

# RF Exposure Exemption Report

TTP PLC

Model: Velaris Module, Velaris Module Plus,  
Velaris 200 and Velaris Multilink



In accordance with FCC CFR 47 Part 1.1307

Prepared for: TTP PLC  
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## COMMERCIAL-IN-CONFIDENCE

FCC ID: 2BO4Q-VMODULE200A, 2BO4Q-V200, 2BO4Q-VMULTIL200A

Document 75962190-14 Issue: 02

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NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
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FCC Accreditation  
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### EXECUTIVE SUMMARY

The wireless devices described within this report are compliant with the exemption criteria related to human exposure to electromagnetic fields laid out in FCC CFR Title 47 Part 1.1307.

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## 1 Report Summary

### 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	19 June 2025
2	Amendment of 200 A antenna from 2.5 dBi to 3.5 dBi	30 July 2025

**Table 1**

### 1.2 Introduction

Applicant	TTP PLC		
Manufacturer	TTP PLC		
Sample Information	Model Number(s)	Hardware Version(s)	Software Version(s)
	Velaris Module	1	1.5.8931
	Velaris Module Plus	1	1.5.8931
	Velaris 200	1	1.5.8931
	Velaris Multilink	1	1.5.8931
Specification/Issue/Date	FCC 47 CFR Part 1.1307: 2022		
Order Number	PURORDTTP23503/PUROR		
Date	06-August-2024		
Related Document(s)	<ul style="list-style-type: none"><li>KDB 447498 D04 v01</li><li>FCC 47 CFR Part 2.1093: 2023</li></ul>		



### 1.3 Brief Summary of Results

The wireless devices described within this report are compliant with the exemption criteria related to human exposure to electromagnetic fields laid out in FCC CFR Title 47 Part 1.1307.

The calculations shown in this report were made in accordance with the procedures specified in the applied test specification(s).



## 1.4 Application Form

### Equipment Description

Technical Description: <i>(Please provide a brief description of the intended use of the equipment)</i>	Mobile earth station satellite communication data modem L-Band, up to 200kbps will be plugged into OMNI 200A antenna for radiative purposes
Manufacturer:	Gotonomi
Model:	200 A
Part Number:	Velaris Omni 200 A

If more than one frequency band is supported, please confirm which combinations of bands are capable of Simultaneous Transmit.	Inmarsat band transmit & singular LTE band transmit
--	---

### Frequency Band 1: BGAN

Antenna Model:	200 A	
Antenna length:	9.5	cm
Bottom frequency:	1626.5	MHz
Middle frequency:	1650.75	MHz
Top frequency:	1675	MHz

Maximum power (input to the antenna including a tolerance):	+37.5	dBm
Antenna gain (or maximum gain allowed):	3.5	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



### Frequency Band 2: LTE Cat-1 Band 1

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1920	MHz
Middle frequency:		MHz
Top frequency:	1980	MHz
Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:	dB $\mu$ A/M	
Measurement Distance:	cm	
Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

### Frequency Band 3: LTE Cat-1 Band 2

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1850	MHz
Middle frequency:		MHz
Top frequency:	1910	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:	dB $\mu$ A/M	
Measurement Distance:	cm	

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 4: LTE Cat-1 Band 3

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1710	MHz
Middle frequency:		MHz
Top frequency:	1785	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 5: LTE Cat-1 Band 4

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1710	MHz
Middle frequency:		MHz
Top frequency:	1755	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 6: LTE Cat-1 Band 5

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	824	MHz
Middle frequency:		MHz
Top frequency:	849	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 7: LTE Cat-1 Band 7

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	2500	MHz
Middle frequency:		MHz
Top frequency:	2570	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 8: LTE Cat-1 Band 8

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	885	MHz
Middle frequency:		MHz
Top frequency:	915	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 9: LTE Cat-1 Band 12

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	699	MHz
Middle frequency:		MHz
Top frequency:	716	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



Frequency Band 10: LTE Cat-1 Band 13

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	777	MHz
Middle frequency:		MHz
Top frequency:	787	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

