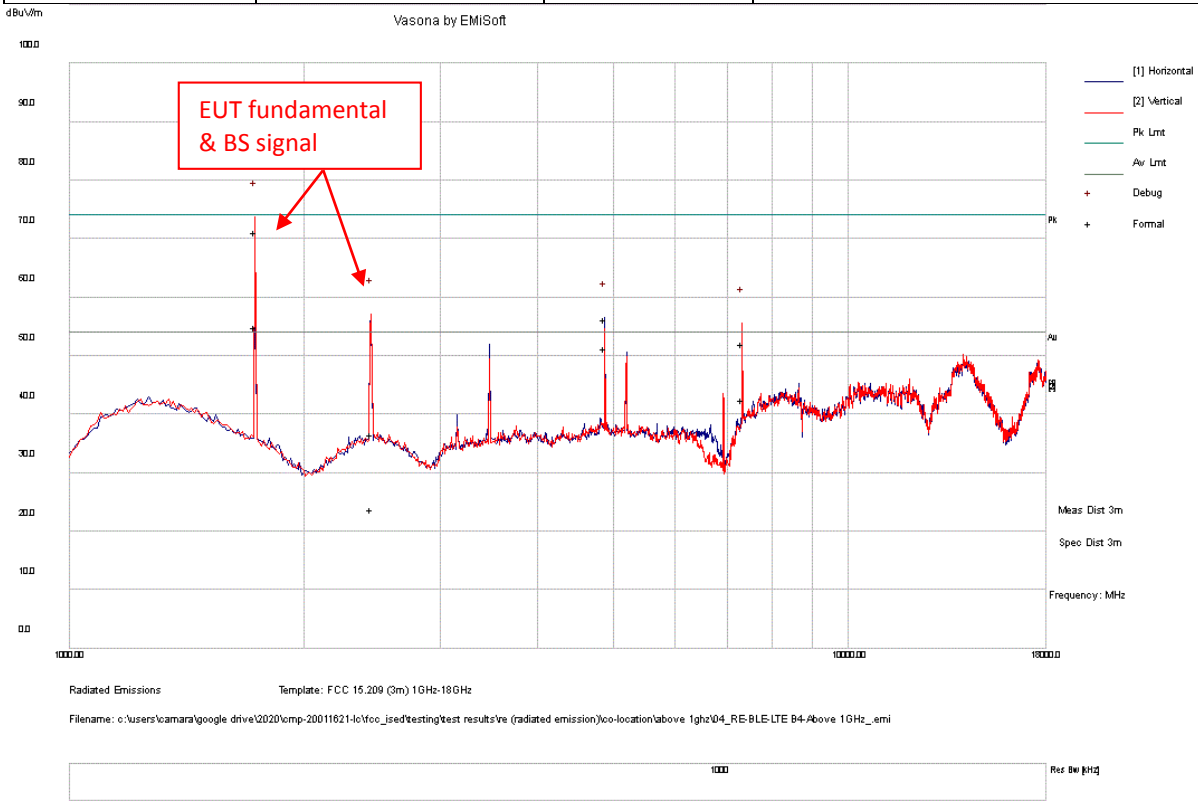
Test Standard:	15.247, RSS-247	Mode:	BLE+LTE B2
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



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
3753.865	43.2	16.3	-16.5	43	Peak Max	H	167	243	74	-31	Pass
7513.295	50.6	21	-7.5	64.1	Peak Max	V	187	304	74	-9.9	Pass
7320.69	40.4	20.7	-7.9	53.2	Peak Max	V	120	230	74	-20.8	Pass
4879.905	51.3	17.4	-13.3	55.5	Peak Max	H	110	158	74	-18.6	Pass
3753.865	26.6	16.3	-16.5	26.4	Average Max	H	167	243	54	-27.6	Pass
7513.295	33.4	21	-7.5	46.9	Average Max	V	187	304	54	-7.1	Pass
7513.295	33.4	21	-7.5	46.9	Average Max	V	187	304	54	-7.1	Pass
4879.905	46.6	17.4	-13.3	50.7	Average Max	H	110	158	54	-3.3	Pass

RADIATED EMISSIONS 1 - 18 GHZ

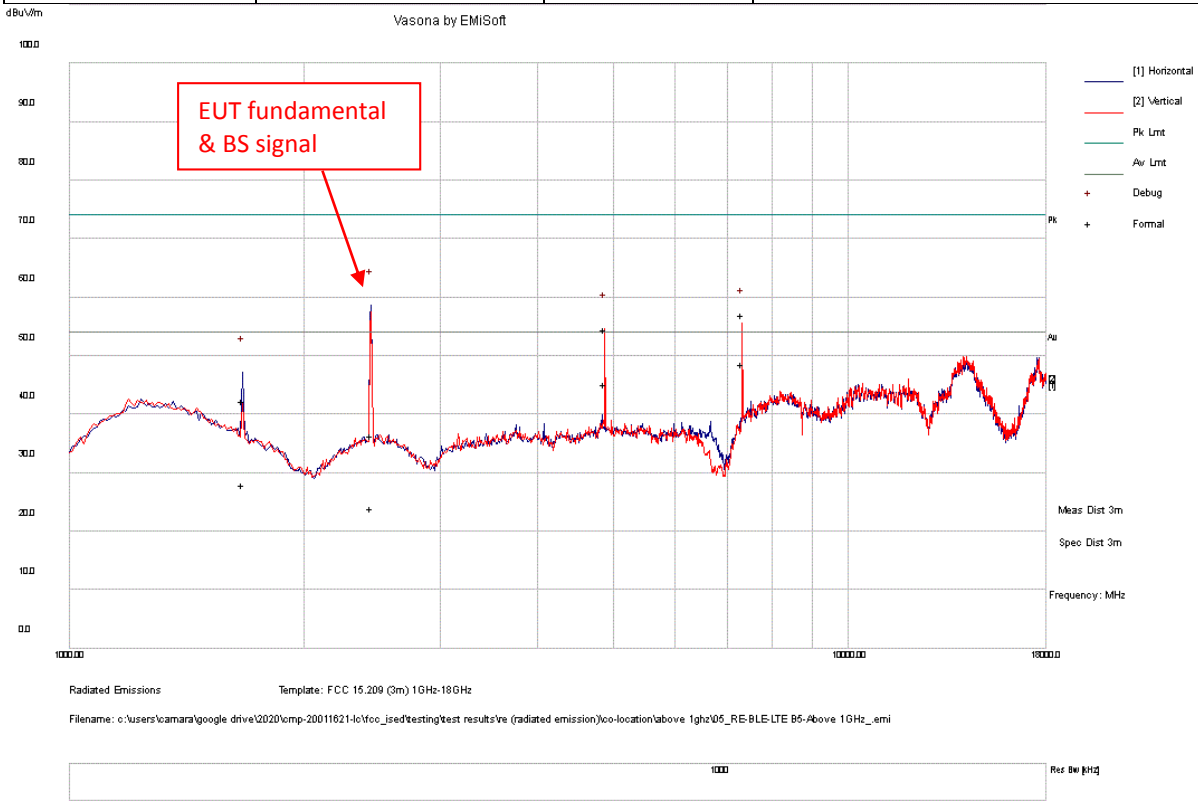
Test Standard:	15.247, RSS-247	Mode:	BLE+LTE B4
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



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
4879.855	52.2	17.4	-13.3	56.3	Peak Max	H	140	0	74	-17.7	Pass
7320.37	39.3	20.7	-7.9	52.1	Peak Max	V	100	137	74	-21.9	Pass
4879.855	47.2	17.4	-13.3	51.3	Average Max	H	140	0	54	-2.7	Pass
7320.37	29.8	20.7	-7.9	42.6	Average Max	V	100	137	54	-11.4	Pass

