
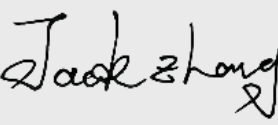




Test report No:  
22A0738R-RF-US-P20V01

## FCC Exposure TEST REPORT

Product Name	Infotainment Headunit
FCC ID	2ACRL-X297
Trademark	HARMAN
Model and /or type reference	X297
Applicant's name / address	Harman Automotive Electronic Systems (Suzhou) Co., Ltd. No.125, Fangzhou Road, Suzhou Industrial Park, Jiangsu Province, China 215024
Test method requested, standard	FCC 47CFR §2.1091
Verdict Summary	IN COMPLIANCE
Documented By (name / position & signature)	Jun Xu/ Project Engineer 
Approved by (name / position & signature)	Jack Zhang/ Manager 
Date of issue	2022-12-20
Report template No	Template_FCC-MPE-RF-V1.0

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## COMPETENCES AND GUARANTEES

DEKRA is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated in the report and it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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## GENERAL CONDITIONS

Test Location	No. 99, Hongye Road, Suzhou Industrial Park Suzhou, 215006, P.R. China
Date(receive sample)	Oct. 19, 2022
Date (start test)	Oct. 21, 2022
Date (finish test)	Nov. 29, 2022

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or Competent Authorities.
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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA.

## ENVIRONMENTAL CONDITIONS

The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment. The climatic conditions during the tests were within the following limits:

Ambient temperature	15 °C – 35 °C
Relative Humidity air	30% - 60%

If explicitly required in the basic standard or applied product / product family standard the climatic values are recorded and documented separately in this test report.

## POSSIBLE TEST CASE VERDICTS

Test case does not apply to test object	N/A
Test object does meet requirement	P (Pass) / PASS
Test object does not meet requirement	F (Fail) / FAIL
Not measured	N/M

## ABBREVIATIONS

For the purposes of the present document, the following abbreviations apply:

EUT	: Equipment Under Test
QP	: Quasi-Peak
CAV	: CISPR Average
AV	: Average
CDN	: Coupling Decoupling Network
SAC	: Semi-Anechoic Chamber
OATS	: Open Area Test Site
BW	: Bandwidth
AM	: Amplitude Modulation
PM	: Pulse Modulation
HCP	: Horizontal Coupling Plane
VCP	: Vertical Coupling Plane
$U_N$	: Nominal voltage
$T_x$	: Transmitter
$R_x$	: Receiver
N/A	: Not Applicable
N/M	: Not Measured

## DOCUMENT HISTORY

Report No.	Version	Description	Issued Date
22A0738R-RF-US-P20V01	V1.0	Initial issue of report.	2022-12-20

## REMARKS AND COMMENTS

1. The equipment under test (EUT) does meet the essential requirements of the stated standard(s)/test(s).
2. These test results on a sample of the device are for the purpose of demonstrating Compliance with FCC 47CFR §2.1091.
3. The measurement result is considered in conformance with the requirement if it is within the prescribed limit, It is not necessary to account the uncertainty associated with the measurement result.
4. The test results relate only to the samples tested.
5. The test report shall not be reproduced without the written approval of DEKRA Testing and Certification (Suzhou) Co., Ltd.
6. This report will not be used for social proof function in China market.
7. DEKRA declines any responsibility with the following test data provided by customer that may affect the validity of result:
  - Chapter 1.1 General Description of the Item(s);
  - Chapter 1.2 Antenna Informaion;

### 1.1 General Description of the Item(s)

Product Name .....	Infotainment Headunit
Model No. ....	X297
Trademark .....	HARMAN
FCC ID .....	2ACRL-X297
Manufacturer .....	Harman Automotive Electronic Systems (Suzhou) Co., Ltd.
Manufacturer Address .....	No.125, Fangzhou Road, Suzhou Industrial Park, Jiangsu Province, China 215024
Factory .....	Harman Automotive Electronic Systems (Suzhou) Co., Ltd.
Address .....	No.125, Fangzhou Road, Suzhou Industrial Park, Jiangsu Province, China 215024

Wireless specification .....	WIFI
Operating frequency range(s).....	2400~2483.5MHz
Type of modulation .....	802.11b: DSSS-DBPSK, DQPSK, CCK 802.11g/n: OFDM-BPSK, QPSK, 16QAM, 64QAM
Number of channel .....	802.11b/g/n(20MHz) : 11
Data Rate.....	802.11n: up to 72.2Mbps
Device category .....	<input type="checkbox"/> Fixed point-to-point <input type="checkbox"/> Emit multiple directional beams, simultaneously or sequentially <input checked="" type="checkbox"/> Other cases

