

**RF EXPOSURE EVALUATION**  
**Maximum Permissible Exposure (MPE)**

**Applicant Name:**  
 Pivotal Commware  
 10801 120th Ave NE #200,  
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 United States

**Date of Testing:**  
 02/24/2022-04/14/2022  
**Test Report Issue Date:**  
 04/19/2022  
**Test Site/Location:**  
 Element Lab., Columbia, MD, USA  
**Test Report Serial No.:**  
 1M2202210020-03.2AUVU

<b>FCC ID:</b>	<b>2AUVU-ESB261</b>
<b>APPLICANT:</b>	<b>Pivotal Commware</b>

**Application Type:** Certification  
**Model:** ESBoost-n261  
**EUT Type:** 5G mmWave Repeater  
**FCC Classifications:** Part 20 Industrial Booster (CMRS) (B2I)  
**FCC Rule Parts:** FCC Part 1 (§1.1310) and Part 2 (§2.1091)  
**Test Procedure(s):** KDB 447498 D01 v06, KDB 680106 D01 v03r01


This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in FCC KDB 447498 D01 v06. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



**RJ Ortanez**  
**Executive Vice President**




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# 1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)

## 1.1 Introduction

This document is prepared to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
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	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
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

\* = Plane-wave equivalent power density


**Table 1-1. Limits for Maximum Permissible Exposure (MPE)**

## 1.2 EUT Description

The **Pivotal Commware FCC ID: 2AUVU-ESB261** is a bidirectional, two-unit repeater system consisting of an Outdoor Unit (ODU) and an Indoor Unit (IDU). Each unit is mounted on opposite sides of low emissivity glass. Both units are required for operation as neither can be operated in a standalone mode.

The IDU contains an open-ended waveguide horn antenna that transmits 5G NR n261 mmWave signals. This antenna is comprised of two separate horizontally polarized and vertically polarized antenna feeds labelled “H-DL” and “V-DL,” respectively. The IDU also has wireless power transfer (WPT) capabilities in order to power the ODU through low emissivity glass.

The ODU contains a holographic beam-forming antenna that transmits 5G NR n261 mmWave signals. This antenna is comprised of two separate horizontally polarized and vertically polarized antenna feeds labelled “H-UL” and “V-UL,” respectively. Additionally, the ODU integrates the following modules: an LTE Cat M1 module (FCC ID: 2AUVU-UBR410M) and a 2.4GHz Bluetooth/BLE module (FCC ID: Z64-WL18SBMOD).

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For this MPE evaluation, the device is treated as a mobile device and evaluated as such per the requirements of FCC 2.1091 and KDB 447498 D01. Additionally, since each unit of this device is mounted on opposite sides of low emissivity glass that permits negligible levels of RF transmission at frequencies above 30MHz, the MPE for the IDU and ODU are evaluated separately.

### 1.3 Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements. The radiated power (EIRP) generated by 5G mmWave antennas are measured for both the horizontal and vertical components using a spectrum analyzer. The LTE and BLE powers used for the MPE evaluation were taken from the power levels shown on the respective Grants of Authorization. The power level used for MPE evaluation of WPT operation is calculated from a worst-case measurement of the magnetic field strength.

Through use of the Friis transmission formula and knowledge of the maximum antenna gain to be used, the power density level is calculated at the minimum distance required to show compliance to the MPE limit.

#### Friis Transmission Formula

Friis transmission formula:  $P_d = (P_{out} * G) / (4\pi r^2)$

Where,

$P_d$  = Power Density (mW/cm<sup>2</sup>)

$\pi$  = 3.1416

$P_{out}$  = output power to antenna (mW)

$r$  = distance between observation point and center of the radiator (cm)

$G$  = gain of antenna in linear scale

#### Calculated MPE

The power density limit for General Population/Uncontrolled Exposure at each frequency is determined based on the information in Table 1-1.

IDU (H-DL + V-DL)								
Radio	Frequency (GHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	Tolerance (dB)	Maximum EIRP (dBm)	Measurement Distance (cm)	Calculated MPE (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
H-DL	27.5 - 28.35	17.00	7.00	1.50	25.50	20	0.071	1.000
V-DL	27.5 - 28.35	17.00	7.00	1.50	25.50	20	0.071	1.000
<b>Total:</b>							<b>0.141</b>	1.000

Table 1-2. Calculated MPE Data for Simultaneous Transmissions - IDU

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ODU (H-UL + V-UL + LTE + BLE)								
Radio	Frequency (GHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	Tolerance (dB)	Maximum EIRP (dBm)	Measurement Distance (cm)	Calculated MPE (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
H-UL	27.5 - 28.35	10.00	17.00	1.50	28.50	20	0.141	1.000
V-UL	27.5 - 28.35	10.00	17.00	1.50	28.50	20	0.141	1.000
LTE	0.777 - 0.787	25.00	2.50	-	27.50	20	0.112	0.518
BLE	2.4	13.00	3.20	-	16.20	20	0.008	1.000
<b>Total:</b>							<b>0.506</b>	1.000


**Table 1-3. Calculated MPE Data for Simultaneous Transmissions – ODU**

Further, the MPE evaluation of the WPT functionality of the IDU is included separately from the other transmitters in order to address the RF Exposure requirements of WPT operation. Per the guidance of KDB 680106 D01 v03r01 Section 3(c), the RF Exposure limit for WPT operation is assessed versus the limit at 300kHz as indicated in Table 1-1 above.

Per the guidance of KDB 680106 for the 121kHz Wireless Power Transfer capability, an H-Field probe (Model: EHP-200AC) is used to measure the H-Field in A/m from all six sides of the EUT at distances of 15cm and 20cm. This is performed in both standalone mode (WPT operation only) and simultaneous transmission mode (WPT + LTE + mmWave). The data is shown in the tables below.


WPT Standalone MPE			
EUT Side	Magnetic field strength (A/m) at Test Distance 'D'		H-Field Limit (A/m)
	D = 15 cm	D = 20 cm	
Front	0.4987	0.2759	1.63
Back	0.4277	0.2574	
Left	0.1494	0.1081	
Right	0.1844	0.1190	
Top	0.1494	0.1117	
Bottom	0.1342	0.0854	

**Table 1-4. Measured MPE (H-Field) Data for WPT Only – IDU**

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WPT + LTE + mmWave MPE			
EUT Side	Magnetic field strength (A/m) at Test Distance 'D'		H-Field Limit (A/m)
	D = 15 cm	D = 20 cm	
Front	0.3119	0.1781	1.63
Back	0.2491	0.1532	
Left	0.1419	0.1113	
Right	0.1917	0.1384	
Top	0.1844	0.1237	
Bottom	0.1419	0.1036	

**Table 1-5. Measured MPE (H-Field) Data for WPT + LTE + mmWave – IDU**

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## 2.0 CONCLUSION

The device meets the mobile RF exposure limit at a 20cm separation distance as specified in §2.1091 of the FCC Rules and Regulations. An appropriate RF exposure compliance statement will be placed in the user's manual.

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