

RF Exposure Evaluation Report

Application No.: ZR/2020/90059
Applicant: Nauto
Address of Applicant: 220 Portage Avenue, Palo Alto, California 94306
Manufacturer: Nauto
Address of Manufacturer: 220 Portage Avenue, Palo Alto, California 94306
EUT Description: In-vehicle Camera
Model No.: Nauto 3-1
Trade Mark: Nauto
FCC ID: 2AKJ5-N31
Standards: 47 CFR Part 2.1091
 FCC KDB 447498 D01 v06
Date of Receipt: 2020/10/27
Date of Test: 2020/10/27 to 2020/11/23
Date of Issue: 2020/11/23

Test Result:	PASS*
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* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Derek Yang
Wireless Laboratory Manager



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1 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2020/11/23		Original

Authorized for issue by:			
			
		<hr/> Mike Hu /Project Engineer	
			
		<hr/> David Chen /Reviewer	



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2 General Information

2.1 Client Information

Applicant:	Nauto
Address of Applicant:	220 Portage Avenue, Palo Alto, California 94306
Manufacturer:	Nauto
Address of Manufacturer:	220 Portage Avenue, Palo Alto, California 94306

2.2 Test Location

Company:	SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch
Address:	No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China
Post code:	518057

2.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

• **Industry Canada (IC)**

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.



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2.4 General Description of EUT

EUT Description::	In-vehicle Camera
Model No.:	Nauto 3-1
Trade Mark:	Nauto
Hardware Version:	N3V8-NA
Software Version:	NautoN3_Shipping_U82_202010230751_SECURED
Antenna Gain:	WCDMA Band II:0.7dBi WCDMA Band V:-0.1dBi LTE Band 2:0.7dBi; LTE Band 4:0.6dBi; LTE Band 5:-0.1dBi; LTE Band 12: -0.2dBi LTE Band 14: 0.1dBi LTE Band 66: 0.6dBi LTE Band 71: -0.1dBi 2.4G WIFI/BT/BLE: -1.0 dBi



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3 RF Exposure Evaluation

3.1 RF Exposure Compliance Requirement

3.1.1 Limits

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6
(B) 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
 RF exposure compliance will need to be determined with respect to 1.1307(c) and (d) of the FCC rules. The emissions should be within the limits at 300kHz in Table 1 of 1.1310(use the 300kHz limits for 150kHz:614V/m,1.63A/m).

Friis Formula

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

Where

Pd = power density in mW/cm²

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

Pd is the limit of MPE, 1 mW/cm². 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.



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3.1.2 Test Procedure

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



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3.1.3 EUT RF Exposure Evaluation

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 2.0 / 2.0 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Remark: Refer to report No. ZR/2020/9005901 for EUT test Max Conducted Output Power value.

Operating Band	Frequency (MHz)	Antenna Gain (dBi)	Max Conducted Average Output Power (dBm)	Output Power to Antenna (dBm)	EIRP(ERP) Limit (dBm)	Output Power to Antenna (mw)	Power Density at R = 20 cm (mW/cm2)	Limit (mW/cm2)	Gain according to EIRP (dBi)	Gain according to Pd (dBi)	Max Gain Allowed (dBi)	conclusion
WCDMA B2	1852.4	0.70	24.00	24.70	33.00	251.1886	0.0587	1.0000	9.00	13.01	9.00	Pass
WCDMA B5	826.4	-0.10	24.00	21.75	38.45	251.1886	0.0488	0.5509	16.60	10.42	10.42	Pass
LTE B2	1880	0.70	24.00	24.70	33.00	251.1886	0.0587	1.0000	9.00	13.01	9.00	Pass
LTE B4	1710.7	0.60	24.00	24.60	30.00	251.1886	0.0574	1.0000	6.00	13.01	6.00	Pass
LTE B5	824.70	-0.10	24.00	21.75	38.45	251.1886	0.0488	0.5498	16.60	10.41	10.41	Pass
LTE B12	699.70	-0.20	24.00	21.65	34.77	251.1886	0.0477	0.4665	12.92	9.70	9.70	Pass
LTE B14	790.5	0.10	24.00	21.95	34.77	251.1886	0.0511	0.5270	12.92	10.23	10.23	Pass
LTE B66	1710.7	0.60	24.00	24.60	30.00	251.1886	0.0574	1.0000	6.00	13.01	6.00	Pass
LTE B71	1710.7	-0.10	24.00	23.90	34.77	251.1886	0.0488	1.0000	10.77	13.01	10.77	Pass
Bluetooth	2402	-1.00	8.50	7.50	20.97	7.0795	0.0011	1.0000	12.47	28.51	12.47	Pass
2.4G WiFi	2412	-1.00	17.00	16.00	20.97	50.1187	0.0079	1.0000	3.97	20.01	3.97	Pass

All of the WWAN WLAN and Bluetooth can transmit simultaneously, the formula of the calculated the MPE is:

$$CPD1/ LPD1+ CPD2/ LPD2+.....etc.<1$$

CPD=Calculation power density

LPD= Limit of power density

Therefore, the worst-case situation is $0.102308+0.00792=0.110228$, which is less than "1", this confirmed that the device comply with MPE limit.



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