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# Verizon Connect, Inc. MPE REPORT

## SCOPE OF WORK

MPE CALCULATION  
ON THE MERIDIAN PRIME AND ZENITH

## REPORT NUMBER

104473451LEX-002.1

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## MPE TEST REPORT

**Report Number:** 104473451LEX-002.1

**Project Number:** G104473451

**Report Issue Date:** 2/12/2021

**Product Name:** Meridian Prime and Zenith

**Standards:** FCC Part 1.1310 Limits for Maximum  
Permissible Exposure (MPE)

**RSS-102 Issue 5 RF Field Strength Limits for  
Devices Used by the General Public**

**Tested by:**  
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USA

**Client:**  
Verizon Connect, Inc.  
5055 North Point Parkway  
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## 1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

## 2 Test Summary

Section	Test full name	Result
10	FCC Part 1.1310 Limits for Maximum Permissible Exposure (MPE) (Limits for General Population / Uncontrolled Exposure)	Pass
	RSS-102 Issue 5 RF Field Strength Limits (For Devices Used by the General Public)	Pass



### 3 Client Information

This product was tested at the request of the following:

Client Information	
<b>Client Name:</b>	Verizon Connect, Inc.
<b>Address:</b>	5055 North Point Parkway Alpharetta, GA USA
<b>Contact:</b>	Keith Wright
<b>Telephone:</b>	908.208.9789
<b>Email:</b>	Keith.wright@verizonconnect.com
Manufacturer Information	
<b>Manufacturer Name:</b>	Verizon Connect, Inc.
<b>Manufacturer Address:</b>	5055 North Point Parkway Alpharetta, GA USA



#### 4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Meridian Prime and Zenith
Model Number	AI-110
Serial Number	2400000267
Supported Trasmitters	LTE, GSM, Bluetooth Low Energy
Embedded Module	BG95-M3
Embedded Module hardware Version	R2.1
Embedded Module Software Version	BG95M3LAR02A03
FCCID	XMR201910BG95M3
Receive Date	12/17/2020
Test Start Date	12/16/2020
Test End Date	12/21/2020
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	4.5VDC
Low Voltage	3.6VDC
High Voltage	5.4VDC
Description of Equipment Under Test (provided by client)	
Meridian Zenith is a battery-only device for use as an asset tracker. The Meridian Prime includes a wiring harness for external power. Both models include the BG95-M3 cellular module and Bluetooth Low Energy transmitter.	

##### 4.1 Variant Models:

There were no variant models covered by this evaluation.

**5 Antenna Gains:**

The antenna gains used in the MPE calculations were provided by the client and could impact the test results. For each transmit band supported the worst case antenna gain was used from the following antenna spec sheets:

Performance (Typical as measured in housing)						
Part Number	335-500058-001				335-500059-001	335-500056-001
Frequency	746 MHz	869 MHz	1720 MHz	1930 MHz	1575 MHz	2440 MHz
Efficiency (%)	52.26	64.17	66.10	59.74	56.5	79.6
Peak Gain (dB)	0.6	0.93	1.20	1.86	2.49	2.50
Impedance (ohms)	50	50	50	50	50	50
VSWR	≤ 2	≤ 1.5	≤ 2	≤ 2	≤ 2	≤ 3
Polarization	Linear	Linear	Linear	Linear	Linear	Linear
Maximum Input Power	5W	5W	5W	5W	5W	5W

Performance (Typical as measured in housing)						
Part Number	335-500064-001				335-500059-001	335-500056-001
Frequency	746 MHz	869 MHz	1720 MHz	1930 MHz	1575 MHz	2440 MHz
Efficiency (%)	66.2	54.7	73.7	40.5	62.1	72.6
Peak Gain (dB)	1.45	1.04	2.98	1.59	1.51	3.47
Impedance (ohms)	50	50	50	50	50	50
VSWR	≤ 2.5	≤ 2.5	≤ 2	≤ 3	≤ 2	≤ 3
Polarization	Linear	Linear	Linear	Linear	Linear	Linear
Maximum Input	5W	5W	5W	5W	5W	5W

**6 Output Power:**

The output power used for the Bluetooth Low Energy radio was the worst case measured during testing. The output power used for the cellular radio (LTE and GSM) was identical to that used in the module MPE report on file with the FCC (FCCID: XMR201910BG95M3)



## 7 FCC Limits

**§ 1.1310:** The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

### Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30–300 .....	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.



