RF Exposure Report

Report No.:	FCC_IC_SL02132022_SLX-002_EMF_MPE_Rev2.0
Test Model:	40002
FCC ID:	STJ-NFC
IC ID:	5627-NFC
Series Model:	N/A
Received Date:	08/16/2021
Test Date:	01/05/2022-01/09/2022
Issued Date:	03/08/2022
Applicant:	ICU Medical Inc.
Address:	951 Calle Amanecer, San Clemente, CA 92673
Manufacturer:	ICU Medical Costa Rica Ltd
Address:	1Km NE Del Centro Comm Real Cariari Zona Franca Global Park La Aurora, Heredia, 40104 Costa Rica
Issued By:	Bureau Veritas Consumer Products Services, Inc.
Lab Address:	775 Montague Expressway, Milpitas, CA 95035
Test Location (1):	775 Montague Expressway, Milpitas, CA 95035
FCC Registration / Designation Number:	540430

ACCREDITED
TESTING CERT # 2742-01

shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any government agencies.

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Release Control Record

Issue No.	Description	Date Issued
FCC_IC_SL02132022_SLX-002_EMF_MPE	Original Release	03/03/2022
FCC_IC_SL02132022_SLX-002_EMF_MPE_Rev1.0	Updated Sections 3.1, 4.3, 4.4, 4.6, 4.7, and 4.8	03/08/2022
FCC_IC_SL02132022_SLX-002_EMF_MPE_Rev2.0	Updated standards and added portable SAR exclusion for NFC transmitter	05/17/2022

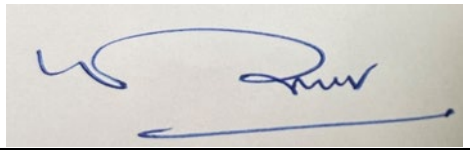
1 Certificate of Conformity

Product:	Plum Duo (with NFC and Wi-Fi radios)
Brand:	Plum
Test Model:	40002
Series Model:	N/A
Sample Status:	Production Sample
Applicant:	ICU Medical Inc.
Test Date:	01/05/2022-01/09/2022
Standards:	FCC Part 2.1091 and Part 2.1093 RSS-102 issue 5

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by :  **,Date:** 03/08/2022

Jose Huamani / Test Engineer

Approved by :  **, Date:** 03/08/2022

Suresh Kondapalli/ Engineer Reviewer

2 Introduction

As per manufacturers operational description NFC is only used for initial installation and not used in normal operation of the device.

3 General Information

3.1 General Description of EUT

Product	Plum Duo (with NFC and Wi-Fi radios)
Brand	Plum
Test Model	40002
Serial Number	8000000284
Series Model	N/A
Status of EUT	Production Sample
Power Supply Rating	The EUT is designed with AC power supply rating of 100-240Vac, 50/60Hz
Modulation Type	For NFC: ASK For 2.4GHz & 5.0GHz: CCK, DQPSK, DBPSK for DSSS 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	For NFC: Near Field Communication (NFC) For 2.4GHz & 5.0GHz: DSSS, OFDM
Transfer Rate	For NFC: N/A For 2.4GHz: 802.11b: 1/2/5.5/11 Mbps 802.11g: 6/9/12/18/24/36/48/54 Mbps 802.11n: MCS 0/1/2/3/4/5/6/7 For 5.0GHz: 802.11a: 6/9/12/18/24/36/48/54 Mbps 802.11n: MCS 0/1/2/3/4/5/6/7 802.11ac: MCS 0/1/2/3/4/5/6/7/8/9
Operating Frequency	For NFC: 13.56 MHz For 2.4GHz: 2.412 ~ 2.472GHz For 5.0GHz: 5180 ~ 5350MHz and 5470 ~ 5825MHz
Number of Channels	For NFC: 1 For 2.4GHz: 11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40) For 5.0GHz: 24 for 802.11a, 802.11n (HT20), 802.11ac (VHT20) 11 for 802.11n (HT40), 802.11ac (VHT40) 5 for 802.11ac (VHT80)
Antenna Type	For NFC:

	Rectangular / Flexible / Near-field Coupling For 2.4GHz & 5.0GHz: High efficiency FPC antenna for low band and high band Wi-Fi
Antenna Gain	For NFC: N/A For 2.4GHz: 2.42 – 2.48 GHz, Peak Gain (dB) 3.00 For 5.0GHz: 5.18 – 5.8 GHz, Peak Gain (dB) 4.45
Antenna Connector	For NFC: Wire to board For 2.4GHz & 5.0GHz: MFH1 (u.FL Compatible)

