RF Exposure Evaluation Report

APPLICANT	:	DZS Inc.
EQUIPMENT	:	GPON ONT
BRAND NAME	:	DZS
MODEL NAME	:	2428GN, 2428TE
FCC ID	:	PJZ2428GN
STANDARD	:	47 CFR Part 2.1091

The product evaluation date was started from Jul. 14, 2023 and completed on Jul. 14, 2023. We, Sporton International Inc. (Kunshan), would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Si Zhang

Approved by: Si Zhang

ACCREDITED Cert #5145.02

Sporton International Inc. (Kunshan)
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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA332121-01	Rev. 01	Initial issue of report.	Jul. 25, 2023

1. Administration Data

1.1. Testing Laboratory

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR01-KS	CN1257	314309

Applicant	
Company Name	DZS Inc.
Address	5700 Tennyson Parkway, Plano, TX 75024 USA

Manufacturer	
Company Name	DZS Inc.
Address	5700 Tennyson Parkway, Plano, TX 75024 USA

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	GPON ONT
Brand Name	DZS
Model Name	2428GN, 2428TE
FCC ID	PJZ2428GN
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80/VHT160 WLAN 5GHz 802.11ax HE20/HE40/HE80/HE160
Antenna Gain	

WLAN	Ant 0	Ant 1	Ant 2
WLAN2.4GHz	3.52	3.60	3.61

WLAN	Ant 0	Ant 1	Ant 2	Ant 3
WLAN5.2GHz	4.61	4.67	4.55	4.57
WLAN5.3GHz	4.67	4.67	4.58	4.57
WLAN5.5GHz	4.70	4.69	4.67	4.67
WLAN5.8GHz	4.60	4.58	4.55	4.52

Antenna Type	WLAN: PCB Antenna
HW Version	V02
SW Version	S7.0.023
EUT Stage	Production Unit

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. WLAN2.4GHz/WLAN5GHz all support SISO and MIMO mode, we chose MIMO tune up power to perform MPE calculation conservatively.
3. The device supports 1S3T(CDD&TXBF) mode in WLAN 2.4GHz and 1S4T(CDD&TXBF) mode in WLAN 5GHz.
4. This device support beamforming for WLAN 2.4GHz 802.11n/ax HT20/HT40/HE20/HE40, WLAN 5GHz 802.11n/ac/ax HT20/HT40/VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160.
5. The gain calculation method of WLAN beamforming mode is referrenced to KDB 662911.
6. There are two types of EUT. For the differences please refer to the 2428GN, 2428TE_Operational Description of Product Equality Declaration exhibit separately. According to the difference, it has no influence on the test results, chose the maximum power to do MPE analysis.
7. This is a variant report. The difference between current project and previous project is enabled WLAN5.3GHz/5.5GHz by software. According to the difference, added WLAN5.3GHz/5.5GHz evaluation based on original report, and other Bands leverage from original report which can be referred to Sporton Report Number FA332121.

Comments and Explanations:
1. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.
2. The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer.

3. Maximum RF average output tune up power among production units

<For MIMO mode>

<2.4GHz WLAN >

Mode		Maximum Average Power (dBm)
		Ant 0+1+2
2.4GHz	802.11b	30.0
	802.11g	30.0
	802.11n-HT20	29.0
	802.11n-HT40	25.0
	802.11ax-HE20	29.0
	802.11ax-HE40	25.0

<5GHz WLAN >

Mode		Maximum Average Power (dBm)
		Ant 0+1+2+3
5.2GHz	802.11a	26.0
	802.11n-HT20	26.0
	802.11n-HT40	27.0
	802.11ac-VHT20	26.0
	802.11ac-VHT40	27.0
	802.11ac-VHT80	22.0
	802.11ax-HE20	26.0
	802.11ax-HE40	27.0
	802.11ax-HE80	22.0
5.3GHz	802.11a	19.0
	802.11n-HT20	20.0
	802.11n-HT40	23.0
	802.11ac-VHT20	20.0
	802.11ac-VHT40	23.0
	802.11ac-VHT80	21.0
	802.11ac-VHT160	17.0
	802.11ax-HE20	20.0
	802.11ax-HE40	23.0
	802.11ax-HE80	21.0
	802.11ax-HE160	17.0
5.5GHz	802.11a	19.0
	802.11n-HT20	20.0
	802.11n-HT40	23.0
	802.11ac-VHT20	20.0
	802.11ac-VHT40	23.0
	802.11ac-VHT80	23.7
	802.11ax-HE20	20.0
	802.11ax-HE40	23.0
	802.11ax-HE80	23.7
5.8GHz	802.11a	23.0
	802.11n-HT20	23.0