Wireless specification .....	Bluetooth
Operating frequency range(s).....	2400~2483.5MHz
Type of Modulation .....	GFSK
PHYs.....	<input checked="" type="checkbox"/> GFSK <input checked="" type="checkbox"/> Pi/4 DQPSK <input checked="" type="checkbox"/> 8DPSK
Data Rate.....	<input checked="" type="checkbox"/> 1Mbit/s <input checked="" type="checkbox"/> 2Mbit/s <input checked="" type="checkbox"/> 3Mbit/s
Number of channel .....	79

Wireless specification .....	BLE
Operating frequency range(s).....	2400~2483.5MHz
Type of Modulation .....	GFSK
PHYs.....	<input checked="" type="checkbox"/> LE 1M <input type="checkbox"/> LE 2M <input type="checkbox"/> LE Coded S=2/8
Data Rate.....	<input checked="" type="checkbox"/> 1Mbit/s <input type="checkbox"/> 2Mbit/s <input type="checkbox"/> 500/125 Kbit/s
Number of channel .....	40

Wireless specification .....	WIFI					
Type of Modulation .....	OFDM-BPSK, QPSK, 16QAM, 64QAM, 256QAM					
Transmit modes .....	<input checked="" type="checkbox"/>	802.11a	<input checked="" type="checkbox"/>	802.11n(20MHz)	<input checked="" type="checkbox"/>	802.11n(40MHz)
	<input checked="" type="checkbox"/>	802.11ac(20MHz)	<input checked="" type="checkbox"/>	802.11ac(40MHz)	<input checked="" type="checkbox"/>	802.11ac(80MHz)
Frequency Range .....	<input checked="" type="checkbox"/>	5150MHz~5250MHz	<input type="checkbox"/>	Outdoor access point		
			<input type="checkbox"/>	RF Module		
	<input checked="" type="checkbox"/>	5725MHz~5850MHz	<input type="checkbox"/>	Fixed point-to-point AP		
			<input checked="" type="checkbox"/>	Mobile and Portable Client		
Date Rate .....	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 300Mbps 802.11ac: up to 866.7Mbps					

Rated power supply .....	Voltage and Frequency	
	<input type="checkbox"/>	AC: 220 – 240 V, 50/60 Hz
	<input type="checkbox"/>	AC: 100 – 240 V, 50/60 Hz
	<input checked="" type="checkbox"/>	DC: 12V
	<input type="checkbox"/>	PoE: -48Vdc
Mounting position.....	<input type="checkbox"/>	Table top equipment
	<input type="checkbox"/>	Wall/Ceiling mounted equipment
	<input type="checkbox"/>	Floor standing equipment
	<input type="checkbox"/>	Hand-held equipment
	<input checked="" type="checkbox"/>	Other: Equipment for vehicular use

## 1.2 Antenna Information

### 2.4G WIFI:

Antenna model / type number.....:	N/A			
Antenna serial number.....:	N/A			
Antenna Delivery .....	<input checked="" type="checkbox"/>	1TX + 1RX		
	<input type="checkbox"/>	2TX + 2RX		
	<input type="checkbox"/>	Others:.....		
Antenna technology .....	<input checked="" type="checkbox"/>	SISO		
	<input type="checkbox"/>	MIMO	<input type="checkbox"/>	CDD
			<input type="checkbox"/>	Beam-forming
Antenna Type .....	<input type="checkbox"/>	External	<input type="checkbox"/>	Dipole
			<input type="checkbox"/>	Sectorized
			<input checked="" type="checkbox"/>	Internal
	<input checked="" type="checkbox"/>	Internal	<input checked="" type="checkbox"/>	PCB
	<input type="checkbox"/>		Dipole	
	<input type="checkbox"/>		Others.....	
Antenna Gain .....	-4.08dBi			

### BT:

Antenna model / type number.....:	N/A			
Antenna serial number.....:	N/A			
Antenna Delivery .....	<input checked="" type="checkbox"/>	1TX + 1RX		
	<input type="checkbox"/>	2TX + 2RX		
	<input type="checkbox"/>	Others:.....		
Antenna technology .....	<input checked="" type="checkbox"/>	SISO		
	<input type="checkbox"/>	MIMO	<input type="checkbox"/>	CDD
			<input type="checkbox"/>	Beam-forming
Antenna Type .....	<input type="checkbox"/>	External	<input type="checkbox"/>	Dipole
			<input type="checkbox"/>	Sectorized
			<input checked="" type="checkbox"/>	Internal
	<input checked="" type="checkbox"/>	Internal	<input checked="" type="checkbox"/>	PCB
	<input type="checkbox"/>		Dipole	
	<input type="checkbox"/>		Others.....	
Antenna Gain .....	-3.29dBi			