**8 RSS-102 Issue 5 Exposure Limits:**

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Reference Period (minutes)
0.003-10 <sup>21</sup>	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> <sup>0.5</sup>	-	-	6**
10-20	27.46	0.0728	-2	6
20-48	58.07/ <i>f</i> <sup>0.25</sup>	0.1540/ <i>f</i> <sup>0.25</sup>	8.944/ <i>f</i> <sup>0.5</sup>	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> <sup>0.3417</sup>	0.008335 <i>f</i> <sup>0.3417</sup>	0.02619 <i>f</i> <sup>0.6834</sup>	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> <sup>1.2</sup>
150000-300000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> <i>f</i>	616000/ <i>f</i> <sup>1.2</sup>

**Note:** *f* is frequency in MHz.  
\* Based on nerve stimulation (NS).  
\*\* Based on specific absorption rate (SAR).



## 9 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with the general population exposure limits from FCC §2.1091 and RSS-102 Issue 5. The maximum power density was calculated for each transmitter band at a separation distance of 20cm using the maximum declared output power including tune up tolerance.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$\text{Conducted Power}_{mW} = 10^{\text{Conducted Power (dBm)}/10}$$

$$\text{Power Density} = \frac{\text{Conducted Power}_{mW} \times \text{Ant. Gain}}{4\pi \times (20_{cm})^2}$$

For transmitters that could operate simultaneously, the MPE to limit ratio for each was calculated and then summed. If the sum of the MPE to limit ratios was less than 1, that specific combination of transmitters was deemed to comply.

**10 FCC Results:**

The calculated maximum power density at 20cm distance was equal to or less than the required limits for general population exposure for FCC Part 1.1310. The Bluetooth Low Energy radio could transmit simultaneously with either the GSM or the LTE radios. The worst case sum of MPE/Limit ratios occurs with BLE transmitting simultaneously with GSM850. Since the sum of those two worst case MPE/Limit ratios is less than 1 the Meridian Prime and Zenith devices are considered compliant to the simultaneous transmission requirements.

$$0.001 + 0.1999 = 0.2009$$

**Bluetooth Low Energy Data**

Duty Cycle	100 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Margin to Limit (mW/cm <sup>2</sup> )	MPE / Limit Ratio (for Co-Location)
Bluetooth Low Energy	2402	3.73	3.73	3.47	0.0010	1.00	0.9990	0.0010

**GSM Data**

Duty Cycle	12.5 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Margin to Limit (mW/cm <sup>2</sup> )	MPE / Limit Ratio (for Co-Location)
GSM850	824	35	25.96910013	1.45	0.1098	0.55	0.4395	0.1999
GSM1900	1900	32	22.96910013	1.86	0.0605	1.00	0.9395	0.0605

Note: the 12.5% duty cycle comes from the GSM radio using 1 out of 8 time slots available.

**LTE Data**

Duty Cycle	100 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Margin to Limit (mW/cm <sup>2</sup> )	MPE / Limit Ratio (for Co-Location)
LTE Band 2	1850	22	22	2.98	0.0626	1.00	0.9374	0.0626
LTE Band 4	1710	22	22	2.98	0.0626	1.00	0.9374	0.0626
LTE Band 5	850	22	22	1.45	0.0440	0.57	0.5226	0.0777
LTE Band 12	698	22	22	1.45	0.0440	0.47	0.4213	0.0946
LTE Band 13	777	22	22	1.45	0.0440	0.52	0.4740	0.0850
LTE Band 14	788	22	22	1.45	0.0440	0.53	0.4813	0.0838
LTE Band 25	1850	22	22	2.98	0.0626	1.00	0.9374	0.0626
LTE Band 26	814	22	22	1.45	0.0440	0.54	0.4986	0.0811
LTE Band 66	1710	22	22	2.98	0.0626	1.00	0.9374	0.0626
LTE Band 85	698	22	22	1.45	0.0440	0.47	0.4213	0.0946
NB-IOT Band 2	1850	22	22	2.98	0.0626	1.00	0.9374	0.0626
NB-IOT Band 4	1710	22	22	2.98	0.0626	1.00	0.9374	0.0626
NB-IOT Band 5	850	22	22	1.45	0.0440	0.57	0.5226	0.0777
NB-IOT Band 12	698	22	22	1.45	0.0440	0.47	0.4213	0.0946
NB-IOT Band 13	777	22	22	1.45	0.0440	0.52	0.4740	0.0850
NB-IOT Band 25	1850	22	22	2.98	0.0626	1.00	0.9374	0.0626
NB-IOT Band 26	814	22	22	1.45	0.0440	0.54	0.4986	0.0811
NB-IOT Band 66	1710	22	22	2.98	0.0626	1.00	0.9374	0.0626
NB-IOT Band 71	663	22	22	1.45	0.0440	0.44	0.3980	0.0996
NB-IOT Band 85	698	22	22	1.45	0.0440	0.47	0.4213	0.0946