RADIATED EMISSIONS 1 - 18 GHZ

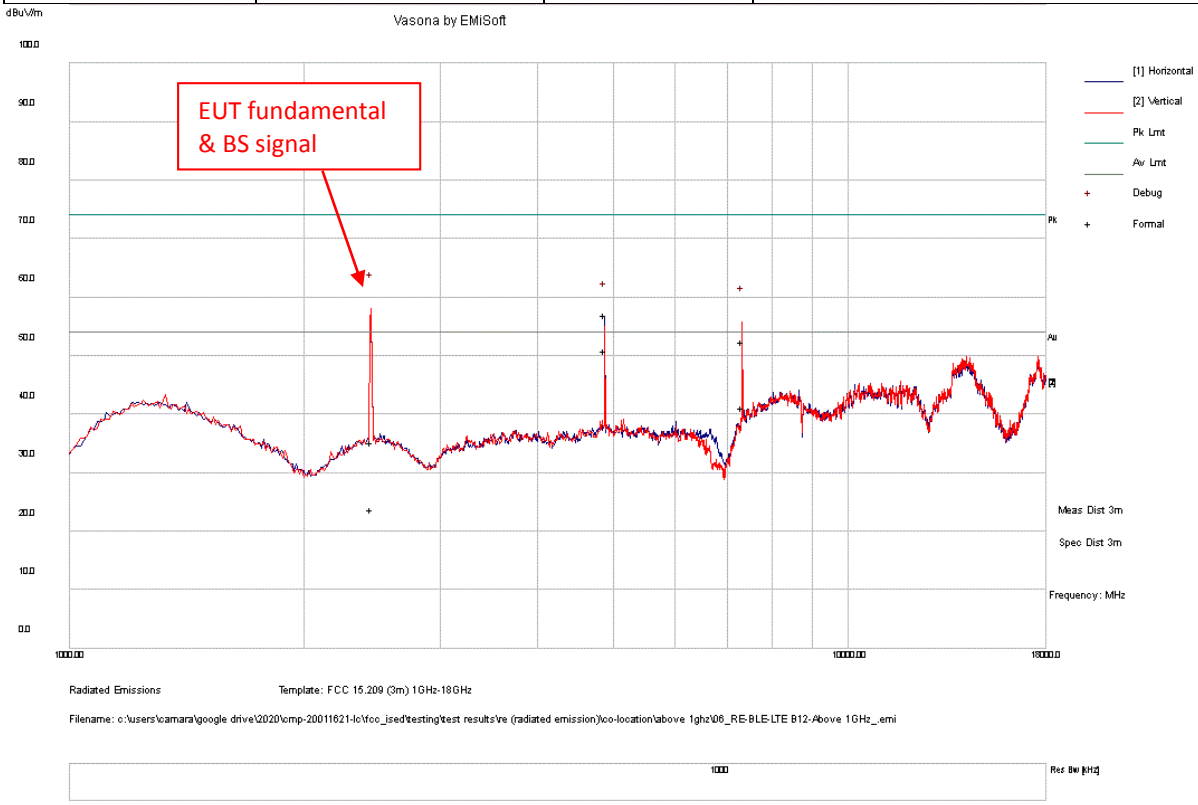
Test Standard:	15.247, RSS-247	Mode:	BLE+LTE B5
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



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
7319.893	44.2	20.7	-7.9	57	Peak Max	V	172	130	74	-17	Pass
4879.41	50.4	17.4	-13.3	54.5	Peak Max	V	110	100	74	-19.5	Pass
1669.365	50.2	14.6	-22.5	42.3	Peak Max	H	114	234	74	-31.7	Pass
7319.893	35.9	20.7	-7.9	48.6	Average Max	V	172	130	54	-5.4	Pass
4879.41	41.1	17.4	-13.3	45.2	Average Max	V	110	100	54	-8.8	Pass
1669.365	35.9	14.6	-22.5	28	Average Max	H	114	234	54	-26	Pass

RADIATED EMISSIONS 1 - 18 GHZ

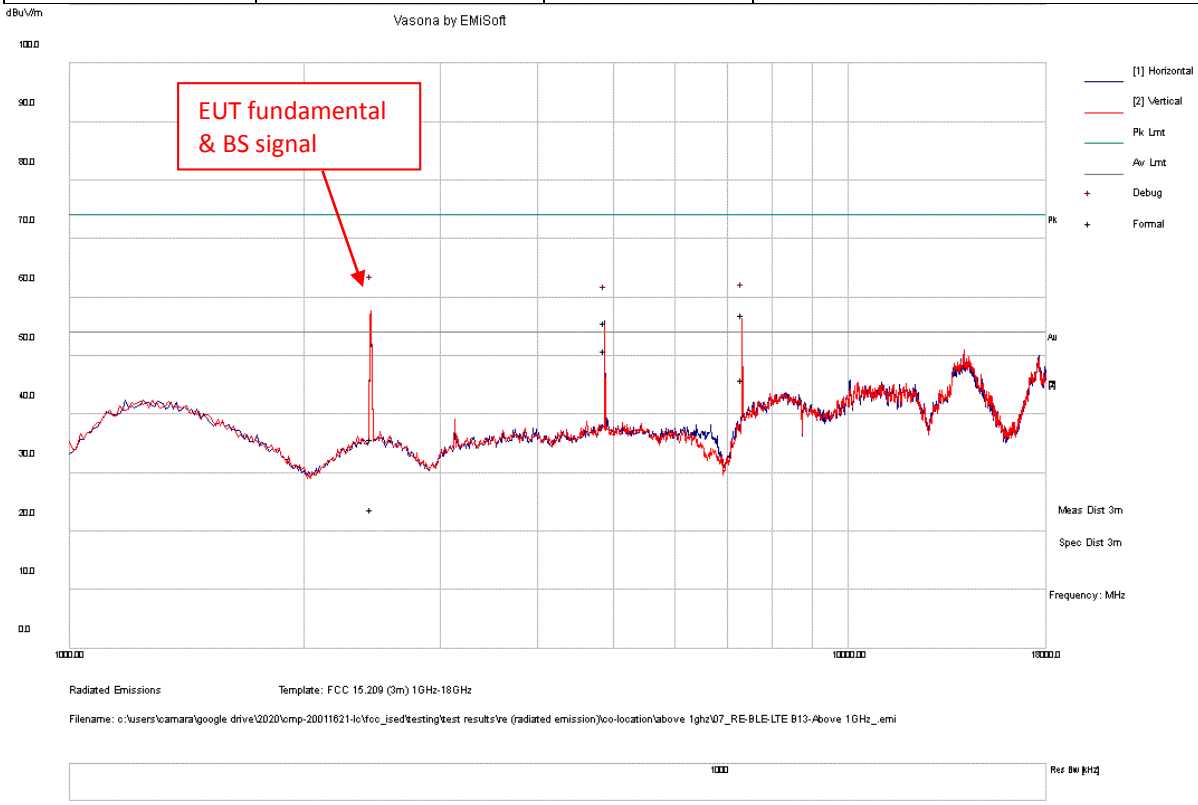
Test Standard:	15.247, RSS-247	Mode:	BLE+LTE B12
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



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
4879.598	52.9	17.4	-13.3	57	Peak Max	H	101	0	74	-17	Pass
7320.598	39.7	20.7	-7.9	52.5	Peak Max	V	119	136	74	-21.5	Pass
4879.598	46.9	17.4	-13.3	51	Average Max	H	101	0	54	-3	Pass
7320.598	28.3	20.7	-7.9	41.1	Average Max	V	119	136	54	-12.9	Pass

RADIATED EMISSIONS 1 - 18 GHZ

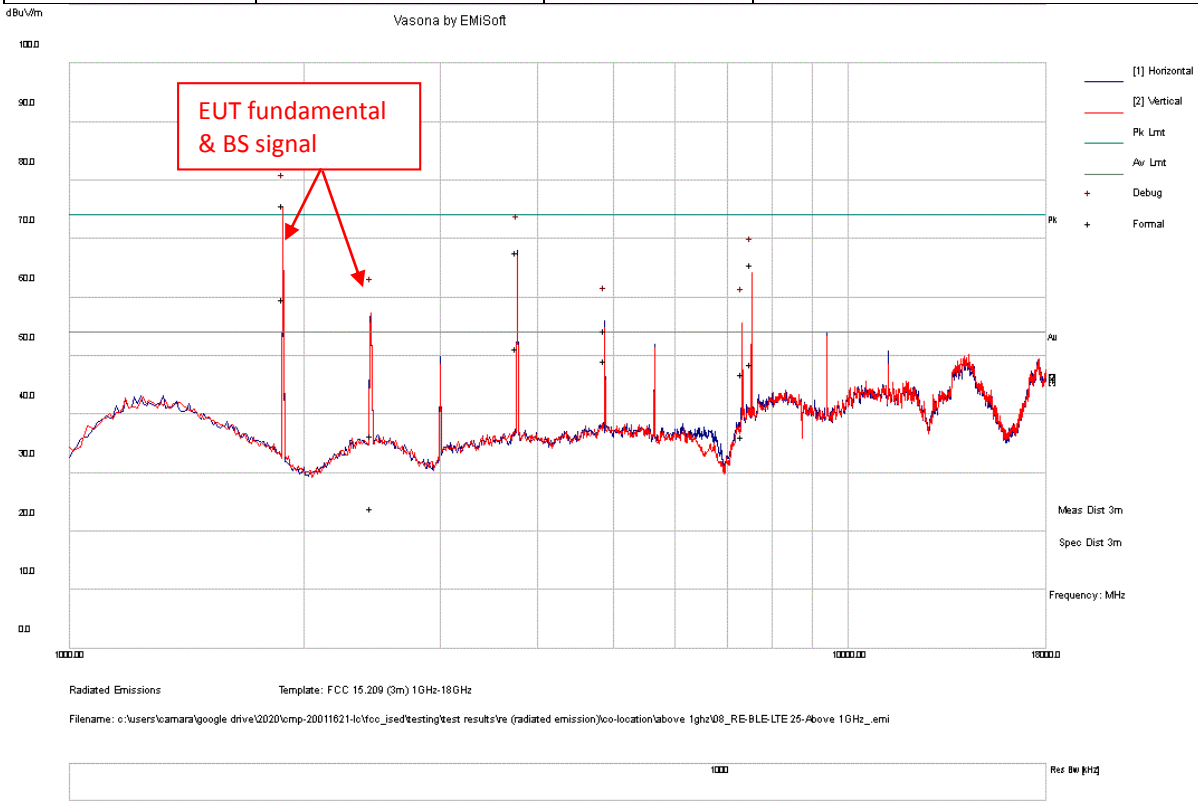
Test Standard:	15.247, RSS-247	Mode:	BLE+LTE B13
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



