

Prüfbericht - Nr.: 14034388 001
Test Report No.:
Seite 1 von 16
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Auftraggeber: Sunflex Europe GmbH
Client: Konrad-Zuse-Str. 13
 58239 Schwerte
 Germany

Gegenstand der Prüfung: Airmouse
Test Item:

Bezeichnung:	V908354	Serien-Nr.:	Engineering sample
<i>Identification:</i>		<i>Serial No.:</i>	

Wareneingangs-Nr.:	00131127146-012	Eingangsdatum:	27.11.2013
<i>Receipt No.:</i>		<i>Date of Receipt:</i>	

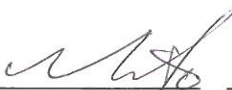
Zustand des Prüfgegenstandes bei Anlieferung:	Test sample(s) is/are not damaged and suitable for testing.
<i>Condition of test item at delivery:</i>	

Prüfort:	TÜV Rheinland Hong Kong Ltd.
<i>Testing Location:</i>	8/F., First Group Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong
	Global United Technology Services Co., Ltd.
	2nd Floor, Block No.2, Laodong Industrial Zone, Xixiang Road Baoan District, Shenzhen, China

Prüfgrundlage:	FCC Part 15 Subpart C
<i>Test Specification:</i>	ANSI C63.4-2003
	CISPR 22:1997

Prüfergebnis:	Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).
<i>Test Results:</i>	The test item passed the test specification(s).

Prüflaboratorium:	TÜV Rheinland Hong Kong Ltd.
<i>Testing Laboratory:</i>	8 - 10/F., Goldin Financial Global Square, 7 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong

geprüft/ tested by:			kontrolliert/ reviewed by:		
06.02.2014	Mika Chan Project Manager		06.02.2014	Sharon Li Section Manager	
Datum	Name/Stellung	Unterschrift	Datum	Name/Stellung	Unterschrift
<i>Date</i>	<i>Name/Position</i>	<i>Signature</i>	<i>Date</i>	<i>Name/Position</i>	<i>Signature</i>

Sonstiges:	FCCID: 2AA95-V908354
<i>Other Aspects</i>	

Abkürzungen:	P(ass) = entspricht Prüfgrundlage	Abbreviations:	P(ass) = passed
F(ail) = entspricht nicht Prüfgrundlage		F(ail) = failed	
N/A = nicht anwendbar		N/A = not applicable	
N/T = nicht getestet		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.
This test report 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 safety mark on this or similar products.

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Product information

Manufacturers declarations

	Transceiver
Operating frequency range	2402 - 2480 MHz
Type of modulation	GFSK; Pi/4 DQPSK; 8 DPSK
Number of channels	79
Channel separation	1 MHz
Type of antenna	PCB Antenna
Antenna gain (dBi)	0
Power level	fix
Type of equipment	stand alone radio device
Connection to public utility power line	No
Nominal voltage	Internal battery V_{nor} : 3.7V DC Charging: 5.0V DC
Independent Operation Modes	Page scan Inquiry scan Connection state - BT Link

Product function and intended use

The test item is a Bluetooth Air Mouse based on the Bluetooth technology.

Bluetooth is a short-range radio link intended to be a cable replacement between portable and/or fixed electronic devices.

Bluetooth operates in the unlicensed ISM Band at 2.4 GHz. In the US a band of 83.5 MHz width is available. In this band, 79 RF channels spaced 1MHz apart are defined.

The channel is represented by a pseudo-random hopping sequence through the 79 channels. The channel is divided into time slots, with a nominal slot length of 625µs, where each slot corresponds to different RF hop frequencies. The nominal hop rate is 1600 hops/s. The symbol rate on the channel is 1 -3Mbps. The device supports basic rate (BR) and enhanced data rate (EDR).

The USB connector is for charging only, no data exchange supported.

Submitted documents

Circuit Diagram
Block Diagram
Bill of material
User Manual
Label Artwork

Remark

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases.

