

Prüfbericht - Nr.: 14024130 001
Test Report No.:
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Auftraggeber: **geobra Brandstaetter GmbH & Co. KG**
Client: **Brandstaetterstr.2-10**
Postfach 1260
90513 Zirndorf
Nuremberg
Germany

Gegenstand der Prüfung: **2.4GHz Wireless LCD Monitor**
Test Item:

Bezeichnung: **4879-M** **Serien-Nr.:** **Engineering sample**
Identification: **Serial No.:**

Wareneingangs-Nr.: **00100607149-002** **Eingangsdatum:** **07.06.2010**
Receipt No.: **Date of Receipt:**

Prüfort: **TÜV Rheinland Hong Kong Ltd.**
Testing Location: **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: **FCC Part 15 Subpart C**
Test Specification: **ANSI C63.4-2003**
CISPR 22:1997

Prüfergebnis: **Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben genannter Prüfgrundlage.**
Test Results: **The above mentioned product was tested and **passed**.**

Prüflaboratorium: **TÜV Rheinland Hong Kong Ltd.**
Testing Laboratory: **9-10/F., Emperor International Square , 7 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong**

geprüft/ tested by:
kontrolliert/ reviewed by:

17.01.2011	Mika Chan Project Engineer		17.01.2011	Sharon Li Project Manager	
Datum Date	Name/Stellung Name/Position	Unterschrift Signature	Datum Date	Name/Stellung Name/Position	Unterschrift Signature

Sonstiges: **FCCID: N2T30829642**
Other Aspects

Abkürzungen: **P(ass)** = **entspricht Prüfgrundlage**
Fail = **entspricht nicht Prüfgrundlage**
N/A = **nicht anwendbar**
N/T = **nicht getestet**

Abbreviations: **P(ass)** = **passed**
Fail = **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.

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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 _{nor} : 6V Batteries AAX4
Independent Operation Modes	Connection state - Data Link

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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 dB μ V	Average dB μ V	Limit QP (dB μ V)	Limit AV (dB μ V)	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 dB μ V	Average dB μ V	Limit QP (dB μ V)	Limit AV (dB μ V)	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

Frequency range (MHz)	Frequency (MHz)	Quasi-peak dB μ V	Average dB μ V	Limit QP (dB μ V)	Limit AV (dB μ V)	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 = $0.4 \times 19 = 7.6\text{s}$ Dwell time = $56 \times 0.494 \times 10^{-3} = 27.664 \times 10^{-3}$ $\leq 400 \times 10^{-3} \text{ s}$		
For test protocols please refer to Appendix 1, page 6-7.		
Verdict:	Pass	

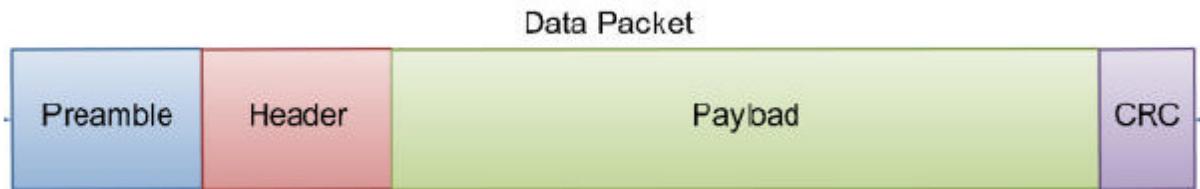
Subclause 15.247 (a) – 20 dB Bandwidth		Pass	
Requirement:		Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.	
Test Specification	:	FCC Part 15 Subpart A – Subclause 15.31	
Mode 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.	
<p>Hopping sequence</p> <p>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.</p> <p>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.</p>	

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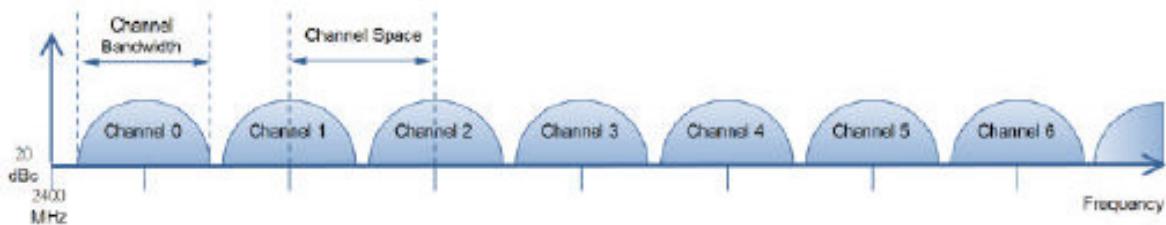
Example data:

Format of each data packet

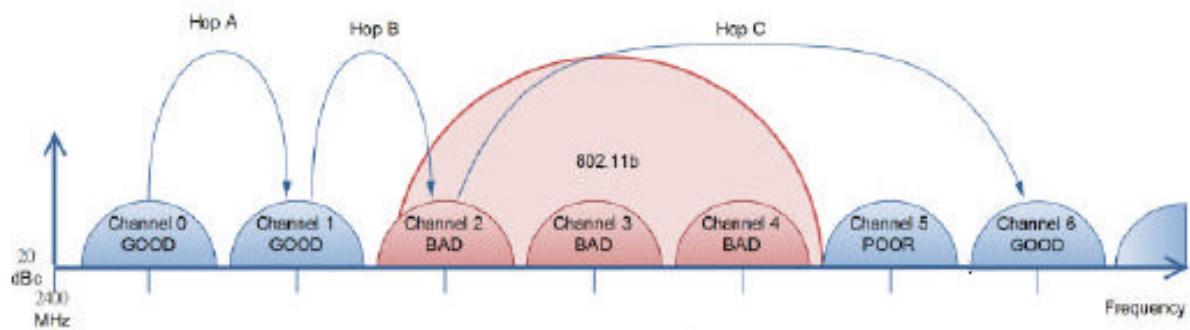


Hopping Rules

It uses 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 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 2406MHz	Vertical Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
4811.314	58.16	74.0 / P

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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