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
7320.608	44.3	20.7	-7.9	57	Peak Max	V	152	139	74	-17	Pass
4880.033	51.6	17.4	-13.3	55.7	Peak Max	H	114	158	74	-18.3	Pass
7320.608	33.2	20.7	-7.9	45.9	Average Max	V	152	139	54	-8.1	Pass
4880.033	46.7	17.4	-13.3	50.8	Average Max	H	114	158	54	-3.2	Pass

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.247, RSS-247	Mode:	BLE+LTE B25
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/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
3761.553	67.8	16.4	-16.5	67.7	Peak Max	H	201	0	74	-6.3	Pass
7523.175	52.1	21	-7.5	65.6	Peak Max	V	182	328	74	-8.4	Pass
4879.85	50.3	17.4	-13.3	54.4	Peak Max	H	124	163	74	-19.6	Pass
7320.468	34.2	20.7	-7.9	47	Peak Max	V	178	197	74	-27	Pass
3761.553	51.3	16.4	-16.5	51.2	Average Max	H	201	0	54	-2.8	Pass
7523.175	35.1	21	-7.5	48.6	Average Max	V	182	328	54	-5.4	Pass
4879.85	45	17.4	-13.3	49.2	Average Max	H	124	163	54	-4.9	Pass
7320.468	23.4	20.7	-7.9	36.2	Average Max	V	178	197	54	-17.8	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 log10 (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.

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 log10 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 log10 p (watts), dB, for base and fixed equipment, and

(ii) 65 + 10 log10 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 log10 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 log10 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 log10 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 log10 p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

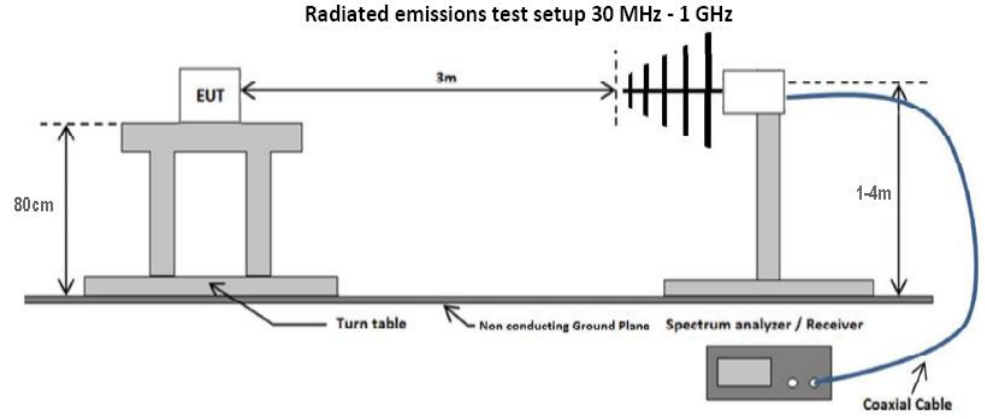
RSS-139, Clause 6.6

(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 log10 p (watts) dB.

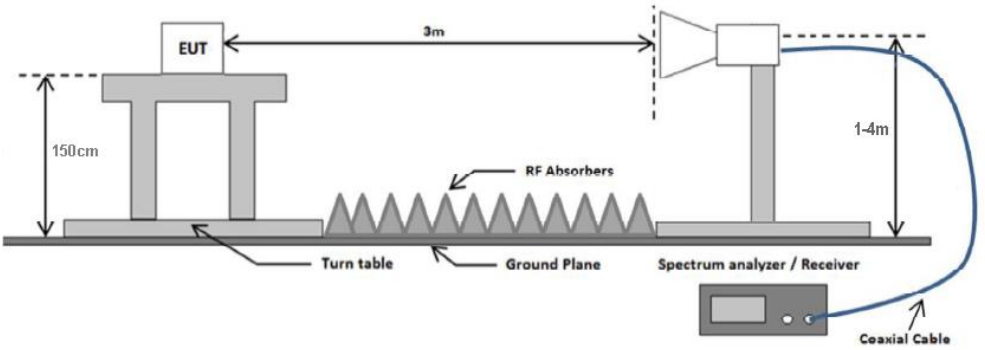
(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 p (watts) dB.

7.2.2 Test setup

Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



7.2.3 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 C62.10-2013 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.

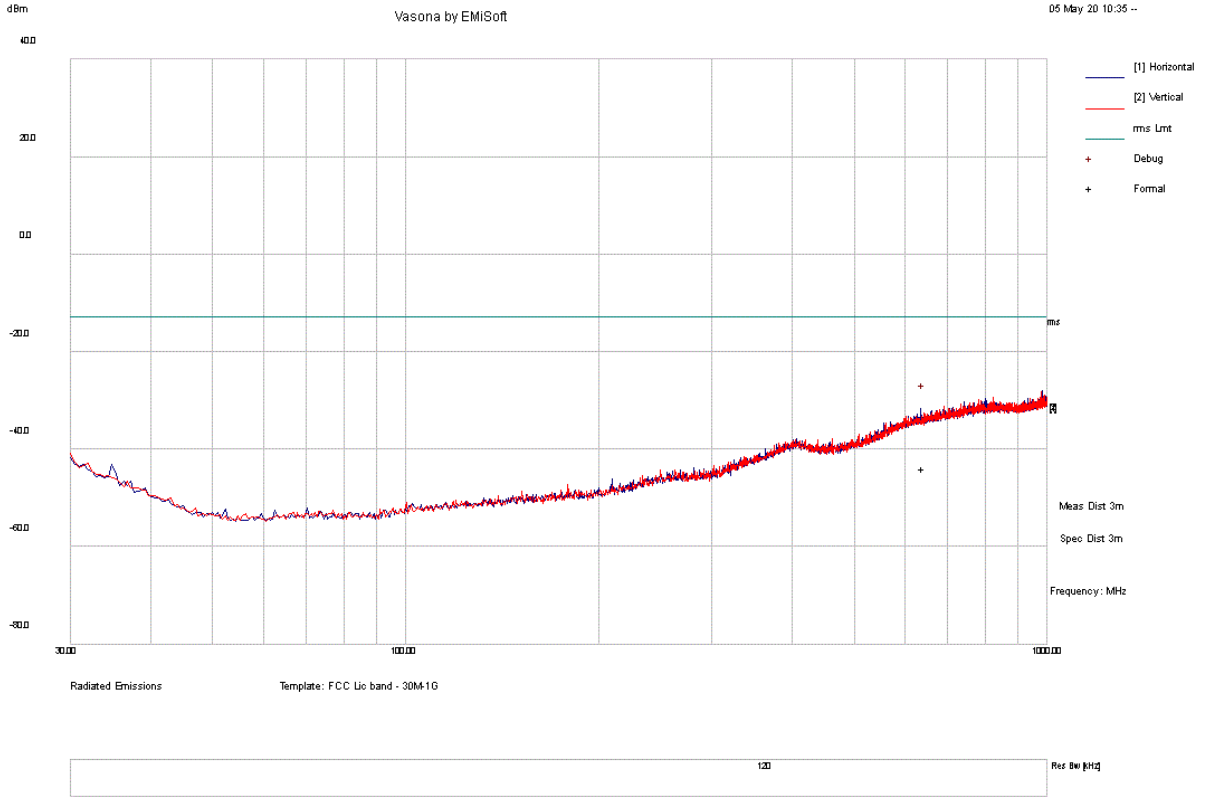
1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting 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.

