

Prüfbericht-Nr.: Test report no.:	CN23CNS7 001	Auftrags-Nr.: Order no.:	168449710	Seite 1 von 22 Page 1 of 22
Kunden-Referenz-Nr.: Client reference no.:	N/A	Auftragsdatum: Order date:	2023-10-12	
Auftraggeber: Client:	Honeywell International Inc. 12 Clintonville Road, Northford, CT 06472, USA			
Prüfgegenstand: Test item:	I/O Module			
Bezeichnung / Typ-Nr.: Identification / Type no.:	IQ5-IO-8DOS-B, IQ5-IO-8DOS-HOA-B			
Auftrags-Inhalt: Order content:	Test Report			
Prüfgrundlage: Test specification:	CFR47 FCC Part 15: Subpart C Section 15.247 RSS-247 Issue 3 RSS-Gen Issue 5			
Wareneingangsdatum: Date of sample receipt:	2023-10-18	Please refer to Photo Document		
Prüfmuster-Nr.: Test sample no:	A003584092-002,007, A003591690-001			
Prüfzeitraum: Testing period:	2023-11-07 - 2023-11-28			
Ort der Prüfung: Place of testing:	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:			genehmigt von: authorized by:	
Datum: Date:	2024-02-21	Signed by: Bell Hu	Ausstellungsdatum: Issue date:	2024-02-21
			Signed by: Jonathan Li	
Stellung / Position:	Sachverständige(r)/Expert		Stellung / Position:	Sachverständige(r)/Expert
Sonstiges / Other:	FCC ID: 2A8LT-IQ5IO8DOS IC: 1609A-IQ5IO8DOS HVIN: 601007 PMN: IQ5-IO-8DOS-B, IQ5-IO-8DOS-HOA-B			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory F(ail) = failed a.m. test specification(s)	4 = sufficient N/A = not applicable
				5 = mangelhaft N/T = nicht getestet 5 = poor 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 a. m. 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>				

Prüfbericht-Nr.: CN23CNS7 001
Test report no.:

Page 2 of 22
Seite 2 von 22

Anmerkungen
Remarks

1	The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request. <i>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben.</i> <i>Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</i>
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3	Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report. <i>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</i>
4	The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019. <i>Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</i>

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 3 von 22
Page 3 of 22

Test Summary

5.1.1 ANTENNA REQUIREMENT

RESULT: Pass

5.1.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER

RESULT: Pass

5.1.3 CONDUCTED POWER SPECTRAL DENSITY

RESULT: Pass

5.1.4 6dB BANDWIDTH

RESULT: Pass

5.1.5 99% BANDWIDTH

RESULT: Pass

5.1.6 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 kHz BANDWIDTH

RESULT: Pass

5.1.7 RADIATED SPURIOUS EMISSION

RESULT: Pass

5.1.8 CONDUCTED EMISSION ON AC MAINS

RESULT: Pass

Contents

1	GENERAL REMARKS	5
1.1	COMPLEMENTARY MATERIALS.....	5
2	TEST SITES.....	6
2.1	TEST FACILITIES	6
2.2	LIST OF TEST AND MEASUREMENT INSTRUMENTS	6
2.3	TRACEABILITY	7
2.4	CALIBRATION.....	7
2.5	MEASUREMENT UNCERTAINTY	7
2.6	LOCATION OF ORIGINAL DATA	8
2.7	STATUS OF FACILITY USED FOR TESTING	8
3	GENERAL PRODUCT INFORMATION	9
3.1	PRODUCT FUNCTION AND INTENDED USE	9
3.2	RATINGS AND SYSTEM DETAILS.....	9
3.3	INDEPENDENT OPERATION MODES.....	10
3.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS	10
3.5	SUBMITTED DOCUMENTS.....	10
4	TEST SET-UP AND OPERATION MODES.....	11
4.1	PRINCIPLE OF CONFIGURATION SELECTION	11
4.2	TEST OPERATION AND TEST SOFTWARE	11
4.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	11
4.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE	11
4.5	TEST SETUP DIAGRAM	12
5	TEST RESULTS	14
5.1	TRANSMITTER REQUIREMENT & TEST SUITES.....	14
5.1.1	Antenna Requirement.....	14
5.1.2	Maximum Peak Conducted Output Power	15
5.1.3	Conducted Power Spectral Density.....	16
5.1.4	6dB Bandwidth	17
5.1.5	99% Bandwidth.....	18
5.1.6	Conducted Spurious Emissions Measured in 100 kHz Bandwidth.....	19
5.1.7	Radiated Spurious Emission	20
5.1.8	Conducted Emission on AC Mains.....	21
6	PHOTOGRAPHS OF THE TEST SET-UP	22
7	LIST OF TABLES.....	22