Special accessories and auxiliary equipment

Additional accessory used for testing

The product has been tested together with the following additional accessory:



List of Test and Measurement Instruments

Global United Technology Services Co., Ltd. (Registration number: 600491)

Radiated Emission

Equipment	Manufacturer	Type	S/N	Cal Due Date
3m Semi- Anechoic Chamber	ZhongYu Electron	9.0(L)*6.0(W)* 6.0(H)	--	05 Apr 2015
Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	--	N/A
ESU EMI Test Receiver	R&S	ESU26	--	28 Jun 2014
Loop Antenna	Zhinan	ZN30900A	--	28 Jun 2014
Bi-log Hybrid Antenna	SCHWARZBECK	VULB9163	--	17 Mar 2014
Double-ridged horn antenna	SCHWARZBECK	9120D	--	17 Mar 2014
Horn Antenna	ETS-LINDGREN	3160-09	--	17 Mar 2014
RF Amplifier	HP	8347A	--	28 Jun 2014
RF Amplifier	HP	8349B	--	28 Jun 2014
EMI Test Software	AUDIX	E3	--	N/A
Coaxial cable	GTS	N/A	--	28 Jun 2014
Coaxial Cable	GTS	N/A	--	28 Jun 2014
Thermo meter	N/A	N/A	--	30 Jun 2014

TÜV Rheinland Hong Kong Ltd.

Radio Frequency Test

Equipment	Manufacturer	Type	S/N	Cal Due Date
Spectrum Analyzer	Rohde & Schwarz	FSP30	100007	03 Dec 2014

Results FCC Part 15 – Subpart C

Subclause 15.203 – Antenna Information		Pass
Requirement:	No antenna other than that furnished by the responsible party shall be used with the device	
Results:	Permanent PCB printed antenna	
Verdict:	Pass	

Subclause 15.204 – Antenna Information		Pass
Requirement:	Provide information for every antenna proposed for the use with the EUT	
Results:	a) Antenna type: PCB printed antenna b) Manufacturer and model no: N.A. c) Gain with reference to an isotropic radiator: 0 dBi	
Verdict:	Pass	

Subclause 15.207 – Disturbance Voltage on AC Mains						Pass
Test Port: AC mains input port of the AC/DC adapter. Applied Voltage: 120VAC Power supply model: Please refer to page 4 Mode of operation: Charging + Transmitting						
Live measurement						
Frequency range (MHz)	Frequency (MHz)	Quasi-peak (dBµV)	Average (dBµV)	Limit QP (dBµV)	Limit AV (dBµV)	Verdict
0,15 – 0,5	0.150	59.0	42.2	66 - 56	56 - 46	Pass
	0.228	50.1	32.0	66 - 56	56 - 46	Pass
> 0,5 - 5	0.534	34.6	15.8	56	46	Pass
> 5 - 30	13.428	33.2	28.3	60	50	Pass
Neutral measurement						
Frequency range (MHz)	Frequency (MHz)	Quasi-peak (dBµV)	Average (dBµV)	Limit QP (dBµV)	Limit AV (dBµV)	Verdict
0,15 – 0,5	0.150	61.2	43.3	66 - 56	56 - 46	Pass
	0.174	56.9	37.0	66 - 56	56 - 46	Pass
> 0,5 - 5	0.543	35.9	27.1	56	46	Pass
> 5 – 30	12.900	35.3	33.0	60	50	Pass
Results: The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30MHz does not exceed the limits. For test results plots refer to Appendix 1, page 2-3.						

