



## FCC / ISED Test Report

**FOR:**  
Geoforce Inc.

**Model Name:**  
Geoforce GT2

**Product Description:**  
GNSS enabled logistics modem

**FCC ID:** OWA00GT2X  
**IC ID:** 10540A-00GT2X

**Applied Rules and Standards:**  
47 CFR Part 25  
RSS-170 Issue 3

**REPORT #:** EMC\_Geoforce\_GT2\_FCC\_25

**DATE:** 2020-04-20



**A2LA Accredited**

**IC recognized #**  
**3462B-1**

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## 1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.25 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-170.

No deviations were ascertained.

Company	Description	Marketing Name	Model #
Geoforce Inc.	GNSS enabled logistics modem	Geoforce GT2	OWAC00 OWAS86 OWAH86

### Responsible for Testing Laboratory:

2020-04-20	Compliance	Cindy Li (EMC Lab Manager)
Date	Section	Name

### Responsible for the Report:

2020-04-20	Compliance	Kevin Wang (Senior EMC Engineer)
Date	Section	Name

The test results of this test report relate exclusively to the test item specified in Section 3. CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

<b>Company Name:</b>	CETECOM Inc.
<b>Department:</b>	Compliance
<b>Street Address:</b>	411 Dixon Landing Road
<b>City/Zip Code</b>	Milpitas, CA 95035
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<b>EMC Lab Manager:</b>	Cindy Li
<b>Responsible Project Leader:</b>	Sangeetha Sivaraman

### 2.2 Identification of the Client

<b>Applicant's Name:</b>	Geoforce Inc.
<b>Street Address:</b>	5830 Granite Parkway, Suite 1200
<b>City/Zip Code</b>	Plano, TX 75024
<b>Country</b>	United States

### 2.3 Identification of the Manufacturer

<b>Manufacturer's Name:</b>	Same as Applicant
<b>Manufacturers Address:</b>	-----
<b>City/Zip Code</b>	-----
<b>Country</b>	-----

### 3 Equipment Under Test (EUT)

#### 3.1 EUT Specifications

<b>Marketing Name:</b>	Geoforce GT2
<b>Model Number</b>	OWAC00 OWAS86 OWAH86
<b>HW Version</b>	R1
<b>SW Version</b>	0.4.T (Test supporting software version)
<b>FCC-ID :</b>	OWA00GT2X
<b>IC-ID:</b>	10540A-00GT2X
<b>FVIN:</b>	0.4.T
<b>HVIN:</b>	R1
<b>PMN:</b>	Geoforce GT2
<b>Product Description</b>	GNSS enabled logistics modem, the difference for each Model are: OWAC00 (Cellular Only, BLE+WIFI) OWAS86 (Sat Only, BLE+WIFI) OWAH86 (Sat and Cellular, BLE+WIFI) Model OWAH86 was used for all tests as the worst case configuration.
<b>Radio Technology:</b>	Iridium 9603N
<b>Frequency Range / number of channels:</b>	Nominal band: 1616 MHz – 1626.5 MHz
<b>Type(s) of Modulation:</b>	DE-QPSK/DE-BPSK
<b>Antenna Information as declared:</b>	5 dBi
<b>Max. declared conducted output powers:</b>	33.71 dBm
<b>Power Supply/ Rated Operating Voltage Range:</b>	Dedicated Battery Pack Vmin: 1.8 VDC/ Vnom: 3.6 VDC / Vmax: 3.7 VDC
<b>Operating Temperature Range</b>	-40 <sup>0</sup> to 85 <sup>0</sup> C
<b>Other Radios included in the device:</b>	Zentri, AMW007, 802.11b/g/n Nordic, nRF52840, Bluetooth LE Nordic, nRF9160, Cat M1 & NB-IoT (pending) u-blox, ZOE-M8, GNSS
<b>Sample Revision</b>	<input type="checkbox"/> Prototype Unit; <input checked="" type="checkbox"/> Production Unit; <input type="checkbox"/> Pre-Production
<b>EUT Dimensions</b>	164 X 71 X 33 mm

### 3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	00092018	R1	0.4.T	Bluetooth LE Conducted Sample
2	00092021	R1	0.4.T	Bluetooth LE Radiated Sample
3	00092016	R1	0.4.T	GPS/WiFi/Iridium Conducted Sample
4	00092042	R1	0.4.T	GPS/WiFi/Iridium Radiated Sample

### 3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	J-Link	J-Link	Segger	N/A
2	Laptop	ENVY dv4	HP	geoforce 10178
3	Laptop AC adaptor	PPP009D	HP	WBGSV0ACX0NR54

### 3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#3+AE#1+AE#2+AE#3	The radio of the EUT was configured to a fixed channel transmission with 9.2% duty cycle using putty tool to configure the EUT. The measurement equipment was connected to the 50 ohm RF port of the EUT.
2	EUT#4+AE#1+AE#2+AE#3	The radio of the EUT was configured to a fixed channel transmission with 9.2% duty cycle using putty tool to configure the EUT. The internal antenna was connected.

### 3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and 9.2% duty cycle.

For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

#### **4 Subject of Investigation**

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.25 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-170 Issue 3 of ISED Canada.

This test report is to support a request for new equipment authorization under the:

- FCC ID: OWA00GT2X
- IC ID: 10540A-00GT2X

#### **5 Measurement Results Summary**

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§2.1055 §25.202(d) RSS-170 5.2	Frequency Tolerance	Nominal	Fix Channel	■	□	□	Complies
§2.1053 §25.202(f) RSS-170 5.4.3.1	Emission Limitations	Nominal	Fix Channel	■	□	□	Complies
§25.204 RSS-170 5.3	Power Limits	Nominal	Fix Channel	■	□	□	Complies
§2.1047(d)	Modulation Characteristics	Nominal	Fix Channel	□	□	■	Complies Note2
§25.216 RSS-170 5.4.3	Limits on Emissions	Nominal	Fix Channel	■	□	□	Complies
§2.1049 RSS-170 4.6.1	Occupied Bandwidth	Nominal	Fix Channel	■	□	□	Complies

**Note1:** NA= Not Applicable; NP= Not Performed.

**Note2:** Please refer to the previous module test report, FCC ID: Q639603N

## 6 Measurements

### 6.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

RF conducted measurement	±0.5 dB
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### 6.2 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25°C
- Relative humidity: 40-60%

### 6.3 Dates of Testing:

03/12/2020 – 03/25/2020

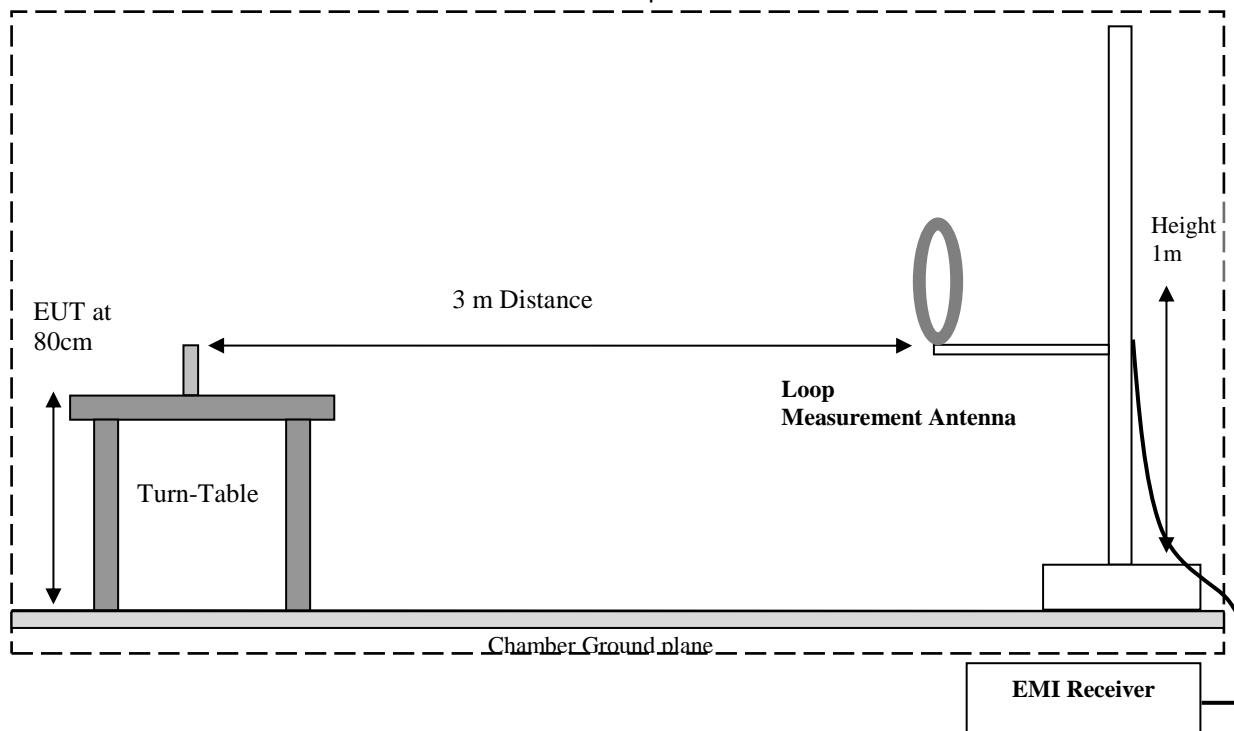
## 7 Measurement Procedures

### 7.1 Radiated Measurement

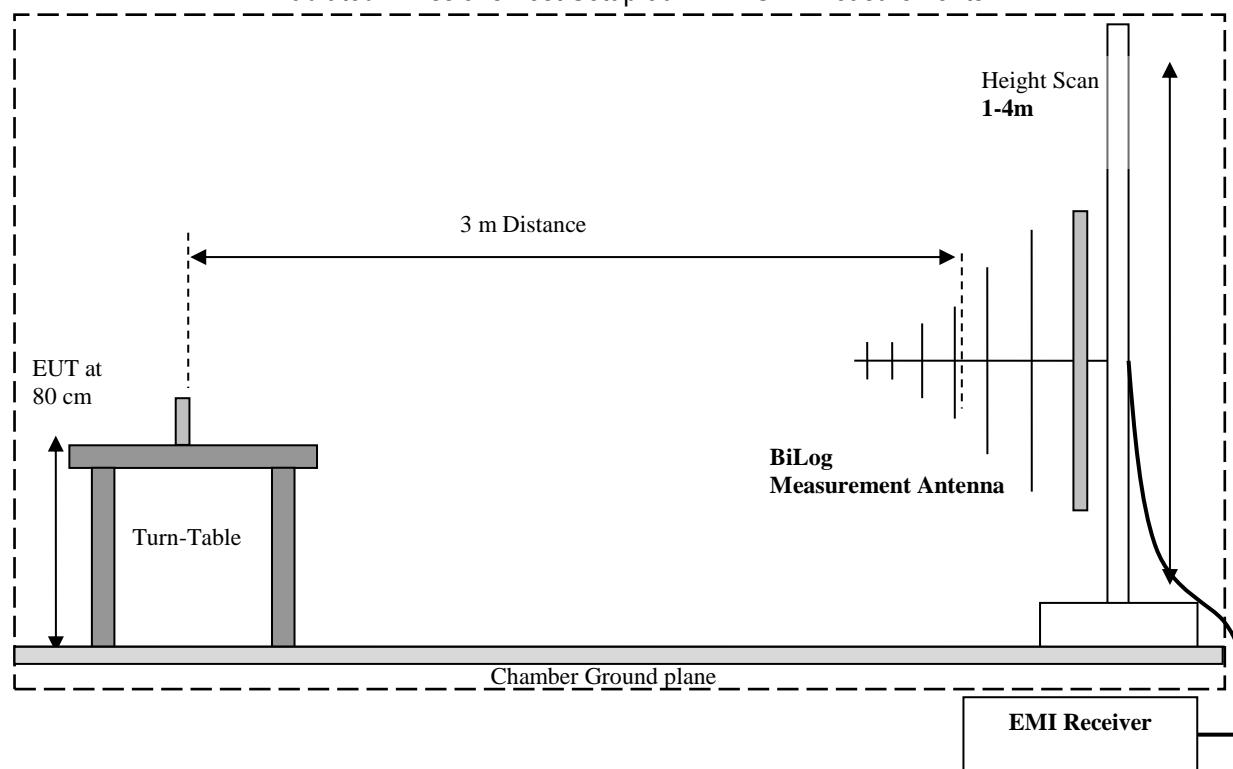
The radiated measurement is performed according to: ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