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 5 von 22
Page 5 of 22

1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Photographs of the Test Set-up

Appendix B: Test Results of Bluetooth Low energy

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

No. 362 Huanguan Road Middle, Longhua District, 518110, Shenzhen, P. R. China.

FCC Registration No.: 694916

IC Registration No.: 25069 and the CAB identifier is CN0078.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Radio Spectrum Testing (TS8997)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
Signal Analyzer	R&S	FSV 40	101441	2024-07-25
OSP	R&S	OSP 150	101017	2024-11-13
Control PC	DELL	OptiPlex 7050	FTJZ9P2	N/A
Test Software	R&S	WMS32 (V11.00.00)	N/A	N/A
Power Meter	R&S	NRP2	107105	2024-11-13
Wideband Power Sensor	R&S	NRP-Z81	105677	2024-07-25
Shielding Room 8#	Albatross	SR8	APC17151-SR8	2024-06-22
Radio Spectrum Testing (SRD-Tonscend)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
EXA Signal Analyzer, Multi-touch	Keysight	N9010B	MY60241175	2024-09-21
MXG X-Series RF Vector Signal Generator	Keysight	N5182B	MY61250137	2024-09-21
EXG X-Series Microwave Analog Signal Generator	Keysight	N5173B	MY61250141	2024-09-21
DC Power Supply	Keysight	E3642A	MY61276100	2024-09-21
Wireless Connectivity Tester	R&S	CMW270	102505	2024-09-21
Power Control Unit	Tonscend	JS0806-4ADC	N/A	2024-09-21
Automation Control Unit	Tonscend	JS0806-2	21C8060396	2024-09-21
Test Software	Tonscend	JS1120-3	N/A	N/A
Unwanted Emission Testing (TS9975)				
Equipment	Manufacturer	Model	Serial No.	Cal. until
EMI Test Receiver	R&S	ESR 7	102021	2024-07-25
Signal Analyzer	R&S	FSV 40	101439	2024-07-25
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2024-07-25

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 7 von 22
Page 7 of 22

OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2024-07-25
Amplifier	R&S	SCU-18F	180070	2024-07-25
Amplifier	R&S	SCU40A	100475	2024-07-25
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2024-08-06
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2024-08-06
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2024-08-27
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2024-08-06
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	2024-06-22

Conducted Emission

Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
EMI Test Receiver	R&S	ESR3	102428	2024-07-30
Artificial Mains Network	R&S	ENV216	102333	2024-07-31
EMC32 test software	R&S	EMC32(Ver.10.50.00)	N/A	N/A

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 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.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table.

Parameter	Uncertainty (k=2)
Occupied Channel Bandwidth	± 2.08 %
RF output power, conducted	± 0.99 dB
Unwanted Emissions, conducted	± 0.89 dB
All emissions, radiated	± 4.17 dB
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	± 3.70 dB / ± 3.30 dB

2.6 Location of Original Data

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

2.7 Status of Facility Used for Testing

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

3 General Product Information

3.1 Product Function and Intended Use

The EUT is I/O Module, which supports Bluetooth (Low Energy) wireless technology.
For details refer to the User Manual, Technical Description and Circuit Diagram.

