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|---|----------------------|---|---|--|---------------------|
| Prüfbericht - Nr.: 14024130 001 <i>Test Report No.:</i> | | | Seite 1 von 15 <i>Page 1 of 15</i> | | |
| Auftraggeber: <i>Client:</i> | | geobra Brandstaetter GmbH & Co. KG Brandstaetterstr.2-10 Postfach 1260 90513 Zirndorf Nuremberg Germany | | | |
| Gegenstand der Prüfung: 2.4GHz Wireless LCD Monitor <i>Test Item:</i> | | | | | |
| Bezeichnung: <i>Identification:</i> | | 4879-M | | Serien-Nr.: <i>Serial No.:</i> | |
| | | | | Engineering sample | |
| Wareneingangs-Nr.: <i>Receipt No.:</i> | | 00100607149-002 | | Eingangsdatum: <i>Date of Receipt:</i> | |
| | | | | 07.06.2010 | |
| Prüfört: <i>Testing Location:</i> | | TÜV Rheinland Hong Kong Ltd. 8/F, Niche Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong Hong Kong Productivity Council HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong | | | |
| Prüfgrundlage: <i>Test Specification:</i> | | FCC Part 15 Subpart C ANSI C63.4-2003 CISPR 22:1997 | | | |
| Prüfergebnis: <i>Test Results:</i> | | Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben genannter Prüfgrundlage. The above mentioned product was tested and passed. | | | |
| Prüflaboratorium: <i>Testing Laboratory:</i> | | TÜV Rheinland Hong Kong Ltd. 9-10/F., Emperor International Square, 7 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong | | | |
| geprüft/ tested by: | | | kontrolliert/ reviewed by: | | |
| <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> 17.01.2011 Mika Chan <i>Project Engineer</i> </div> <div style="text-align: center;">  <i>Signature</i> </div> </div> | | | <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> 17.01.2011 Sharon Li <i>Project Manager</i> </div> <div style="text-align: center;">  <i>Signature</i> </div> </div> | | |
| 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: <i>Other Aspects</i> | | FCCID: N2T30829642 | | | |
| 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 | | |
| 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 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.</i> | | | | | |

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Product information

Manufacturers declarations

| | Transceiver |
|---|--------------------------------------|
| Operating frequency range | 2406 - 2478 MHz |
| Type of modulation | FHSS modulation |
| Number of channels | 19 |
| Channel separation | 3.375-6.75 MHz |
| Type of antenna | Integral |
| Antenna gain (dBi) | 0 |
| Power level | fix |
| Type of equipment | stand alone |
| Connection to public utility power line | No |
| Nominal voltage | V _{nom} : 6V Batteries AAX4 |
| Independent Operation Modes | Connection state - Data Link |

Product function and intended use

The EUT is wireless LCD monitor which operating at 2.4GHz band. It receives the RF signal from wireless camera which contains the video information and display on its LCD screen.

Further it contains a wireless webcam function which displays the video information on the computer screen via USB connection.

Submitted documents

Circuit Diagram
Block Diagram
Bill of material
User manual

Remark

NOTE: The EUT is also considered as a kind of computer peripheral, because the connection to computer is necessary for typical use. It has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

