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EMC-EMF Safety Approvals

**47 CFR Part 2.1091**  
**Radiofrequency radiation exposure evaluation:**  
**Mobile devices**

Test Sample: MULTI VIAL READER (MVR)  
Model Number: BLU-1200 (10X10 VARIANT)  
Tested For: BLUECHIP LIMITED

Report Number: M181212-9  
Date of Issue: 19 December 2019

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## Radiofrequency radiation exposure evaluation


**Device under Test:** MULTI VIAL READER (MVR)  
**Model Number:** BLU-1200 (10X10 VARIANT)  
**Manufacturer:** BLUECHIIP LIMITED

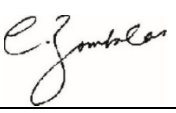
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**Standards:** **FCC KDB 447498 D01 General RF Exposure Guidance v6**  
Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

**Result:** The MULTI VIAL READER (MVR) model BLU-1200 (10X10 VARIANT) complied with the RF exposure requirements of 47 CFR Part 2.1091, however an exclusion zone of 20 cm in front of the antenna applies, elsewhere the exposure level was below the mobile device limits.

**Test Dates:** 17<sup>th</sup> December 2019

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## 1 INTRODUCTION

This report is intended to demonstrate compliance of the MULTI VIAL READER (MVR), Model No. BLU-1200 (10X10 VARIANT) with the RF exposure requirements of 47 CFR Part 2.1091. Evaluation was performed in accordance with FCC KDB 447498 D01.

The test sample was provided by the Client. The conclusion herein is based on the information provided by the client.

## 2 GENERAL INFORMATION

(Information supplied by the Client)

### 2.1 EUT Details

<b>Radio #1:</b>	WiFi Module*
<b>Radio Module:</b>	Texas Instruments WL18MODGB
<b>Operating Band:</b>	2.4 GHz
<b>Radio Module FCC ID:</b>	Z64-WL18SBMOD
<b>Output power:</b>	13 dBm
<b>Antenna:</b>	2.4 GHz Whip Antenna
<b>Antenna Gain:</b>	2.0 dBi
<b>Radio#2:</b>	
<b>Radio Module:</b>	RFID module
<b>Operating Band:</b>	1.2 – 4.1 MHz
<b>Output power:</b>	20 dBm

\*Note1: The Texas Instruments WL18MODGB is a combo device (Wi-Fi/BT), the Bluetooth disabled from the firmware

## 3 UNCERTAINTY

EMC Technologies has evaluated the tools and methods used to perform Radiated Electromagnetic Field predictions.

The estimated measurement uncertainties for the calculation shown within this report are as follows:

Electromagnetic Modelling

30 MHz to 100GHz                       $\pm 2.8$  dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95%.

#### 4 LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE), §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 Exposure</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
300-1,500			f/300	6
1,500-100,000			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
300-1,500			f/1500	30
1,500-100,000			1.0	30

Where f = Frequency in MHz, \* = Plane-wave power density

#### 5 ASSUMPTIONS IN THIS ASSESSMENT

This assessment does not include accumulated RF fields from nearby sites/antennas or possible radio signal reflections or attenuation due to buildings or the general environment.

Antenna Parameters and power settings were supplied by the customer.

The aperture of the radiating element assumed to be a point source in free space and far field conditions.

## 6 EVALUATION RESULT

The MPE was evaluated at 20 cm to show compliance with the power density listed in table 1,

The following formula was used to calculate the power density at 20 cm

$$S = \frac{P * G}{4\pi R^2}$$

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

Where

(S): Power density ( $mW/cm^2$ )

(P): Output power at antenna terminal ( $mW$ )

(G): Gain (ratio)

(R): Minimum test separation distance (20 cm)

Technology	Frequency Band	Power	Gain	Duty Cycle	EIRP	EIRP	Flux Density at 20 cm	Flux Density limit	Percentage of the limit
		<i>dBm</i>	<i>dBi</i>	%	<i>dBm</i>	<i>mW</i>	<i>mW/cm<sup>2</sup></i>	<i>mW/cm<sup>2</sup></i>	<i>mW/cm<sup>2</sup></i>
WL18MODGB	2450	13	2	100%	15.00	31.62	0.006	1	0.63%
Worst case									0.63%

For the RFID System, if the RFID system complies with the magnetic field general public exposure limit, it intrinsically will comply with the Electric field general public limit as the magnetic field is the dominant component of the electromagnetic field.

Therefore, the following formula was used to calculate the Magnetic Flux density at 0.2m from the RFID reader:

$$B = \frac{\mu_o I N a^2}{2 (R^2 + a^2)^{\frac{3}{2}}}$$

Where

(B): Magnetic density (Weber/ $m^2$ ) or Tesla

( $\mu_o$ ): Permeability of free space ( $4\pi * 10(exp - 7)$  H/m)

(I): Current (2 mA)

(N): Number of windings in the coil (48)

(a): Radius of the coil (8.8 mm)

(R): Distance from RFID reader (0.2 m)

$$B = 0.000582 \mu T$$

Therefore, the magnetic field strength is equal to

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$$H = 0.000464 \text{ A/m}$$

Now,

$$\%lim = \frac{(H \text{ cal})^2}{(H \text{ lim})^2} * 100\%$$

$$\%lim = 0.0009 \%$$

The limit at 4.1 MHz is 0.5341 A/m (lowest limit at the frequency range)

#### **Co-location consideration:**

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is  $\leq 1.0$ .

$$\sum_{1}^N \frac{S_{eqN}}{S_{limN}} = \frac{S_{eq1}}{S_{lim1}} + \frac{S_{eq2}}{S_{lim2}} + \dots + \frac{S_{eqN}}{S_{limN}} \leq 1$$

Where: Seq = Power Spectral density (mW/cm<sup>2</sup>) of a specific transmitter  
 Slim = MPE limit (mW/cm<sup>2</sup>)

## 7 CONCLUSION

The MULTI VIAL READER (MVR), Model No. BLU-1200 (10X10 VARIANT) was evaluated on behalf of BLUECHIIP LIMITED with the RF exposure requirements of 47 CFR Part 2.1091. An exclusion zone of 20 cm was required in front of the antennas, away from this area the electric field measured at 20 cm did not exceed the MPE limit.