4 RF Exposure

Following FCC KDB 447498 D01 "General SAR test exclusion guidance"

a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

b) For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following (also illustrated in Appendix B):

1) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz

2) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

c) For frequencies below 100 MHz, the following may be considered for SAR test exclusion (also illustrated in Appendix C):

1) For test separation distances > 50 mm and < 200 mm, the power threshold at the Corresponding test separation distance at 100 MHz in step b) is multiplied by [1 + log(100/f(MHz))]

2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in 1) for 50 mm and 100 MHz is multiplied by ½

3) SAR measurement procedures are not established below 100 MHz. When SAR tes exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any SAR test results below 100 MHz to be acceptable.

4.1**ISED RSS 102 RF 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^2)	Reference Period (minutes)
$0.003\text{-}10^{21}$	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616000/f^{1.2}$

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

4.2**Limits for Maximum Permissible Exposure (MPE)**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
Limits For General Population / Uncontrolled Exposure				
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	$(180/f^2)$*	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

4.3 Electromagnetic Field (EMF) Assessment Method

Since the electromagnetic field is far from source, that region of the field of an antenna where the angular field distribution is essentially independent of the distance from the antenna. In this free space region, the field has a predominantly plane-wave character. The electromagnetic field calculation does not take into account the antenna size, which is assumed to be a point source. An ideal isotropic antenna is used as a reference to compare the performance of practical antennas.

For calculating the field in the far-field region the free space formulas below is used to determine the Electric field (1) or Power Density (2) at a distance r from the transmitting antenna.

$$\text{Electric Field } (E) = \frac{\sqrt{30PG}}{\text{R}} \qquad (1)$$

$$\text{Power Density } (\text{S}) = E * H = \frac{E^2}{\eta} = \frac{EIRP}{4\pi r^2} = \frac{PG}{4\pi r^2} \qquad (2)$$

Where:

S	=	Power density in W/m^2
E	=	Electric Field Strength in V/m
EIRP	=	Radiated Power, unit in watts
P	=	Power input to the antenna, unit in Watts
G	=	Power gain of the antenna in the direction of interest relative to an isotropic radiator
r	=	Distance from observation point to the antenna, in meters
η	=	Characteristic impedance of free space

4.4 Maximum Conducted Power Calculation

From Annex IV of the Council Recommendation 1999/519/EC for Sources with multiple frequencies (n frequencies) compliance with the basic restrictions is ensured if the calculation for the Maximum Conducted Power equation below is meet.

$$\sum_{i=1}^{n} (S\,i/Li) < 1$$

Where:
S i – Power Density at i-frequency
L i – Limit of Power Density at i-frequency

4.5 Classification Mobile device

The antenna of this product, under normal use condition, is at least 20cm away from the body of the user. So, this device is classified as a Mobile Device.

4.5.1 Calculation Result of Maximum Field Strength:

NFC (13.56 MHz Worst Case)

Frequency Band (MHz)	Max Field Strength dB(uV/m) at 3m	Max Field Strength dB(uV/m) at 20cm	E-Field Strength (V/m) at 20cm	E-Field Strength Limit (V/m)	Pass / Fail
13.56	74.5	121.54365	1.19449	60.7669617	Pass

Note:

1. Max Field Strength was taken from Report No.: FCC Part 15.225 RF Test Report (Filename: FCC_IC_SL02132022_SLX-002_NFC)
2. Determining compliance based on the results of the compliance measurement, not considering measurement instrumentation uncertainty.
3. Calculate SAR test exclusion thresholds from condition “1” formulas.
4. At 13.56MHz, maximum field strength is the preferred method to show compliance with the RF exposure limits. Power density calculation is the preferred method for higher frequencies; hence it is not applicable in this section.
5. Distance correction factor was used to derive the Max Field Strength at 20cm.