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment:	I/O Module
Type Designation:	IQ5-IO-8DOS-B, IQ5-IO-8DOS-HOA-B (They mainly share the same electrical circuit design and PCB layout, the only difference is that IQ5-IO-8DOS-HOA-B has a screen, which is not contained in IQ5-IO-8DOS-B.)
FCC ID:	2A8LT-IQ5IO8DOS
IC:	1609A-IQ5IO8DOS
HVIN:	601007
PMN:	IQ5-IO-8DOS-B, IQ5-IO-8DOS-HOA-B
Operating Voltage:	AC/DC 24V
Testing Voltage:	AC 120V, 60Hz (AC-AC Adapter with AC 24V output)
Technical Specification of Bluetooth (Low Energy)	
Frequency Range:	2402 MHz to 2480 MHz
Type of Modulation:	GFSK
Channel Number:	40 channels
Data Rate:	2Mbps, 1Mbps, 500kbps, 125kbps
Channel Separation:	2 MHz
Antenna Type:	Integral antenna
Antenna Gain:	3.1 dBi

Table 3: RF Channel and Frequency of Bluetooth (Low Energy)

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

Test frequencies are lowest channel: 2402 MHz, middle channel: 2440 MHz and highest channel: 2480 MHz

3.3 Independent Operation Modes

The basic operation modes are:

- A. On, Bluetooth Low Energy transmitting mode
 - 1) Low Channel
 - 2) Middle Channel
 - 3) High Channel
- B. On, Normal Working with Bluetooth connected
- C. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- Application Form
- FCC/IC Label and Location Info
- User Manual

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All tests were performed according to the procedures in ANSI C63.10: 2013.

4.3 Special Accessories and Auxiliary Equipment

Table 4: Auxiliary Equipment Used during Test

Name	Model	Manufacturer
Portable Laptop	E5440	DELL
Phone	K30	Redmi
AC-AC Adapter	BK-100	DELIXI
Wiring Adapter	IQ5-IO-ADPT	Honeywell
I/O Module	IQ5-IO-8DOS-HOA-B	Honeywell
Portable Laptop	T480	Lenovo