Subclause 15.247 (a)(1) – Carrier Frequency Separation		Pass
Requirement:	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the two-third of the 20dB bandwidth of the hopping channel, whichever is greater.	
Test Specification :	FCC Part 15 Subpart A – Subclause 15.31	
Mode of operation :	Tx mode (hopping on) at 8 DPSK	
Port of testing :	Temporary antenna port	
Detector :	Peak	
RBW/VBW :	100 kHz / 300 kHz	
Supply voltage :	3.7VDC	
Temperature :	23°C	
Humidity :	50%	
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. The centre frequencies of the hopping channels are separated by more than the two-third of the 20dB bandwidth. For test Results plots refer to Appendix 1, page 4.	
Verdict:	Pass	

Subclause 15.247 (a)(1)(iii) – Number of Hopping Channels		Pass
Requirement:	Frequency hopping systems operating in the 2400MHz-2483.5MHz bands shall use at least 15 hopping frequencies.	
Test Specification :	FCC Part 15 Subpart A – Subclause 15.31	
Mode of operation :	Tx mode (hopping on) at GFSK, Pi/4 DQPSK, 8 DPSK	
Port of testing :	Temporary antenna port	
Detector :	Peak	
RBW/VBW :	1 MHz / 3 MHz	
Supply voltage :	3.7VDC	
Temperature :	23°C	
Humidity :	50%	
Results:	The total number of hopping frequencies is more than 15. For test result plots, please refer to Appendix 1, page 5.	
Verdict:	Pass	

Subclause 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time)		Pass
Requirement:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.	
Test Specification :	FCC Part 15 Subpart A – Subclause 15.31	
Mode of operation :	Tx mode (hopping on), DH5 packet at GFSK	
Port of testing :	Temporary antenna port	
Detector :	Peak	
RBW/VBW :	1 MHz / 3 MHz	
Supply voltage :	3.7VDC	
Temperature :	23°C	
Humidity :	50%	
Results:	Time period calculation = $0.4 \times 79 = 31.6\text{s}$ Dwell time (GFSK) = $130 \times 2.904 \times 10^{-3} = 377.52 \times 10^{-3} \text{ s}$ $\leq 400 \times 10^{-3} \text{ s}$	
For test result plots, please refer to Appendix 1, page 6.		
Verdict:	Pass	

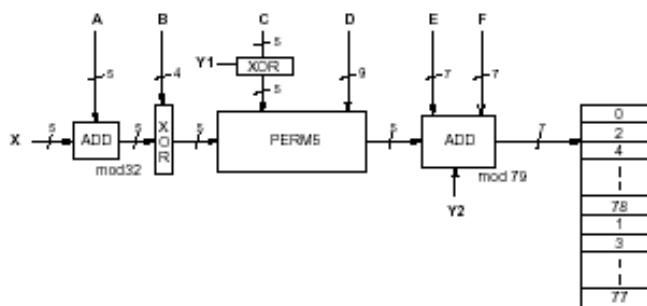
Subclause 15.247 (a) – 20 dB Bandwidth		Pass	
Requirement:	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the two-third of the 20dB bandwidth of the hopping channel, whichever is greater.		
Test Specification :	FCC Part 15 Subpart A – Subclause 15.31		
Mode of operation :	Tx mode (hopping off) at GFSK, 8 DPSK		
Port of testing :	Temporary antenna port		
Detector :	Peak		
RBW/VBW :	30 kHz / 100 kHz		
Supply voltage :	3.7VDC		
Temperature :	23°C		
Humidity :	50%		
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. For test protocols refer to Appendix 1, page 7-10.		
GFSK Modulation			
Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2402	0.468	0.408	0.876
2441	0.468	0.474	0.942
2480	0.450	0.396	0.846
8 DPSK Modulation			
Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2402	0.660	0.660	1.320
2441	0.666	0.654	1.320
2480	0.666	0.648	1.314

Subclause 15.247 (a)(1) – Hopping Sequence
Pass

Requirement: The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies.

Hopping sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master. The X input determines the phase in the 32-hop segment, whereas Y1 and Y2 selects between master-to-slave and slave-to-master transmission. The inputs A to D determine the ordering within the segment, the inputs E and F determine the mapping onto the hop frequencies.