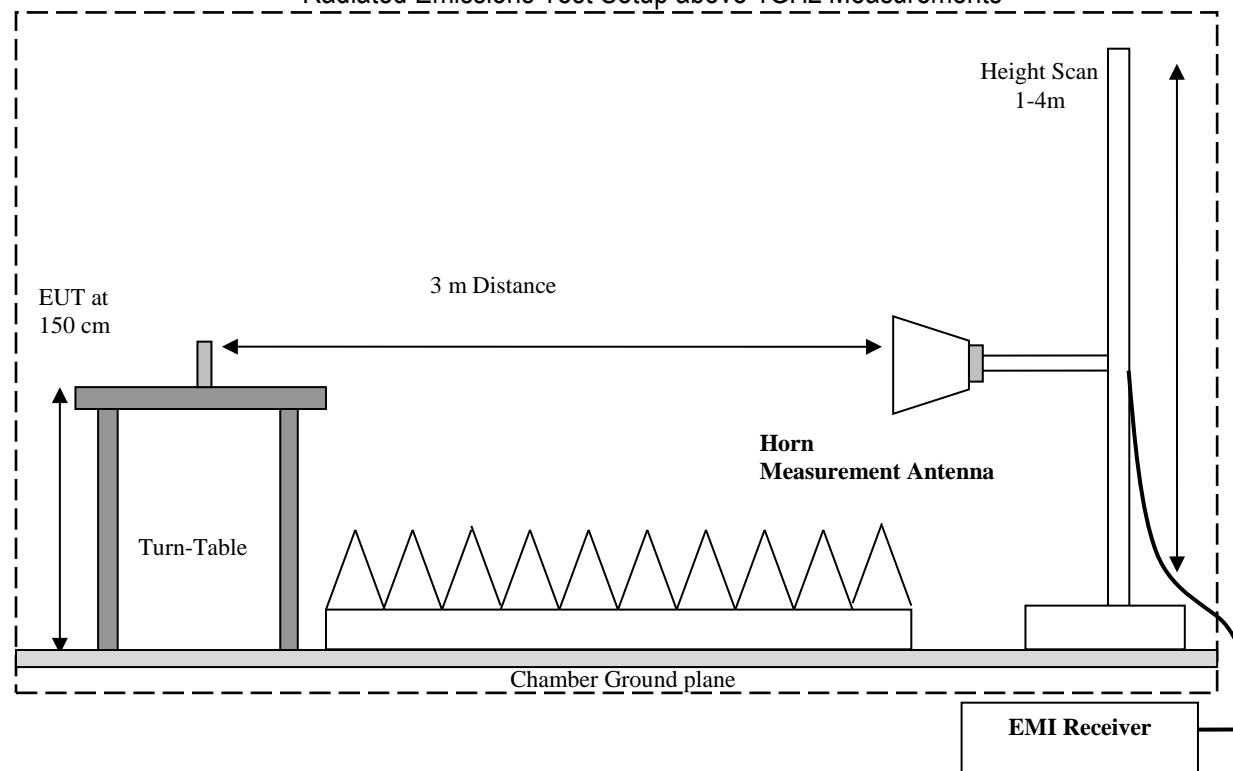
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



### 7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dB $\mu$ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

$$FS (\text{dB}\mu\text{V}/\text{m}) = \text{Measured Value on SA (dB}\mu\text{V}) - \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

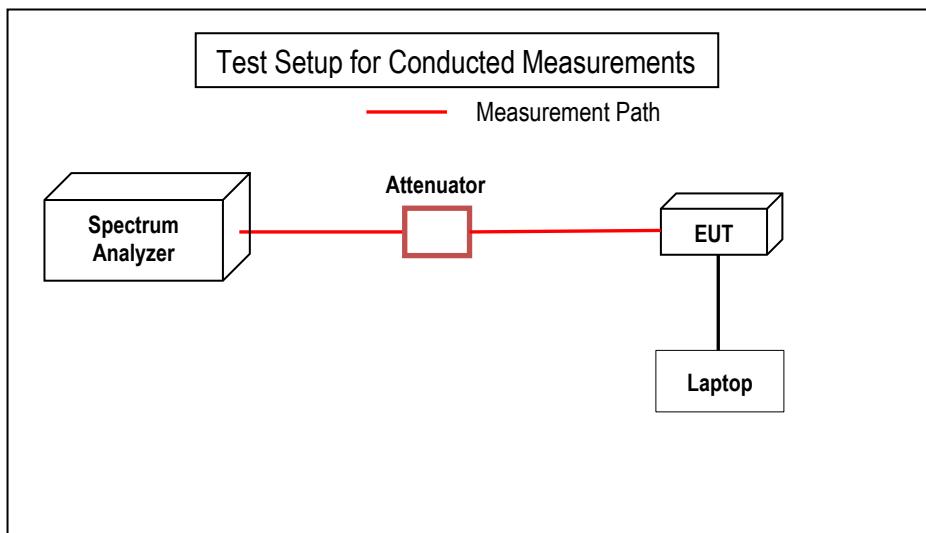
Frequency (MHz)	Measured SA (dB $\mu$ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB $\mu$ V/m)
1000	80.5	3.5	14	98.0

### 7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

### 7.3 RF Conducted Measurement Procedure

Reference: ANSI C63.10 (2013) Section 6.9, 6.10, and 7.8



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

## **8 Test Result Data**

### **8.1 Frequency Tolerance**

#### **8.1.1 Measurement according to FCC CFR 47 Part 25.202(d) and FCC CRF 47 Part 2.1055(a)(1),(d)(1).**

##### **Spectrum Analyzer settings:**

- RBW =20 kHz
- VBW = 50 kHz
- Set span = 100 kHz
- Sweep time = auto couple
- Detector = Pk
- Trace mode = Max Hold
- Marker StepSize = SWP POINTS
- Sweep Points = 10000 points
- Use the marker-peak function to set the marker to the peak of the emission

##### **8.1.2 Limits:**

FCC 25.202(d): Frequency tolerance, Earth stations. The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent of the reference frequency.

RSS-170 5.2: For mobile earth station equipment, the carrier frequency shall not depart from the reference frequency by more than  $\pm 10$  ppm.

##### **8.1.3 Test conditions and setup:**

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23° C	1	unmodulated, fix channel	3.3 VDC

#### 8.1.4 Measurement result:

3.3V DC Supply, Under Temperature Variations

Temperature (° C )	Frequency Error (%)	Frequency Error(ppm)	Limit (ppm)	Result
-30	-0.0001	-0.988	10	Pass
-20	-0.0001	-0.988	10	Pass
-10	-0.0001	-0.988	10	Pass
0	0	0	10	Pass
10	0	0	10	Pass
20	0	0	10	Pass
30	0	0	10	Pass
40	0	0	10	Pass
50	0	0	10	Pass

Under Voltage Variations

DC Voltage (v)	Frequency Error (%)	Frequency Error(ppm)	Limit (ppm)	Result
2.8	0	0	10	Pass
3.3	0	0	10	Pass
3.8	0	0	10	Pass

## 8.2 Emission Limitations

### 8.2.1 Measurement according to FCC 25.202(f), FCC 2.1051 and 2.1053

#### Spectrum Analyzer settings

##### Conducted

- Centre Frequency = Centre frequency of the channel being tested
- Span = 300 kHz
- RBW = 3 kHz
- VBW = 30 kHz
- $10\log(4/3) = 1.25\text{dB}$  should be added to the reference level offset to make the result relative to any 4kHz band.
- Detector Mode = RMS
- Trace Mode = Max Hold
- Sweep Points = Coupled

##### Radiated

- Frequency = 9 KHz – 30 MHz
- Detector = Peak / RMS
- RBW = 9 KHz
- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW = 120 KHz (<1 GHz)
- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1MHz

### 8.2.2 Limits:

FCC 25.202(f) and RSS-170 5.4.3.1

- (1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;
- (2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;
- (3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

### 8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna gain
22° C	1, 2	Modulated Fix channel	3.3 VDC	5 dBi

### 8.2.4 Measurement result:

Conducted

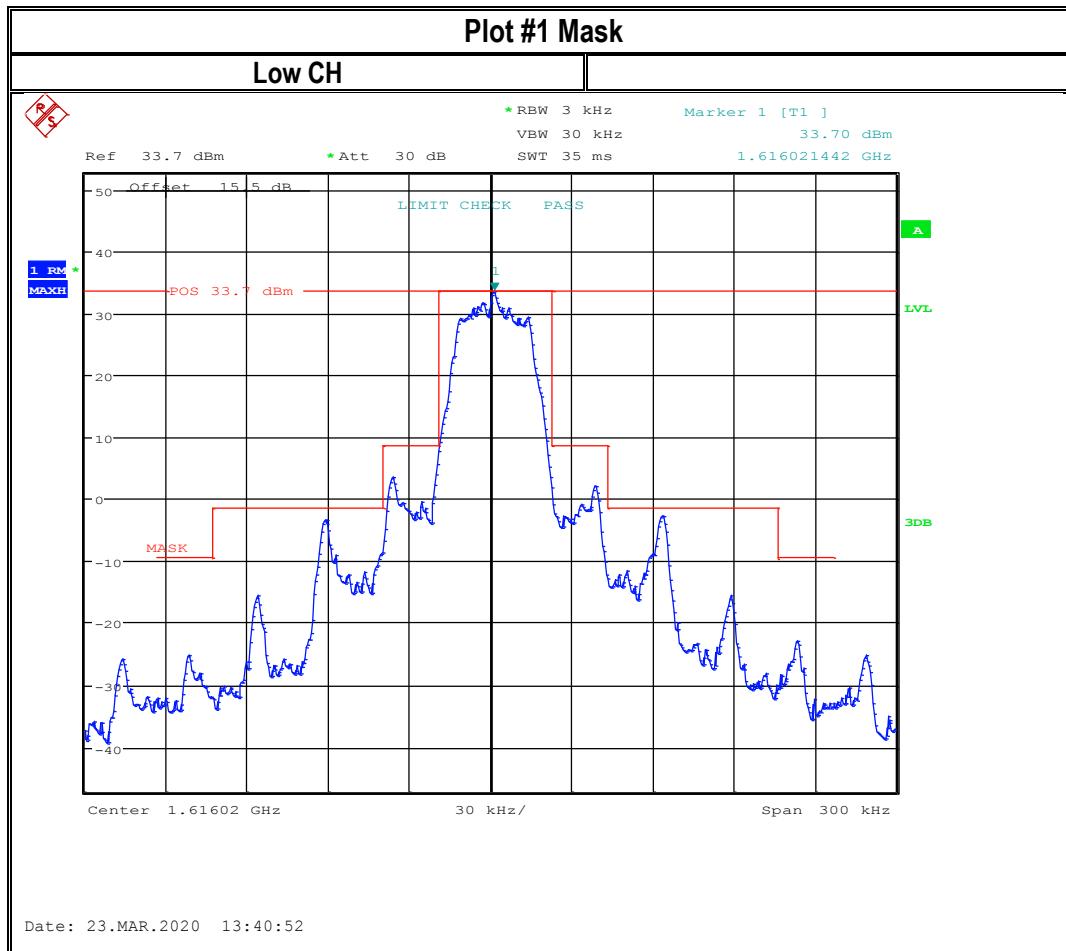
Plot #	Channel #	Frequency Span	Limit	Result
1	Low	300 kHz	See section 8.2.2	Pass
2	Mid	300 kHz	See section 8.2.2	Pass
3	High	300 kHz	See section 8.2.2	Pass