7.2.4 Test Result

RADIATED EMISSIONS BELOW 1 GHZ

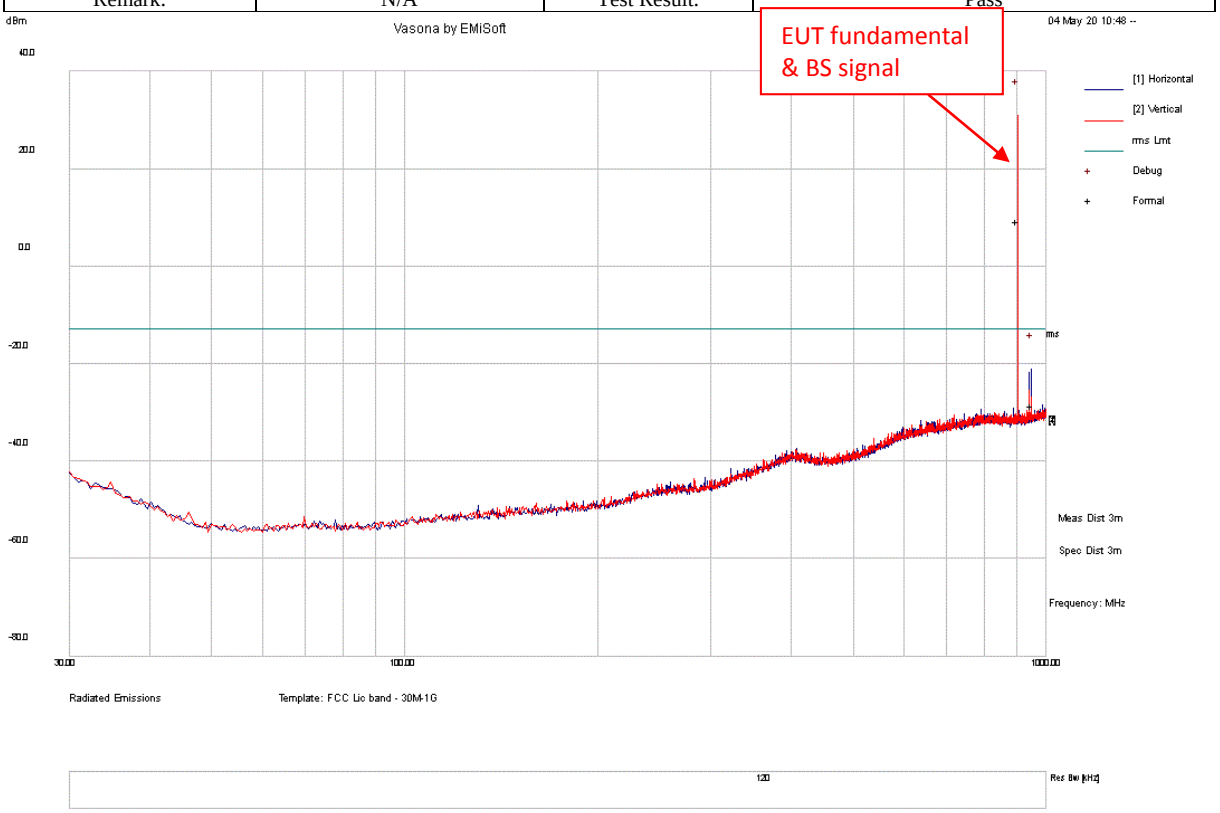
Test Standard:	Part 24E & RSS 133	Mode:	BLE+GSM B2
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
639.387	-84.5	19	21.7	-43.8	RMS Max	V	332	349	-13	-30.8	Pass

RADIATED EMISSIONS BELOW 1 GHZ

Test **Standard**:	Part 22 & RSS 132	Mode:	BLE+GSM B5
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

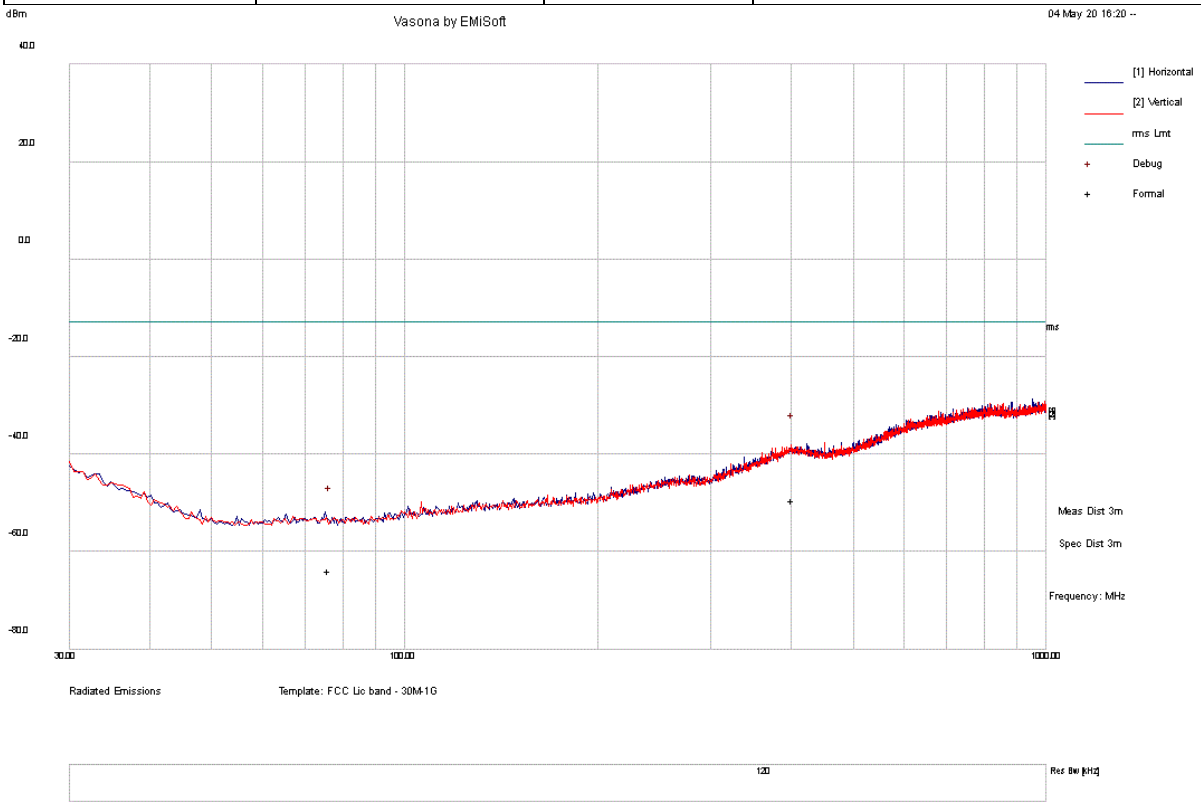


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
902.325	-33.3	19.4	23.3	9.4	RMS Max	H	100	360	-13	22.4	N/A
947.395	-72	19.6	23.8	-28.6	RMS Max	H	100	304	-13	-15.6	Pass

Note: Frequency at around 900MHz is EUT fundamental emission.

RADIATED EMISSIONS BELOW 1 GHZ

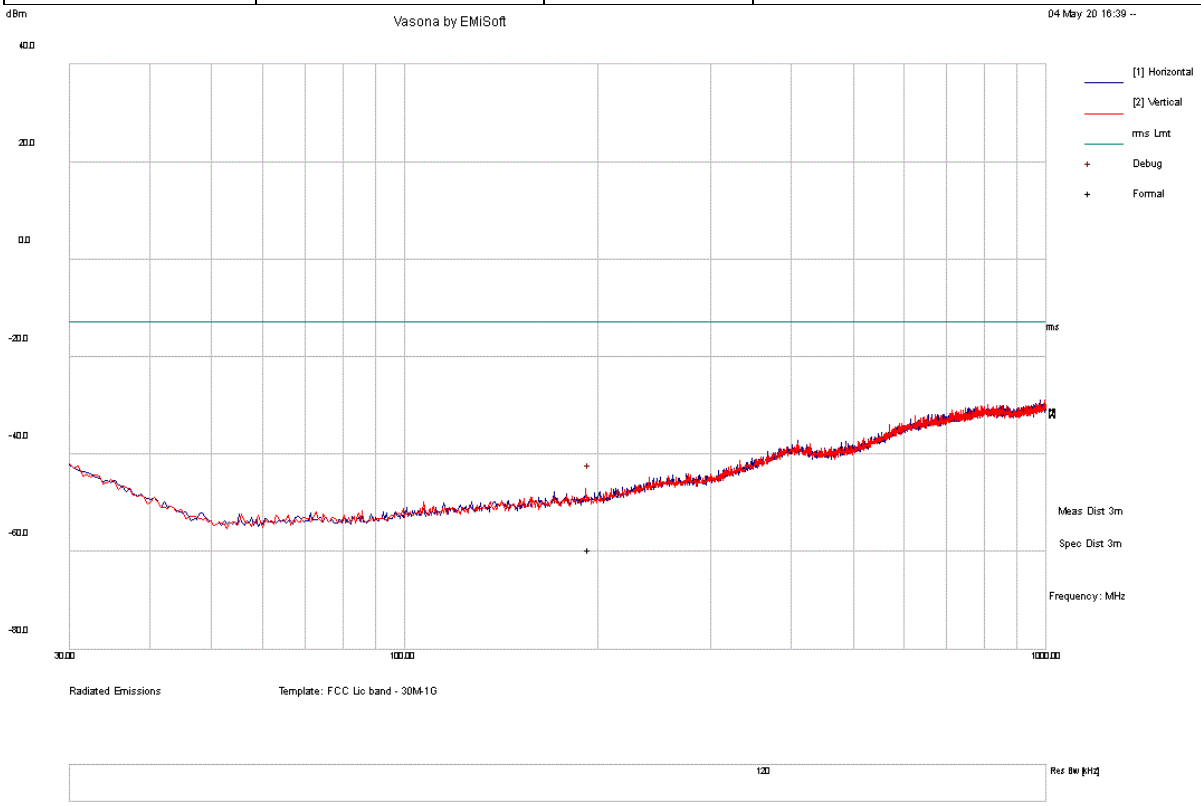
Test Standard:	Part 24E & RSS 133	Mode:	BLE+LTE B2
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
402.015	-85.6	18.1	18.1	-49.4	RMS Max	V	351	242	-13	-36.4	Pass
76.15	-85.7	15	6.9	-63.8	RMS Max	H	146	290	-13	-50.8	Pass

