

Prüfbericht-Nr.: <i>Test report no.:</i>	CN23HQZY 004	Auftrags-Nr.: <i>Order no.:</i>	168417547 Seite 1 von 10 Page 1 of 10
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2023-03-09
Auftraggeber: <i>Client:</i>	Promethean Ltd. Promethean House, Lower Philips Rd, Blackburn, United Kingdom, BB1 5TH		
Prüfgegenstand: <i>Test item:</i>	OPS-A		
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	OPS-A1-8R64S, OPS-A1-4R32S		
Auftrags-Inhalt: <i>Order content:</i>	Test Report		
Prüfgrundlage: <i>Test specification:</i>	47 CFR FCC Part 2.1091 RSS-102 Issue 5		
Wareneingangsdatum: <i>Date of sample receipt:</i>	2023-03-13	Please refer to Photo Document	
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003427527-002~003 A003427527-006~010		
Prüfzeitraum: <i>Testing period:</i>	2023-03-24 - 2023-04-03		
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.		
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.		
Prüfergebnis*: <i>Test result*:</i>	Pass		
geprüft von: <i>tested by:</i>		genehmigt von: <i>authorized by:</i>	
Datum: <i>Date:</i> 2023-04-24	Signed by: Bell Hu	Ausstellungsdatum: <i>Issue date:</i> 2023-04-24	Signed by: Lin Lin
Stellung / Position:	Sachverständige(r)/Expert	Stellung / Position:	Sachverständige(r)/Expert
Sonstiges / Other:	FCC ID: QAM024 IC: 5459A-024 HVIN: OPS-A1-8R64S, OPS-A1-4R32S		
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested			
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>			

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TEST SUMMARY

3.1.1 RF EXPOSURE COMPLIANCE
RESULT: Pass

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1. TEST SITES

1.1 TEST FACILITIES

TÜV Rheinland (Shenzhen) Co., Ltd.

Address: No.362, Huanguan Middle Road, Songyuansha Community, Guanhu Subdistrict, Longhua District, Shenzhen 518110, Guangdong, China

FCC Registration No.: 694916

ISED wireless device testing laboratory: 25069

1.2 Traceability

All measurement equipment calibrations are traceable to NIST or where calibration is performed outside the United States, to equivalent nationally recognized standards organizations.

1.3 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

1.4 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendixes of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) file for certification follow-up purposes.

1.5 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. facility located at No.362, Huanguan Middle Road, Songyuansha Community, Guanhu Subdistrict, Longhua District, Shenzhen 518110, Guangdong, China is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

2. GENERAL PRODUCT INFORMATION

2.1 GENERAL DESCRIPTION

The EUT is an OPS-A, which supports Bluetooth(dual mode), 2.4GHz Wi-Fi 802.11 b/g/n/ax and 5GHz Wi-Fi 802.11a/n/ac/ax wireless technology.

For details refer to the User Manual, Technical Description and Circuit Diagram.

2.2 RATING AND SYSTEM DETAILS

Table 1: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment:	OPS-A
Type Designation:	OPS-A1-8R64S, OPS-A1-4R32S
FCC ID:	QAM024
IC ID:	5459A-024
PMN:	OPS-A
HVIN:	OPS-A1-8R64S, OPS-A1-4R32S
Operating Voltage:	12V ~ 19V DC input via panel JAE port
Testing Voltage:	AC 120V, 60Hz
Technical Specification of Bluetooth (dual mode)	
Operating Frequency:	2402 MHz to 2480 MHz
Type of Modulation:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Channel Number:	BDR & EDR mode:79 channels; Low Energy mode:40 channels
Channel Separation:	BDR & EDR mode: 1MHz, 2MHz; Low Energy mode: 2MHz
Data Rate:	BDR & EDR mode: 1Mbps, 2Mbps, 3Mbps Low Energy mode: 1Mbps, 2Mbps
Antenna Type:	External Antenna
Antenna Gain of Bluetooth:	5.0 dBi Max(As detailed in Antenna spec)
Technical Specification of Wi-Fi 802.11 b/g/n/ax	
Operating Frequency:	2412 - 2462 MHz for 802.11b/g/n(HT20)/ax(HE20) 2422 - 2452 MHz for 802.11n(HT40)/ax(HE40)
Type of Modulation:	802.11b: CCK, DQPSK, DBPSK 802.11g/n : BPSK, QPSK, 16QAM, 64QAM 802.11ax: BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
Data Rate:	1/2/5.5/11 Mbps for 802.11b 6/9/12/18/24/36/48/54 Mbps for 802.11g MCS0~MCS 7 for 802.11n(HT20/40) MCS0~MCS11 for 802.11ax(HE20/40) (All data rates considered, only the Worst-cases reported)

