

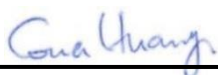
# RF EXPOSURE EVALUATION REPORT

FCC ID : UZ7VC8300  
Equipment : Vehicle Computer  
Brand Name : Zebra  
Model Name : VC8300  
Applicant : Zebra Technologies Corporation  
1 Zebra Plaza, Holtsville, NY 11742  
Manufacturer : Zebra Technologies Corporation  
1 Zebra Plaza, Holtsville, NY 11742  
Standard : 47 CFR Part 2.1091

We, SPORTON INTERNATIONAL INC has been evaluated in accordance with 47 CFR Part 2.1091 for the device and pass the limit.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.



Approved by: Cona Huang / Deputy Manager

**SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory**  
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



## **Table of Contents**

|                                                                        |           |
|------------------------------------------------------------------------|-----------|
| <b>1. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) .....</b>              | <b>4</b>  |
| <b>2. MAXIMUM RF AVERAGE OUTPUT POWER AMONG PRODUCTION UNITS .....</b> | <b>5</b>  |
| <b>3. RF EXPOSURE LIMIT INTRODUCTION .....</b>                         | <b>12</b> |
| <b>4. RADIO FREQUENCY RADIATION EXPOSURE EVALUATION .....</b>          | <b>13</b> |
| 4.1. Standalone Power Density Calculation .....                        | 13        |
| 4.2. Collocated Power Density Calculation.....                         | 13        |



## History of this test report

| Report No.  | Version | Description             | Issued Date  |
|-------------|---------|-------------------------|--------------|
| FA8N0846-03 | Rev. 01 | Initial issue of report | May 06, 2019 |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |
|             |         |                         |              |

**1. Description of Equipment Under Test (EUT)**

| Product Feature & Specification                                                                                                                 |                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EUT Type                                                                                                                                        | Vehicle Computer                                                                                                                                                                                                                            |
| Brand Name                                                                                                                                      | Zebra                                                                                                                                                                                                                                       |
| Model Name                                                                                                                                      | VC8300                                                                                                                                                                                                                                      |
| FCC ID                                                                                                                                          | UZ7VC8300                                                                                                                                                                                                                                   |
| Wireless Technology and Frequency Range                                                                                                         | WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz<br>WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz<br>WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz<br>WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz<br>WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz<br>Bluetooth: 2402 MHz ~ 2480 MHz |
| Mode                                                                                                                                            | 802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80<br>Bluetooth BR/EDR/LE                                                                                                                                                                         |
| HW Version                                                                                                                                      | EVT1                                                                                                                                                                                                                                        |
| SW Version                                                                                                                                      | Zebra/VC8300/VC8310:8.1.0/01-14-12-00-ON-U00-PRD/266:eng/release-keys                                                                                                                                                                       |
| FW Version                                                                                                                                      | 01-14-12.00-ON-U00-PRD                                                                                                                                                                                                                      |
| MFD                                                                                                                                             | 03Nov18                                                                                                                                                                                                                                     |
| EUT Stage                                                                                                                                       | Identical Prototype                                                                                                                                                                                                                         |
| <b>Remark:</b>                                                                                                                                  |                                                                                                                                                                                                                                             |
| 1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description. |                                                                                                                                                                                                                                             |
| 2. This is a variant report by adding TXBF Mode.                                                                                                |                                                                                                                                                                                                                                             |

**Reviewed by: Jason Wang****Report Producer: Wan Liu**

## 2. Maximum RF average output power among production units

<Non-beamforming mode>

| Band / Mode | Average Power (dBm) |    |    |      |
|-------------|---------------------|----|----|------|
|             | BR / EDR            |    |    | LE   |
|             | 1M                  | 2M | 3M | GFSK |
| Bluetooth   | 4                   | 1  | 1  | 1.5  |