RADIATED EMISSIONS BELOW 1 GHZ

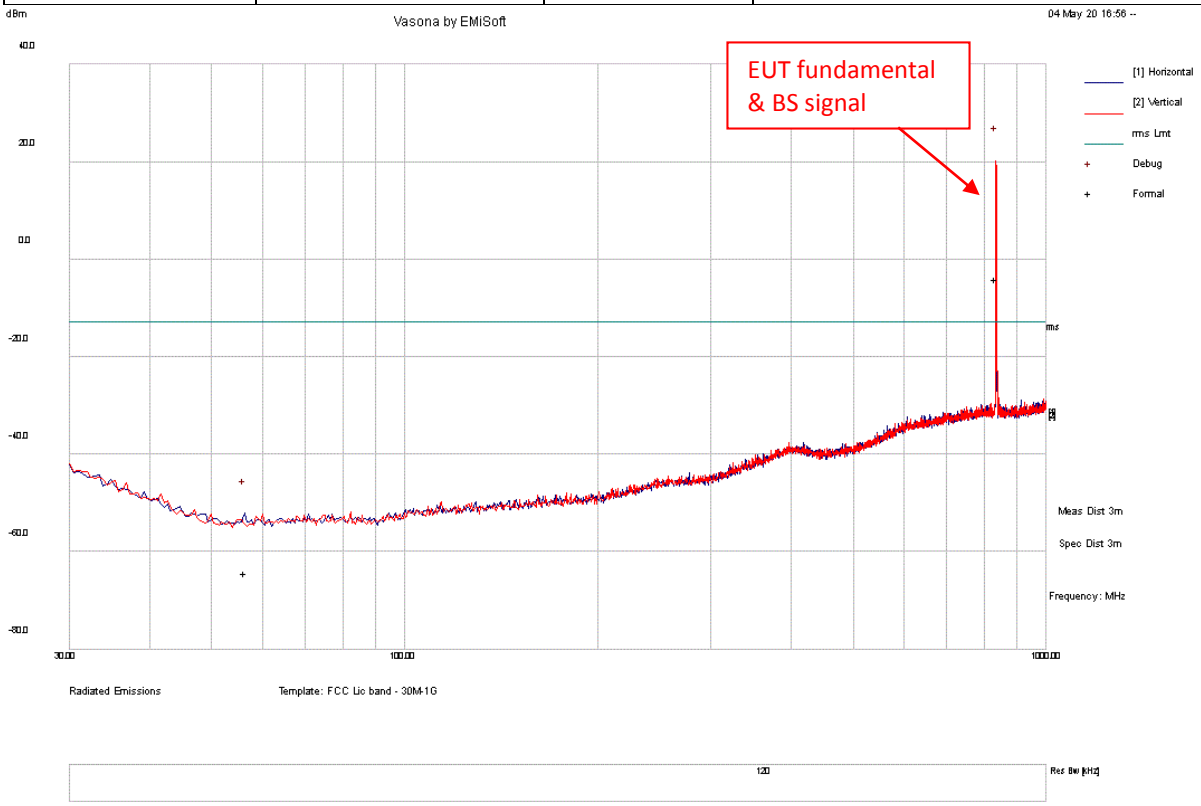
Test Standard:	Part 27 & RSS 139	Mode:	BLE+LTE B4
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
193.772	-86	16.4	9.9	-59.6	RMS Max	V	286	47	-13	-46.6	Pass

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 22 & RSS 132	Mode:	BLE+LTE B5
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

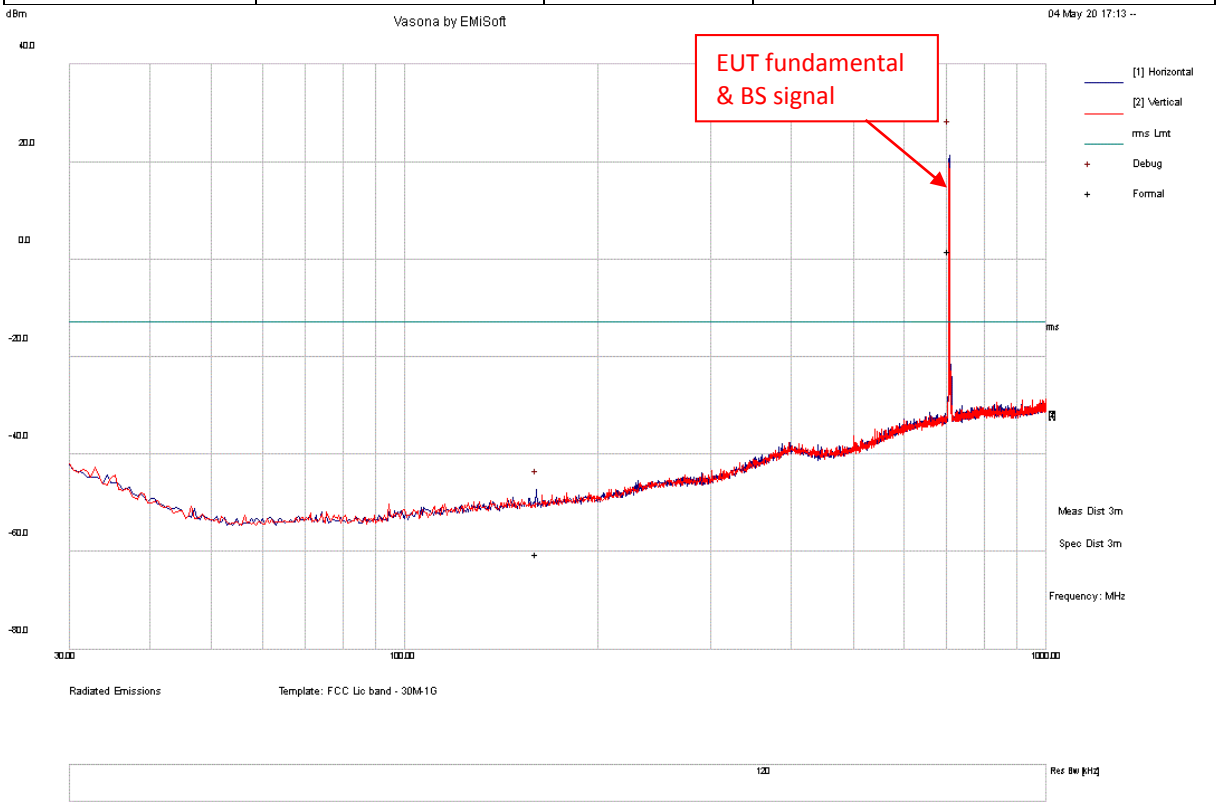


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
835.197	-46.9	19.1	23.6	-4.1	RMS Max	V	146	191	-13	8.9	N/A
56.299	-85.4	14.7	6.4	-64.3	RMS Max	H	261	184	-13	-51.3	Pass

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

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE B12
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