Special accessories and auxiliary equipment

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

-

List of Test and Measurement Instruments

| | Equipment used | Manufacturer | Model No. | S/N | Due Date |
|-------------------------------------|--|--------------|--------------------|-------------------|-----------|
| <input checked="" type="checkbox"/> | Semi-anechoic Chamber | Frankonia | Nil | Nil | 27-Apr-11 |
| <input checked="" type="checkbox"/> | Test Receiver | R & S | ESU26 | 100050 | 25-May-11 |
| <input checked="" type="checkbox"/> | Bi-conical Antenna | R & S | HK116 | 100242 | 13-Apr-12 |
| <input checked="" type="checkbox"/> | Log Periodic Antenna | R & S | HL223 | 841516/020 | 13-Apr-12 |
| <input checked="" type="checkbox"/> | Coaxial cable 50ohm | Rosenberger | RTK081-05S-05S-10m | LA2-001-10M / 001 | 07-Dec-10 |
| <input checked="" type="checkbox"/> | Microwave amplifier 0.5-26.5GHz, 25dB gain | HP | 83017A | 3950M00241 | 03-Oct-11 |
| <input checked="" type="checkbox"/> | High Pass Filter (cutoff freq. =1000MHz) | Trilithic | 23042 | 9829213 | 30-Oct-11 |
| <input checked="" type="checkbox"/> | Horn Antenna | EMCO | 3115 | 9002-3351 | 16-Apr-12 |
| <input checked="" type="checkbox"/> | Spectrum Analyser | R & S | FSP 30 | 100416 | 17-Sep-12 |
| <input checked="" type="checkbox"/> | Active Loop Antenna | EMCO | 6502 | 9107-2651 | 06-Feb-11 |
| <input checked="" type="checkbox"/> | Test Receiver | R & S | ESCS 30 | 100201 | 17 Jan 11 |
| <input checked="" type="checkbox"/> | Artificial Mains Network | R & S | ESH3-Z5 | 100230 | 11 Jan 11 |

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: Integral b) Manufacturer and model no: N.A. c) Gain with reference to an isotropic radiator: 0 dBi | |
| Verdict: | Pass | |

| RSS-Gen 7.2.2 – Transmitter AC Wireline Conducted Emissions | | | | | | Pass |
|---|-----------------|-----------------|--------------|-----------------|-----------------|---------|
| Test Port: Laptop Computer AC Adaptor Applied voltage: 100VAC Applicable only to equipment designed to be connected to the public utility power line. 1) Mode of operation: Normal operation | | | | | | |
| 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 | 37.2 | 13.6 | 66 - 56 | 56 - 46 | Pass |
| | 0.204 | 47.0 | 43.8 | 66 - 56 | 56 - 46 | Pass |
| | 0.270 | 41.2 | 37.7 | 66 - 56 | 56 - 46 | Pass |
| | 0.408 | 33.6 | 31.1 | 66 - 56 | 56 - 46 | Pass |
| > 0,5 - 5 | - | - | - | 56 | 46 | Pass |
| > 5 - 30 | - | - | - | 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 | 36.9 | 12.8 | 66 - 56 | 56 - 46 | Pass |
| | 0.204 | 47.2 | 42.1 | 66 - 56 | 56 - 46 | Pass |
| | 0.270 | 40.8 | 36.2 | 66 - 56 | 56 - 46 | Pass |
| | 0.336 | 36.3 | 32.5 | 66 - 56 | 56 - 46 | Pass |
| > 0,5 - 5 | - | - | - | 56 | 46 | Pass |
| > 5 - 30 | - | - | - | 60 | 50 | Pass |

Result: 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 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), FHSS Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 6VDC from DC power supply Temperature : 23°C 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 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), FHSS | |
| Port of testing | : Temporary antenna port | |
| Detector | : Peak | |
| RBW/VBW | : 1 MHz / 3 MHz | |
| Supply voltage | : 6VDC from DC power supply | |
| Temperature | : 23°C | |
| Humidity | : 50% | |
| Results: | The total number of hopping frequencies is more than 15. For test Results plots 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), FHSS | |
| Port of testing | : Temporary antenna port | |
| Detector | : Peak | |
| RBW/VBW | : 1 MHz / 3 MHz | |
| Supply voltage | : 6VDC from DC power supply | |
| Temperature | : 23°C | |
| Humidity | : 50% | |
| Results: | Time period calculation = 0.4 x 19 = 7.6s Dwell time = 56 x 0.494 x 10 ⁻³ = 27.664 x 10 ⁻³ <= 400 x 10 ⁻³ s | |
| For test protocols please refer to Appendix 1, page 6-7. | | |
| 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 (2406MHz, 2436MHz, 2478MHz), (FHSS) Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 30 kHz / 100 kHz Supply voltage : 6VDC from DC power supply Temperature : 23°C Humidity : 50% | | | |
| Results: For test protocols refer to Appendix 1, page 8-9. | | | |
| FHSS Modulation | | | |
| Frequency (MHz) | 20 dB left (MHz) | 20 dB right (MHz) | 20dB bandwidth (MHz) |
| 2406 | 1.568 | 1.582 | 3.150 |
| 2436 | 1.568 | 1.582 | 3.150 |
| 2478 | 1.568 | 1.582 | 3.150 |

