| **Prüfbericht - Nr.:** *Test Report No.:* | **14017616 001** | **Seite 1 von 12** *Page 1 of 12* |
|---|---|---|

| **Auftraggeber:** *Client:* | **Armour Automotive Ltd.** **Woolmer Way, Bordon** **Hampshire, GU35 9QE** **United Kingdom** |
|---|---|

| **Gegenstand der Prüfung:** *Test Item:* | **Wideband Transmission System - Bluetooth Car Kit** |
|---|---|

| **Bezeichnung:** *Identification:* | **iOPLAY** | **Serien-Nr.:** *Serial No.:* | **Engineering sample** |
|---|---|---|---|

| **Wareneingangs-Nr.:** *Receipt No.:* | **071203005-3** | **Eingangsdatum:** *Date of Receipt:* | **03.12.2007** |
|---|---|---|---|

| **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 Result:* | **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/** *checked by:*

| 13.12.2007 | Sharon Li Project Engineer | | 13.12.2007 | Thomas Berns Manager | |
|---|---|---|---|---|---|
| **Datum** *Date* | **Name/Stellung** *Name/Position* | **Unterschrift** *Signature* | **Datum** *Date* | **Name/Stellung** *Name/Position* | **Unterschrift** *Signature* |

| **Sonstiges:** Other Aspects | **FCCID: VUHIOPLAY** |
|---|---|

| **Abkürzungen:** | P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet | **Abbreviations:** | P(ass) = passed F(ail) = failed 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.**
*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.*

# Table of Content

TÜVRheinland®

# 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 | Integral Antenna |
| Antenna gain (dBi) | 3 |
| 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<br>Inquiry scan<br>Connection state - ACL Link<br>Connection state - SCO Link |

## Product function and intended use

The test item is a Handsfree 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. The symbol rate on the channel is 1 Ms/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 | Cal. Date | Due Date |
|---|---|---|---|---|---|---|
| ☒ | Semi-anechoic Chamber | Frankonia | Nil | Nil | 28-Mar-07 | 28-Mar-08 |
| ☒ | Test Receiver | R & S | ESVS30 | 842807/009 | 06-Aug-07 | 06-Aug-08 |
| ☒ | Bi-conical Antenna | R & S | HK116 | 841489/016 | 08-Feb-06 | 08-Feb-08 |
| ☒ | Log Periodic Antenna | R & S | HL223 | 841516/020 | 03-Feb-06 | 03-Feb-08 |
| ☒ | Coaxial cable 50ohm | Rosenberger | RTK081-05S-05S-10m | LA2-001-10M / 002 | 15-May-07 | 15-May-08 |
| ☒ | Microwave amplifer 0.5-26.5GHz, 25dB gain | HP | 83017A | 3950M00241 | Nil | Nil |
| ☒ | High Pass Filter (cutoff freq. =1000MHz) | Trilithic | 23042 | 9829213 | Nil | Nil |
| ☒ | Horn Antenna | EMCO | 3115 | 9002-3347 | 02-Feb-06 | 02-Feb-08 |
| ☒ | Spectrum Analyser | R & S | FSP 30 | 100416 | 08-Jun-07 | 08-Jun-08 |
| ☒ | Loop Antenna | EMCO | 6502 | 9107-2651 | 16-Nov-05 | 16-Nov-07 |
| ☒ | EMI Test receiver | R & S | ESCS 30 | 100201 | 05-Dec-06 | 05-Dec-07 |
| ☐ | Artificial Mains Network | R & S | ESH3-Z5 | 100230 | 05-Dec-06 | 05-Dec-07 |
| ☐ | Pulse Limiter | R & S | ESH3-Z2 | 100161 | 06-Dec-06 | 06-Dec-07 |
| ☐ | Spectrum Analyzer | R & S | FSP 30 | 100007 | 13-Feb-06 | 12-Feb-08 |

## Result FCC Part 15 – Subpart C

| Subclause 15.203 – Antenna Information | Pass |
|---|---|

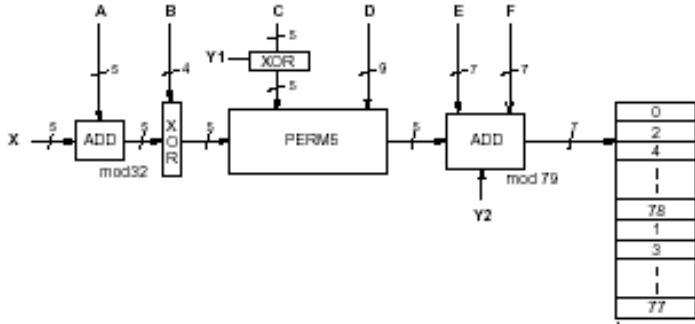| | |
|---|---|
| **Requirement:** | No antenna other than that furnished by the responsible party shall be used with the device |
| **Result:** | Permanent attached antenna |
| **Verdict:** | Pass |

| Subclause 15.204 – Antenna Information | Pass |
|---|---|

**Requirement:** Provide information for every antenna proposed for the use with the EUT

**Result:** a) Antenna type: Permanent attached antenna
b) Manufacturer and model no: N.A.
c) Gain with reference to an isotropic radiator: 3 dBi

**Verdict:** Pass

| Subclause 15.207 – Disturbance Voltage on AC Mains | N.A. |
|---|---|

| Subclause 15.247 (a) – Carrier Frequency Separation | Pass |
|---|---|

**Requirement:** Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or 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), DH1 packet
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%

**Result:** The centre frequencies of the hopping channels are separated by more than the 20dB bandwidth. For test results plots refer to Appendix 1, page 2.