Example data:

Hop sequence {k} for CONNECTION STATE:

CLK start: 0x0000010

ULAP: 0x00000000

#ticks: 00 02 | 04 06 | 08 0a | 0c 0e | 10 12 | 14 16 | 18 1a | 1c 1e |

0x0000010:	08 66	10 70	12 19	14 23	16 01	18 05	20 33	22 37
0x0000030:	24 03	26 07	28 35	30 39	32 72	34 76	36 25	38 29
0x0000050:	40 74	42 78	44 27	46 31	48 09	50 13	52 41	54 45
0x0000070:	56 11	58 15	60 43	62 47	32 17	36 19	34 49	38 51
0x0000090:	40 21	44 23	42 53	46 55	48 33	52 35	50 65	54 67
0x00000b0:	56 37	60 39	58 69	62 71	64 25	68 27	66 57	70 59
0x00000d0:	72 29	76 31	74 61	78 63	01 41	05 43	03 73	07 75
0x00000f0:	09 45	13 47	11 77	15 00	64 49	66 53	68 02	70 06
0x0000110:	01 51	03 55	05 04	07 08	72 57	74 61	76 10	78 14
0x0000130:	09 59	11 63	13 12	15 16	17 65	19 69	21 18	23 22
0x0000150:	33 67	35 71	37 20	39 24	25 73	27 77	29 26	31 30
0x0000170:	41 75	43 00	45 28	47 32	17 02	21 04	19 34	23 36
0x0000190:	33 06	37 08	35 38	39 40	25 10	29 12	27 42	31 44
0x00001b0:	41 14	45 16	43 46	47 48	49 18	53 20	51 50	55 52
0x00001d0:	65 22	69 24	67 54	71 56	57 26	61 28	59 58	63 60
0x00001f0:	73 30	77 32	75 62	00 64	49 34	51 42	57 66	59 74
0x0000210:	53 36	55 44	61 68	63 76	65 50	67 58	73 03	75 11
0x0000230:	69 52	71 60	77 05	00 13	02 38	04 46	10 70	12 78
0x0000250:	06 40	08 48	14 72	16 01	18 54	20 62	26 07	28 15
0x0000270:	22 56	24 64	30 09	32 17	02 66	06 74	10 19	14 27
0x0000290:	04 70	08 78	12 23	16 31	18 03	22 11	26 35	30 43
0x00002b0:	20 07	24 15	28 39	32 47	34 68	38 76	42 21	46 29
0x00002d0:	36 72	40 01	44 25	48 33	50 05	54 13	58 37	62 45
0x00002f0:	52 09	56 17	60 41	64 49	34 19	36 35	50 51	52 67
0x0000310:	38 21	40 37	54 53	56 69	42 27	44 43	58 59	60 75
0x0000330:	46 29	48 45	62 61	64 77	66 23	68 39	03 55	05 71
0x0000350:	70 25	72 41	07 57	09 73	74 31	76 47	11 63	13 00
0x0000370:	78 33	01 49	15 65	17 02	66 51	70 67	03 04	07 20
0x0000390:	68 55	72 71	05 08	09 24	74 59	78 75	11 12	15 28
0x00003b0:	76 63	01 00	13 16	17 32	19 53	23 69	35 06	39 22
0x00003d0:	21 57	25 73	37 10	41 26	27 61	31 77	43 14	47 30
0x00003f0:	29 65	33 02	45 18	49 34	19 04	21 08	23 20	25 24

Subclause 15.247 (b)(1) – Peak Output Power					Pass
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (hopping off) at GFSK, Pi/4 DQPSK, 8 DPSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 3 MHz / 10 MHz Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%					
Requirement: For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 Watt. For all other frequency hopping systems in the 2400 – 2483.5 MHz band: 0.125 Watts.					
Results: For test result plots, please refer to Appendix 1, page 11-16.					
GFSK Modulation					
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-3.46	0.00	-3.46	1 / 30.0	Pass
2441	-2.39	0.00	-2.39	1 / 30.0	Pass
2480	-1.87	0.00	-1.87	1 / 30.0	Pass
Pi/4 DQPSK Modulation					
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-2.54	0.00	-2.54	0.125 / 21.0	Pass
2441	-1.38	0.00	-1.38	0.125 / 21.0	Pass
2480	-1.29	0.00	-1.29	0.125 / 21.0	Pass
8 DPSK Modulation					
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-2.51	0.00	-2.51	0.125 / 21.0	Pass
2441	-1.41	0.00	-1.41	0.125 / 21.0	Pass
2480	-1.29	0.00	-1.29	0.125 / 21.0	Pass

