FCC IC RF Exposure (MPE) Report

Report No.: FCC_IC_RF_SL21012101-APT-012_MPE_Ver3

FCC ID: L2CEP2000: ISED: 3432A-EP2000

Test Model (host): EP-2000

Series Model: EP-2000 00126 (Radiated)
EP-2000 00127 (unit modified for conducted testing)

Received Date: 10/14/2021

Test Date: 10/14/2021 to 07/07/2022

Issued Date: **07/28**/202**2**

Applicant: APTIV Connected Services

Address: 5725 Innovation Dr., Troy, MI, 48098

Manufacturer: APTIV Connected Services

Address: 5725 Innovation Dr., Troy, MI, 48098

Issued By: Bureau Veritas Consumer Products Services, Inc.

Lab Address: 775 Montague Expressway, Milpitas, CA 95035

FCC Registration / Designation Number: 540430

ISED# / CAB identifier: 4842D

TESTING CERT # 2742-01

Table of Contents

Release Control Record

Issue No.	Description	Date Issued
FCC_IC_RF_SL21012101-APT-012_MPE	Orignal Release	03/18/2022
FCC_IC_RF_SL21012101-APT-012_MPE Ver1	Added other pre- certified Tx in the Host	05/12/2022
FCC_IC_RF_SL21012101-APT-012_MPE Ver2	Updated power	07/27/2022
FCC_IC_RF_SL21012101-APT-012_MPE Ver3	Updated calculation	07/28/2022

1 Certificate of Conformity

Product:	Vehicle Data Recorder
Brand:	APTIV Connected Services
Test Model (host):	EP-2000
Series Model:	EP-2000
Sample Status:	Engineering Sample
Standards:	47 CFR FCC Part 1.1310 47 CFR FCC Part 2.1091 447498 D01 General RF Exposure Guidance ISED 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:** 03/18/2021

Jose Huamani / Test Engineer

Approved by :  , **Date:** 07/28/2022

Suresh Kondapalli /Engineer Reviewer

2 General Information

2.1 General Description of EUT

Product	Vehicle Data Recorder
Brand	APTIV Connected Services
Test Model	EP-2000
Series Model	EP-2000
Status of EUT	Engineering Sample
Power Supply Rating	The EUT is supplied with power from host, which is designed to with power supply rating of 100-240Vdc, 50/60Hz but the EUT requires 12Vdc.
Modulation Type	802.11a/b/ac/g/n/ax for WLAN
Operating Frequency	BT: 2402-2480MHz For 5.0GHz: 5150 ~ 5250MHz, 5745~5825MHz, For 2.4GHz: 2400 MHz to 2483.5 MHz
Antenna Gain (dBi)	See below antenna info
Antenna Connector	Internal PCB Trace; custom 4-Way FAKRA antenna connector

WLAN antenna Gain

Internal WLAN maximum antenna gain (2.4 GHz)= +0.97 dBi

Internal WLAN maximum antenna gain (5 GHz)= -4.31 dBi

External WLAN maximum antenna gain (2.4 GHz)= +3 dBi

External WLAN maximum antenna gain (5 GHz) = +3dBi

BT Classic Details

Frequencies	Modes Supported	Maximum Antenna Gain
2400-2483.5 MHz	DH5、3DH5	+1.11 dBi

BLE Details

Frequencies	Modes Supported	Maximum Antenna Gain
2400-2483.5 MHz	1 Mbps, 2 Mbps	+1.11 dBi

2.4GHz directional gain = 5.054dBi , 5GHz directional gain = 3.103dBi

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3 RF Exposure

3.1 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
30-1500	…	…	f/1500	30
1500-100,000	…	…	1.0	30

F= Frequency in MHz; *Plane-wave equivalent power density

3.2 Far Field Calculation

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.