**Verdict:** Pass

| Subclause 15.247 (a) – Time of Occupancy (Dwell Time) | Pass |
|---|---|

**Requirement:** Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping 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%

**Result:** The screenshot in Appendix 1 page 4 shows the occurrence of a channel in a 31.6 s time period. In normal hopping mode Bluetooth is using 79 hopping channels only. The frequency was used 64 times. The dwell time for the longest supported packet type is about 3 ms. As a result the average time of occupancy will not be greater than 400 ms.

i.e.     Time period calculation:
0.4 x 79 = 31.6s

Limit calculation:
$64 \times 2.920 \times 10^{-3} = 186.8 \times 10^{-3}$
$\qquad\qquad\quad <= 400 \times 10^{-3} \text{ s}$

For test protocols please refer to Appendix 1, page 3.

**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 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), DH5 packet
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 4-5.

| Frequency (MHz) | 20 dB left (MHz) | 20 dB right (MHz) | 20dB bandwidth (MHz) |
|---|---|---|---|
| 2402 | 0.460 | 0.468 | 0.928 |
| 2441 | 0.420 | 0.412 | 0.832 |
| 2480 | 0.420 | 0.408 | 0.828 |

| 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<br><br>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) – Peak Output Power | Pass |
|---|---|

| Test Specification | : FCC Part 15 Subpart A – Subclause 15.31 |
|---|---|
| Mode of operation | : Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 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% |

| 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. |
|---|---|

**Result**

All three transmit frequency modes comply with the maximum peak output power limit.

For test protocols please refer to Appendix 1, page 6-7.

| Frequency (MHz) | Maximum peak output power (dBm) | Cable attenuation (dB) | Output power (dBm) | Limit (W/dBm) | Verdict |
|---|---|---|---|---|---|
| 2402 | -1.95 | 3.52 | 1.57 | 1 / 30.0 | Pass |
| 2441 | -4.10 | 3.65 | -0.45 | 1 / 30.0 | Pass |
| 2480 | -5.42 | 3.60 | -1.82 | 1 / 30.0 | Pass |

---

| **Subclause 15.247 (b) – Band edge compliance** | **Pass** |
|---|---|

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 300 kHz / 1 MHz
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. |
|---|---|

**Result**

There is no peak found outside any 100 kHz 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(c).

For test protocols refer to Appendix 1, page 8-12.

---

| **Subclause 15.247 (c) – Spurious Conducted Emissions** | **Pass** |
|---|---|

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
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. |
|---|---|

**Result**

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(c).

For test protocols refer to Appendix 1, page 13-16.

| Operating frequency (MHz) | Spurious frequency (MHz) | Spurious Level (dBm) | Reference value (dBm) | Delta (dB) | Verdict |
|---|---|---|---|---|---|
| 2402 | No Peak Found | - | - | - | Pass |
| 2441 | No Peak Found | - | - | - | Pass |
| 2480 | No Peak Found | - | - | - | Pass |

---

| Subclause 15.247 (c) – Spurious Radiated Emissions | Pass |
|---|---|

Test Specification : ANSI C63.4 - 2003
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), DH1 packet
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 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.

**Result**

All three transmit frequency modes comply with the field strength within the restricted bands.

There is no peak found below 30MHz.

Tx frequency 2402MHz                    Vertical Polarization

| Freq MHz | Level dBuV/m | Limit/ Detector dBuV/m |
|---|---|---|
| 192.000 | 33.00 | 43.5 / QP |
| 208.001 | 36.30 | 43.5 / QP |
| 1601.897 | 43.89 | 74.0 / P |
| 1601.977 | 42.59 | 54.0 / A |

Tx frequency 2402MHz                    Horizontal Polarization

| Freq MHz | Level dBuV/m | Limit/ Detector dBuV/m |
|---|---|---|
| 208.002 | 27.3 | 43.5 / QP |
| 1602.016 | 47.18 | 74.0 / P |
| 1601.951 | 46.22 | 54.0 / A |

| Tx frequency 2441MHz | Vertical Polarization | |
|---|---|---|
| **Freq MHz** | **Level dBuV/m** | **Limit/ Detector dBuV/m** |
| 191.999 | 30.2 | 43.5 / QP |
| 208.001 | 37.2 | 43.5 / QP |
| 1628.060 | 43.10 | 74.0 / P |
| 1628.029 | 41.64 | 54.0 / A |
| Tx frequency 2441MHz | Horizontal Polarization | |
| **Freq MHz** | **Level dBuV/m** | **Limit/ Detector dBuV/m** |
| - | - | 43.5 / QP |
| 1627.981 | 49.48 | 74.0 / P |
| 1627.997 | 48.58 | 54.0 / A |
| Tx frequency 2480MHz | Vertical Polarization | |
| **Freq MHz** | **Level dBuV/m** | **Limit/ Detector dBuV/m** |
| 80.001 | 18.6 | 43.5 / QP |
| 192.000 | 26.4 | 43.5 / QP |
| 208.001 | 36.8 | 43.5 / QP |
| 1653.965 | 44.56 | 74.0 / P |
| 1653.933 | 43.28 | 54.0 / A |
| Tx frequency 2480MHz | Horizontal Polarization | |
| **Freq MHz** | **Level dBuV/m** | **Limit/ Detector dBuV/m** |
| 192.000 | 24.6 | 43.5 / QP |
| 208.001 | 33.3 | 43.5 / QP |
| 1653.958 | 48.98 | 74.0 / P |
| 1654.071 | 48.48 | 54.0 / A |