Subclause 15.247 (d) – Band-edge Compliance of Conducted Emissions		Pass
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (hopping off and on modes) at GFSK, Pi/4 DQPSK, 8 DPSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%		
Requirement:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.	
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. The spurious found outside any 100 kHz bandwidth of the operating frequency band are well below 20dB of the highest desired transmit power. For test result plots, please refer to Appendix 1, page 17-18.	

Subclause 15.205 (a) – Restricted Bands next to Band-Edge		Pass
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (hopping off) at GFSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1 MHz / 1 MHz Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%		
Requirement:	Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).	
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. There is no peak found in the restricted bands. For test result plots, please refer to Appendix 1, page 19-22.	

Subclause 15.247 (d) – Spurious Conducted Emissions					Pass
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (hopping off) at 8 DPSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 3.7VDC Temperature : 23 °C Humidity : 50 %					
Requirement: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.					
Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. The spurious emissions found outside any 100kHz bandwidth of the operating frequency band in the three transmit frequency are well below 20dB of the highest desired transmit power. All three transmit frequency modes comply with the limit stated in subclause 15.247(d). For test protocols refer to Appendix 1, page 23-24.					
8 DPSK Modulation					
Operating Frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	4800	-46.09	-4.19	-41.90	Pass
2441	4850	-45.66	-5.53	-40.13	Pass
2480	4950	-46.41	-5.84	-40.57	Pass

Subclause 15.247 (d) – Spurious Radiated Emissions		Pass
Test Specification : ANSI C63.4 – 2003 Mode of operation : Tx mode (hopping off) at GFSK Port of testing : Enclosure Detector : Peak RBW/VBW : 100 kHz / 300 kHz for $f < 1$ GHz 1 MHz / 3 MHz for $f > 1$ GHz Supply voltage : 3.7VDC Temperature : 23°C Humidity : 50%		
Requirement: In any 100kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).		
Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.		
Tx frequency 2402MHz Vertical Polarization		
Frequency (MHz)	Level (dB μ V/m)	Limit/ Detector (dB μ V/m)
4804.000	53.83	74.0 / PK
4804.000	41.17	54.0 / AV
Tx frequency 2402MHz Horizontal Polarization		
Frequency (MHz)	Level (dB μ V/m)	Limit/ Detector (dB μ V/m)
4804.000	51.36	74.0 / PK
4804.000	39.07	54.0 / AV
Tx frequency 2441MHz Vertical Polarization		
Frequency (MHz)	Level (dB μ V/m)	Limit/ Detector (dB μ V/m)
4876.000	52.90	74.0 / PK
4876.000	38.28	54.0 / AV
Tx frequency 2441MHz Horizontal Polarization		
Frequency (MHz)	Level (dB μ V/m)	Limit/ Detector (dB μ V/m)
4882.000	49.12	74.0 / PK
4882.000	36.77	54.0 / AV
Tx frequency 2480MHz Vertical Polarization		
Frequency (MHz)	Level (dB μ V/m)	Limit/ Detector (dB μ V/m)
4960.000	48.39	74.0 / PK
4960.000	36.34	54.0 / AV

Tx frequency 2480MHz		Horizontal Polarization	
Frequency (MHz)	Level (dB μ V/m)	Limit/ Detector (dB μ V/m)	
4960.000	51.28	74.0 / PK	
4960.000	37.88	54.0 / AV	