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

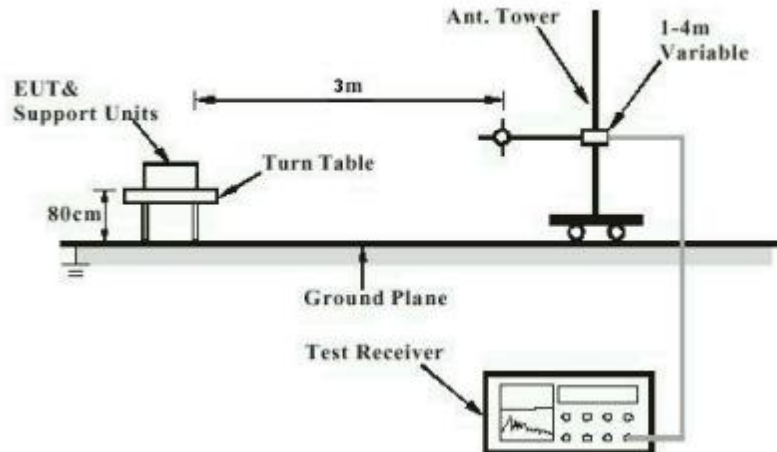


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

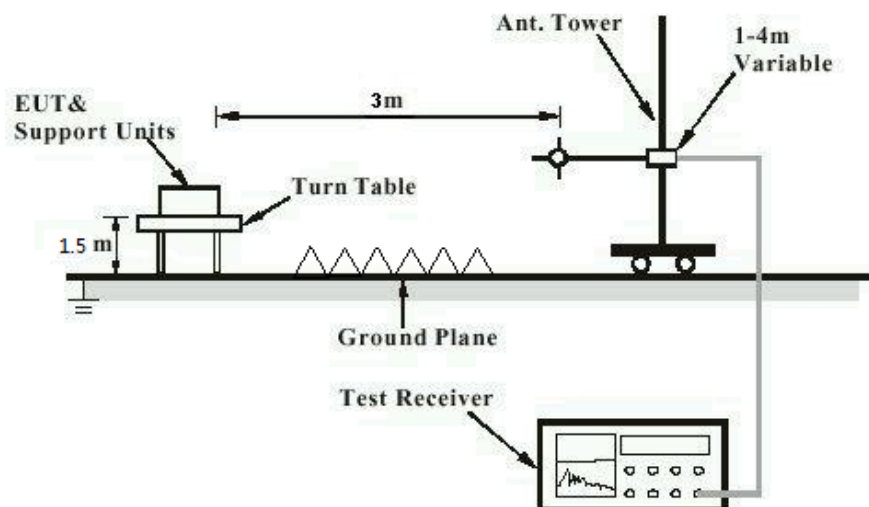


Diagram of Measurement Configuration for Mains Conduction Measurement

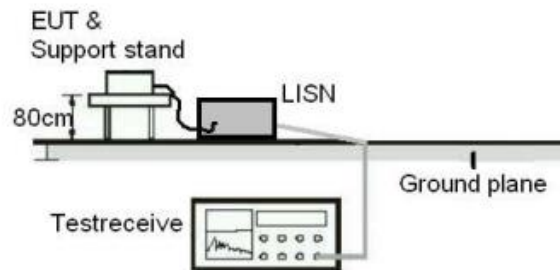
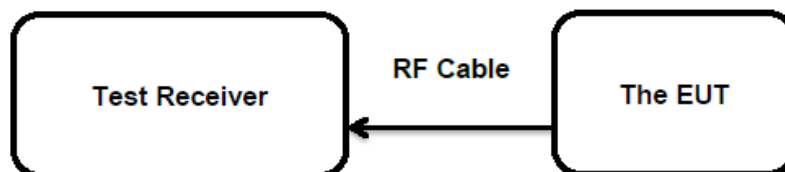


Diagram of Measurement Configuration for Conducted Transmitter Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:

Pass

Test Specification

Test standard : FCC Part 15.247(b)(4) and Part 15.203
RSS-Gen Clause 6.8

The EUT has an Integral antenna, the directional gain of antenna is 3.1 dBi, permanent attachment and no consideration of replacement.

Therefore, the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 15 von 22
Page 15 of 22

5.1.2 Maximum Peak Conducted Output Power

RESULT:

Pass

Test Specification

Test standard : FCC Part 15.247(b)(3)
RSS-247 Clause 5.4(d)
Basic standard : ANSI C63.10: 2013
Limits : 1.0 Watts
Kind of test site : Shielded Room

Test Setup

Date of testing : 2023-11-07- 2023-11-28
Input voltage : DC 3.3 V
Operation mode : A
Test channel : Low / Middle / High
Ambient temperature : 24.3 °C
Relative humidity : 50 %
Atmospheric pressure : 101 kPa

Table 5: Test Result of Maximum Peak Conducted Output Power

Test Mode	Data Rate	Test Channel (MHz)	Measured Peak Power		Limit (W)
			(dBm)	(W)	
Bluetooth (Low Energy)	2Mbps	2402	8.6	0.0072	< 1.0
		2440	8.8	0.0076	
		2480	8.8	0.0076	
	1Mbps	2402	8.6	0.0072	
		2440	8.7	0.0074	
		2480	8.7	0.0074	
	500kbps	2402	9.66	0.0092	
		2440	9.83	0.0096	
		2480	9.91	0.0098	
	125kbps	2402	9.62	0.0092	
		2440	9.81	0.0096	
		2480	9.87	0.0097	
Maximum Measured Value			9.91	0.0098	

Note:

- 1) The cable loss is taken into account in results.
- 2) Antenna gain(G): 3.1 dBi,
e.i.r.p.=P_(Peak power)+ G, which is far below the 4 W

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 16 von 22
Page 16 of 22

5.1.3 Conducted Power Spectral Density

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.247(e) RSS-247 Clause 5.2(b)
Basic standard	: ANSI C63.10: 2013
Limits	: < 8 dBm / 3kHz
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2023-11-07- 2023-11-28
Input voltage	: DC 3.3 V
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 24.3 °C
Relative humidity	: 50 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix B.

