TÜVRheinland®

Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**14018405 001**	**Seite 1 von 15** *Page 1 of 15*
Auftraggeber: *Client:*	**Armour Automotive Limited** **Woolmer Way, Bordon** **Hampshire GU35 9QE** **United Kingdom**	
Gegenstand der Prüfung: *Test Item:*	**Wideband Transmission System - Bluetooth Car Kit**	
Bezeichnung: *Identification:*	**iOTALK1**	**Serien-Nr.:** *Serial No.:* **Engineering sample**
Wareneingangs-Nr.: *Receipt No.:*	**080403003-3**	**Eingangsdatum:** *Date of Receipt:* **03.04.2008**
Prüfort: *Testing Location:*	**TÜV Rheinland Hong Kong Ltd.** 9th Floor, Oriental News Building, 7 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong **Hong Kong Productivity Council** HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong	
Prüfgrundlage: *Test Specification:*	**FCC Part 15 Subpart C** **ANSI C63.4-2003** **CISPR 22:1997**	
Prüfergebnis: *Test Results:*	**Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben genannter Prüfgrundlage.** The above mentioned product was tested and **passed**.	
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Hong Kong Ltd.** 9th Floor, Oriental News Building, 7 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong	

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
21.07.2008	Sharon Li Project Engineer		21.07.2008	Thomas Berns Manager	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges: **FCCID: VUHIOTALK1**
Other Aspects

Abkürzungen:				*Abbreviations:*			
	P(ass)	=	*entspricht Prüfgrundlage*		*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*

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Table of Content

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Product information

Manufacturers declarations

	Transceiver
Operating frequency range	2402 - 2480 MHz
Type of modulation	FHSS modulation
Number of channels	79
Channel separation	1 MHz
Type of antenna	Integrated Antenna
Antenna gain (dBi)	3.0
Power level	fix
Type of equipment	stand alone, plug-in radio device
Connection to public utility power line	No
Nominal voltage	V_{nor}: 12 V
Independent Operation Modes	Page scan Inquiry scan Connection state - ACL Link Connection state - SCO Link

Product function and intended use

The test item is a Bluetooth Car Kit 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 1 MHz 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 625 µs, where each slot corresponds to different RF hop frequencies. The nominal hop rate is 1600 hops/s.

Submitted documents

Circuit Diagram
Block Diagram
Bill of material
User manual

List of Test and Measurement Instruments

	Equipment used	Manufacturer	Model No.	S/N	Due Date
☒	Semi-anechoic Chamber	Frankonia	Nil	Nil	28-Mar-09
☒	Test Receiver	R & S	ESU26	100050	06-Aug-08
☒	Bi-conical Antenna	R & S	HK116	841489/015	08-Mar-09
☒	Log Periodic Antenna	R & S	HL223	841516/017	28-Feb-09
☒	Coaxial cable 50ohm	Rosenberger	RTK081-05S-05S-10m	LA2-001-10M / 002	15-May-09
☒	Microwave amplifer 0.5-26.5GHz, 25dB gain	HP	83017A	3950M00241	01-Oct-08
☒	High Pass Filter (cutoff freq. =1000MHz)	Trilithic	23042	9829213	31-Oct-08
☒	Bass Pass Filter (2.4GHz)	Micro-Tronic	BRM13026	1	31-Oct-08
☒	Horn Antenna	EMCO	3115	9002-3351	27-Feb-10
☒	Spectrum Analyser	R & S	FSP 30	100416	08-Jun-09
☒	Active Loop Antenna	EMCO	6502	9107-2651	20-Dec-09
☒	Test Receiver	R & S	ESCS 30	100201	14-Dec-08
☒	Artificial Mains Network	R & S	ESH3-Z5	100230	10-Dec-08
☒	Pulse Limiter	R & S	ESH3-Z2	100161	10-Dec-08

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 attached 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: Permanent attached antenna b) Manufacturer and model no: N.A. c) Gain with reference to an isotropic radiator: 3.0 dBi
Verdict:	Pass

Subclause 15.207 – Disturbance Voltage on AC Mains	**N/A**

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 2/3*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), GFSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 12VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Results:	The centre frequencies of the hopping channels are separated by more than the 2/3*20dB bandwidth. For test Results plots refer to Appendix 1, page 2.
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 Mode of operation Port of testing Detector RBW/VBW Supply voltage Temperature Humidity	: FCC Part 15 Subpart A – Subclause 15.31 : Tx mode (hopping on), GFSK : Temporary antenna port : Peak : 1 MHz / 3 MHz : 12VDC from DC power supply : 23ºC : 50%
Results:	The total number of hopping frequencies is more than 15. For test Results plots refer to Appendix 1, page 3.
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
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 1 MHz / 3 MHz
Supply voltage : 12VDC from DC power supply
Temperature : 23ºC
Humidity : 50%

Results: **T**ime period calculation = 0.4 x 79 = 31.6s
Dwell time = 64 x 2.912 x 10^{-3} = 186.4 x 10^{-3}
<= 400 x 10^{-3} s

For test protocols please refer to Appendix 1, page 4.

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 2/3*20dB bandwidth of the hopping channel, whichever is greater.

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), GFSK
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 30 kHz / 100 kHz
Supply voltage : 12VDC from DC power supply
Temperature : 23ºC
Humidity : 50%

Results: For test protocols refer to Appendix 1, page 5-6.

