

Produkte
Products

Prüfbericht - Nr.: 14022306 001		Seite 1 von 12	
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Auftraggeber: <i>Client:</i>	Sengital Limited Unit 708, Lakeside 2, No. 10 Science Part West Ave., Science Park, N.T. Hong Kong		
Gegenstand der Prüfung: <i>Test Item:</i>	2.4GHz Wireless Joystick		
Bezeichnung: <i>Identification:</i>	VRMS i-too Controller: VS PCWL-C	Serien-Nr.: <i>Serial No.:</i>	Engineering sample
Wareneingangs-Nr.: <i>Receipt No.:</i>	00100212035-007	Eingangsdatum: <i>Date of Receipt:</i>	12.02.2010
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:	
30.04.2010	Mika Chan Project Engineer	30.04.2010	Sharon Li Project Manager
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Unterschrift <i>Signature</i>
Sonstiges: FCCID: XXB-VRMS-I-TOO-C Other Aspects			
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. <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	2402 - 2481 MHz
Type of modulation	FHSS modulation
Number of channels	80
Channel separation	1 MHz
Type of antenna	PCB Antenna
Antenna gain (dBi)	2
Power level	fix
Type of equipment	stand alone
Connection to public utility power line	No
Nominal voltage	V _{nom} : 6 V Batteries AAAX4
Independent Operation Modes	Connection state - Data Link

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Product function and intended use

The test item is a wireless PC controller working based a proprietary hopping protocol. It is a fast-hopping transceiver operates in the 2.4 GHz ISM band. The over-the-air symbol rate is 1MHz. The RF packets use the GFSK modulation.

There are mainly 3 statuses for the controller in normal operation as described below:

1. Enquiry: When the controller is forced to connect with dongle, the device is in enquiry mode. In this mode, the controller randomly generation a frequency to listen and wait for the pair request from dongle.
2. Connected: When both devices are in connection, the hopping scheme will be applied for both the devices to communicate to each other.
3. Disconnected: If dongle is unplugged or the connection between dongle and controller is lost, the controller enters search mode. In this mode, the controller randomly generation a frequency to listen and wait for the synchronization request from dongle.

Submitted documents

Circuit Diagram
Block Diagram
Bill of material
User manual

Remark

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Special accessories and auxiliary equipment

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

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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-Feb-10
<input checked="" type="checkbox"/>	Test Receiver	R & S	ESU8	100141	08-Sep-10
<input checked="" type="checkbox"/>	Bi-conical Antenna	R & S	HK116	100242	22-May-10
<input checked="" type="checkbox"/>	Log Periodic Antenna	R & S	HL223	841516/020	21-May-10
<input checked="" type="checkbox"/>	Coaxial cable 50ohm	Rosenberger	RTK081-05S-05S-10m	LA2-001-10M / 002	15-May-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	27-Feb-10
<input checked="" type="checkbox"/>	Spectrum Analyser	R & S	FSP 30	100416	28-Feb-10
<input checked="" type="checkbox"/>	Active Loop Antenna	EMCO	6502	9107-2651	06-Feb-11
<input checked="" type="checkbox"/>	Test Receiver	R & S	ESCS 30	847115/005	24-Aug-10
<input checked="" type="checkbox"/>	Artificial Mains Network	R & S	ESH3-Z5	849876/027	24-Aug-10
<input checked="" type="checkbox"/>	Pulse Limiter	R & S	ESH3-Z2	100161	05-Jun-10

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:	2 dBi
Verdict:	Pass	

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 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	: 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 3-4.	
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 80 = 32s Dwell time = 44 x 0.4704 x 10 ⁻³ = 20.698 x 10 ⁻³ <= 400 x 10 ⁻³ s	
For test protocols please refer to Appendix 1, page 5-6.		
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 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, 2481MHz), (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 7-8.		
FHSS Modulation			
Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2402	0.426	0.612	1.038
2441	0.366	0.468	0.834
2481	0.282	0.342	0.624

Subclause 15.247 (a) – Hopping Sequence	Pass
Requirement:	The hopping sequence is generated and provided with an example.
Hopping sequence	The controller hops through the 80 RF channels. In connected status, controller synchronizes with dongle every period. Each period is 9ms long.
Example data:	<p>The seed number (S) and the bit sequence (Q) are decided by dongle. When the dongle starts pair to the controller, it sends both S and Q to the controller. Then both sides use the S and Q to predict the hopping frequency (F).</p> <p>S: Seed Number = S7-S0 (8 bits)</p> <p>Q: Bit Sequence = Q[0]-Q[6] (7 bytes)</p> <p>F: Frequency Number (0F<80)</p> <p>S(k) represents the S in the kth period.</p> <p>The frequency is predicted by the following steps:</p> <ol style="list-style-type: none"> 1. $S(k+1) = S(k)+1$ [$S(k+1) = s(k+1)7 \sim s(k+1)0$] 2. Predict R(k+1) by rearrange the sequence of bit6 to bit0 in S(k+1) [$R(k+1) = r(k+1)7 \sim r(k+1)0$] <p>□ $r(k+1)i = s(k+1)Q[i]$ (0i6)</p> <p>□ $r(k+1)7 = s(k+1)7$</p> <ol style="list-style-type: none"> 3. $F(k+1) = R(k+1) \bmod 80$

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 80 hopping channel mode, which is 1MHz. 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 (2402MHz, 2441MHz, 2481MHz) Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 3 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 9-10.			
FHSS Modulation					
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-2.55	1.95	-0.600	1 / 30.0	Pass
2441	-2.80	1.95	-0.850	1 / 30.0	Pass
2481	-2.77	1.95	-0.820	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, 2481MHz), 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 11-12.	

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 (2402MHz, 2481MHz), 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 (2402MHz, 2441MHz, 2481MHz), 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
2402	4800.000	-37.41	-5.39	-32.02	Pass
2441	4850.000	-45.94	-2.95	-42.99	Pass
2481	4950.000	-44.87	-3.21	-41.66	Pass

Subclause 15.247 (d) – Spurious Radiated Emissions		Pass
Test Specification : ANSI C63.4 – 2003 Mode of operation : Tx mode (2402MHz, 2441MHz, 2481MHz), 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 2402MHz		Vertical Polarization
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
4804.711	50.21	74.0 / P
4804.711	32.55	54.0 / A

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Tx frequency 2402MHz			Horizontal Polarization		
Freq MHz		Level dBuV/m		Limit/ Detector dBuV/m	
4804.711		50.37		74.0 / P	
4804.711		32.64		54.0 / A	
Tx frequency 2441MHz			Vertical Polarization		
Freq MHz		Level dBuV/m		Limit/ Detector dBuV/m	
4882.884		48.99		74.0 / P	
4882.884		32.37		54.0 / A	
Tx frequency 2441MHz			Horizontal Polarization		
Freq MHz		Level dBuV/m		Limit/ Detector dBuV/m	
4882.467		48.97		74.0 / P	
4882.467		32.34		54.0 / A	
Tx frequency 2480MHz			Vertical Polarization		
Freq MHz		Level dBuV/m		Limit/ Detector dBuV/m	
4962.724		48.60		74.0 / P	
4962.724		32.69		54.0 / A	
Tx frequency 2480MHz			Horizontal Polarization		
Freq MHz		Level dBuV/m		Limit/ Detector dBuV/m	
4962.772		47.78		74.0 / P	
4962.772		32.40		54.0 / A	