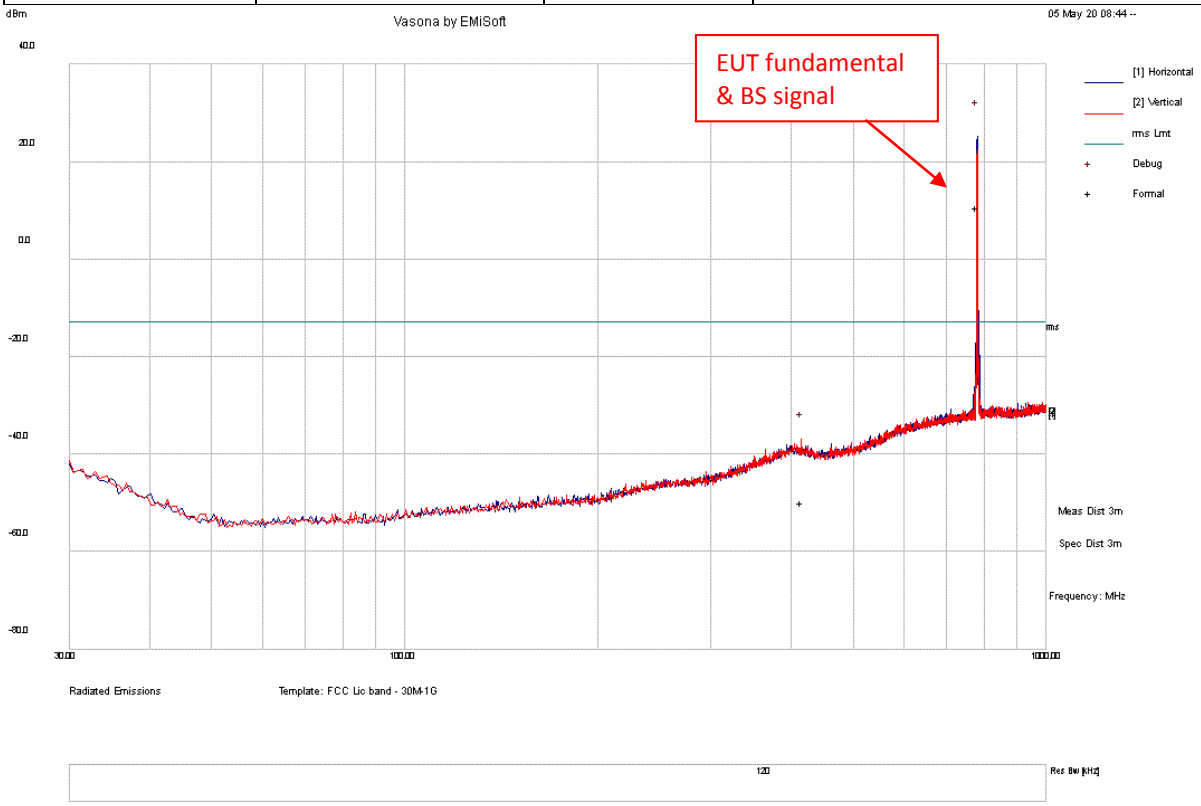


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
706.327	-40.1	19.1	22.7	1.7	RMS Max	H	191	231	-13	14.7	N/A
160.898	-85.9	16.1	9.4	-60.4	RMS Max	H	100	311	-13	-47.4	Pass

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

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE B13
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

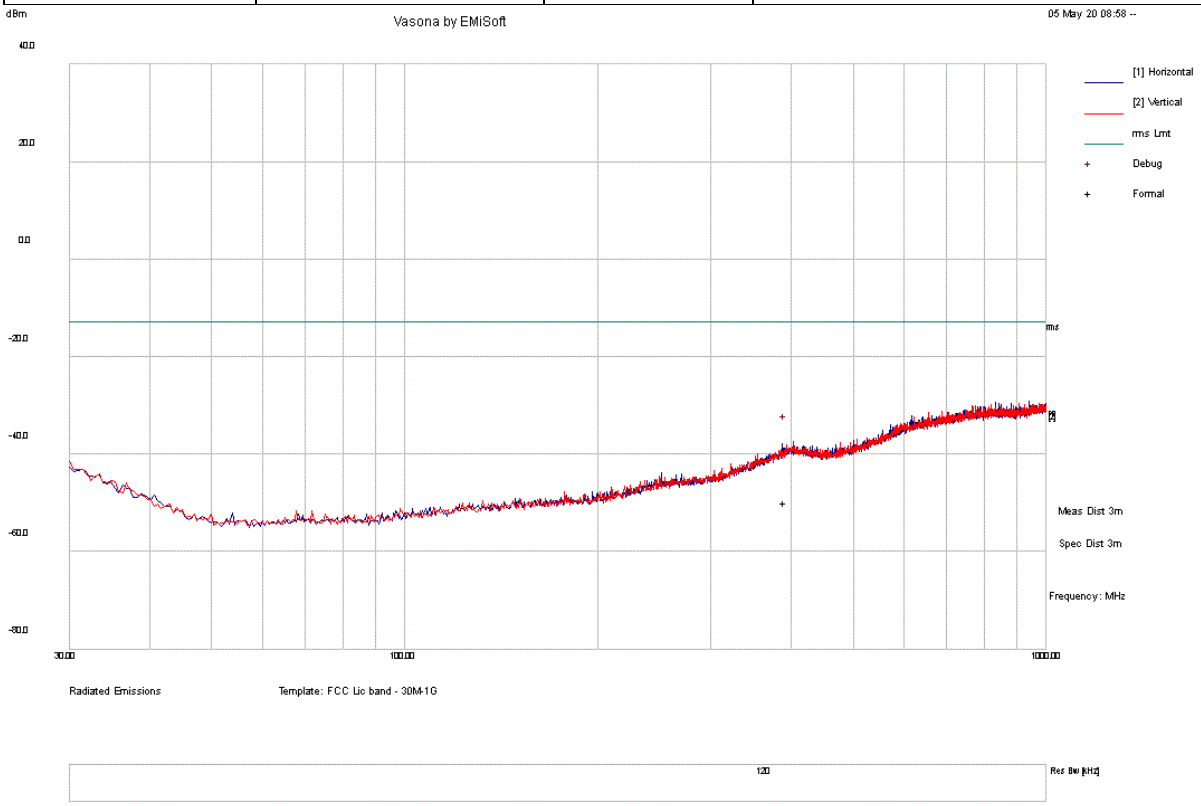


Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
780.341	-31.9	19	23.6	10.7	RMS Max	H	103	150	-13	23.7	N/A
416.044	-85.7	18.1	17.8	-49.8	RMS Max	V	324	142	-13	-36.8	Pass

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

RADIATED EMISSIONS BELOW 1 GHZ

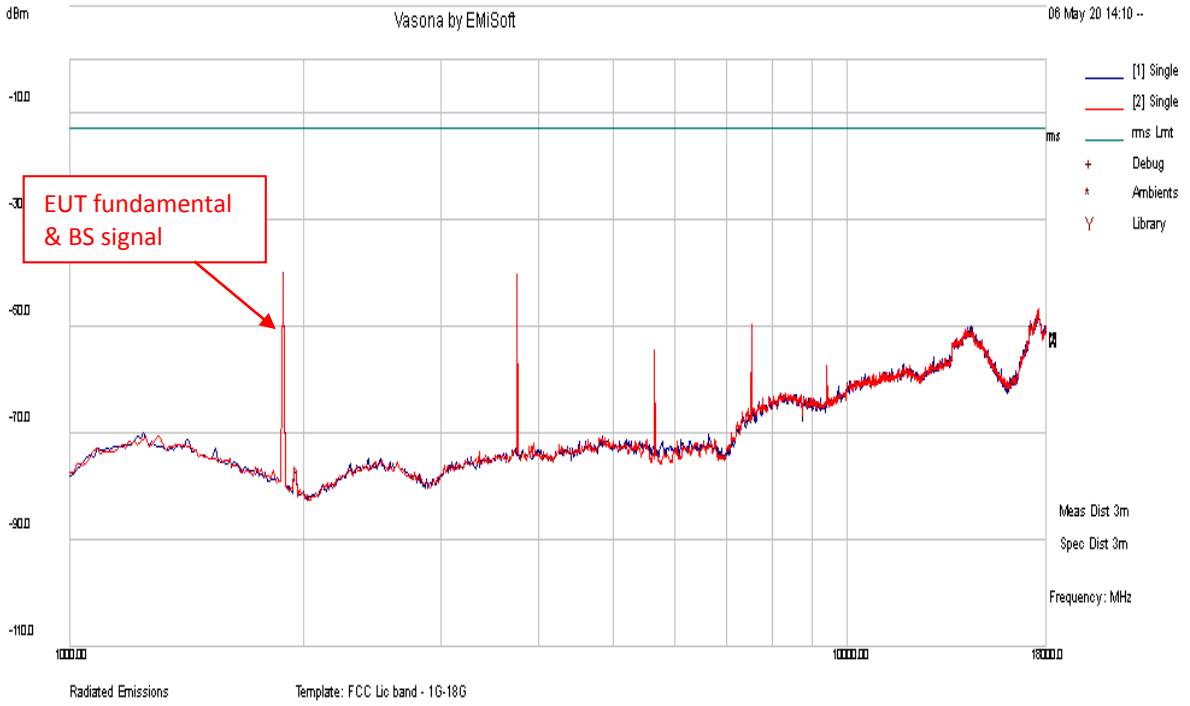
Test Standard:	Part 24E & RSS 133	Mode:	BLE+LTE B25
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
390.494	-85.7	18.1	17.6	-50	RMS Max	V	179	162	-13	-37	Pass