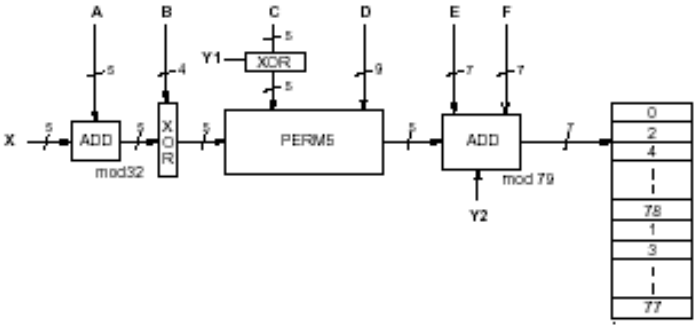
Frequency (MHz)	**20 dB left (MHz)**	**20 dB right (MHz)**	**20dB bandwidth (MHz)**
2402	0.456	0.414	0.870
2441	0.462	0.462	0.924
2480	0.468	0.462	0.930

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

Requirement: The hopping sequence is generated and provided with an example.

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 (a) – Equal Hopping Frequency Use	**Pass**
Requirement: Each of the transmitter's hopping channels is used equally on average.	
Equal hopping frequency use The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.	

Subclause 15.247 (a) – Receiver Input Bandwidth	**Pass**
Requirement:	The associated receiver(s) complies with the requirement that its input bandwidth matches the bandwidth of the transmitted signal.
Receiver input bandwidth The receiver bandwidth is equal to the receiver bandwidth in the 79 hopping channel mode, which is 1 MHz. The receiver bandwidth was verified during Bluetooth RF conformance testing.	

Subclause 15.247 (a) – Receiver Hopping Capability	**Pass**
Requirement:	The associated receiver has the ability to shift frequencies in synchronisation with the transmitted signals.
Receiver hopping Capability The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.	

Subclause 15.247 (b)(1) – Peak Output Power **Pass**

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz)
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 3 MHz / 10 MHz
Supply voltage : 12VDC from DC power supply
Temperature : 23ºC
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 protocols please refer to Appendix 1, page 7-8

Frequency (MHz)	**Maximum peak output power (dBm)**	**Cable attenuation (dB)**	**Output power (dBm)**	**Limit (W/dBm)**	**Verdict**
2402	0.16	3.52	3.68	1 / 30.0	Pass
2441	-0.85	3.65	2.80	1 / 30.0	Pass
2480	-1.43	3.60	2.17	1 / 30.0	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 (2402MHz, 2480MHz), GFSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 12VDC from DC power supply Temperature : 23ºC 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:	There is no peak found outside any 100 kHz bandwidth of the operating frequency band. For test protocols refer to Appendix 1, page 9-10.

Subclause 15.205 – Band edge compliance of radiated emissions	**Pass**
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (2402MHz, 2480MHz), GFSK Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1 MHz / 3 MHz Supply voltage : 12VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Requirement:	Radiated emissions which fall in the restricted bans, as defined in 15.205 (a), must also comply with the radiated emission limits specified in 15.209(a).
Results:	There is no peak found in the restricted bands. For test protocols refer to Appendix 1, page 11-14.

Subclause 15.247 (d) – Spurious Conducted Emissions **Pass**

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), GFSK
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 100 kHz / 300 kHz
Supply voltage : 12VDC from DC power supply
Temperature : 23 ºC
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: There is no peak found outside any 100kHz bandwidth of the operating frequency band in the three transmit frequency. All three transmit frequency modes comply with the limit stated in subclause 15.247(d). For test protocols refer to Appendix 1, page 15-16.

Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	---	---	---	---	Pass
2441	---	---	---	---	Pass
2480	---	---	---	---	Pass

Subclause 15.247 (c) – Spurious Radiated Emissions **Pass**

Test Specification : ANSI C63.4 – 2003
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), 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 : internal batteries has been activated
Temperature : 23ºC
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 section15.205(a), must also comply with the radiated emission limits specified in section 15.205(c).

Results: 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

Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
208.008	30.30	43.5 / QP
272.036	27.00	46.0 / QP
1182.340	49.10	74.0 / P
1180.208	22.36	54.0 / A
4803.630	52.35	74.0 / P
4803.934	35.63	54.0 / A
7205.340	52.62	74.0 / P
7206.029	37.12	54.0 / A

Tx frequency 2402MHz Horizontal Polarization

Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
208.008	39.20	43.5 / QP
400.010	34.10	46.0 / QP
1602.003	52.37	74.0 / P
1601.987	51.41	54.0 / A
4803.702	54.60	74.0 / P
4803.958	36.72	54.0 / A

Tx frequency 2441MHz Vertical Polarization

Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
208.010	31.50	43.5 / QP
272.043	27.40	46.0 / QP
1628.029	48.51	74.0 / P
1627.997	47.21	54.0 / A
4882.067	50.39	74.0 / P
4881.987	35.00	54.0 / A

Tx frequency 2441MHz Horizontal Polarization

Freq	**Level**	**Limit/ Detector**

MHz	dBuV/m	dBuV/m
208.006	37.6	43.5 / QP
400.010	35.2	46.0 / QP
1627.965	51.16	74.0 / P
1627.981	49.71	54.0 / A
4881.907	55.41	74.0 / P
4881.923	37.62	54.0 / A
Tx frequency 2480MHz	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
208.008	32.40	43.5 / QP
272.044	26.10	46.0 / QP
1654.038	49.95	74.0 / P
1653.974	48.06	54.0 / A
4959.599	48.19	74.0 / P
4960.000	33.91	54.0 / A
Tx frequency 2480MHz	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
207.999	38.5	43.5 / QP
400.010	35.3	46.0 / QP
1653.990	51.05	74.0 / P
1653.990	49.51	54.0 / A
4959.760	54.48	74.0 / P
4959.904	37.12	54.0 / A