Frequency Band 11: LTE Cat-1 Band 18

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	815	MHz
Middle frequency:		MHz
Top frequency:	830	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



Frequency Band 12: LTE Cat-1 Band 20

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	832	MHz
Middle frequency:		MHz
Top frequency:	862	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

Frequency Band 13: LTE Cat-1 Band 25

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1850	MHz
Middle frequency:		MHz
Top frequency:	1915	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 14: LTE Cat-1 Band 26

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	814	MHz
Middle frequency:		MHz
Top frequency:	849	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 15: LTE Cat-1 Band 28

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	703	MHz
Middle frequency:		MHz
Top frequency:	748	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



Frequency Band 16: LTE Cat-1 Band 38

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	2570	MHz
Middle frequency:		MHz
Top frequency:	2620	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

Frequency Band 17: LTE Cat-1 Band 39

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1880	MHz
Middle frequency:		MHz
Top frequency:	1920	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 18: LTE Cat-1 Band 40

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	2300	MHz
Middle frequency:		MHz
Top frequency:	2400	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 19: LTE Cat-1 Band 41

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	2496	MHz
Middle frequency:		MHz
Top frequency:	2690	MHz

Maximum power (input to the antenna including a tolerance):	+23	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 20: GSM 850MHz

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	824.2	MHz
Middle frequency:		MHz
Top frequency:	848.8	MHz

Maximum power (input to the antenna including a tolerance):	+33	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 21: GSM 900MHz

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	880	MHz
Middle frequency:		MHz
Top frequency:	915	MHz

Maximum power (input to the antenna including a tolerance):	+33	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 22: GSM 1800MHz

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1710.2	MHz
Middle frequency:		MHz
Top frequency:	1784.8	MHz

Maximum power (input to the antenna including a tolerance):	+30	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 23: GSM 1900MHz

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1850.2	MHz
Middle frequency:		MHz
Top frequency:	1909.8	MHz

Maximum power (input to the antenna including a tolerance):	+30	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 24: WCDMA B1

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1920	MHz
Middle frequency:		MHz
Top frequency:	1980	MHz

Maximum power (input to the antenna including a tolerance):	+24	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 25: WCDMA B2

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1850	MHz
Middle frequency:		MHz
Top frequency:	1910	MHz

Maximum power (input to the antenna including a tolerance):	+24	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



Frequency Band 26: WCDMA B4

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	1710	MHz
Middle frequency:		MHz
Top frequency:	1755	MHz

Maximum power (input to the antenna including a tolerance):	+24	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

Frequency Band 27: WCDMA B5

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	824	MHz
Middle frequency:		MHz
Top frequency:	849	MHz

Maximum power (input to the antenna including a tolerance):	+24	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



#### Frequency Band 28: WCDMA B6

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	830	MHz
Middle frequency:		MHz
Top frequency:	840	MHz

Maximum power (input to the antenna including a tolerance):	+24	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

#### Frequency Band 24: WCDMA B8

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	880	MHz
Middle frequency:		MHz
Top frequency:	915	MHz

Maximum power (input to the antenna including a tolerance):	+24	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%



Frequency Band 24: WCDMA B19

Antenna Model:	RF Solutions 4G LTE GSM Helical Antenna	
Antenna length:	9.5	cm
Bottom frequency:	830	MHz
Middle frequency:		MHz
Top frequency:	845	MHz

Maximum power (input to the antenna including a tolerance):	+24	dBm
Antenna gain (or maximum gain allowed):	+2	dBi

Or

Field Strength Measurement:		dB $\mu$ A/M
Measurement Distance:		cm

Separation distance from antenna to the user/bystander	100	cm
Transmitter Duty Cycle:	100	%

I hereby declare that the information supplied is correct and complete.

Name: Roderick van den Bergh  
Position held: Operations Manager  
Date: 11 Sept 2024



## 1.5 Product Information

### 1.5.1 Technical Description

The Velaris module is a mobile earth station satellite communication data modem operating in the L-Band, up to 200kbps with integral antenna.