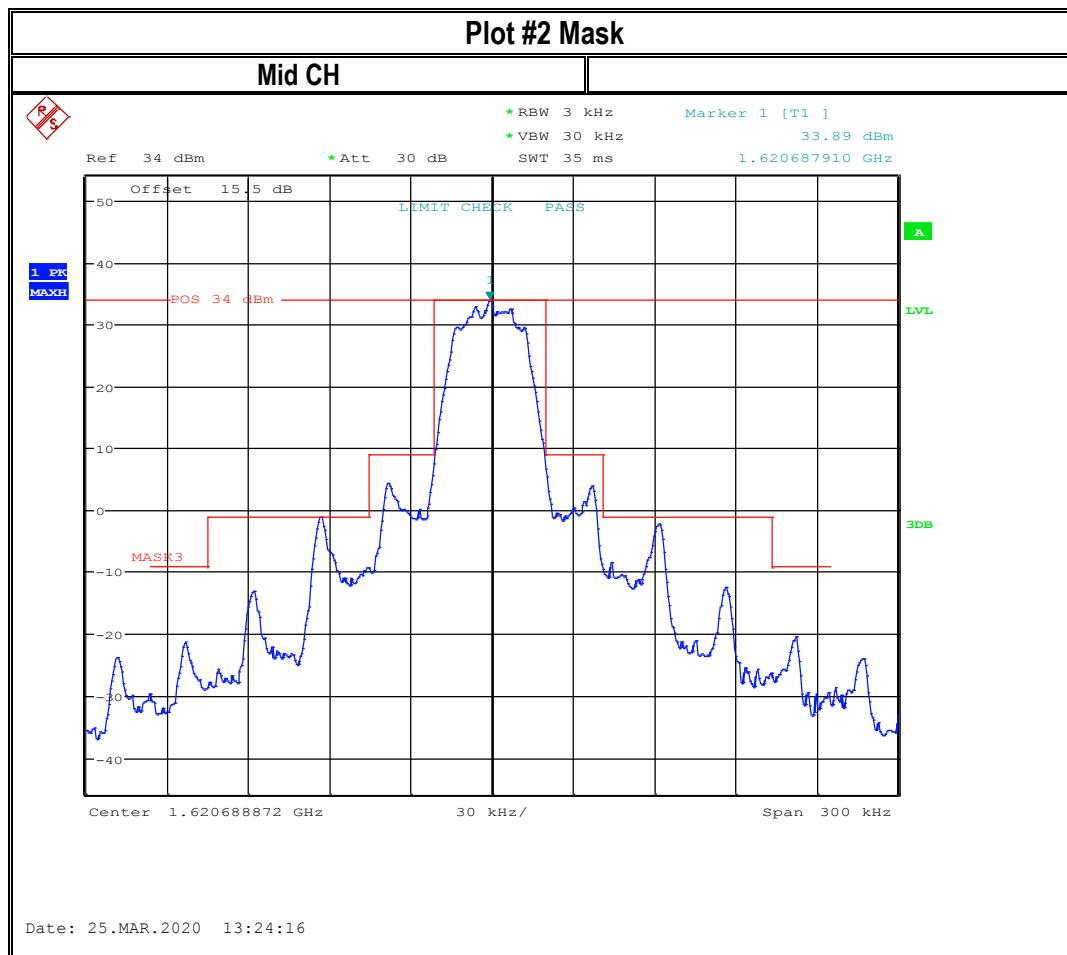
Radiated

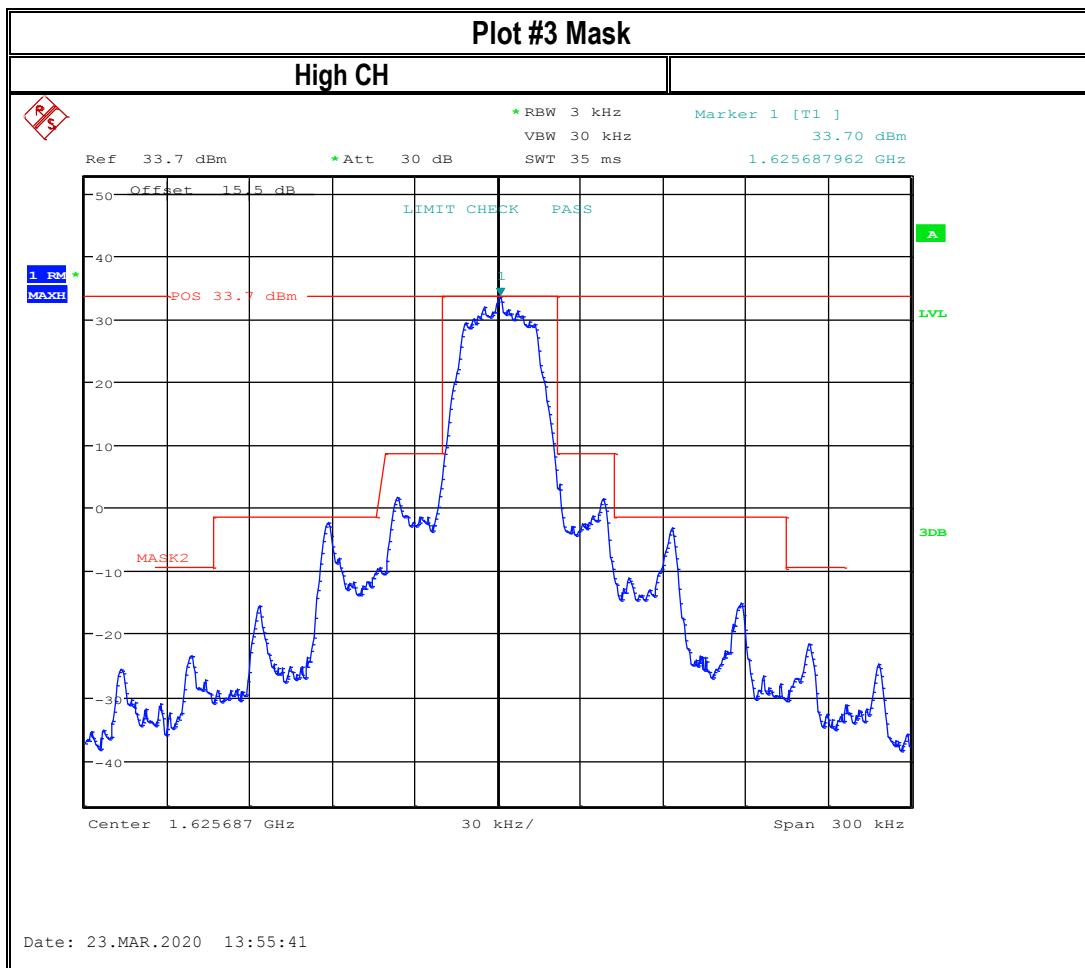
Plot #	Channel #	Scan Frequency	Limit	Result
4-6	Low	30 MHz – 18 GHz	See section 8.2.2	Pass
7-10	Mid	9 kHz – 18 GHz	See section 8.2.2	Pass
11-13	High	30 MHz – 18 GHz	See section 8.2.2	Pass

### 8.2.5 Measurement Plots:

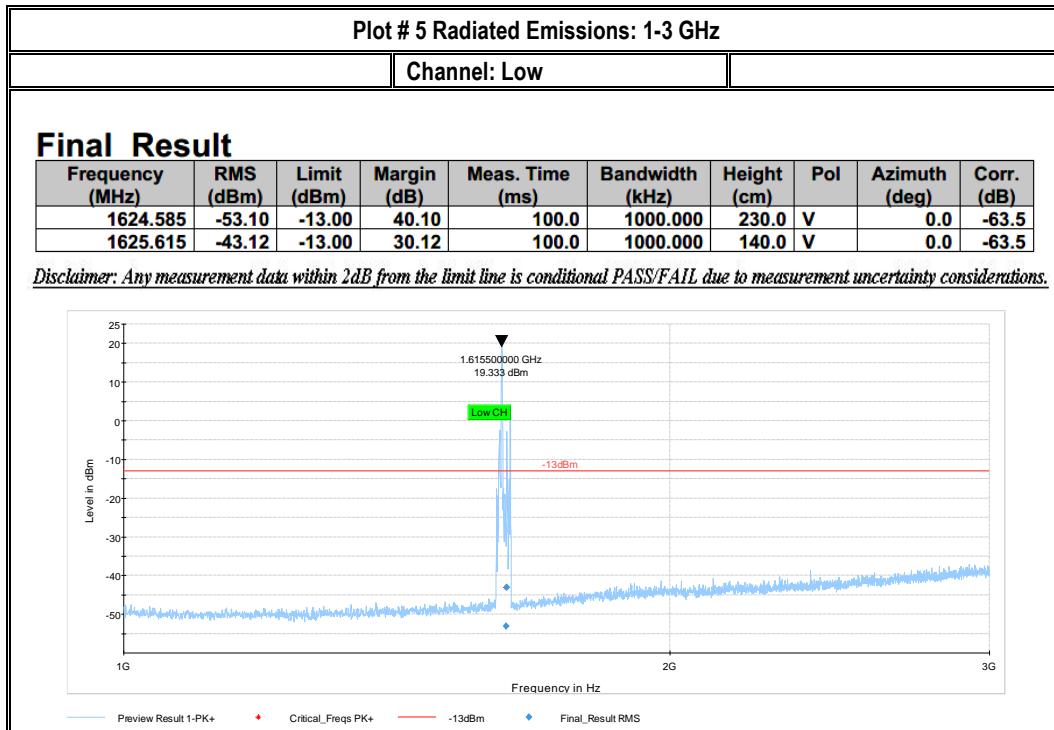
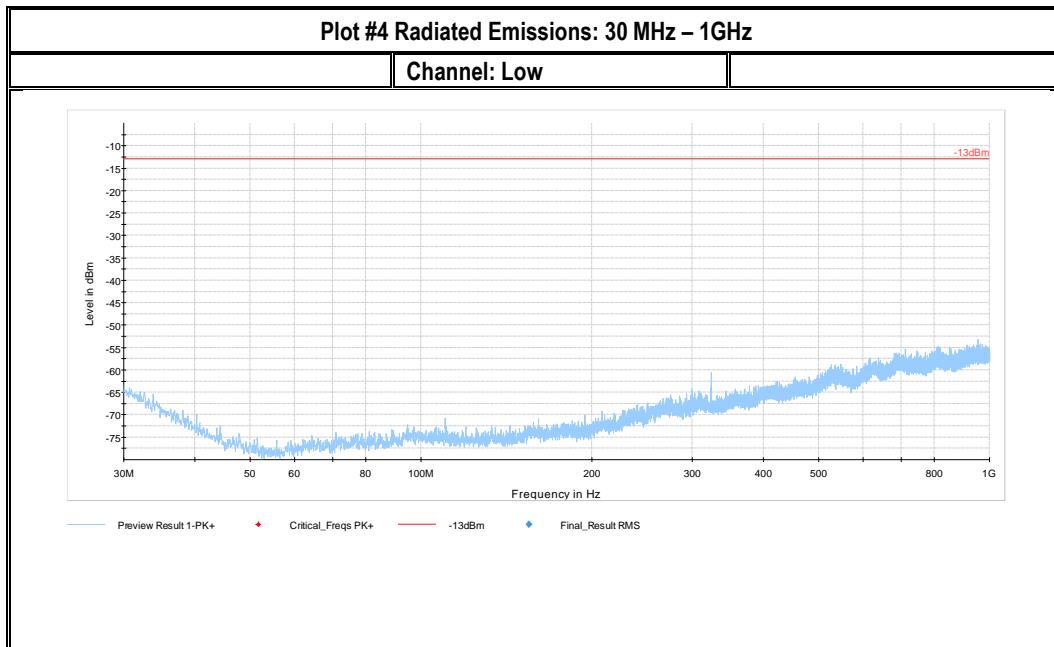
Conducted