| Subclause 15.247 (a) – Hopping Sequence | Pass |
|--|------|
| Requirement: The hopping sequence is generated and provided with an example. | |
| Hopping sequence | |
| This device operate in the 2.4GHz ISM band, the baseband protocol employ FHSS (Frequency Hopping Spread Spectrum) technology for data communication. It change the communication channel in a pseudo random sequence, it will also monitor the preformance of each channel so that to avoid using over crowded channels. | |
| It hops in following 19 channels in a pseudo random way - 2406.375MHz, 2413.125MHz, 2416.500MHz, 2419.875MHz, 2423.250MHz, 2426.625MHz, 2430.000MHz, 2433.375MHz, 2436.750MHz, 2441.250MHz, 2444.625MHz, 2448.000MHz, 2451.375MHz, 2454.750MHz, 2458.125MHz, 2461.500MHz, 2464.875MHz, 2468.250MHz, 2478.375MHz. | |

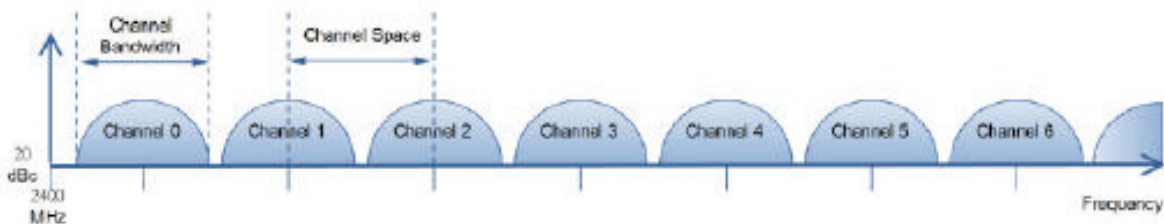
Example data:

Format of each data packet

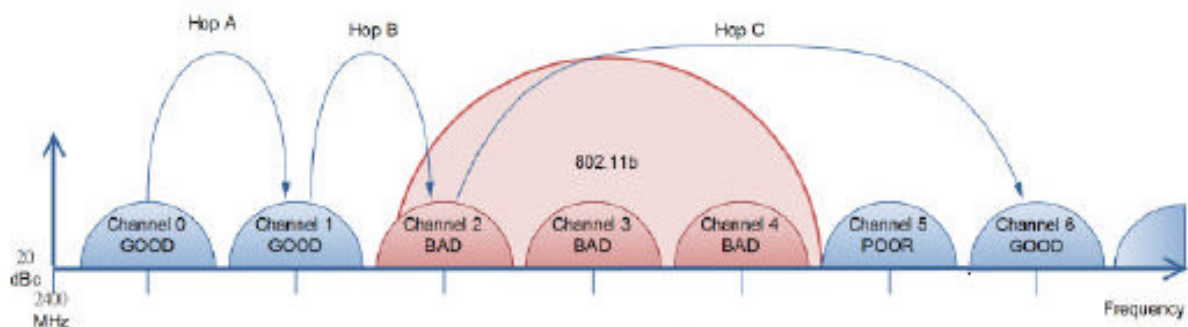


Hopping Rules

It use adaptive frequency hopping with the above 19 Channels. They are non-overlapped (above 20dBc) in the 2.4GHz ISM band. The channel spacing are at or above 3.375MHz while the channel bandwidth is below 2.500MHz.



In the below graph, there are 3 hopping conditions, Hop A is a normal condition, Hop B is when the channel is interfered by other device. The interfered channels are graded to Good, Bad & Poor, and being monitored to update the garding. Hop C is when some channels are bad, it hops to next good channel.



There are number of hopping sequence build- in. Each paired device will select a hopping sequence at "paired". In a selected hopping sequence, there still some pseudo variation so that even if, although very low possibility, two set of "paired" device selected the same hopping sequence, they can still work properly.