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Channel Number:	11 channels for 802.11b/g/n(HT20)/ax(HE20) 7 channels for 802.11n(HT40)/ax(HE40)
Channel Separation:	5 MHz
Antenna Type:	External Antenna
Number of Antenna:	2
Antenna Gain:	5.0 dBi Max(As detailed in Antenna spec)
Note: WLAN 2.4GHz 802.11n and 802.11ax support. For directional gain: Array Gain = $10 \log(NANT/NSS)$ dB. So the Directional gain = GANT + $10 \log(NANT)$ dBi (The worst case directional gain will occur when NSS = 1).	
Technical Specification of Wi-Fi 802.11 a/n/ac/ax	
Operating Frequency:	5180-5320MHz, 5500-5720MHz, 5745-5825MHz
Type of Modulation:	802.11n/a: BPSK, QPSK, 16QAM, 64QAM 802.11ac: BPSK, QPSK, 16QAM, 64QAM, 256QAM 802.11ax: BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
Protocol:	802.11 a/n20/n40/ac20/ac40/ac80/ ax20/ax40/ax80
Data Rate:	6/9/12/18/24/36/48/54 Mbps for 802.11a MCS0~MCS7 for 802.11n MCS0~MCS9 for 802.11ac MCS0~MCS11 for 802.11ax (All data rates considered, only the Worst-cases reported)
Channel Separation	5 MHz
Antenna Type:	External Antenna
Number of Antenna:	2
Antenna Gain:	5.0 dBi Max(As detailed in Antenna spec)
TPC function:	Supported
Type of Device	Slave Device without Radar Detection
Note: WLAN 5GHz 802.11n/802.11ac/802.11ax. For directional gain: Array Gain = $10 \log(NANT/NSS)$ dB. So the Directional gain = GANT + $10 \log(NANT)$ dBi (The worst case directional gain will occur when NSS = 1).	

3. Test Results

3.1 Transmitter Requirements & Test Suites

3.1.1 RF Exposure Compliance

RESULT:**Pass**

Test standard	:	RSS-102 Issue 5 FCC Part 1.1091
Limit	:	Table 1 of 47 CFR FCC Part 1.1310 Section 2.5.2 of RSS-102 Issue 5
Kind of test site	:	Shielded room

This device is mobile device, and the applicant declares that the minimum separation distance is greater than 20cm. Therefore MPE measurement or computational modelling should be used to determine compliance.

MPE Calculation is based on the conducted power, and considering maximum power and Antenna gain. The following formula is used to MPE evaluation.

$$Pd = \frac{P_{out} * G}{4R^2\pi}$$

Where

P_d = power density in mW/cm² or W/m²

P_{out} = output power to antenna in mW or W

G_{num} = Antenna gain in numeric

π = 3.14159

R = Distance between observation point and the center of radiator in cm or m

3.1.1.1 FCC Part 1.1310, Part 2.1091

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/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

Table 2: Test Results of RF Exposure Calculations for FCC, stand-alone mode

Operating Mode	Max. EIRP incl. tune-up (dBm)	Distance (cm)	MPE P _d (mW/cm ²)	Limit (mW/cm ²)	Verdict
Bluetooth	15.53	20	0.007	1.0	Pass
2.4G Wi-Fi	28.52	20	0.142	1.0	Pass
5G Wi-Fi	28.92	20	0.155	1.0	Pass

1. RF Output Power above: Refer to test report CN23HQZY 001~003.
2. EIRP= Average Conducted power +Directional Gain

Table 3: Test Results of RF Exposure Calculations for FCC, Simultaneous mode

Operating Mode (Worst-Case)	Sum of the MPE ratios for all simultaneously	Limit	Verdict
Bluetooth+5G Wi-Fi	0.164, far less than limit	1.0	Pass

Note: Simultaneous mode only supported for BLE +Wi-Fi.

3.1.1.2 RSS-102 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

Table 4: Test Results of RF Exposure Calculations for ISED, Stand-alone mode

Operating Mode	Max. EIRP incl. tune-up (dBm)	Distance (cm)	Maximum EIRP (W)	Threshold power (W)	Verdict
Bluetooth	15.53	20	0.036	2.68	Pass
2.4G Wi-Fi	28.52	20	0.711	2.70	Pass
5G Wi-Fi	28.92	20	0.780	4.90	Pass

Note: The maximum EIRP lower than the threshold power in section 2.5.2, thus compliant.

1. RF Output Power above: Refer to test report CN23HQZY 001~003.
2. EIRP= Average Conducted power +Directional Gain

Table 5: Test Results of RF Exposure Calculations for ISED, Simultaneous mode

Operating Mode(Worst-Case)	Sum of the ratios	Limit	Verdict
BLE+2.4G Wi-Fi	$0.036/2.68+0.711/2.7$, far less than 1.0	1.0	Pass

Note: Simultaneous mode only supported for BLE +Wi-Fi.

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