|             | Mode           | Channel | Frequency<br>(MHz) | SISO ANT 1       | SISO ANT 2       | MIMO             |
|-------------|----------------|---------|--------------------|------------------|------------------|------------------|
|             |                |         |                    | Tune-Up<br>Limit | Tune-Up<br>Limit | Tune-Up<br>Limit |
| 2.4GHz WLAN | 802.11b        | 1       | 2412               | 20.50            | 21.00            | 23.50            |
|             |                | 6       | 2437               | 21.50            | 21.50            | 22.50            |
|             |                | 11      | 2462               | 21.50            | 18.00            | 21.50            |
|             | 802.11g        | 1       | 2412               | 13.00            | 15.50            | 15.00            |
|             |                | 6       | 2437               | 23.00            | 23.00            | 25.00            |
|             |                | 11      | 2462               | 14.00            | 15.50            | 17.00            |
|             | 802.11n-HT20   | 1       | 2412               | 11.00            | 14.00            | 14.00            |
|             |                | 6       | 2437               | 22.50            | 22.00            | 24.50            |
|             |                | 11      | 2462               | 13.50            | 14.50            | 15.50            |
|             | 802.11n-HT40   | 3       | 2422               | 11.00            | 14.00            | 13.00            |
|             |                | 6       | 2437               | 13.00            | 19.00            | 17.00            |
|             |                | 9       | 2452               | 13.00            | 14.50            | 13.00            |
|             | 802.11ac-VHT20 | 1       | 2412               | 11.00            | 14.00            | 14.00            |
|             |                | 6       | 2437               | 22.50            | 22.00            | 24.50            |
|             |                | 11      | 2462               | 13.50            | 14.50            | 15.50            |
|             | 802.11ac-VHT40 | 3       | 2422               | 11.00            | 14.00            | 13.00            |
|             |                | 6       | 2437               | 13.00            | 19.00            | 17.00            |
|             |                | 9       | 2452               | 12.50            | 14.50            | 13.00            |



| 5.2GHz WLAN | Mode           | Channel | Frequency<br>(MHz) | SISO ANT 1<br>Tune-Up<br>Limit | SISO ANT 2<br>Tune-Up<br>Limit | MIMO<br>Tune-Up<br>Limit |
|-------------|----------------|---------|--------------------|--------------------------------|--------------------------------|--------------------------|
|             | 802.11a        | 36      | 5180               | 21.00                          | 19.50                          | 20.00                    |
|             |                | 40      | 5200               | 21.00                          | 21.00                          | 20.00                    |
|             |                | 44      | 5220               | 21.50                          | 21.00                          | 20.00                    |
|             |                | 48      | 5240               | 21.50                          | 21.50                          | 19.50                    |
|             | 802.11n-HT20   | 36      | 5180               | 21.00                          | 19.50                          | 20.00                    |
|             |                | 40      | 5200               | 21.00                          | 21.50                          | 20.00                    |
|             |                | 44      | 5220               | 21.50                          | 21.50                          | 20.00                    |
|             |                | 48      | 5240               | 21.50                          | 21.50                          | 20.00                    |
|             | 802.11n-HT40   | 38      | 5190               | 17.50                          | 15.50                          | 19.50                    |
|             |                | 46      | 5230               | 21.00                          | 20.00                          | 22.50                    |
|             | 802.11ac-VHT20 | 36      | 5180               | 21.00                          | 19.00                          | 20.00                    |
|             |                | 40      | 5200               | 21.00                          | 21.50                          | 20.00                    |
|             |                | 44      | 5220               | 21.50                          | 21.50                          | 20.00                    |
|             |                | 48      | 5240               | 21.50                          | 21.50                          | 20.00                    |
|             | 802.11ac-VHT40 | 38      | 5190               | 17.00                          | 16.00                          | 19.50                    |
|             |                | 46      | 5230               | 21.00                          | 20.00                          | 22.50                    |
|             | 802.11ac-VHT80 | 42      | 5210               | 16.50                          | 15.50                          | 17.00                    |