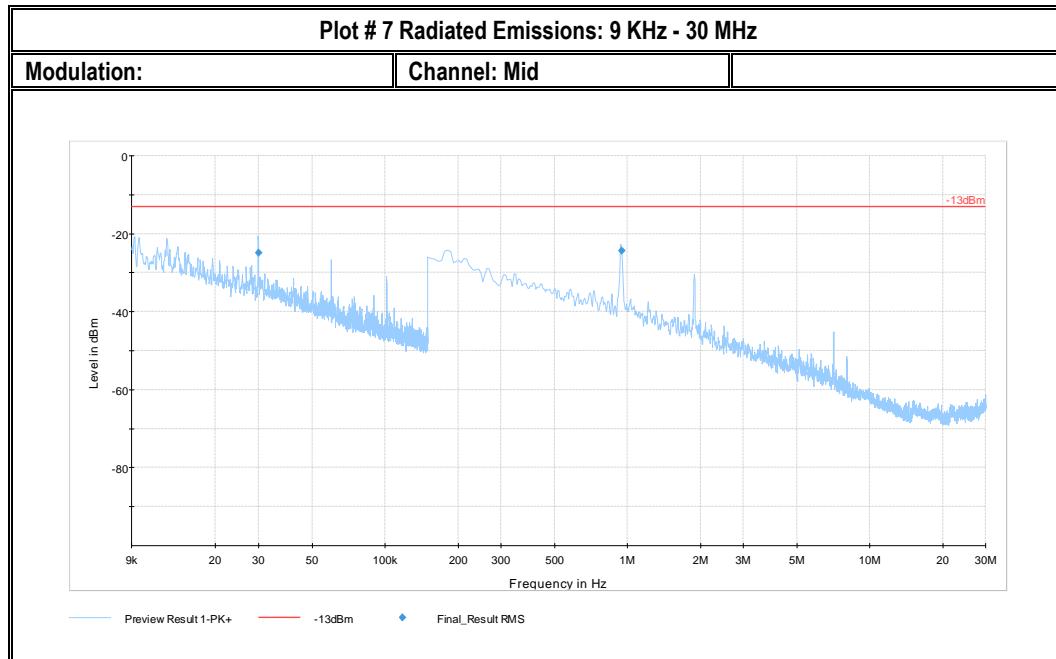
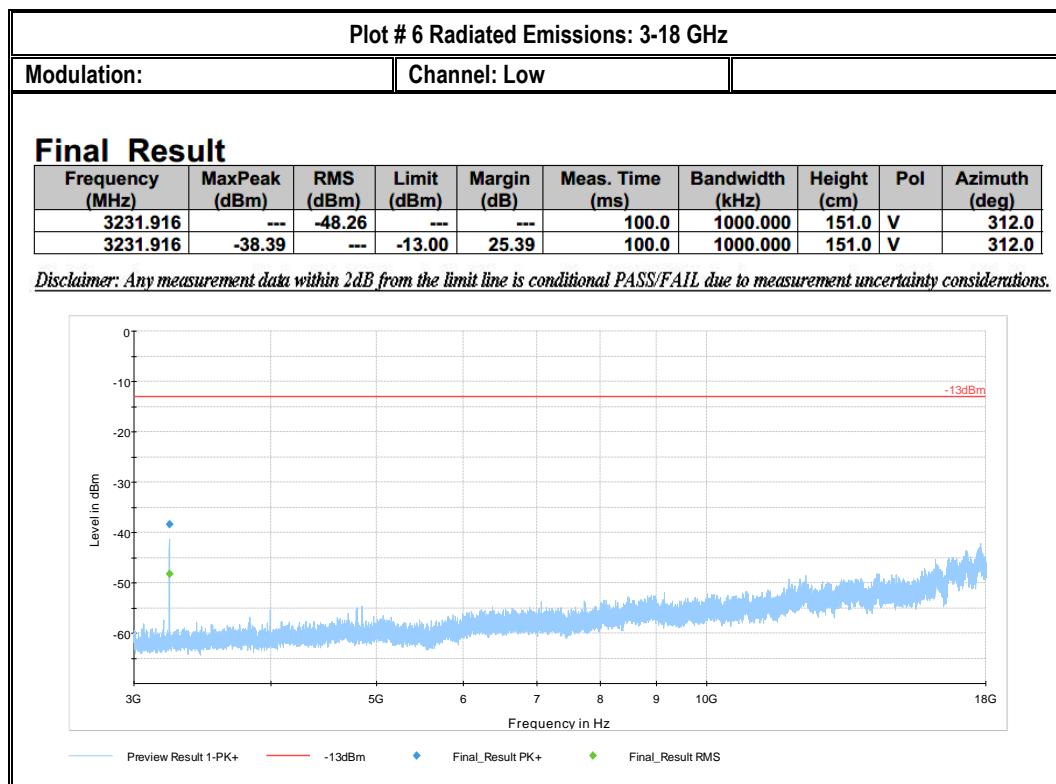


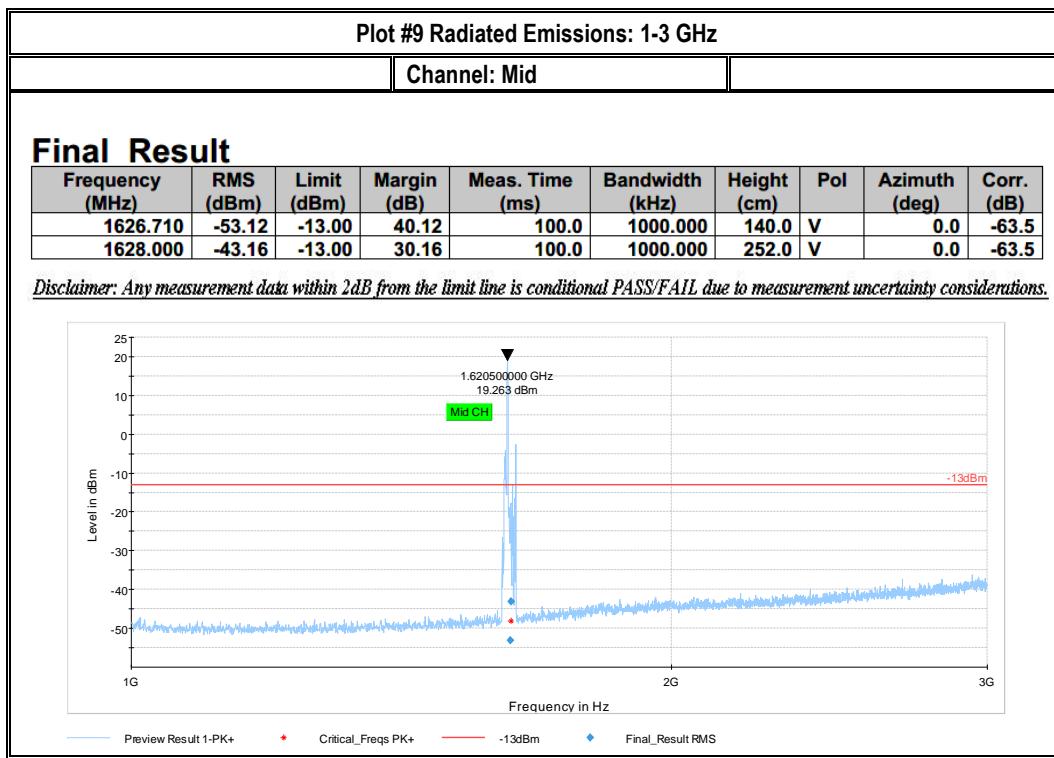
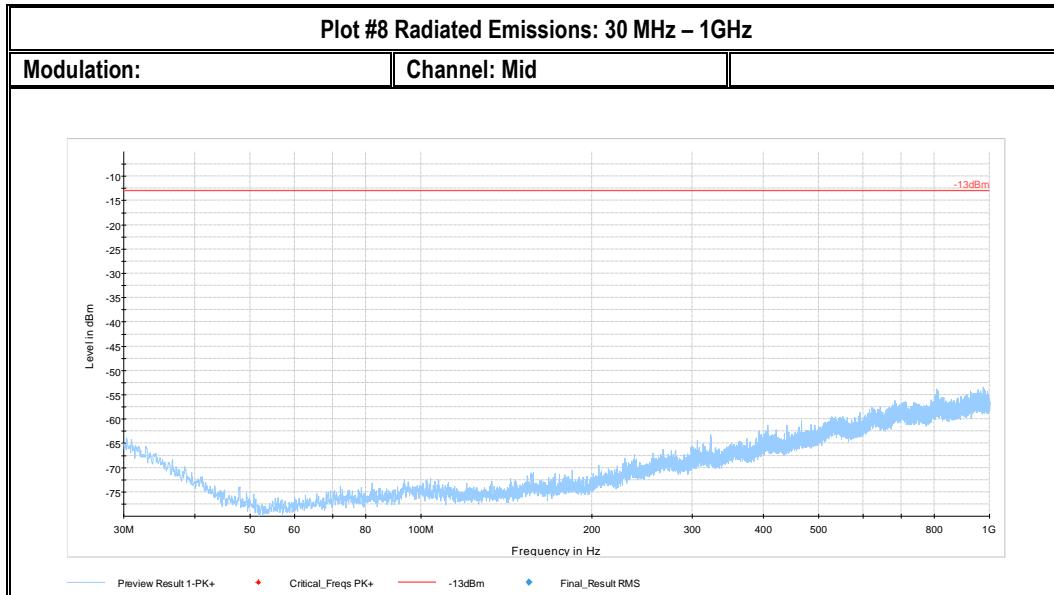


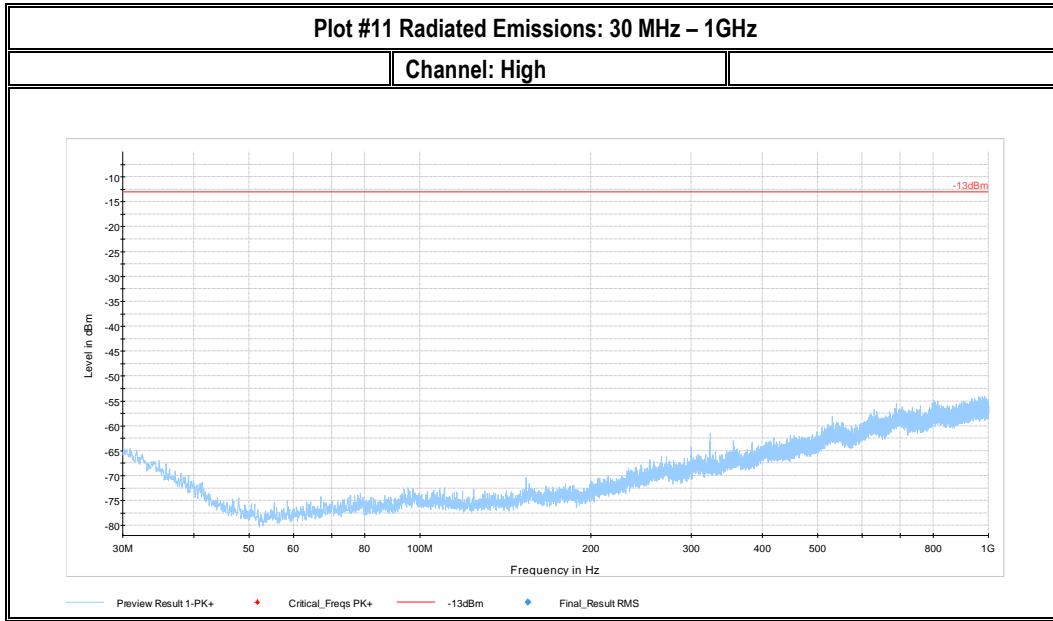
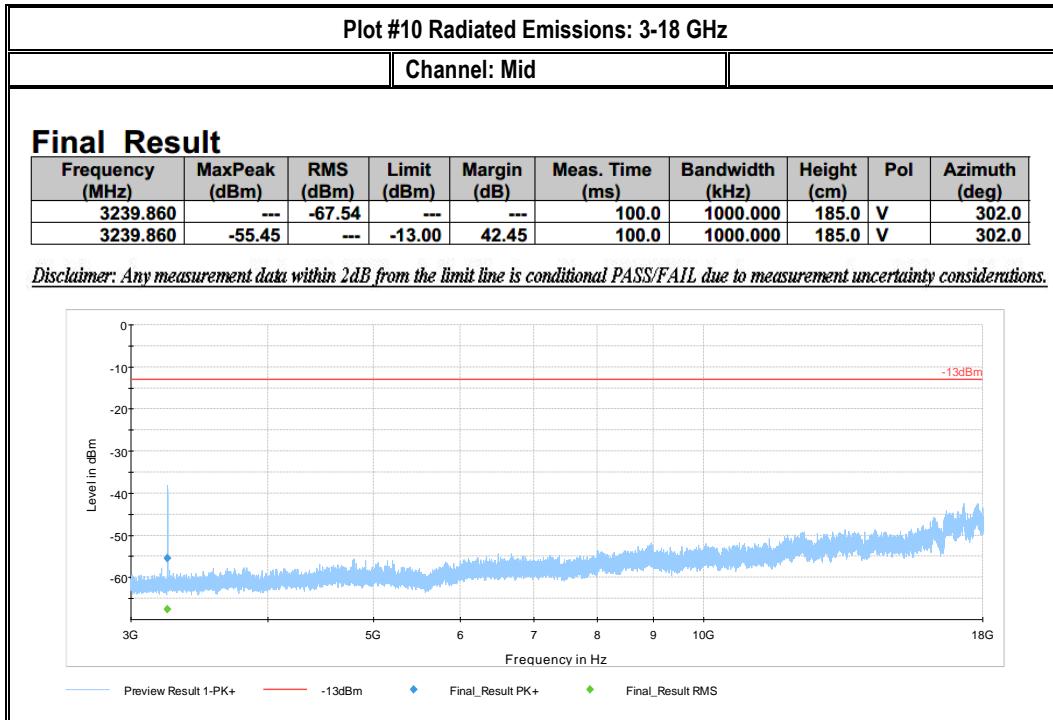