	802.11n-HT40	23.0
	802.11ac-VHT20	23.0
	802.11ac-VHT40	23.0
	802.11ac-VHT80	23.0
	802.11ax-HE20	23.0
	802.11ax-HE40	23.0
	802.11ax-HE80	23.0

<For Beamforming mode>

<2.4GHz WLAN >

Mode		Maximum Average Power (dBm)
		Ant 0+1+2
2.4GHz	802.11n-HT20	25.0
	802.11n-HT40	20.0
	802.11ax-HE20	25.0
	802.11ax-HE40	20.0

<5GHz WLAN >

Mode		Maximum Average Power (dBm)
		Ant 0+1+2+3
5.2GHz	802.11n-HT20	20.5
	802.11n-HT40	20.5
	802.11ac-VHT20	20.5
	802.11ac-VHT40	20.5
	802.11ac-VHT80	15.5
	802.11ax-HE20	20.5
	802.11ax-HE40	20.5
	802.11ax-HE80	15.5
5.3GHz	802.11n-HT20	14.0
	802.11n-HT40	16.0
	802.11ac-VHT20	14.0
	802.11ac-VHT40	16.0
	802.11ac-VHT80	15.0
	802.11ac-VHT160	11.0
	802.11ax-HE20	14.0
	802.11ax-HE40	16.0
	802.11ax-HE80	15.0
	802.11ax-HE160	11.0
5.5GHz	802.11n-HT20	14.0
	802.11n-HT40	17.0
	802.11ac-VHT20	14.0
	802.11ac-VHT40	17.0
	802.11ac-VHT80	19.0
	802.11ax-HE20	14.0
	802.11ax-HE40	17.0
	802.11ax-HE80	19.0
5.8GHz	802.11n-HT20	16.5
	802.11n-HT40	16.5

	802.11ac-VHT20	16.5
	802.11ac-VHT40	16.5
	802.11ac-VHT80	16.5
	802.11ax-HE20	16.5
	802.11ax-HE40	16.5
	802.11ax-HE80	16.5

Note: This device support beamforming for WLAN 2.4GHz 802.11n/ax HT20/HT40/HE20/HE40, WLAN 5GHz 802.11n/ac/ax HT20/HT40/VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160.

4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

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/f2)	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/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

5. Radio Frequency Radiation Exposure Evaluation

5.1. Standalone Power Density Calculation

<MIMO mode>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit
2.4GHz WLAN	2412.0	3.61	30.00	33.610	2296.149	0.457	1.000	**0.457**
5.2GHz WLAN	5180.0	4.67	27.00	31.670	1468.926	0.292	1.000	**0.292**
5.3GHz WLAN	5260.0	4.67	23.00	27.670	584.790	0.116	1.000	0.116
5.5GHz WLAN	5500.0	4.70	23.70	28.400	691.831	0.138	1.000	0.138
5.8GHz WLAN	5745.0	4.60	23.00	27.600	575.440	0.115	1.000	0.115

<Beamforming mode>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit
2.4GHz WLAN	2412.0	8.35	25.00	33.350	2162.719	0.430	1.000	**0.430**
5.2GHz WLAN	5180.0	10.62	20.50	31.120	1294.196	0.258	1.000	**0.258**
5.3GHz WLAN	5260.0	10.64	16.00	26.640	461.318	0.092	1.000	0.092
5.5GHz WLAN	5500.0	10.70	19.00	29.700	933.254	0.186	1.000	0.186
5.8GHz WLAN	5745.0	10.58	16.50	27.080	510.505	0.102	1.000	0.102

Note:

1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. Chose the maximum power to do MPE analysis.
3. WLAN2.4GHz and WLAN5GHz chose the higher SISO gain as MIMO gain to perform MPE calculation.
4. The gain calculation method of WLAN beamforming mode is referrenced to KDB 662911.

5.2. Collocated Power Density Calculation

<For MIMO mode>

WLAN2.4GHz Power Density / Limit	WLAN5GHz Power Density / Limit	Σ(Power Density / Limit) of WLAN2.4GHz + WLAN5GH
0.457	0.292	0.749

<For Beamforming mode>

WLAN2.4GHz Power Density / Limit	WLAN5GHz Power Density / Limit	Σ(Power Density / Limit) of WLAN2.4GHz + WLAN5GH
0.430	0.258	0.688

Note:

1. According to the EUT characteristic, WLAN2.4GHz and WLAN 5GHz can transmit simultaneously.
2. Σ(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WLAN2.4GHz + WLAN5GHz.
3. The aggregated (power density /limit) is smaller than 1, and MPE of 2 collocated transmitters is compliant.

Conclusion:

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

------THE END------