| 5.3GHz WLAN | Mode           | Channel | Frequency<br>(MHz) | SISO ANT 1<br>Tune-Up<br>Limit | SISO ANT 2<br>Tune-Up<br>Limit | MIMO<br>Tune-Up<br>Limit |
|-------------|----------------|---------|--------------------|--------------------------------|--------------------------------|--------------------------|
|             | 802.11a        | 52      | 5260               | 21.50                          | 21.50                          | 19.50                    |
|             |                | 56      | 5280               | 21.50                          | 21.50                          | 19.50                    |
|             |                | 60      | 5300               | 21.50                          | 18.50                          | 19.50                    |
|             |                | 64      | 5320               | 21.50                          | 21.00                          | 19.50                    |
|             | 802.11n-HT20   | 52      | 5260               | 21.50                          | 22.00                          | 20.00                    |
|             |                | 56      | 5280               | 21.50                          | 22.00                          | 20.00                    |
|             |                | 60      | 5300               | 21.50                          | 18.00                          | 20.00                    |
|             |                | 64      | 5320               | 22.00                          | 21.00                          | 21.00                    |
|             | 802.11n-HT40   | 54      | 5270               | 22.00                          | 17.00                          | 22.00                    |
|             |                | 62      | 5310               | 17.50                          | 16.50                          | 18.50                    |
|             | 802.11ac-VHT20 | 52      | 5260               | 21.50                          | 21.00                          | 20.00                    |
|             |                | 56      | 5280               | 21.50                          | 22.00                          | 20.00                    |
|             |                | 60      | 5300               | 21.50                          | 18.00                          | 20.00                    |
|             |                | 64      | 5320               | 22.00                          | 21.00                          | 21.00                    |
|             | 802.11ac-VHT40 | 54      | 5270               | 22.00                          | 17.00                          | 22.00                    |
|             |                | 62      | 5310               | 17.50                          | 16.00                          | 18.50                    |
|             | 802.11ac-VHT80 | 58      | 5290               | 16.00                          | 13.50                          | 13.00                    |



|             | Mode           | Channel | Frequency<br>(MHz) | SISO ANT 1<br>Tune-Up<br>Limit | SISO ANT 2<br>Tune-Up<br>Limit | MIMO<br>Tune-Up<br>Limit |
|-------------|----------------|---------|--------------------|--------------------------------|--------------------------------|--------------------------|
|             |                |         |                    |                                |                                |                          |
| 5.5GHz WLAN | 802.11a        | 100     | 5500               | 19.00                          | 21.00                          | 19.50                    |
|             |                | 116     | 5580               | 21.00                          | 21.00                          | 20.50                    |
|             |                | 124     | 5620               | 21.00                          | 21.00                          | 20.50                    |
|             |                | 132     | 5660               | 14.00                          | 21.00                          | 20.50                    |
|             |                | 140     | 5700               | 14.00                          | 19.50                          | 20.00                    |
|             |                | 144     | 5720               | 21.00                          | 21.00                          | 19.00                    |
|             | 802.11n-HT20   | 100     | 5500               | 18.50                          | 20.00                          | 19.00                    |
|             |                | 116     | 5580               | 21.00                          | 21.00                          | 21.00                    |
|             |                | 124     | 5620               | 21.00                          | 21.00                          | 21.00                    |
|             |                | 132     | 5660               | 21.00                          | 21.00                          | 21.00                    |
|             |                | 140     | 5700               | 16.50                          | 19.00                          | 16.50                    |
|             |                | 144     | 5720               | 19.50                          | 21.50                          | 19.50                    |
|             | 802.11n-HT40   | 102     | 5510               | 18.00                          | 16.50                          | 20.50                    |
|             |                | 110     | 5550               | 22.00                          | 22.50                          | 22.50                    |
|             |                | 126     | 5630               | 22.00                          | 22.50                          | 20.50                    |
|             |                | 134     | 5670               | 20.50                          | 18.00                          | 20.50                    |
|             |                | 142     | 5710               | 21.00                          | 23.00                          | 22.50                    |
|             | 802.11ac-VHT20 | 100     | 5500               | 18.50                          | 20.00                          | 19.00                    |
|             |                | 116     | 5580               | 21.00                          | 21.00                          | 21.00                    |
|             |                | 124     | 5620               | 21.00                          | 21.00                          | 21.00                    |
|             |                | 132     | 5660               | 21.00                          | 21.00                          | 21.00                    |
|             |                | 140     | 5700               | 16.50                          | 19.00                          | 16.50                    |
|             |                | 144     | 5720               | 19.50                          | 21.00                          | 19.50                    |
|             | 802.11ac-VHT40 | 102     | 5510               | 18.00                          | 16.50                          | 20.50                    |
|             |                | 110     | 5550               | 22.00                          | 22.50                          | 22.50                    |
|             |                | 126     | 5630               | 22.00                          | 22.50                          | 22.50                    |
|             |                | 134     | 5670               | 20.50                          | 18.00                          | 20.50                    |
|             |                | 142     | 5710               | 21.00                          | 23.00                          | 22.00                    |
|             | 802.11ac-VHT80 | 106     | 5530               | 17.50                          | 17.00                          | 20.00                    |
|             |                | 122     | 5610               | 21.50                          | 21.00                          | 22.50                    |
|             |                | 138     | 5690               | 22.00                          | 21.50                          | 23.50                    |