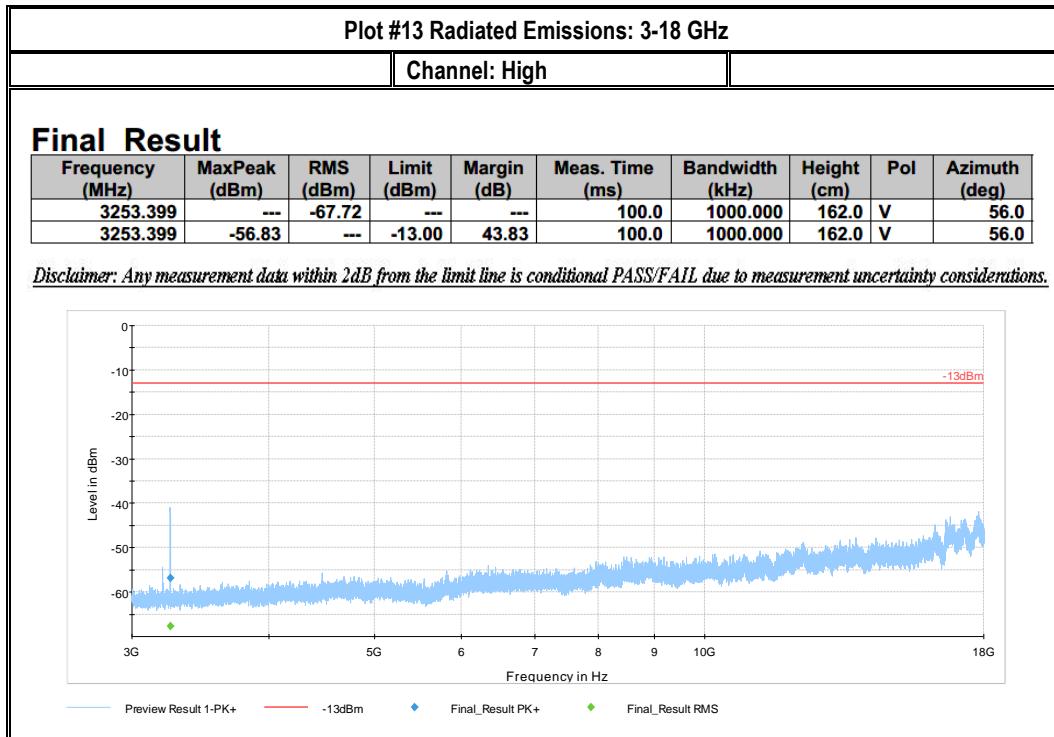
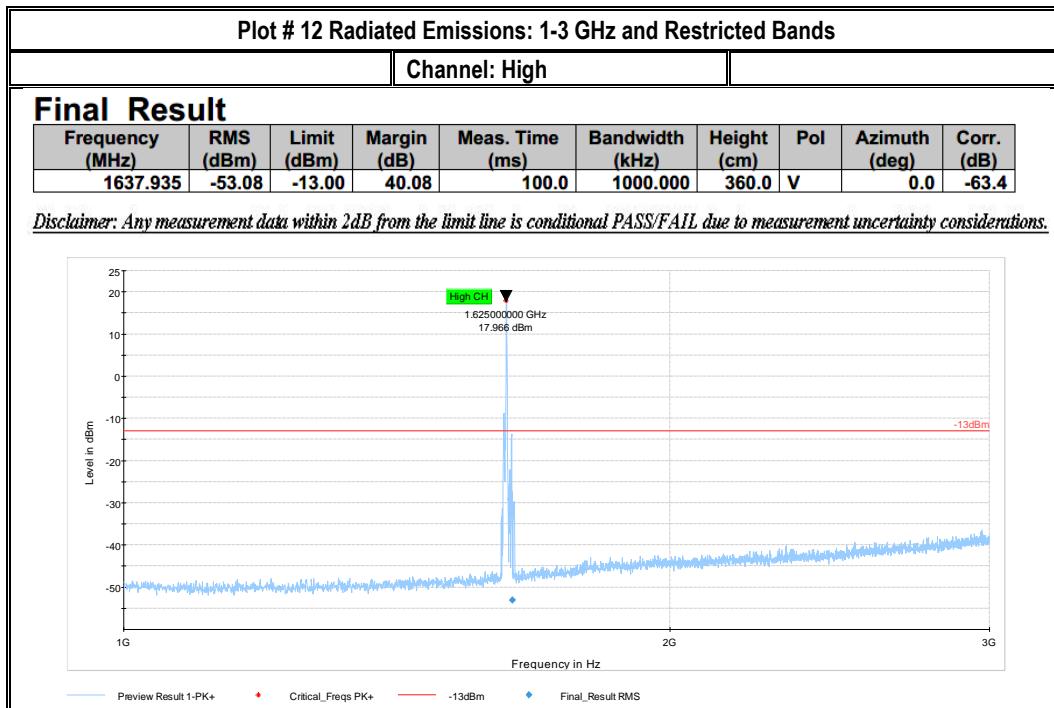
**Radiated:**











## 8.3 Power Limits

### 8.3.1 Measurement according to FCC 25.204, RSS-170 5.3

#### Spectrum Analyzer settings:

- Span = 100 kHz
- RBW = 3 kHz
- VBW = 30 kHz
- $10\log(4/3) = 1.25\text{dB}$  should be added to the reference level offset to make the result relative to any 4kHz band.
- Detector Mode = Peak
- Trace Mode = Max Hold
- Sweep Points = Coupled

#### 8.3.2 Limits:

##### FCC 25.204

- + 40 dBW in any 4 kHz band for  $\theta \leq 0^\circ$
- + 40 +  $3\theta$  dBW in any 4 kHz band for  $0^\circ < \theta \leq 5^\circ$

##### RSS-170 5.3

The application for MES certification shall state the MES e.i.r.p. that is necessary for satisfactory communication. The maximum permissible e.i.r.p. will be the stated e.i.r.p. plus a 2 dB margin. If a detachable antenna is used, the certification application shall state the recommended antenna type and manufacturer, the antenna gain and the maximum transmitter output power at the antenna terminal.

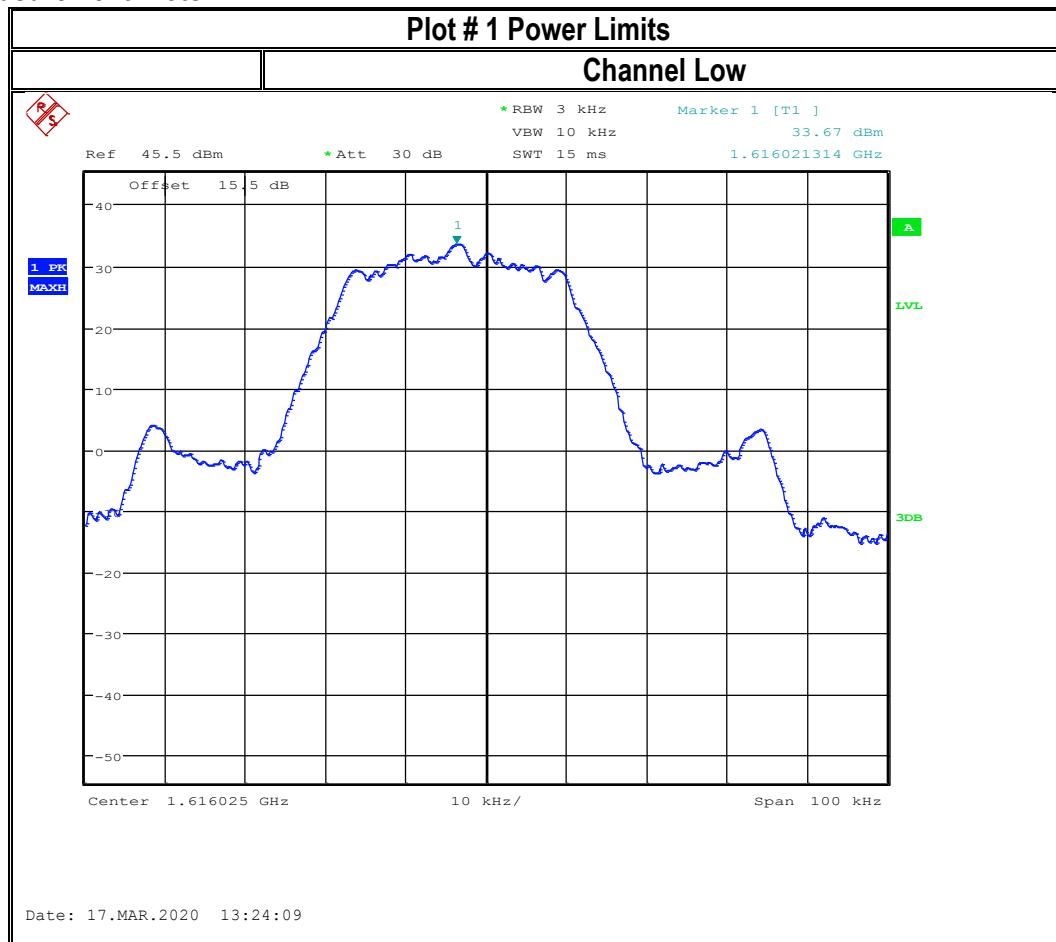
#### 8.3.3 Test conditions and setup:

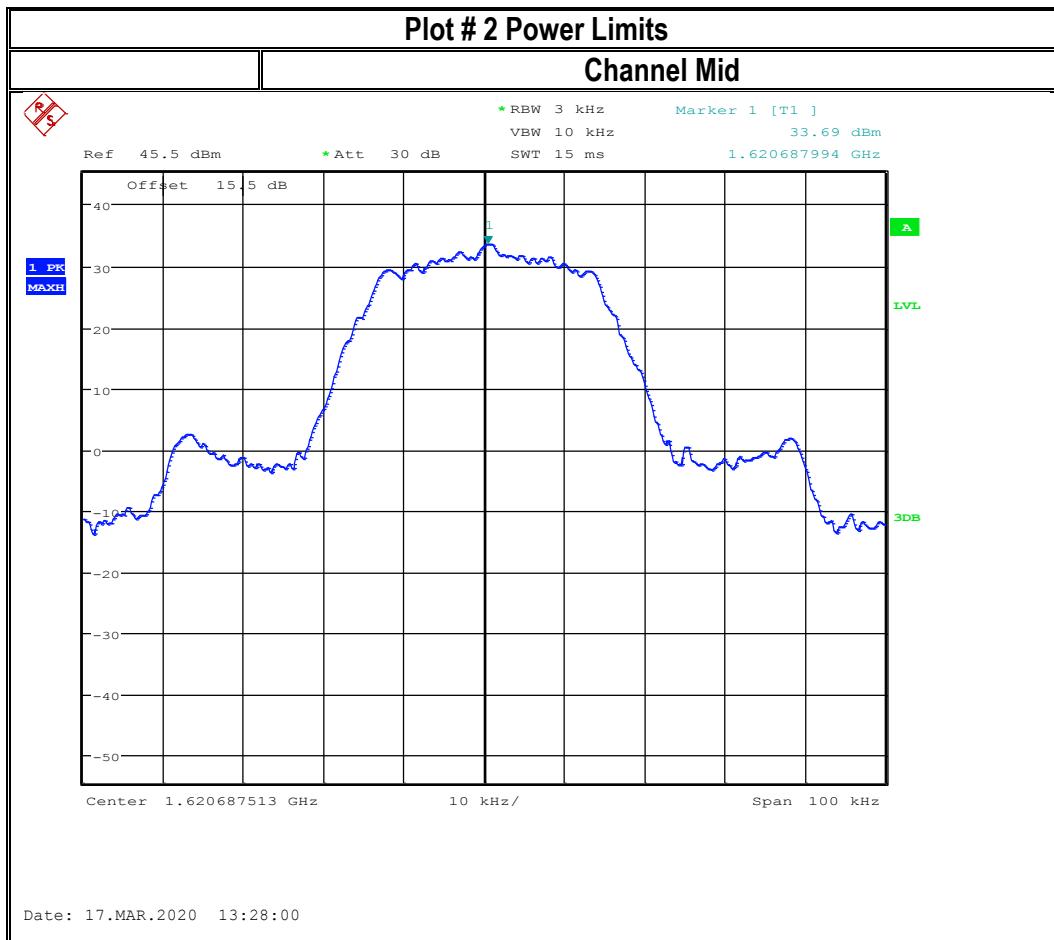
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23° C	1	Modulated Fix Channel	12 VDC	5 dBi