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

In a fixed period, the probability for each available channel to be chosen is equal.

| | |
|--|-------------|
| 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 transmitter bandwidth in the 19 hopping channel mode, which is 5MHz. The receiver bandwidth was verified during RF conformance testing. | |

| Subclause 15.247 (b)(1) – Peak Output Power | | | | Pass | |
|---|---------------------------------|--|--------------------|---------------|---------|
| Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (2406MHz, 2436MHz, 2478MHz) Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 10 MHz / 10 MHz Supply voltage : 6VDC from DC power supply 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 protocols please refer to Appendix 1, page 10-11. | | | |
| FHSS Modulation | | | | | |
| Frequency (MHz) | Maximum peak output power (dBm) | Cable attenuation (dB) | Output power (dBm) | Limit (W/dBm) | Verdict |
| 2406 | 9.26 | 1.95 | 11.210 | 1 / 30.0 | Pass |
| 2436 | 9.56 | 1.95 | 11.510 | 1 / 30.0 | Pass |
| 2478 | 9.56 | 1.95 | 11.510 | 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 (2406MHz, 2478MHz), FHSS Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 6VDC from DC power supply 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: | There is no peak found outside any 100 kHz bandwidth of the operating frequency band. For test protocols refer to Appendix 1, page 12. | |

| 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 (2406MHz, 2478MHz), FHSS Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1 MHz / 3 MHz Supply voltage : 6VDC from DC power supply 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: | There is no peak found in the restricted bands. For test protocols refer to Appendix 1, page 13-20. | |

| Subclause 15.247 (d) – Spurious Conducted Emissions | | | | | Pass |
|---|--------------------------|----------------------|-----------------------|------------|-------------|
| Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (2406MHz, 2436MHz, 2478MHz), FHSS Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 6VDC from DC power supply 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: 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 21-22. | | | | | |
| Operating frequency (MHz) | Spurious frequency (MHz) | Spurious Level (dBm) | Reference value (dBm) | Delta (dB) | Verdict |
| 2406 | 4800.000 | -43.50 | 3.97 | -47.47 | Pass |
| 2436 | no peak found | --- | --- | --- | Pass |
| 2478 | no peak found | --- | --- | --- | Pass |

| Subclause 15.247 (d) – Spurious Radiated Emissions | | | | | Pass |
|---|--------------|--|------------------------|--|-------------|
| Test Specification : ANSI C63.4 – 2003 Mode of operation : Tx mode (2406MHz, 2436MHz, 2478MHz), FHSS 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 : 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 15.205(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 2406MHz | | | Vertical Polarization | | |
| Freq MHz | Level dBuV/m | | Limit/ Detector dBuV/m | | |
| 4811.314 | 58.16 | | 74.0 / P | | |

| | | |
|--|-------------------------|-----------------------------------|
| 4811.026 | 31.35 | 54.0 / A |
| 9628.638 | 60.85 | 74.0 / P |
| 9628.542 | 36.33 | 54.0 / A |
| Tx frequency 2406MHz Horizontal Polarization | | |
| Freq MHz | Level dBuV/m | Limit/ Detector dBuV/m |
| 491.998 | 36.10 | 46 / QP |
| 497.998 | 35.10 | 46 / QP |
| 4814.263 | 53.85 | 74.0 / P |
| 4811.026 | 31.09 | 54.0 / A |
| Tx frequency 2436MHz Vertical Polarization | | |
| Freq MHz | Level dBuV/m | Limit/ Detector dBuV/m |
| 4874.840 | 59.78 | 74.0 / P |
| 4871.795 | 34.62 | 54.0 / A |
| Tx frequency 2436MHz Horizontal Polarization | | |
| Freq MHz | Level dBuV/m | Limit/ Detector dBuV/m |
| 4875.000 | 58.19 | 74.0 / P |
| 4874.920 | 34.34 | 54.0 / A |
| Tx frequency 2478MHz Vertical Polarization | | |
| Freq MHz | Level dBuV/m | Limit/ Detector dBuV/m |
| 4958.157 | 57.56 | 74.0 / P |
| 4955.272 | 34.56 | 54.0 / A |
| Tx frequency 2478MHz Horizontal Polarization | | |
| Freq MHz | Level dBuV/m | Limit/ Detector dBuV/m |
| 4958.285 | 56.86 | 74.0 / P |
| 4955.064 | 34.41 | 54.0 / A |