| 5.8GHz WLAN | Mode           | Channel | Frequency<br>(MHz) | SISO ANT 1<br>Tune-Up<br>Limit | SISO ANT 2<br>Tune-Up<br>Limit | MIMO<br>Tune-Up<br>Limit |
|-------------|----------------|---------|--------------------|--------------------------------|--------------------------------|--------------------------|
|             | 802.11a        | 149     | 5745               | 21.00                          | 24.00                          | 24.00                    |
|             |                | 157     | 5785               | 23.00                          | 23.50                          | 24.00                    |
|             |                | 165     | 5825               | 23.50                          | 23.00                          | 26.00                    |
|             | 802.11n-HT20   | 149     | 5745               | 21.00                          | 24.00                          | 24.50                    |
|             |                | 157     | 5785               | 20.50                          | 23.50                          | 24.50                    |
|             |                | 165     | 5825               | 24.00                          | 23.00                          | 26.00                    |
|             | 802.11n-HT40   | 151     | 5755               | 24.50                          | 24.00                          | 27.00                    |
|             |                | 159     | 5795               | 23.50                          | 24.00                          | 26.50                    |
|             | 802.11ac-VHT20 | 149     | 5745               | 21.00                          | 24.00                          | 24.50                    |
|             |                | 157     | 5785               | 20.00                          | 23.50                          | 24.50                    |
|             |                | 165     | 5825               | 24.00                          | 23.00                          | 26.00                    |
|             | 802.11ac-VHT40 | 151     | 5755               | 24.00                          | 24.00                          | 27.00                    |
|             |                | 159     | 5795               | 23.50                          | 24.00                          | 26.50                    |
|             | 802.11ac-VHT80 | 155     | 5775               | 22.50                          | 21.50                          | 20.00                    |

**<Beamforming mode>**

| 2.4GHz WLAN | Mode           | Channel | Frequency (MHz) | MIMO Tune-Up Limit |
|-------------|----------------|---------|-----------------|--------------------|
|             | 802.11ac-VHT20 | 1       | 2412            | 17.00              |
|             |                | 6       | 2437            | 22.00              |
|             |                | 11      | 2462            | 14.00              |
|             | 802.11ac- MCS0 | 3       | 2422            | 14.00              |
|             |                | 6       | 2437            | 16.00              |
|             |                | 9       | 2452            | 9.00               |

| 5.2GHz WLAN | Mode           | Channel | Frequency (MHz) | MIMO Tune-Up Limit |
|-------------|----------------|---------|-----------------|--------------------|
|             | 802.11ac-VHT20 | 36      | 5180            | 19.50              |
|             |                | 40      | 5200            | 19.50              |
|             |                | 44      | 5220            | 19.50              |
|             |                | 48      | 5240            | 19.50              |
|             | 802.11ac-VHT40 | 38      | 5190            | 17.00              |
|             |                | 46      | 5230            | 22.50              |
|             | 802.11ac-VHT80 | 42      | 5210            | 17.00              |

| 5.3GHz WLAN | Mode           | Channel | Frequency (MHz) | MIMO Tune-Up Limit |
|-------------|----------------|---------|-----------------|--------------------|
|             | 802.11ac-VHT20 | 52      | 5260            | 19.50              |
|             |                | 56      | 5280            | 19.50              |
|             |                | 60      | 5300            | 19.50              |
|             |                | 64      | 5320            | 21.00              |
|             | 802.11ac-VHT40 | 54      | 5270            | 22.00              |
|             |                | 62      | 5310            | 13.50              |
|             | 802.11ac-VHT80 | 58      | 5290            | 13.00              |