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

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

Where:

S = Power density in mW/cm^2
E = Field Strength in V/m
EIRP = Radiated Power, unit in watts
P = Power input to the antenna, unit in mW
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 = is the characteristic impedance of free space

Maximum Conducted Power (MPE):

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

3.3 Classification

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 Mobile Device

3.4 Calculation Result of Maximum Conducted Power

Frequency Band (MHz)	Max Power (dBm)	Turn-Up Tolerance	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
Bluetooth classic	1.684	±1dB	1.855	1.11	20	0.0004	1
Bluetooth	-0.82	±1dB	1.208	1.11	20	0.0003	1
Cellular 779MHz	25	±1dB	398.1	4.45	20	0.2207	0.5193
2400-2483.5 2x2 MIMO	15.09	±1dB	40.64	5.054	20	0.0259	1
5150-5250 5725-5850 Path A (External Antenna)	11.20	±1dB	16.6	3	20	0.007	1
5150-5250 5725-5850 Path B (Internal Antenna)	8.75	±1dB	9.44	-4.31	20	0.0007	1
5150-5250 5725-5850 2x2MIMO	13.2	±1dB	26.3	3.103	20	0.0107	1

Note:

1. Determining compliance based on the results of the compliance measurement, not considering measurement instrumentation uncertainty.
2. Antenna gains below 0 dBi are considered as 0
3. Considered that Path A and Path B (Internal and external antenaas) are coherent.

Reference:

- Cellular- SGS Report No.: HR/2019/1001602
- BLE & Bluetooth EMT Report Number: M220116E01
- WLAN: Bureau Veritas

Simultaneous Operation Matrix

The following spreadsheet shows the product radios simultaneous operation capabilities.

APTIV EP-2000 Radio Simultaneous Operation Matrix					
	Cellular	WLAN 2.4 GHz	WLAN 5 GHz	BT Classic	BLE
Cellular		✓	✓	✓	✓
WLAN 2.4 GHz	✓		✓	✓	✓
WLAN 5 GHz	✓	✓		✓	✓
BT Classic	✓	✓	✓		X
BLE	✓	✓	✓	X	
	✓	indicates simultaneuous operation is allowed			
	X	indicates simultaneuous operation is not allowed			

Considering the highest Power densities all transmitters that can be the same time

Calculation of the Simultaneous MPE value:

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

BT + Cellular + 2.4GHz + 5GHz = 0.0004 + 0.4249 + 0.0259 + 0.0107 = 0.4623

4 FCC requirements

Calculation of the MPE value:

$$\sum_{i=1}^{n}(S\,i/Li) = \quad 0.4623$$

Summation of Ratio (Si/Li) (PD/PD Limit) = 0.4623 < 1

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

4.1 ISED requirements

Recalculating the requireemts for ISED

Frequency Band (MHz)	Max Power (dBm)	Turn-Up Tolerance	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (W/m^2)	Limit (W/m^2)
Bluetooth classic	1.684	±1dB	1.855	1.11	20	0.004	5.351
Bluetooth	-0.82	±1dB	1.208	1.11	20	0.003	5.351
Cellular 779MHz	25	±1dB	398.1	4.45	20	2.207	2.4786
2400-2483.5 2x2 MIMO	15.09	±1dB	40.64	5.054	20	0.259	5.366
5150-5250 5725-5850 Path A (External Antenna)	11.20	±1dB	16.6	3	20	0.07	9.01
5150-5250 5725-5850 Path B (Internal Antenna)	8.75	±1dB	9.44	-4.31	20	0.007	9.01
5150-5250 5725-5850 2x2MIMO	13.2	±1dB	26.3	3.103	20	0.107	9.01

Calculation of the MPE value:

$$\sum_{i=1}^{n}(Si/Li) =$$

BT + Cellular + 2.4GHz + 5GHz =
0.004/5.351 + 2.207/2.4786 + 0.259/5.366 + 0.107/9.01 = 0.00074+0.8904+0.0482+0.0118 = 0.9511

Conclusion

$$\sum_{i=1}^{n}(Si/Li) = \quad 0.9511$$

Summation of Ratio (Si/Li) (PD/PD Limit) = 0.9511 < 1

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

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.

--- END ---