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 17 von 22
Page 17 of 22

5.1.4 6dB Bandwidth

RESULT:

Pass

Test Specification

Test standard : FCC Part 15.247(a)(2)
RSS-247 Clause 5.2(a)
Basic standard : ANSI C63.10: 2013
Limits : > 500 KHz
Kind of test site : Shielded Room

Test Setup

Date of testing : 2023-11-07- 2023-11-28
Input voltage : DC 3.3 V
Operation mode : A
Test channel : Low / Middle / High
Ambient temperature : 24.3 °C
Relative humidity : 50 %
Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 18 von 22
Page 18 of 22

5.1.5 99% Bandwidth

RESULT:

Pass

Test Specification

Test standard : RSS-Gen Clause 6.7
Basic standard : ANSI C63.10: 2013
Kind of test site : Shielded Room

Test Setup

Date of testing : 2023-11-07- 2023-11-28
Input voltage : DC 3.3 V
Operation mode : A
Test channel : Low / Middle / High
Ambient temperature : 24.3 °C
Relative humidity : 50 %
Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 19 von 22
Page 19 of 22

5.1.6 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.247(d) RSS-247 Clause 5.5
Basic standard	: ANSI C63.10: 2013
Limits	: 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power); In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a)
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2023-11-07- 2023-11-28
Input voltage	: DC 3.3 V
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 24.3 °C
Relative humidity	: 50 %
Atmospheric pressure	: 101 kPa

Test results of 100kHz Bandwidth of Frequency Band Edge by Conducted method refer to test plots, and compliance is achieved as well.

For the measurement records, refer to the appendix B.

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 20 von 22
Page 20 of 22

5.1.7 Radiated Spurious Emission

RESULT:

Pass

Test Specification

Test standard : FCC Part 15.247(d) & FCC Part 15.205
RSS-247 Clause 3.3
Basic standard : ANSI C63.10: 2013
Limits : Refer to 15.209(a) of FCC part 15.247(d)
RSS-Gen Section 8.9 & 8.10
Kind of test site : 3m Semi-anechoic Chamber

Test Setup

Date of testing : 2023-11-07- 2023-11-28
Input voltage : AC 24 V
Operation mode : A
Test channel : Low / Middle / High
Ambient temperature : Refer to test result
Relative humidity : Refer to test result
Atmospheric pressure : 101 kPa

Remark:

Testing carried out within frequency range 9kHz to the tenth harmonics. And both the IQ5-IO-8DOS-HOA-B and IQ5-IO-8DOS-B considered, only the worst-case spurious emissions configuration of the each mode were reported.

For the measurement records, refer to the appendix B.

Prüfbericht - Nr.: CN23CNS7 001
Test Report No.:

Seite 21 von 22
Page 21 of 22

5.1.8 Conducted Emission on AC Mains

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.207(a) RSS-Gen Clause 8.8
Basic standard	: ANSI C63.10: 2013
Frequency range	: 0.15 – 30MHz
Classification	: Class B
Limits	: FCC Part 15.207(a) RSS-Gen Table 3
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2023-11-21- 2023-11-26
Input voltage	: AC 120V; 60Hz
Operation mode	: B
Earthing	: Not connected
Ambient temperature	: 24.3 °C
Relative humidity	: 52.8 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix B.

6 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix A.

7 List of Tables

Table 1: List of Test and Measurement Equipment6
 Table 2: Technical Specification of EUT9
 Table 3: RF Channel and Frequency of Bluetooth (Low Energy)10
 Table 4: Auxiliary Equipment Used during Test.....11
 Table 5: Test Result of Maximum Peak Conducted Output Power15