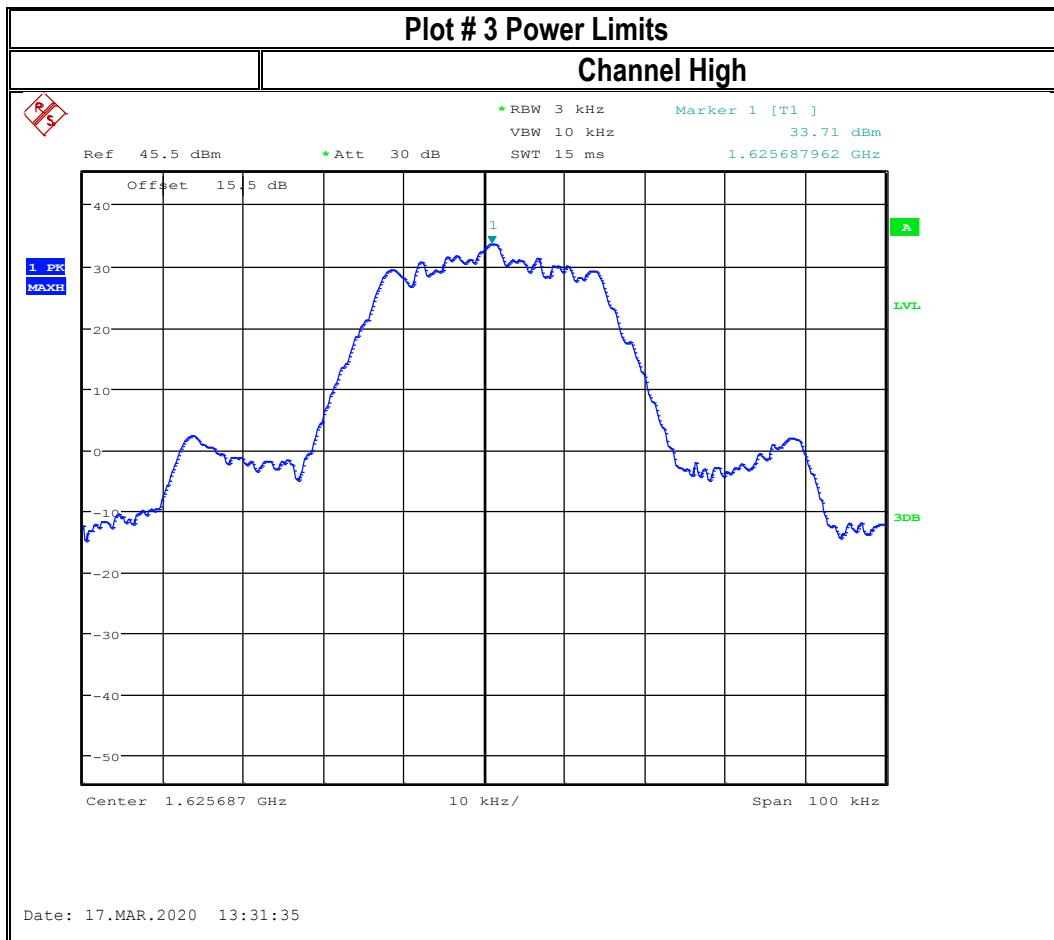
#### 8.3.4 Measurement result:

Plot #	Channel	E.I.R.P(dBm)	E.I.R.P(dBW)	Result
1	Low	38.67	8.67	Pass
2	Mid	38.69	8.69	Pass
3	High	38.71	8.71	Pass

### 8.3.5 Measurement Plots:







## 8.4 Limits on emissions from mobile earth stations fro protection of aeronautical radionavigation-satellite service

### 8.4.1 Measurement according to FCC 25.216 and RSS-170 5.4.3

#### Spectrum Analyzer settings:

- RBW = 1 MHz
- VBW  $\geq$  RBW or 3X
- Sweep = Auto couple
- Detector function = RMS
- Trace = Average

#### 8.4.2 Limits:

##### FCC 25.216

(a) The e.i.r.p. density of emissions from mobile earth stations placed in service on or before July 21, 2002 with assigned uplink frequencies between 1610 MHz and 1660.5 MHz shall not exceed  $-70$  dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1559-1587.42 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth generated by such stations shall not exceed  $-80$  dBW, averaged over any 2 millisecond active transmission interval, in that band.

(b) The e.i.r.p. density of emissions from mobile earth stations placed in service on or before July 21, 2002 with assigned uplink frequencies between 1610 MHz and 1626.5 MHz shall not exceed  $-64$  dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1587.42-1605 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth generated by such stations shall not exceed  $-74$  dBW, averaged over any 2 millisecond active transmission interval, in the 1587.42-1605 MHz band.

(c) The e.i.r.p. density of emissions from mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies between 1610 MHz and 1660.5 MHz shall not exceed  $-70$  dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1559-1605 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed  $-80$  dBW, averaged over any 2 millisecond active transmission interval, in the 1559-1605 MHz band.

##### RSS-170 5.4.3

###### 5.4.3.2.1 Band 1610-1626.5 MHz

Mobile earth stations with transmitting frequencies between 1610 MHz and 1626.5 MHz shall have the e.i.r.p. density of unwanted emissions in the band 1605-1610 MHz, averaged over any 2-ms active transmission interval, not exceed the following limits:

- (1)  $-70$  dBW/MHz at 1605 MHz, linearly interpolated to  $-10$  dBW/MHz at 1610 MHz for broadband emissions; and
- (2)  $-80$  dBW/kHz at 1605 MHz, linearly interpolated to  $-20$  dBW/kHz at 1610 MHz for discrete emissions.

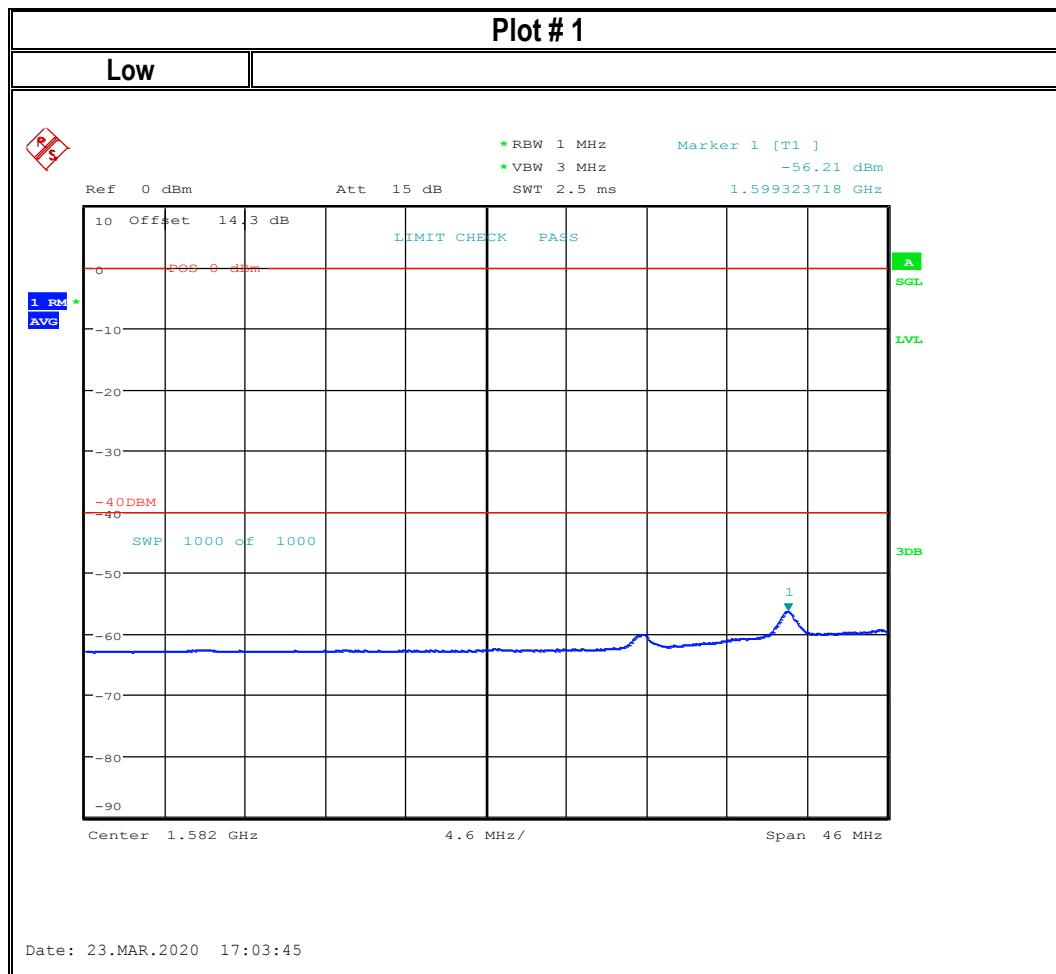
#### 8.4.3 Test conditions and setup:

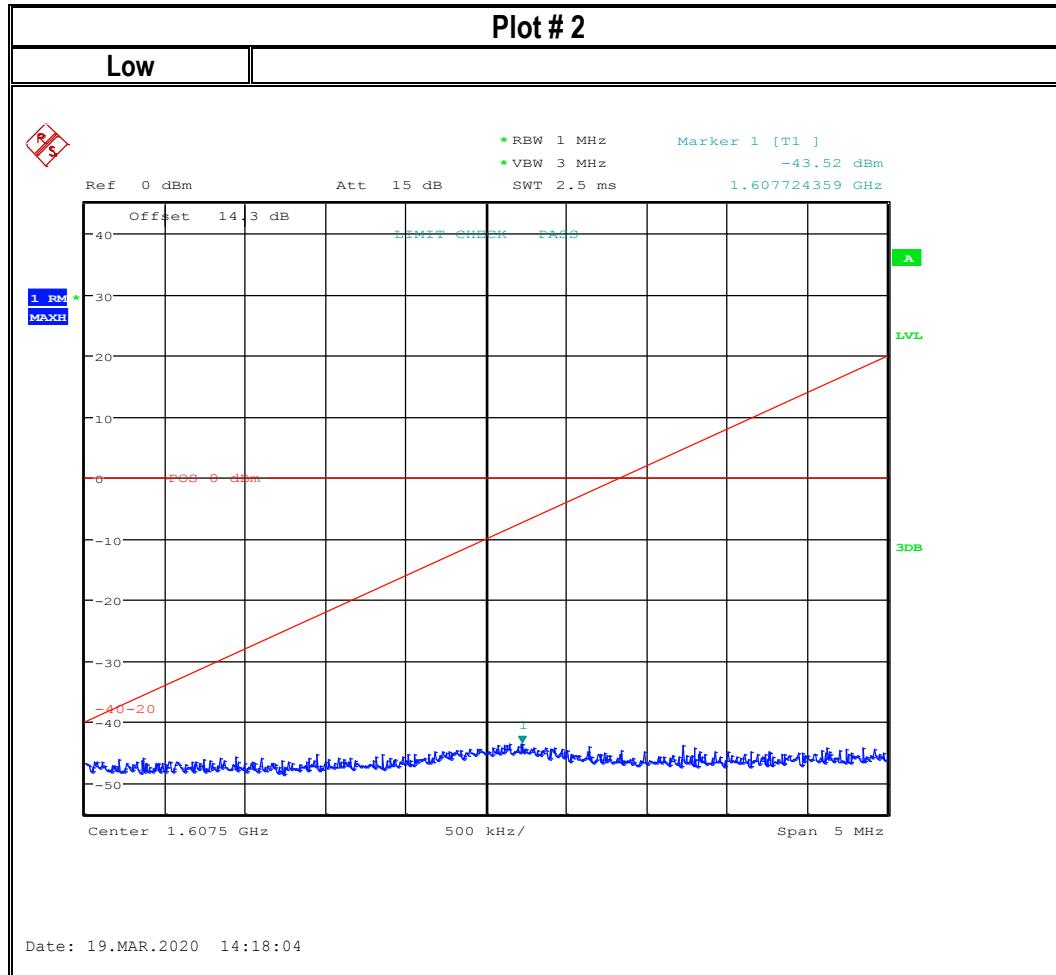
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
23° C	1	Modulated Fix Channel	3.3 VDC	5 dBi