RADIATED EMISSIONS 1 - 18 GHZ

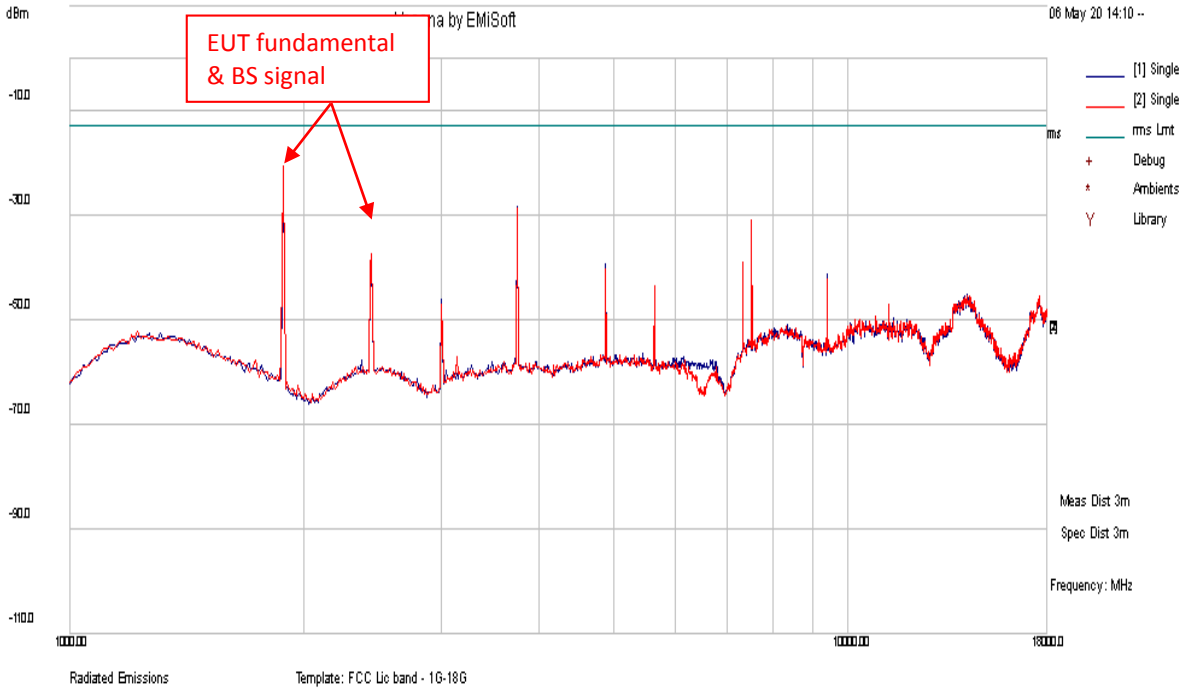
Test Standard:	Part 24E & RSS 133	Mode:	BLE+GSM B2
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
3760.5	-63.93	16.4	-16.5	-64.13	RMS	V	232	32	-13	-51.13	Pass

RADIATED EMISSIONS 1 - 18 GHZ

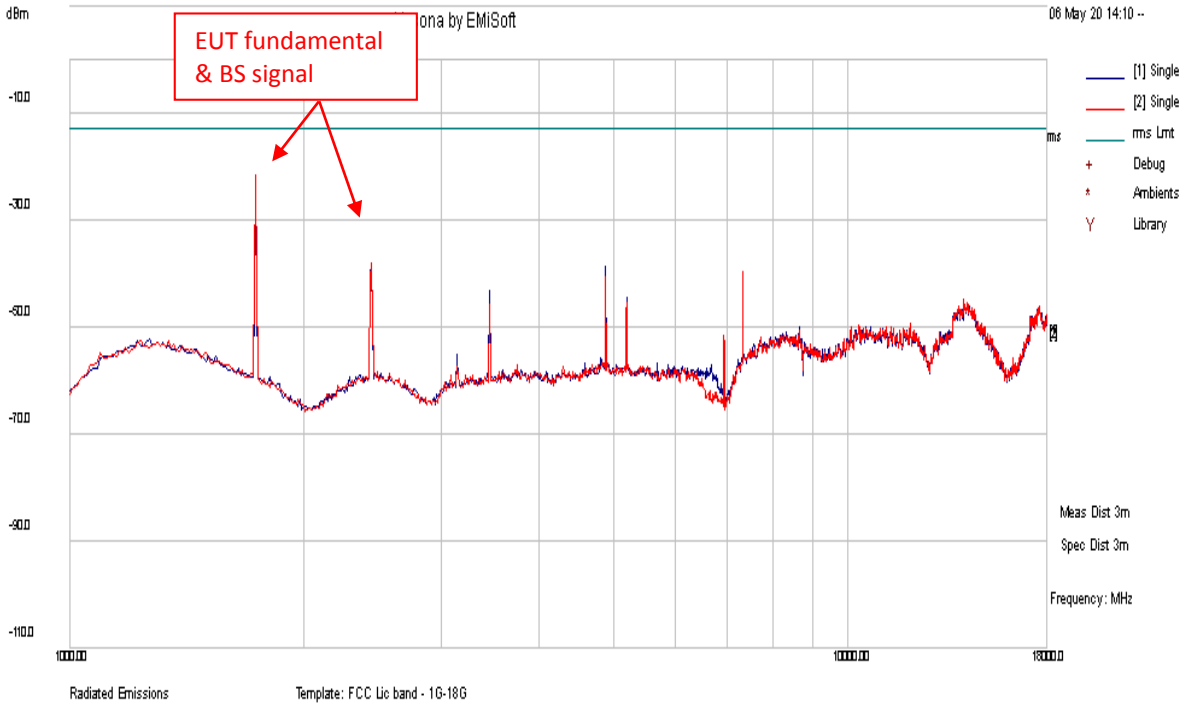
Test Standard:	Part 24E & RSS 133	Mode:	BLE+LTE B2
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
3753.865	-68.63	16.3	-16.5	-68.83	RMS	H	167	243	-13	-55.83	Pass
7513.295	-61.83	21	-7.5	-48.33	RMS	V	187	304	-13	-35.33	Pass
7513.295	-61.83	21	-7.5	-48.33	RMS	V	187	304	-13	-35.33	Pass
4879.905	-48.63	17.4	-13.3	-44.53	RMS	H	110	158	-13	-31.53	Pass

RADIATED EMISSIONS 1 - 18 GHZ

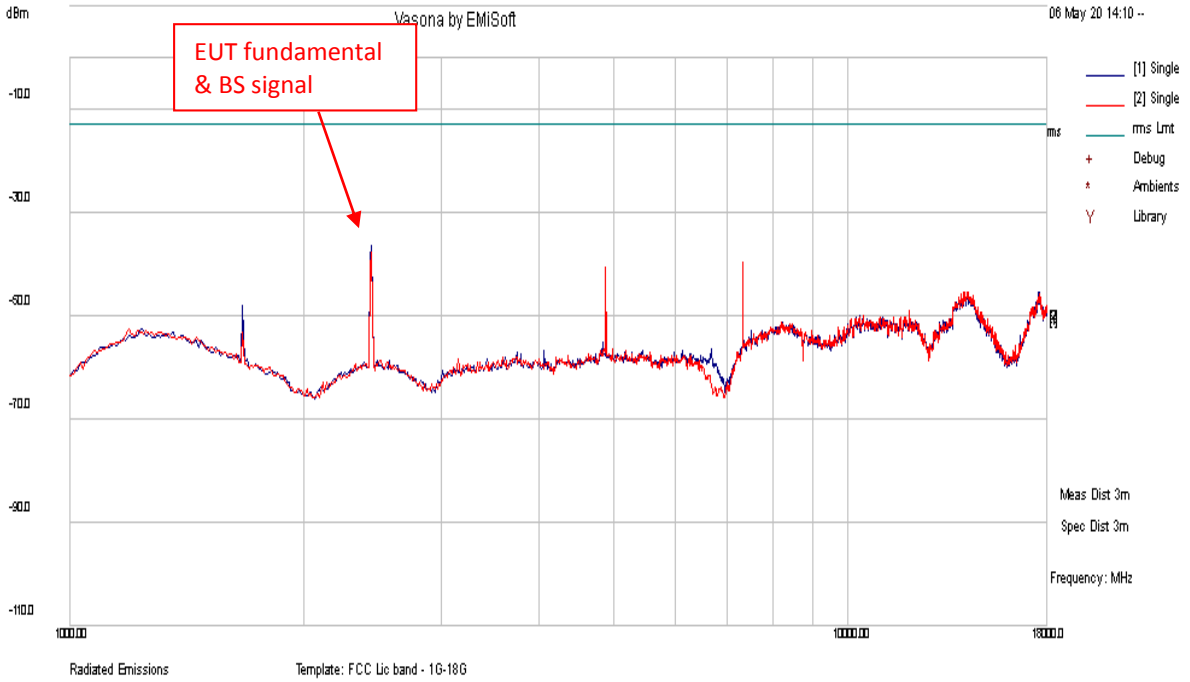
Test Standard:	Part 27 & RSS 139	Mode:	BLE+LTE B4
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
4879.855	-48.03	17.4	-13.3	-43.93	RMS	H	140	0	-13	-30.93	Pass
7320.37	-65.43	20.7	-7.9	-52.63	RMS	V	100	137	-13	-39.63	Pass