**11 ISED Results:**

The calculated maximum power density at 20cm distance was equal to or less than the required limits for general population exposure for RSS-102 Issue 5. The Bluetooth Low Energy radio could transmit simultaneously with either the GSM or the LTE radios. The worst case sum of MPE/Limit ratios occurs with BLE transmitting simultaneously with GSM850. Since the sum of those two worst case MPE/Limit ratios is less than 1 the Meridian Prime and Zenith devices are considered compliant to the simultaneous transmission requirements.

$$0.002 + 0.4263 = 0.4283$$

**Bluetooth Low Energy Data**

Duty Cycle		100 (%)						
Separation Dist.		20 (cm)						
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (W/m <sup>2</sup> )	MPE Limit (W/m <sup>2</sup> )	Margin to Limit (W/m <sup>2</sup> )	MPE / Limit Ratio (for Co-Location)
Bluetooth Low Energy	2402	3.73	3.73	3.47	0.0104	5.35	5.3404	0.0020

**GSM Data**

Duty Cycle		12.5 (%)						
Separation Dist.		20 (cm)						
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (W/m <sup>2</sup> )	MPE Limit (W/m <sup>2</sup> )	Margin to Limit (W/m <sup>2</sup> )	MPE / Limit Ratio (for Co-Location)
GSM850	824	35	25.96910013	1.45	1.0981	2.58	1.4775	0.4263
GSM1900	1900	32	22.96910013	1.86	0.6048	4.56	3.9538	0.1327

Note: the 12.5% duty cycle comes from the GSM radio using 1 out of 8 time slots available.

**LTE Data**

Duty Cycle		100 (%)						
Separation Dist.		20 (cm)						
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (W/m <sup>2</sup> )	MPE Limit (W/m <sup>2</sup> )	Margin to Limit (W/m <sup>2</sup> )	MPE / Limit Ratio (for Co-Location)
LTE Band 2	1850	22	22	2.98	0.6262	4.48	3.8501	0.1399
LTE Band 4	1710	22	22	2.98	0.6262	4.24	3.6157	0.1476
LTE Band 5	850	22	22	1.45	0.4403	2.63	2.1906	0.1674
LTE Band 12	698	22	22	1.45	0.4403	2.30	1.8592	0.1915
LTE Band 13	777	22	22	1.45	0.4403	2.47	2.0340	0.1779
LTE Band 14	788	22	22	1.45	0.4403	2.50	2.0579	0.1762
LTE Band 25	1850	22	22	2.98	0.6262	4.48	3.8501	0.1399
LTE Band 26	814	22	22	1.45	0.4403	2.55	2.1139	0.1724
LTE Band 66	1710	22	22	2.98	0.6262	4.24	3.6157	0.1476
LTE Band 85	698	22	22	1.45	0.4403	2.30	1.8592	0.1915
NB-IOT Band 2	1850	22	22	2.98	0.6262	4.48	3.8501	0.1399
NB-IOT Band 4	1710	22	22	2.98	0.6262	4.24	3.6157	0.1476
NB-IOT Band 5	850	22	22	1.45	0.4403	2.63	2.1906	0.1674
NB-IOT Band 12	698	22	22	1.45	0.4403	2.30	1.8592	0.1915
NB-IOT Band 13	777	22	22	1.45	0.4403	2.47	2.0340	0.1779
NB-IOT Band 25	1850	22	22	2.98	0.6262	4.48	3.8501	0.1399
NB-IOT Band 26	814	22	22	1.45	0.4403	2.55	2.1139	0.1724
NB-IOT Band 66	1710	22	22	2.98	0.6262	4.24	3.6157	0.1476
NB-IOT Band 71	663	22	22	1.45	0.4403	2.22	1.7797	0.1983
NB-IOT Band 85	698	22	22	1.45	0.4403	2.30	1.8592	0.1915



## 12 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	2/12/2021	104473451LEX-002.1	BCT	BL	Original Issue