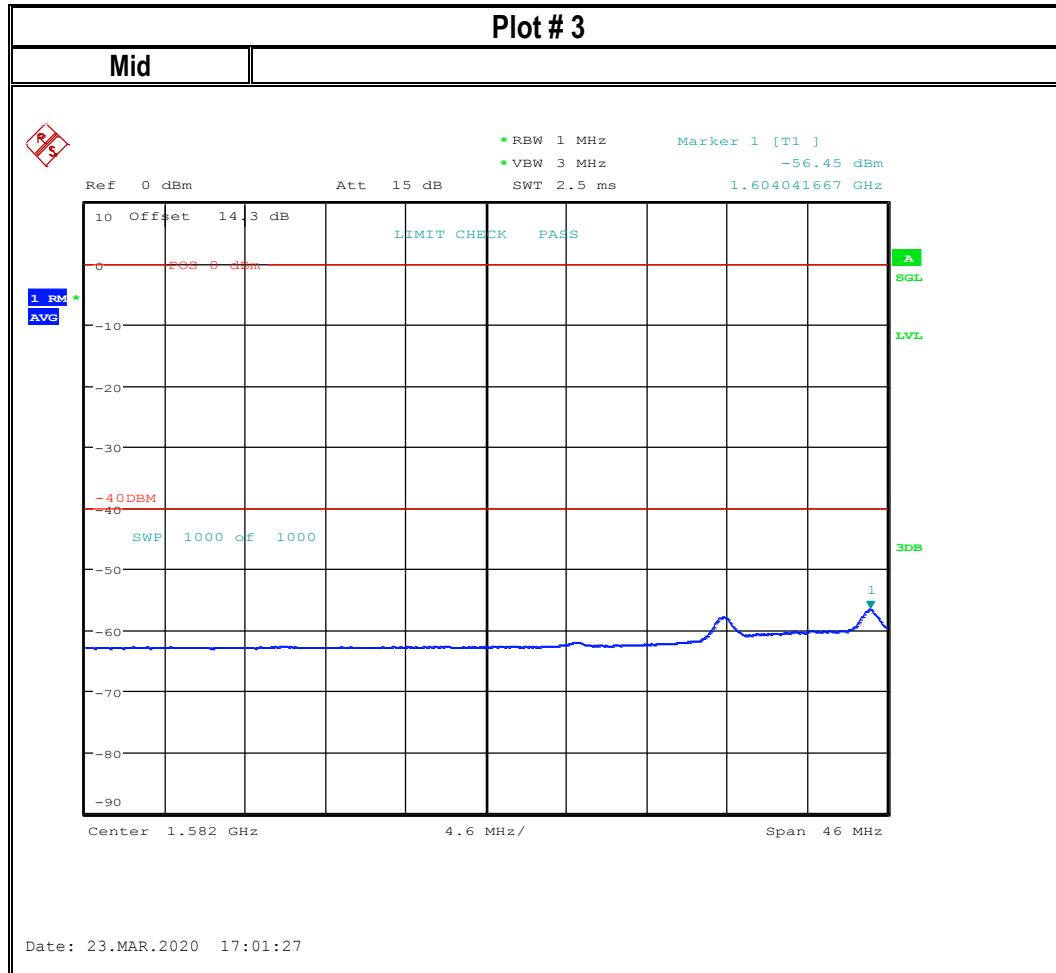
#### 8.4.4 Measurement result:

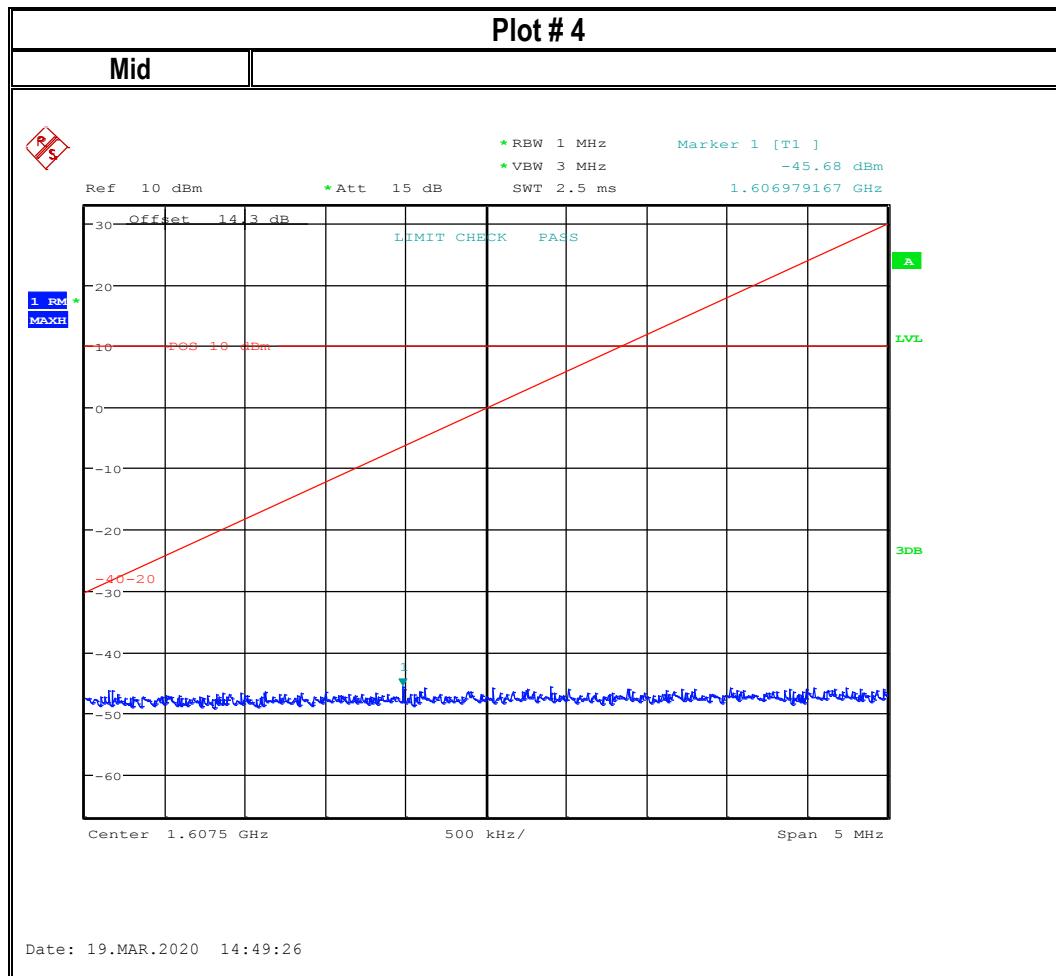
Plot #	Channel	Limit	Result
1, 2	Low	See section 8.2.2	Pass
3, 4	Mid	See section 8.2.2	Pass
5, 6	High	See section 8.2.2	Pass

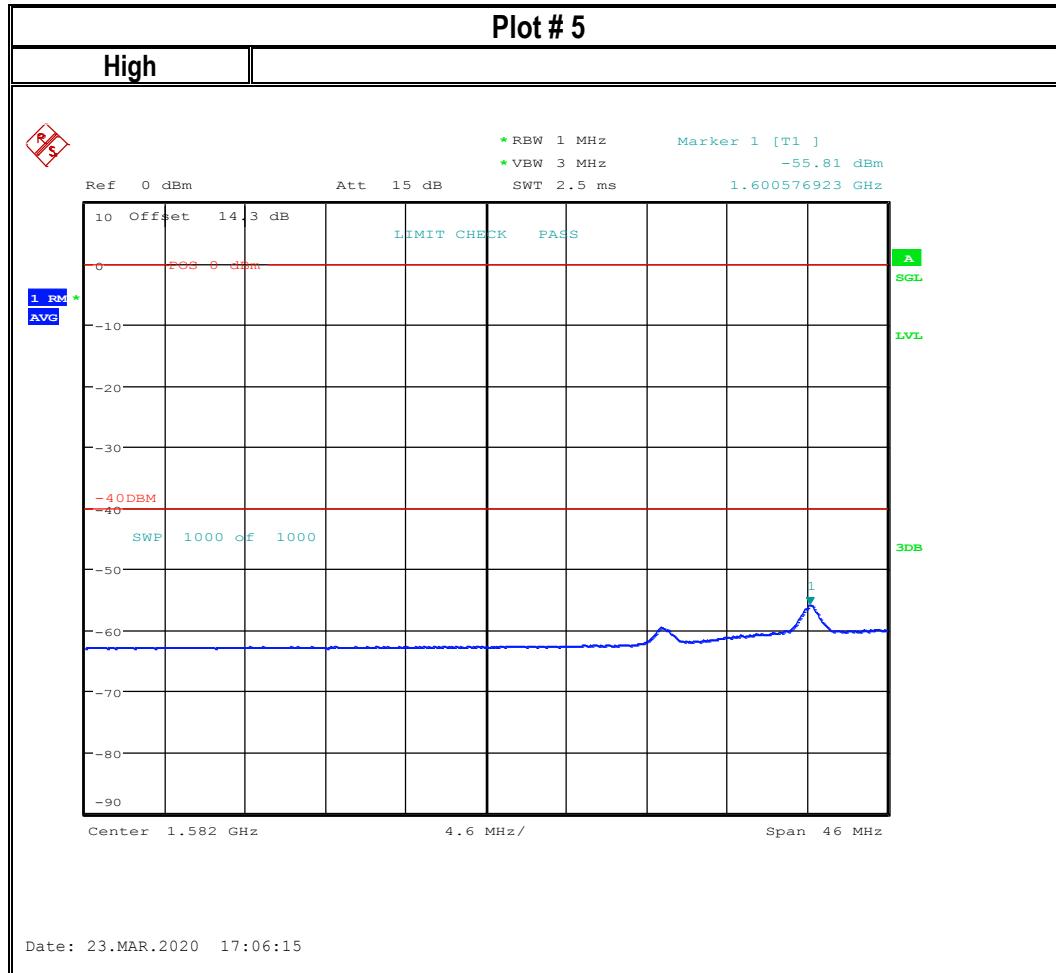
### 8.4.5 Measurement Plots:

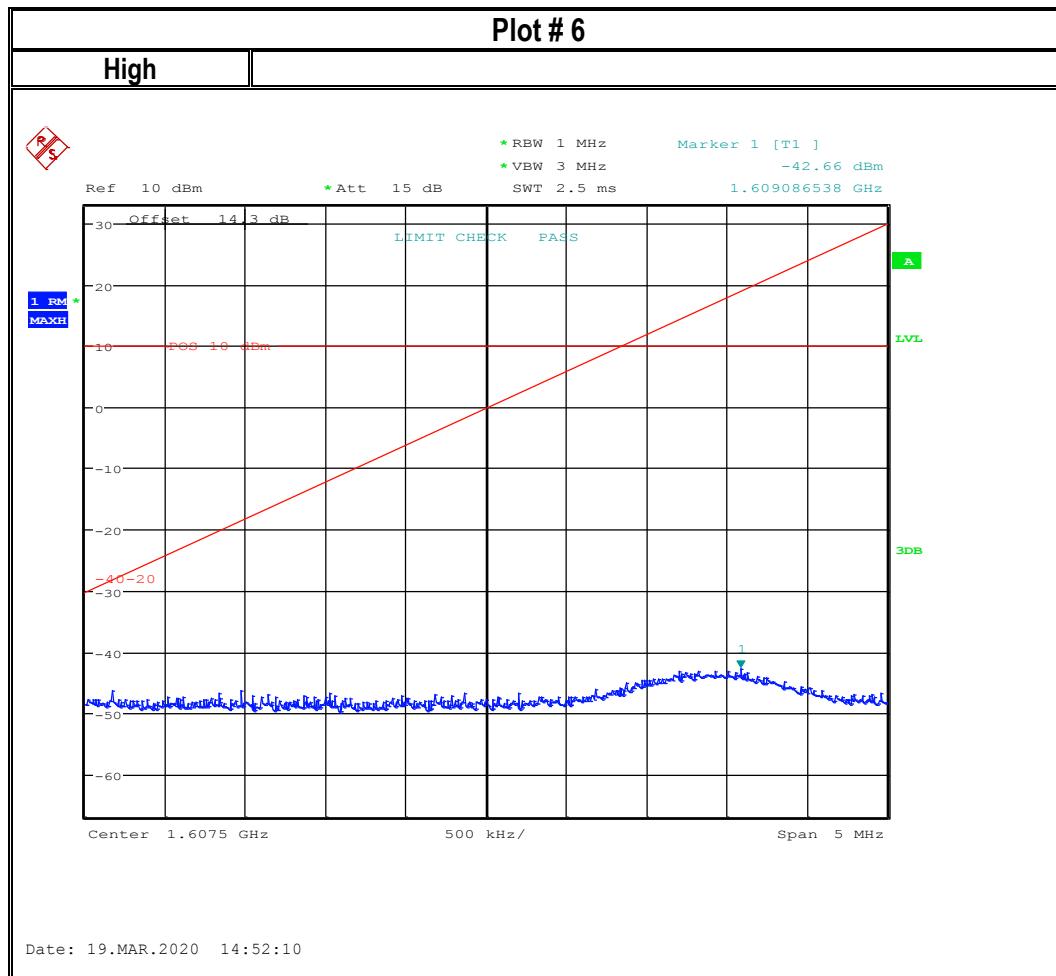












## 8.5 Occupied Bandwidth

### 8.5.1 Measurement according to FCC 25.202(b)

#### Spectrum Analyzer settings:

- Span: 1MHz, centered on the transmission channel
- RBW: 3kHz
- VBW: 10kHz
- Sweep Time = Auto couple
- Detector = Peak
- Trace = Max hold

### 8.5.2 Limits: FCC 25.202(b)

(b) Other frequencies and associated bandwidths of emission may be assigned on a case-by-case basis to space systems under this part in conformance with §2.106 of this chapter and the Commission's rules and policies.

