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Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**14024113 001**	**Seite 1 von 13** *Page 1 of 13*
Auftraggeber: *Client:*	**Vento North America LLC** **6190 Cornerstone CT** **Suite 200** **San Diego** **CA 92121** **USA**	
Gegenstand der Prüfung: *Test Item:*	**2.4GHz Wireless Controller**	
Bezeichnung: *Identification:*	**iGUGU INTERNETV Wireless Controller: TVW-01**	**Serien-Nr.:** *Serial No.:* **Engineering sample**
Wareneingangs-Nr.: *Receipt No.:*	**00100621122-001**	**Eingangsdatum:** *Date of Receipt:* **21.06.2010**
Prüfort: *Testing Location:*	**TÜV Rheinland (Guangdong) Ltd. EMC Laboratory** Guangzhou Auto Market, Yuan Gang Section of Guangshan Road, Guangzhou, 510650, P.R. China **TÜV Rheinland Hong Kong Ltd.** 8/F., Niche Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong	
Prüfgrundlage: *Test Specification:*	**FCC Part 15 Subpart C** **ANSI C63.4-2003** **CISPR 22:1997**	
Prüfergebnis: *Test Results:*	**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.** 9-10/F., Emperor International Square , 7 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong	

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
23.08.2010	Mika Chan Project Engineer		23.08.2010	Sharon Li Project Manager	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges: Other Aspects **FCCID: XZW-IGUGUTV-1-C**

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*

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Table of Content

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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_{nor}: 4.5 V Batteries AAAX3
Independent Operation Modes	Connection state - Data Link

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.

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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

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	100701	16-Mar-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: 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 Mode of operation Port of testing Detector RBW/VBW Supply voltage Temperature Humidity	: FCC Part 15 Subpart A – Subclause 15.31 : Tx mode (hopping on), FHSS : Temporary antenna port : Peak : 100 kHz / 300 kHz : 4.5VDC from DC power supply : 23ºC : 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 : 4.5VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Results:	The total number of hopping frequencies is more than 15. For test Results plots refer to Appendix 1, page 3.
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 : 4.5VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Results: Time period calculation = 0.4 x 80 = 32s Dwell time = 45 x 0.473 x 10^{-3} = 21.285 x 10^{-3} <= 400 x 10^{-3} s For test protocols please refer to Appendix 1, page 4-5.	
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 : 4.5VDC from DC power supply
Temperature : 23ºC
Humidity : 50%

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

FHSS Modulation

Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2402	0.636	0.336	0.972
2441	0.570	0.258	0.828
2481	0.498	0.210	0.708

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:

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).

S: Seed Number = S7-S0 (8 bits)

Q: Bit Sequence = Q[0]-Q[6] (7 bytes)

F: Frequency Number (0F<80)

S(k) represents the S in the kth period.

The frequency is predicted by the following steps:

1. S(k+1) = S(k)+1 [S(k+1) = s(k+1)7~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~r(k+1)0]

□ r(k+1)i = s(k+1)Q[i] (0i6)

□ r（k+1）7 = s（k+1）7

3. F(k+1) = R(k+1) mod 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 : 4.5VDC 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.

Results: For test protocols please refer to Appendix 1, page 8-9.

FHSS Modulation

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-1.64	1.95	0.310	1 / 30.0	Pass
2441	-1.85	1.95	0.100	1 / 30.0	Pass
2481	-2.01	1.95	-0.060	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 : 4.5VDC 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.
Results:	There is no peak found outside any 100 kHz bandwidth of the operating frequency band. For test protocols refer to Appendix 1, page 10-11.

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 : 4.5VDC from DC power supply Temperature : 23ºC Humidity : 50%	
Requirement:	Radiated emissions which fall in the restricted bans, 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 12-15

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 : 4.5VDC 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.

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 16-17.

Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	4800.000	-34.91	-2.39	-32.52	Pass
2441	4850.000	-32.15	-1.66	-30.49	Pass
2481	4950.000	-42.30	-1.90	-40.40	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 : 23ºC
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
45.500	11.3	40 / QP
147.300	14.0	43.5 / QP
317.000	15.7	46 / QP

794.700	22.2	46 / QP
1852.000	35.1	74.0 / P
1852.000	21.4	54.0 / A
4804.000	48.5	74.0 / P
4804.000	32.6	54.0 / A
Tx frequency 2402MHz	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
54.900	10.6	40 / QP
102.000	17.4	43.5 / QP
144.000	20.4	43.5 / QP
622.300	19.9	46 / QP
1369.500	33.5	74.0 / P
1369.500	19.8	54.0 / A
4804.000	50.1	74.0 / P
4804.000	32.1	54.0 / A
Tx frequency 2441MHz	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
32.600	10.4	40 / QP
44.300	10.3	40 / QP
144.000	20.3	43.5 / QP
788.400	22.1	46 / QP
1259.000	33.7	74.0 / P
1259.000	20.2	54.0 / A
4882.000	46.8	74.0 / P
4882.000	33.2	54.0 / A
Tx frequency 2441MHz	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
90.000	17.2	43.5 / QP
132.000	21.7	43.5 / QP
156.000	20.3	43.5 / QP
760.000	21.9	46 / QP
1839.500	34.4	74.0 / P
1839.500	21.3	54.0 / A
4882.000	46.2	74.0 / P
4882.000	31.7	54.0 / A
Tx frequency 2481MHz	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
49.200	10.8	40 / QP
144.000	17.8	43.5 / QP
321.000	14.6	46 / QP
671.300	20.8	46 / QP
1624.500	35.0	74.0 / P
1624.500	20.1	54.0 / A
4962.000	41.6	74.0 / P
4962.000	28.0	54.0 / A

Tx frequency 2481MHz	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
40.300	10.7	40 / QP
132.000	22.7	43.5 / QP
156.000	21.4	43.5 / QP
810.900	22.4	46 / QP
1448.500	34.0	74.0 / P
1448.500	20.8	54.0 / A
4962.000	42.1	74.0 / P
4962.000	27.7	54.0 / A