**5G WIFI:**

Antenna model / type number .....	N/A			
Antenna serial number.....	N/A			
Antenna Delivery .....	<input checked="" type="checkbox"/>	1TX + 1RX		
	<input checked="" type="checkbox"/>	2TX + 2RX		
Antenna technology .....	<input checked="" type="checkbox"/>	SISO		
	<input checked="" type="checkbox"/>	MIMO	<input checked="" type="checkbox"/>	CDD
			<input type="checkbox"/>	Beam-forming
Antenna Type .....	<input type="checkbox"/>	External	<input type="checkbox"/>	Dipole
			<input type="checkbox"/>	Sectorized
	<input checked="" type="checkbox"/>	Internal	<input type="checkbox"/>	PIFA
			<input checked="" type="checkbox"/>	PCB
		<input type="checkbox"/>	Others.....	
SISO Antenna Gain .....	Antenna1:1.20 dBi    Antenna2: 2.09 dBi			

**2. RF Exposure Evaluation**

**2.1. Limits**

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (Minutes)
<b>(A) Limits for Occupational/ Control Exposures</b>				
300-1500	--	--	F/300	6
1500-100,000	--	--	5	6
<b>(B) Limits for General Population/ Uncontrolled Exposures</b>				
300-1500	--	--	F/1500	6
1500-100,000	--	--	1	30

F= Frequency in MHz

Friis Formula

Friis transmission formula:  $Pd = (Pout \cdot G) / (4 \cdot \pi \cdot r^2)$

Where

Pd = power density in mW/cm<sup>2</sup>

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

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$P_d$  is the limit of MPE, 1 mW/cm<sup>2</sup>. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance  $r$  where the MPE limit is reached.

## 2.2. Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

The temperature and related humidity: 18°C and 78% RH.

## 2.3. Test Result of RF Exposure Evaluation

Product	:	Infotainment Headunit
Test Item	:	RF Exposure Evaluation
Test Site	:	AC-6

### Power Density:

#### Standalone modes:

Test Mode	Frequency Band (MHz)	Maximum Power (dBm)	Power Density at R = 20 cm (W/m <sup>2</sup> )	Power Density Limit (W/m <sup>2</sup> )
2.4G WIFI	2400 ~ 2483.5	15.23	0.066	10
5G WIFI	5150 ~ 5250 5725 ~ 5850	11.17	0.026	10
Bluetooth	2400 ~ 2483.5	10.05	0.020	10

#### Simultaneous transmission: BT +2.4G WIFI

Wireless Configure	Frequency Range (MHz)	Maximum Power (dBm)	Limit of Power Density S (W/cm <sup>2</sup> )	Power Density S at R = 20cm (W/m <sup>2</sup> )	Rate	Limit
2.4G WIFI	2400 ~ 2483.5	15.23	10	0.0066	0.0086	1
Bluetooth	2400 ~ 2483.5	10.05	10	0.0020		

#### Simultaneous transmission: BT+5G WIFI

Wireless Configure	Frequency Range (MHz)	Maximum Power (dBm)	Limit of Power Density S (W/cm <sup>2</sup> )	Power Density S at R = 20cm (W/m <sup>2</sup> )	Rate	Limit
5G WIFI	5150 ~ 5250 5725 ~ 5850	11.17	10	0.0026	0.0046	1
Bluetooth	2400 ~ 2483.5	10.05	10	0.0020		

**Simultaneous transmission:BT+2.4GWIFI+5G WIFI**

Wireless Configure	Frequency Range (MHz)	Maximum Power (dBm)	Limit of Power Density S(W/cm <sup>2</sup> )	Power Density S at R = 20cm (W/m <sup>2</sup> )	Rate	Limit
5G WIFI	5150 ~ 5250 5725 ~ 5850	11.17	10	0.0026	0.0112	1
2.4G WIFI	2400 ~ 2483.5	15.23	10	0.0066		
Bluetooth	2400 ~ 2483.5	10.05	10	0.0020		

Note: The safe use distance of the EUT is 20cm, Access Point without any other radio equipment.

\_\_\_\_\_ The End \_\_\_\_\_