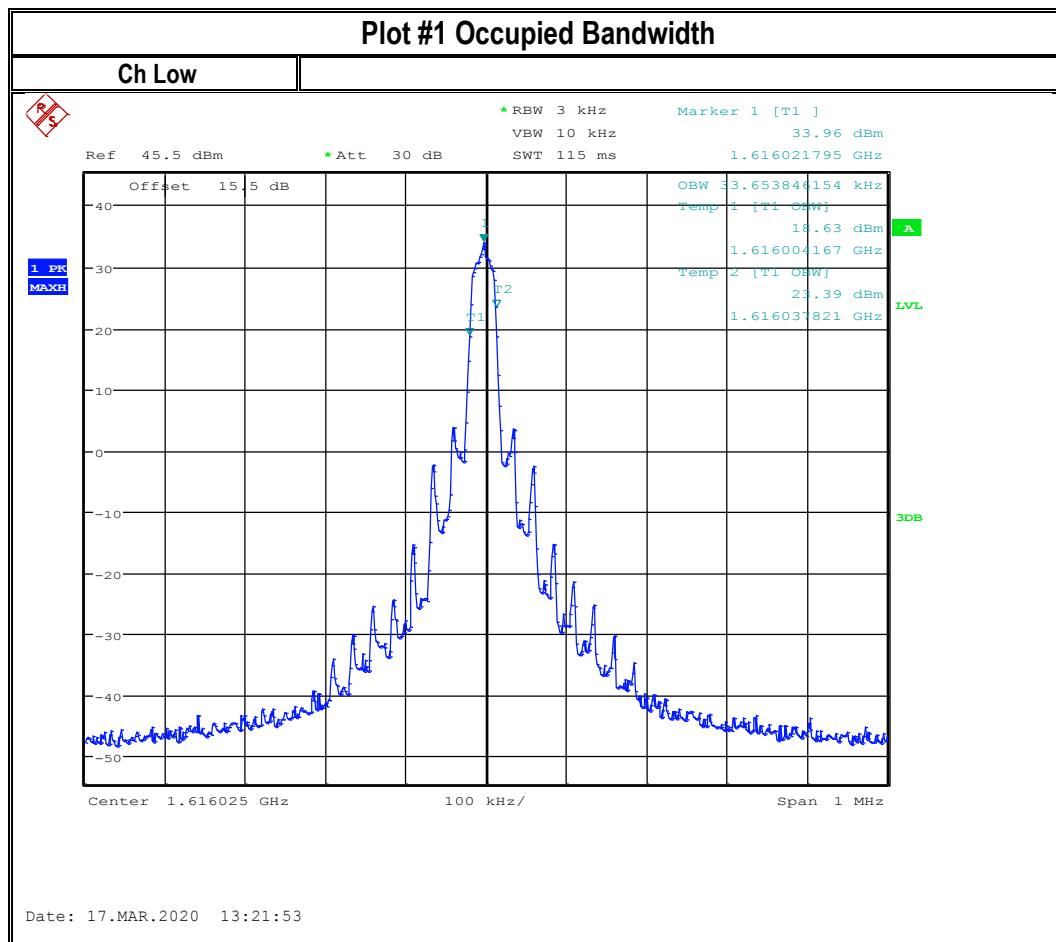
### 8.5.3 Test conditions and setup:

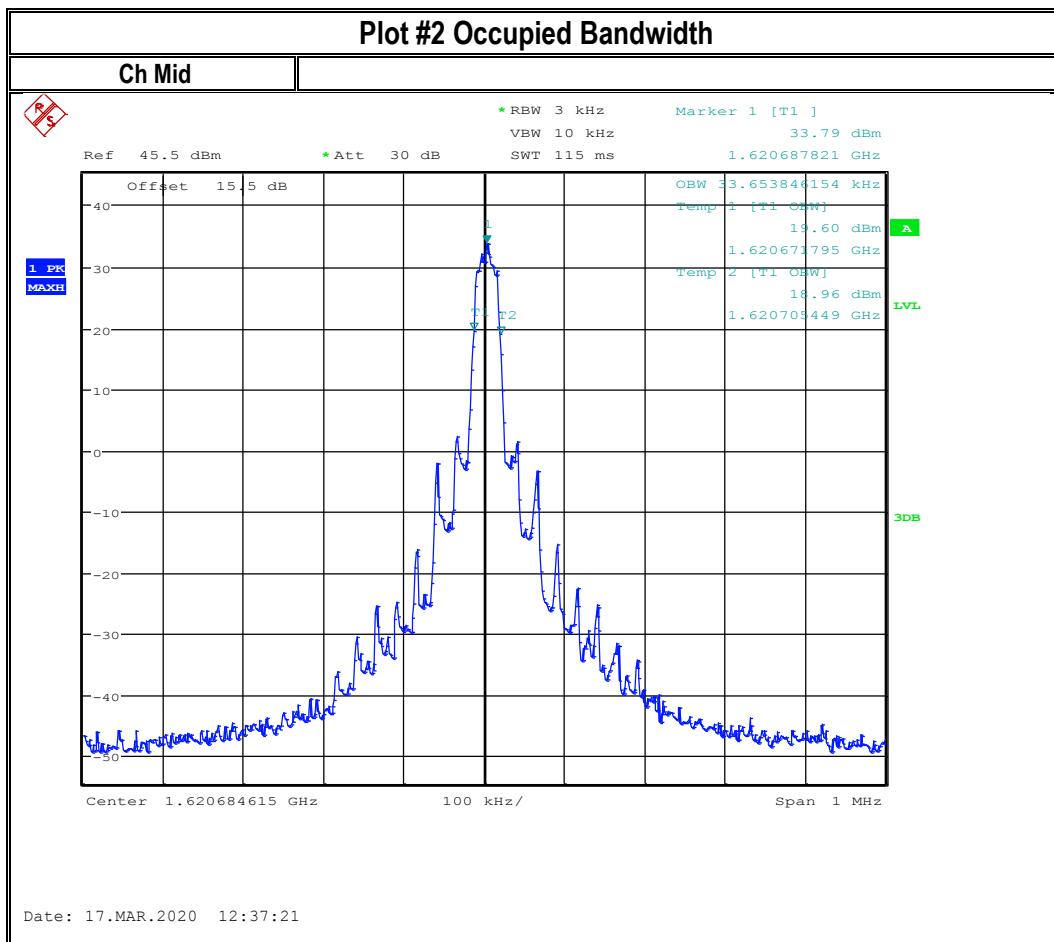
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	1	Modulated Fix Channel	3.3 VDC

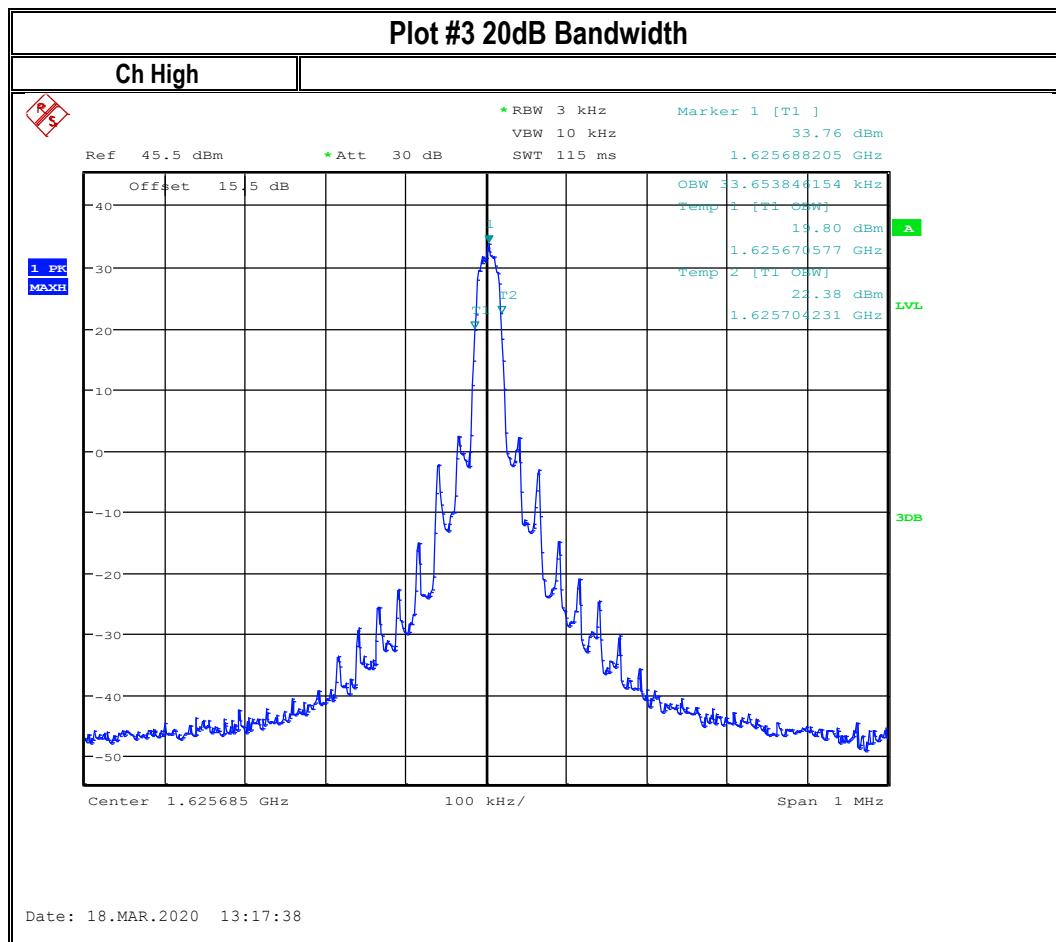
### 8.5.4 Measurement result:

Plot #	Channel	Occupied Bandwidth (kHz)
1	Low	33.65
2	Mid	33.65
3	High	33.65

### 8.5.5 Measurement Plots:







## **9 Test setup photos**

Setup photos are included in supporting file name: "EMC\_Geoforce\_GT2\_FCC\_Setup\_Photos.pdf"

## **10 Test Equipment And Ancillaries Used For Testing**

Model No.	Description	Serial number	Manufacture	Calibration Date	Due
FSV40	Signal Analyzer	101022	Rohde & Schwarz	7/16/2019	7/16/2022
Loop antenna 6512	Loop antenna	16498	ETS Lindgren	8/8/2017	8/8/2020
Bilog antenna CBL6141B	Bilog antenna	41106	Teseq	11/1/2017	11/1/2020
Horn-3115	Horn antenna	00035111	ETS Lindgren	4/17/2019	4/17/2022
Horn 3117-PA	Horn antenna	169547	ETS Lindgren	8/8/2017	8/8/2020
Horn 3116C-PA	Horn antenna	169535	ETS Lindgren	9/24/2017	9/24/2020
OSP130	OSP130	100185	Rohde & Schwarz	N/A	N/A
OSP150	OSP150	100016	Rohde & Schwarz	N/A	N/A
Digital Thermometer	Model:36934-164	181230565	Control company	4/27/2018	4/27/2020
maturo NCD	Antenna Mast	N/A	maturo GmbH	N/A	N/A
Maturo control unit	turn table	N/A	maturo GmbH	N/A	N/A
FSU26	Spectrum Analyzer FSU26	200065	Rohde & Schwarz	7/16/2019	7/16/2022
Digital Thermometer	Model:36934-164	191871994	Control company	1/10/2019	1/10/2021

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.  
Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

## 11 Revision History

Date	Report Name	Changes to report	Report prepared by
2020-04-20	EMC_Geoforce_GT2_FCC_25	Initial Version	Kevin Wang

<<< The End >>>