

Produkte
Products

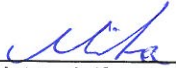

Prüfbericht - Nr.: 14022544 001			Seite 1 von 15		
<i>Test Report No.:</i>			<i>Page 1 of 15</i>		
Auftraggeber: <i>Client:</i>		Sengital Limited Unit 708, Lakeside 2, No. 10 Science Part West Ave., Science Park, N.T. Hong Kong			
Gegenstand der Prüfung: <i>Test Item:</i>		2.4GHz Wireless Dongle			
Bezeichnung: <i>Identification:</i>	VRMS i-too Dongle: VS PCWL-D	Serien-Nr.: <i>Serial No.:</i>	Engineering sample		
Wareneingangs-Nr.: <i>Receipt No.:</i>	00100212035-007 00100514177-001	Eingangsdatum: <i>Date of Receipt:</i>	12.02.2010, 14.05.2010		
Prüfort: <i>Testing Location:</i>	TÜV Rheinland Hong Kong Ltd. 8/F., Niche Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong TÜV Rheinland (Guangdong) Ltd. EMC Laboratory Guangzhou Auto Market, Yuan Gang Section of Guangshan Road, Guangzhou, 510650, P.R. China				
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:		
30.05.2010	Mika Chan Project Engineer		30.05.2010	Sharon Li Project Manager	
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>
Sonstiges: Other Aspects		FCCID: XXB-VRMS-I-TOO-D			
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			
<p>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.</p> <p><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></p>					

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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	plug-in radio device
Connection to public utility power line	No
Nominal voltage	V _{nom} : 5V
Independent Operation Modes	Connection state - Data Link

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Product function and intended use

The test item is a wireless USB dongle 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 dongle in normal operation as described below:

1. Enquiry: In the first second the dongle is just powered ON, the device is in enquiry mode. In this mode, the dongle hop and send the pair request to search if there is controller waiting in the enquiry mode.
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 controller is powered OFF or the connection between dongle and controller is lost, the dongle enters search mode. In this mode, the dongle hop and send the synchronization request to search for the paired controller.

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:

Laptop computer
Brand: Lenovo
Model: T61
S/N: L3-X9333 08/05

AC adaptor
Brand: Lenovo
Model: 92P1103
Input rating: 100-240V ~ 1.7A-0.9A, 50/60Hz
Output rating: 2.0V, 4.5A

List of Test and Measurement Instruments

Kind of Equipment	Manufacturer	Type	S/N	Due Date
FSP30 Spectrum Analyzer	Rohde & Schwarz	FSP30	100286	16-Mar-11
EMI Test Receiver	Rohde & Schwarz	ESCI	100216	16-Mar-11
Trilog-Broadband Antenna	Schwarzbeck	VULB9168	209	21-Aug-11
Double-Ridged Waveguide Horn Antenna	Rohde & Schwarz	HF 906	100385	24-Aug-11
Band Reject Filter	Micro-Tronics	BRM50702	023	16-Mar-11
Pre-Amplifier	MITEQ	AFS42-00101800-25-S-42	1101599	16-Mar-11
Horn Antenna	EMCO	3160-09	21642	26-Jun-14
Pre-Amplifier	MITEQ	AFS33-18002650-30-8P-44	1108282	16-Mar-11
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100111	16-Mar-11
Triple-Loop Antenna	Rohde & Schwarz	HM020	100021	16-Mar-11
SAC	Albatross Projects GmbH	N/A	9460000.9	16-Mar-11
Test Receiver	Rohde & Schwarz	ESCS 30	847115/005	24-Aug-10
Artificial Mains Network	Rohde & Schwarz	ESH3-Z5	849876/027	24-Aug-10
Pulse Limiter	Rohde & Schwarz	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 15.207 – Disturbance Voltage on AC Mains						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	51.2	30.3	66 - 56	56 - 46	Pass
	0.390	43.4	31.7	66 - 56	56 - 46	Pass
	0.486	43.9	31.5	66 - 56	56 - 46	Pass
> 0,5 - 5	0.522	43.1	30.9	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	49.6	30.2	66 - 56	56 - 46	Pass
	0.408	43.6	33.9	66 - 56	56 - 46	Pass
	0.474	42.1	26.0	66 - 56	56 - 46	Pass
> 0,5 - 5	0.504	43.4	33.4	56	46	Pass
> 5 - 30	-	-	-	60	50	Pass
Results: 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 : 5VDC from USB port 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	: 5VDC from USB port	
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 : 5VDC from USB port Temperature : 23°C Humidity : 50%		
Results: Time period calculation = 0.4 x 80 = 32s Dwell time = 43 x 1.0074 x 10 ⁻³ = 43.318 x 10 ⁻³ <= 400 x 10 ⁻³ s For test protocols please refer to Appendix 1, page 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 : 5VDC from USB port 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	0.474	0.858	1.332
2441	0.762	0.408	1.170
2481	0.618	0.336	0.954