The Velaris Module Plus is identical to the multilink except for the exclusion of the LTE chipset. Meaning mechanically, it is comparable to the Velaris Multilink, and electrically it is identical to the Velaris Module

The Velaris 200 is a fully integrated satellite terminal for UAV communications and contains the Velaris module.

The Velaris multilink module contains the Velaris module for BGAN satellite as well as a Quectel EG21-G for LTE connectivity.

### 1.5.2 Transmitter Description

The following radio access technologies and frequency bands are supported by the equipment under test.

Radio Access Technology	Frequency Band (MHz)	Minimum Frequency (MHz)	Output Power (dBm)	Duty Cycle (%)
BGAN	1626.5-1660.5	1626.7	37.5	100

**Table 2 - Transmitter Description (Velaris Module, Velaris Module Plus & Velaris 200)**

Radio Access Technology	Frequency Band (MHz)	Minimum Frequency (MHz)	Output Power (dBm)	Duty Cycle (%)
BGAN	1626.5-1660.5	1626.7	37.5	100
GSM-850	824-849	824.2	33.0	25
PCS-1900	1850-1910	1850.2	30.0	25
LTE Cat1 B4	1710-1755	1710	23.0	100
LTE Cat1 B12	699-716	699	23.0	100
LTE Cat1 B13	777-787	777	23.0	100
LTE Cat1 B25*	1850-1915	1850	23.0	100
LTE Cat1 B26**	814-849	814	23.0	100
LTE Cat1 B41***	2496-2690	2496	23.0	100
WCDMA B2	1850-1910	1850	24.0	100
WCDMA B4	1710-1755	1710	24.0	100
WCDMA B5	824-849	824	24.0	100

**Table 3 - Transmitter Description (Velaris Multilink)**

\*Includes B5 which is a subset of B26.

\*\*Includes B2 which is a subset of B25.

\*\*\*Includes B7 and B38 which is a subset of B41

Transmitter power includes upper bounds of uncertainty therefore maximum values are used.



### 1.5.3 Antenna Description

The following antennas are supported by the equipment under test.

Radio Access Technology	Antenna Model	Gain (dBi)	Antenna Length (cm)	Minimum Separation Distance (mm)
BGAN	Chelton HOA2/1.6	2.0	8.5	635
BGAN	LGA-3000	2.5	34.6	635
BGAN	200-A Omni	3.5	9.5	635

**Table 4 - Antenna Description (Velaris Module, Velaris Module Plus & Velaris 200)**

Radio Access Technology	Antenna Model	Gain (dBi)	Antenna Length (cm)	Minimum Separation Distance (mm)
BGAN	Chelton HOA2/1.6	2.0	8.5	675
BGAN	LGA-3000	2.5	34.6	675
BGAN	200-A Omni	3.5	9.5	675
GSM-850	RF Solutions 4G LTE GSM Helical Antenna	2.0	9.5	675
PCS-1900				675
LTE Cat1 B4				675
LTE Cat1 B12				675
LTE Cat1 B13				675
LTE Cat1 B25*				675
LTE Cat1 B26**				675
LTE Cat1 B41***				675
WCDMA B2				675
WCDMA B4				675
WCDMA B5				675

**Table 5 - Antenna Description (Velaris Multilink)**

In the case of more than one type of antenna being supported by the equipment, the calculation is based on the maximum of the antenna gains. If other antennas can be used that have greater gains, the minimum separation distances will need to be recalculated.

Note: Antenna gain includes upper bounds of uncertainty therefore maximum values are used.



#### 1.5.4 Equipment Configuration

Simultaneous transmission for the following configurations;

**Combination 1** – BGAN + GSM-850

**Combination 2** – BGAN + LTE Cat1 B12

**Combination 3** – BGAN + WCDMA B5

The above combinations were selected for assessment as they resulted in the highest exposure values as a proportion of the limit when assessed as a single RF source.