| 5.5GHz WLAN | Mode           | Channel | Frequency (MHz) | MIMO Tune-Up Limit |
|-------------|----------------|---------|-----------------|--------------------|
|             | 802.11ac-VHT20 | 100     | 5500            | 15.50              |
|             |                | 116     | 5580            | 21.00              |
|             |                | 124     | 5620            | 21.00              |
|             |                | 132     | 5660            | 21.00              |
|             |                | 140     | 5700            | 16.00              |
|             |                | 144     | 5720            | 19.00              |
|             | 802.11ac-VHT40 | 102     | 5510            | 20.50              |
|             |                | 110     | 5550            | 22.00              |
|             |                | 126     | 5630            | 22.00              |
|             |                | 134     | 5670            | 20.50              |
|             |                | 142     | 5710            | 22.00              |
|             | 802.11ac-VHT80 | 106     | 5530            | 19.50              |
|             |                | 122     | 5610            | 22.00              |
|             |                | 138     | 5690            | 22.50              |

| 5.8GHz WLAN | Mode           | Channel | Frequency (MHz) | MIMO Tune-Up Limit |
|-------------|----------------|---------|-----------------|--------------------|
|             | 802.11ac-VHT20 | 149     | 5745            | 21.50              |
|             |                | 157     | 5785            | 22.00              |
|             |                | 165     | 5825            | 22.00              |
|             | 802.11ac-VHT40 | 151     | 5755            | 22.00              |
|             |                | 159     | 5795            | 22.50              |
|             | 802.11ac-VHT80 | 155     | 5775            | 20.00              |

### 3. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

| 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                       |

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = Power Density

P = Output Power at Antenna Terminals

G = Gain of Transmit Antenna (linear gain)

R = Distance from Transmitting Antenna

## **4. Radio Frequency Radiation Exposure Evaluation**

### **4.1. Standalone Power Density Calculation**

<Non-beamforming mode>

| Band        | Frequency (MHz) | Antenna Gain (dBi) | Maximum Power (dBm) | Maximum EIRP (dBm) | Maximum EIRP (W) | Average EIRP (mW) | Power Density at 20cm (mW/cm <sup>2</sup> ) | Limit (mW/cm <sup>2</sup> ) | Power Density / Limit |
|-------------|-----------------|--------------------|---------------------|--------------------|------------------|-------------------|---------------------------------------------|-----------------------------|-----------------------|
| 2.4GHz WLAN | 2412.0          | 4.00               | 25.00               | 29.000             | 0.794            | 794.328           | 0.158                                       | 1.000                       | 0.158                 |
| 5GHz WLAN   | 5180.0          | 5.00               | 27.00               | 32.000             | 1.585            | 1584.893          | 0.315                                       | 1.000                       | 0.315                 |
| Bluetooth   | 2402.0          | 4.00               | 4.00                | 8.000              | 0.006            | 6.310             | 0.001                                       | 1.000                       | 0.001                 |

**Note:** For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band

<Beamforming mode>

| Band        | Frequency (MHz) | Antenna Gain (dBi) | Maximum Power (dBm) | Maximum EIRP (dBm) | Maximum EIRP (W) | Average EIRP (mW) | Power Density at 20cm (mW/cm <sup>2</sup> ) | Limit (mW/cm <sup>2</sup> ) | Power Density / Limit |
|-------------|-----------------|--------------------|---------------------|--------------------|------------------|-------------------|---------------------------------------------|-----------------------------|-----------------------|
| 2.4GHz WLAN | 2412.0          | 0.36               | 22.00               | 22.360             | 0.172            | 172.187           | 0.034                                       | 1.000                       | 0.034                 |
| 5GHz WLAN   | 5180.0          | -11.59             | 22.50               | 10.910             | 0.012            | 12.331            | 0.002                                       | 1.000                       | 0.002                 |

**Note:** For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band

### **4.2. Collocated Power Density Calculation**

| WLAN Power Density / Limit | Bluetooth Power Density / Limit | $\Sigma$ (Power Density / Limit) of WLAN+Bluetooth |
|----------------------------|---------------------------------|----------------------------------------------------|
| 0.315                      | 0.001                           | 0.316                                              |

**Note:**

1.  $\Sigma$  (Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WLAN + Bluetooth.
2. Considering the collocation with the WLAN and Bluetooth transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 2 collocated transmitters is compliant

## **Conclusion:**

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.