4.6 For portable device configuration

Based on field strength 74.5dBuV at 3m transmit power(eirp) of the device was calculated as **0.00847mW using free space formula**

Following FCC KDB 447498 D01 “General SAR test exclusion guidance

a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,

where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

c) For frequencies below 100 MHz, the following may be considered for SAR test exclusion (also illustrated in Appendix C):

SAR Test Exclusion Threshold for < 100 MHz and < 200 mm as per Appendix C

SAR exclusion for 100MHz at 50mm is 237mW

1) For test separation distances > 50 mm and < 200 mm, the power threshold at the Corresponding test separation distance at 100 MHz in step b) is multiplied by [1 + log(100/f(MHz))]

237 x [1+log (100/13.56)] = 442mW

2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in 1) for 50 mm and 100 MHz is multiplied by ½

= 221mW

Transmit power of the device 0.00847mW << 221mW

This device is excluded from SAR evaluation

NFC Transmitter is used for setting up the device and is not used for normal operation of the device hence not considered as simultaneous operation with other transmitters.

For portable configuration of the 2.4GHz and 5GHz transmitters please see SAR test report

4.7 ISED Calculation Result of Maximum Conducted Power

Frequency (MHz)	Max Power EIRP (dBm)	Antenna Gain (dBi)	MP + AG EIRP (W)	Distance from antenna (m)	PD (Si) (W/m2)	PD Limit (Li) (W/m2)	Ratio (Si /Li) (PD/PD Limit)
2437	22.91	3.00	0.38994	0.2	0.776	5.403965492	0.144
5180	11.00	4.45	0.03508	0.2	0.070	9.047080533	0.008

Note:

1. Max power for 2.4GHz was taken from Report No: ER/2017/70042 from FCC website for FCC ID N6C-PMACS.
2. Max power for 5.0GHz was taken from Report No: ER/2017/70043 from FCC website for FCC ID N6C-PMACS.
3. Antenna gain was obtained from antenna data sheet from client, ICU Product Spec Sheet PN FTW6202 Dual band WiFi Antenna Field Theory.
4. Determining compliance based on the results of the compliance measurement, not considering instrumentation uncertainty.
5. Calculate SAR test exclusion thresholds from condition “1” formulas
6. Power density calculation is the preferred method for higher frequencies; hence it is applicable in this section.

4.7.1 ISED Calculation Conclusion

Calculation of the MPE value:

$$\sum_{i=1}^{n}(S\,i/Li) = 0.152 < 1$$

WLAN = 0.152 <1

Therefore, the maximum calculations of above situations are less than the “1” limit.

This device complies with Mobile RF exposure requirements of RSS-102.

4.8 FCC Calculation Result of Maximum Conducted Power

Frequency (MHz)	Max Power EIRP (dBm)	Antenna Gain (dBi)	MP + AG EIRP (mW)	Distance from antenna (cm)	PD (Si) (mW/cm2)	PD Limit (Li) (mW/cm2)	Ratio (Si /Li) (PD/PD Limit)
2437	22.91	3.00	389.94199	20	0.078	1	0.078
5180	11.00	4.45	35.07519	20	0.007	1	0.007

Note:
1. Max power for 2.4GHz was taken from Report No: ER/2017/70042 from FCC website for FCC ID N6C-PMACS.
2. Max power for 5.0GHz was taken from Report No: ER/2017/70043 from FCC website for FCC ID N6C-PMACS.
3. Antenna gain was obtained from antenna data sheet from client, ICU Product Spec Sheet PN FTW6202 Dualband WiFi Antenna Field Theory.
4. Determining compliance based on the results of the compliance measurement, not considering measurement instrumentation uncertainty.
5. Calculate SAR test exclusion thresholds from condition “1” formulas.
6. Power density calculation is the preferred method for higher frequencies; hence it is applicable in this section.

4.8.1 FCC Calculation Conclusion

Calculation of the MPE value:

$$\sum_{i=1}^{n}(S\,i/Li) = 0.085 < 1$$

WLAN = 0.085 <1

Therefore, the maximum calculations of above situations are less than the “1” limit.

This device complies with mobile device RF exposure requirements asper FCC part 2.1091/1093.

Appendix – Information of the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

Milpitas EMC/RF/Safety/Telecom Lab
775 Montague Expressway, Milpitas, CA 95035
Tel: +1 408 526 1188

Sunnyvale OTA/Bluetooth Lab
1293 Anvilwood Avenue, Sunnyvale, CA 94089
Tel: +1 669 600 5293

Littleton EMC/RF/Safety/Environmental Lab
1 Distribution Center Cir #1, Littleton, MA 01460
Tel: +1 978 486 8880

Email: sales.eaw@us.bureauveritas.com
Web Site: www.cpsusa-bureauveritas.com

The address and road map of all our labs can be found in our web site also.

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