Subclause 15.247 (a) – Hopping Sequence	Pass
Requirement: The hopping sequence is generated and provided with an example.	
<p>Hopping sequence</p> <p>The dongle hops through the 80 RF channels. In connected status, controller synchronizes with dongle every period. Each period is 9ms long. In disconnected and enquiry statuses, dongle also hop to search for controller every period. Each period is 9ms long.</p>	
<p>Example data:</p> <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 ($0 \leq F < 80$)</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) $[R(k+1) = r(k+1)7 \sim r(k+1)0]$ <ul style="list-style-type: none"> $\square r(k+1)i = s(k+1)Q[i] \ (0 \leq i \leq 6)$ $\square r(k+1)7 = s(k+1)7$ 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.	
<p>Equal hopping frequency use</p> <p>In a fixed period, the probability for each available channel to be chosen is equal.</p>	

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 80 hopping channel mode, which is 1 MHz. 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 : 5VDC from USB port 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	-0.72	1.95	1.230	1 / 30.0	Pass
2441	-0.75	1.95	1.200	1 / 30.0	Pass
2481	-0.75	1.95	1.200	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 : 5VDC from USB port 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 : 5VDC from USB port 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 13-14.	

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, 2481MHz), FHSS Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 5VDC from USB port 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 15-16.					
Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	2400.000	-7.77	-45.39	37.62	Pass
2441	2400.000	-0.75	-48.20	47.45	Pass
2481	4950.000	-42.88	-5.77	-37.11	Pass

Subclause 15.247 (c) – 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 : 5VDC from USB port 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 2402MHz Vertical Polarization					
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m			
96.000	24.7	43.5 / QP			
129.400	27.6	43.5 / QP			
258.000	30.0	46.0 / QP			

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584.100	35.1	46.0 / QP
1663.000	45.7	74.0 / P
1663.000	24.3	54.0 / A
1998.500	48.0	74.0 / P
1998.500	31.5	54.0 / A
4804.000	47.2	74.0 / P
4804.000	35.8	54.0 / A
9512.500	48.7	74.0 / P
9512.500	35.2	54.0 / A
Tx frequency 2402MHz Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
96.000	30.1	43.5/ QP
107.800	28.6	43.5/ QP
144.000	27.8	43.5/ QP
226.700	32.0	46.0/ QP
259.400	37.3	46.0/ QP
700.000	34.8	46.0/ QP
1100.000	35.2	74.0 / P
1100.000	27.5	54.0 / A
1712.000	33.3	74.0 / P
1712.000	20.0	54.0 / A
4804.000	48.8	74.0 / P
4804.000	33.0	54.0 / A
9534.000	48.9	74.0 / P
9534.000	35.5	54.0 / A
Tx frequency 2441MHz Vertical Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
96.000	26.8	43.5/ QP
129.800	26.3	43.5/ QP
258.800	29.4	46.0/ QP
583.900	32.2	46.0/ QP
1665.000	45.3	74.0 / P
1665.000	24.6	54.0 / A
1992.500	46.5	74.0 / P
1992.500	30.4	54.0 / A
4882.500	48.2	74.0 / P
4882.500	33.9	54.0 / A
9523.500	48.4	74.0 / P
9523.500	35.2	54.0 / A
Tx frequency 2441MHz Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
96.000	32.2	43.5/ QP
144.000	33.4	43.5/ QP
259.800	37.6	46.0/ QP
336.000	33.2	46.0/ QP
1100.000	35.2	74.0 / P
1100.000	25.0	54.0 / A
1599.000	33.8	74.0 / P
1599.000	22.3	54.0 / A
4882.500	45.3	74.0 / P

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4882.500	33.1	54.0 / A
9610.500	48.1	74.0 / P
9610.500	34.7	54.0 / A
Tx frequency 2481MHz Vertical Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
96.000	23.7	43.5/ QP
129.400	27.2	43.5/ QP
258.800	28.3	46.0/ QP
584.400	32.8	46.0/ QP
1100.000	44.9	74.0 / P
1100.000	27.5	54.0 / A
1659.000	47.5	74.0 / P
1659.000	26.3	54.0 / A
4963.000	47.4	74.0 / P
4963.000	33.4	54.0 / A
9512.500	48.6	74.0 / P
9512.500	35.2	54.0 / A
Tx frequency 2481MHz Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
96.000	28.3	43.5/ QP
129.600	29.7	43.5/ QP
144.000	27.2	43.5/ QP
240.000	31.4	46.0/ QP
259.200	36.6	46.0/ QP
1100.000	36.0	74.0 / P
1100.000	27.9	54.0 / A
1656.500	34.8	74.0 / P
1656.500	20.3	54.0 / A
4963.000	47.8	74.0 / P
4963.000	33.5	54.0 / A
9476.500	48.6	74.0 / P
9467.500	35.3	54.0 / A