## 2 Assessment Details

### 2.1 Single RF Source Options for Determination of Exemption

Option	Reference	RF Exposure Test Exemptions for Single Source												
A (1-mW Test Exemption)	FCC 1.1307(b)(3)(i)(A)	The available maximum time averaged power is no more than 1 mW, regardless of separation distance.												
B (SAR-Based Exemption)	FCC 1.1307(b)(3)(i)(B)	<p>The available maximum timeaveraged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold <math>P_{th}</math> (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). <math>P_{th}</math> is given by:</p> $P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$ <p>Where</p> $x = -\log_{10} \left( \frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$ <p>and</p> $ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$ <p><math>d</math> = the separation distance (cm);</p>												
C (MPE-Based Exemption)	FCC 1.1307(b)(3)(i)(C)	<p>Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least <math>\lambda/2\pi</math>, where <math>\lambda</math> is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of <math>\lambda/4</math> or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).</p> <p><b>TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION</b></p> <table border="1"> <thead> <tr> <th>RF Source frequency (MHz)</th> <th>Threshold ERP (watts)</th> </tr> </thead> <tbody> <tr> <td>0.3–1.34 .....</td> <td>1,920 <math>R^2</math>.</td> </tr> <tr> <td>1.34–30 .....</td> <td>3,450 <math>R^2/f^2</math>.</td> </tr> <tr> <td>30–300 .....</td> <td>3.63 <math>R^2</math>.</td> </tr> <tr> <td>300–1,500 .....</td> <td>0.0128 <math>R^2f</math>.</td> </tr> <tr> <td>1,500–100,000 .....</td> <td>19.2 <math>R^2</math>.</td> </tr> </tbody> </table>	RF Source frequency (MHz)	Threshold ERP (watts)	0.3–1.34 .....	1,920 $R^2$ .	1.34–30 .....	3,450 $R^2/f^2$ .	30–300 .....	3.63 $R^2$ .	300–1,500 .....	0.0128 $R^2f$ .	1,500–100,000 .....	19.2 $R^2$ .
RF Source frequency (MHz)	Threshold ERP (watts)													
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1,500–100,000 .....	19.2 $R^2$ .													

Table 6



## 2.2 Multiple RF Sources Options for Determination of Exemption

Option	Reference	
A 1-mW Test Exemption for Multiple Sources	FCC 1.1307(b)(3)(ii)(A)	The available maximum time averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).
B Simultaneous Transmission with both SAR-based and MPE- Based Test Exemptions	FCC 1.1307(b)(3)(ii)(B)	In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation. $\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$

**Table 7**



## 2.3 Individual Antenna Port Exposure Results

### 2.3.1 Single Source Calculation of Exposure at Specified Separation Distance FCC 1.1307(b)(3)(i)(C) 'Option C' (MPE Based Exemption)

RAT	Frequency (MHz)	Conducted Power Output (mW)	Duty Cycle %	Time Average Conducted Power Output (mW)	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Minimum separation distance for MPE evaluation $\lambda/2 \pi$ mm	Actual Distance (mm)	Threshold ERP (mW)	1.1307(b)(3)(i)(C) Exemption (Yes/No) (300 kHz to 100 GHz)
BGAN	1626.7	5623.41	100	5623.41	2.24	12589.25	7676.37	29.4	635	7741.92	Yes

Table 8 - Transmitter Result (Velaris Module, Verlaris Module Plus & Velaris 200)



### 2.3.2 Single Source Calculation of Exposure at Specified Separation Distance FCC 1.1307(b)(3)(i)(C) 'Option C' (MPE Based Exemption)