RADIATED EMISSIONS 1 - 18 GHZ

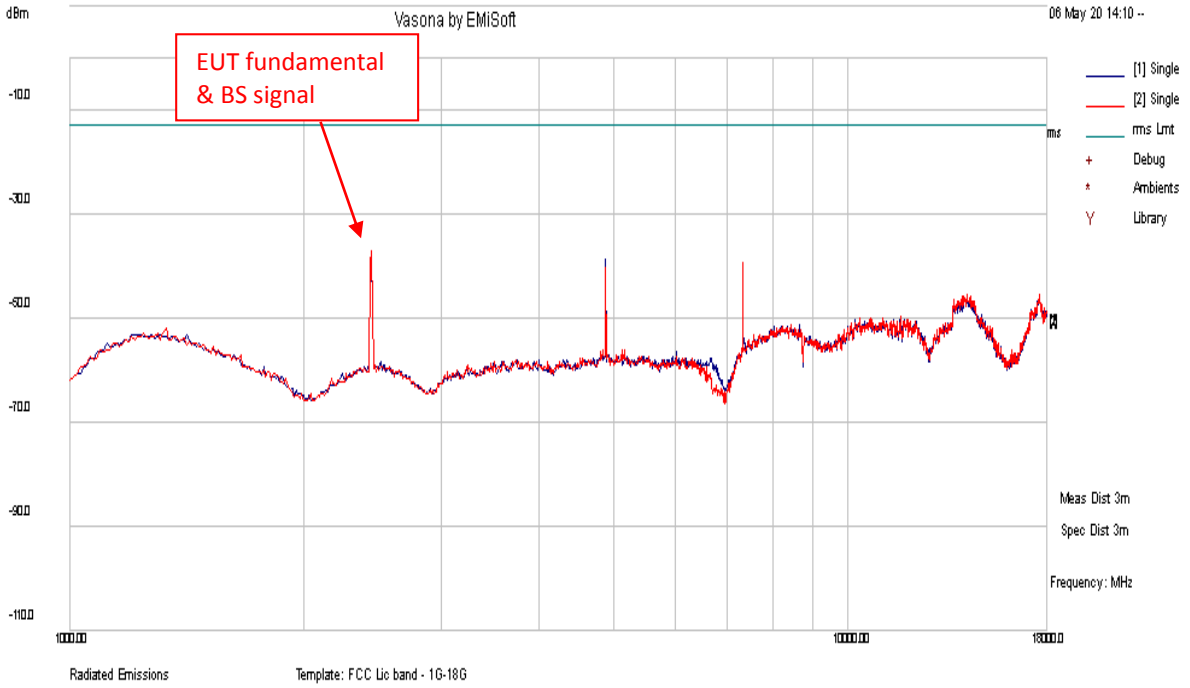
Test Standard:	Part 22 & RSS 132	Mode:	BLE+LTE B5
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
7319.893	-59.33	20.7	-7.9	-46.63	RMS	V	172	130	-13	-33.63	Pass
4879.41	-54.13	17.4	-13.3	-50.03	RMS	V	110	100	-13	-37.03	Pass
1669.365	-59.33	14.6	-22.5	-67.23	RMS	H	114	234	-13	-54.23	Pass

RADIATED EMISSIONS 1 - 18 GHZ

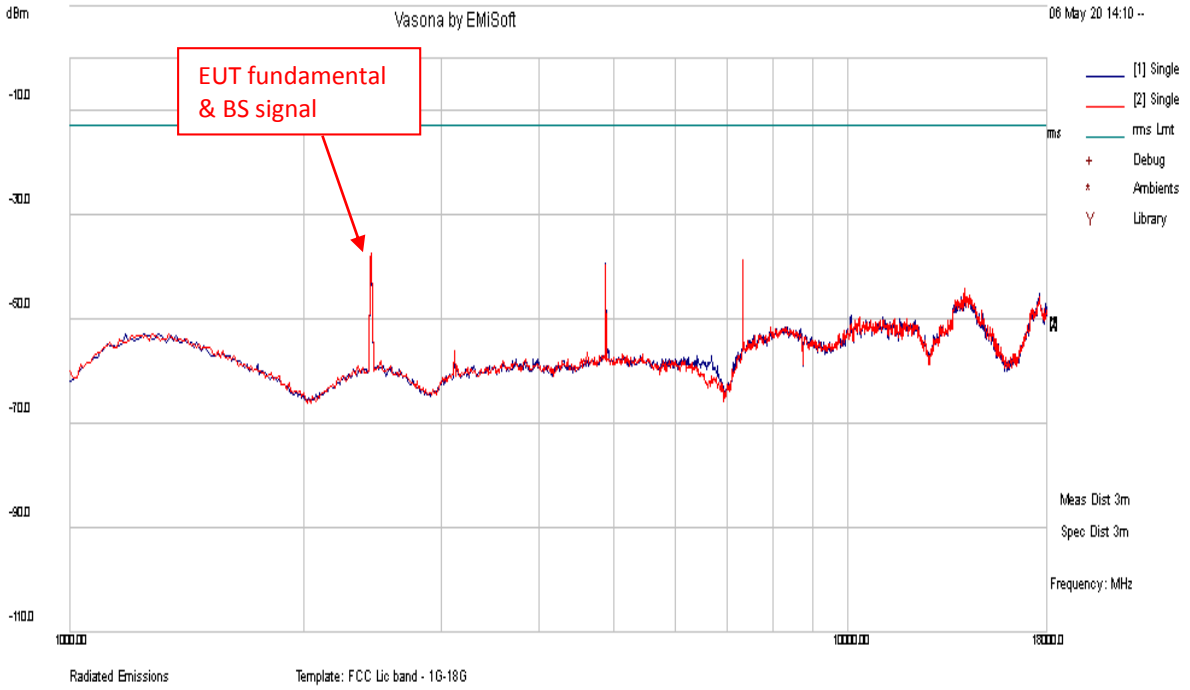
Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE B12
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
4879.598	-48.33	17.4	-13.3	-44.23	RMS	H	101	0	-13	-31.23	Pass
7320.598	-66.93	20.7	-7.9	-54.13	RMS	V	119	136	-13	-41.13	Pass

RADIATED EMISSIONS 1 - 18 GHZ

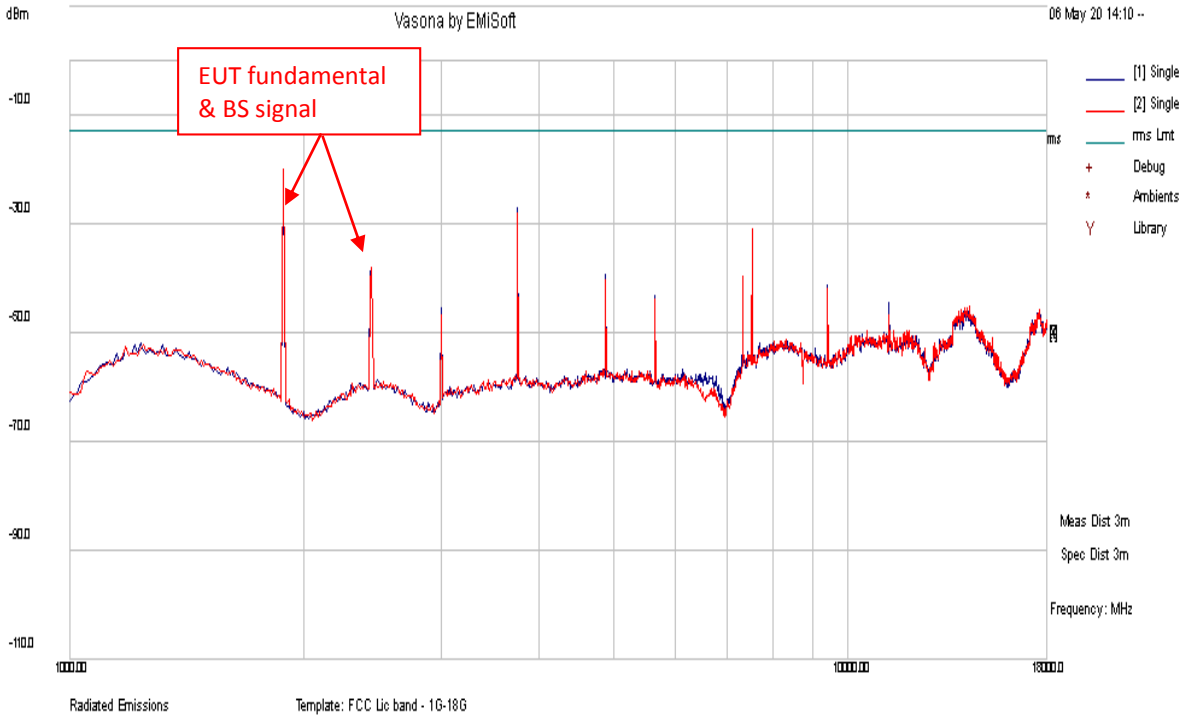
Test Standard:	Part 27 & RSS 130	Mode:	BLE+LTE B13
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBm	Cable Loss	AF dB	Level dBm	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBm	Margin dB	Pass/Fail
7320.608	-62.03	20.7	-7.9	-49.33	RMS	V	152	139	-13	-36.33	Pass
4880.033	-48.53	17.4	-13.3	-44.43	RMS	H	114	158	-13	-31.43	Pass

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	Part 24E & RSS 133	Mode:	BLE+LTE B25
Frequency Range:	1 GHz – 18GHz	Test Date:	05/05/2020
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
3761.553	-43.93	16.4	-16.5	-44.03	RMS	H	201	0	-13	-31.03	Pass
7523.175	-60.13	21	-7.5	-46.63	RMS	V	182	328	-13	-33.63	Pass
4879.85	-50.23	17.4	-13.3	-46.03	RMS	H	124	163	-13	-33.03	Pass
7320.468	-71.83	20.7	-7.9	-59.03	RMS	V	178	197	-13	-46.03	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