RAT	Frequency (MHz)	Conducted Power Output (mW)	Duty Cycle %	Time Average Conducted Power Output (mW)	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Minimum separation distance for MPE evaluation $\lambda/2 \pi$ mm	Actual Distance (mm)	Threshold ERP (mW)	1.1307(b)(3)(i)(C) Exemption (Yes/No) (300 kHz to 100 GHz)
BGAN	1626.7	5623.41	100	5623.41	2.24	12589.25	7676.37	29.4	675	8748.00	Yes
GSM-850	824	1995.26	25	498.82	1.58	790.57	482.05	57.9	675	4806.73	Yes
PCS-1900	1850	1000.00	25	250.00	1.58	396.22	241.60	25.8	675	8748.00	Yes
LTE B4	1710	199.53	100	199.53	1.58	316.23	192.82	27.9	675	8748.00	Yes
LTE B12	699	199.53	100	199.53	1.58	316.23	192.82	68.3	675	4076.57	Yes
LTE B13	777	199.53	100	199.53	1.58	316.23	192.82	61.4	675	4531.46	Yes
LTE B25	1850	199.53	100	199.53	1.58	316.23	192.82	25.8	675	8748.00	Yes
LTE B26	814	199.53	100	199.53	1.58	316.23	192.82	58.7	675	4747.25	Yes
LTE B41	2496	199.53	100	199.53	1.58	316.23	192.82	19.1	675	8748.00	Yes
WCDMA B2	1850	251.19	100	251.19	1.58	398.11	242.75	25.8	675	8748.00	Yes
WCDMA B4	1710	251.19	100	251.19	1.58	398.11	242.75	27.9	675	8748.00	Yes
WCDMA B5	824	251.19	100	251.19	1.58	398.11	242.75	57.9	675	4805.57	Yes

**Table 9 - Transmitter Result (Velaris Multilink)**

The calculations show that the individual transmitters comply with FCC 1.1307(b)(3)(i)(C) MPE-based exception at a minimum distance of 675 mm.



## 2.5 Combined Antenna Port RF Exposure Results FCC 1.1307(b)(3)(ii)(B)

### 2.5.1 Combination 1 (BGAN + GSM-850) - Option C Summation

RAT	Frequency (MHz)	Conducted Power Output mW	Duty Cycle %	Time Average Conducted Power Output mW	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Test Separation Distance (mm)	ERP <sub>j</sub> / ERP <sub>th,j</sub>	Sum of the fractional contributions to the applicable thresholds is less than or equal to 1. Compliant? (Yes/No)
BGAN	1626.7	5623.41	100	5623.41	2.24	12589.25	7676.37	675	0.88	-
GSM-850	824	1995.26	25	498.82	1.58	790.57	482.05	675	0.10	-
Calculated RF exposure level at minimum compliance boundary of 0.675 m as a fraction of the limit										0.98 Yes

**Table 10 - Transmitter Result**

The calculations show that the multiple transmitters comply with FCC 1.1307(b)(3)(ii)(B) summation-based exemption.

### 2.5.2 Combination 2 (BGAN + LTE B12) - Option C Summation

RAT	Frequency (MHz)	Conducted Power Output mW	Duty Cycle %	Time Average Conducted Power Output mW	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Test Separation Distance (mm)	ERP <sub>j</sub> / ERP <sub>th,j</sub>	Sum of the fractional contributions to the applicable thresholds is less than or equal to 1. Compliant? (Yes/No)
BGAN	1626.7	5623.41	100	5623.41	2.24	12589.25	7676.37	675	0.88	-
LTE B12	699	199.53	100	199.53	1.58	316.23	192.82	675	0.04	-
Calculated RF exposure level at minimum compliance boundary of 0.675 m as a fraction of the limit										0.92 Yes

**Table 11 - Transmitter Result**

The calculations show that the multiple transmitters comply with FCC 1.1307(b)(3)(ii)(B) summation-based exemption



### 2.5.3 Combination 3 (BGAN + WCDMA B5) - Option C Summation

RAT	Frequency (MHz)	Conducted Power Output mW	Duty Cycle %	Time Average Conducted Power Output mW	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Test Separation Distance (mm)	ERP <sub>j</sub> / ERP <sub>th,j</sub>	Sum of the fractional contributions to the applicable thresholds is less than or equal to 1. Compliant? (Yes/No)
BGAN	1626.7	5623.41	100	5623.41	2.24	12589.25	7676.37	675	0.88	-
WCDMA B5	824	251.19	100	251.19	1.58	398.11	242.75	675	0.05	-
Calculated RF exposure level at minimum compliance boundary of 0.675 m as a fraction of the limit										0.93
Calculated RF exposure level at minimum compliance boundary of 0.675 m as a fraction of the limit										Yes

**Table 12 - Transmitter Result**

The calculations show that the multiple transmitters comply with FCC 1.1307(b)(3)(ii)(B) summation-based exemption.