

Produkte
Products
Prüfbericht - Nr.: **14030759 001**
Test Report No.:
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Auftraggeber: **JAPAN REMOTE CONTROL CO., LTD.**
Client:
2-2-12 Eiwa
Higashi Osaka-shi, Osaka
577-0809 JAPAN

Gegenstand der Prüfung: **2.4GHz Remote Control Module (Transceiver)**
Test Item:

Bezeichnung: **TG2.4XP** **Serien-Nr.:** **Engineering sample**
Identification: **Serial No.:**

Wareneingangs-Nr.: **00120730154-001** **Eingangsdatum:** **30.07.2012**
Receipt No.: **Date of Receipt:**

Prüfort: **TÜV Rheinland Hong Kong Ltd.**
Testing Location: **8/F, First Group Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong**
Hong Kong Productivity Council
HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong

Zustand des Prüfgegenstandes bei Anlieferung: **Test sample(s) is/are not damaged and suitable for testing.**
Condition of test item at delivery:

Prüfgrundlage: **FCC Part 15 Subpart C**
Test Specification: **ANSI C63.4-2003**

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: **8 - 10/F., Goldin Financial Global Square, 7 Wang Tai Road, Kowloon Bay Kowloon, Hong Kong**

geprüft/ tested by:
kontrolliert/ reviewed by:

15.10.2014	Hugo Wan Senior Project Manager		15.10.2014	Sharon Li Section Manager	
Datum Date	Name/Stellung Name/Position	Unterschrift Signature	Datum Date	Name/Stellung Name/Position	Unterschrift Signature

Sonstiges: **FCCID AXG-TG24XP**
Other Aspects

Abkürzungen: **P(pass)** = **entspricht Prüfgrundlage**
F(fail) = **entspricht nicht Prüfgrundlage**
N/A = **nicht anwendbar**
N/T = **nicht getestet**

Abbreviations: **P(pass)** = **passed**
F(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	2404 - 2479 MHz
Type of modulation	Hybrid System (FHSS+DSSS)
Number of channels	26
Channel separation	3 MHz
Type of antenna	Monopole
Antenna gain (dBi)	2.14
Power level	fix
Type of equipment	Plug in radio device
Connection to public utility power line	No
Nominal voltage	V _{nor} : 9.6V (Depends on host spec)
Independent Operation Modes	Transmitting Receiving

Product function and intended use

The model (TG2.4XP) is a transceiver module for the remote control (R/C) of models such as helicopters, airplane, glider and etc. It also supports the bi-directional communication between transmitter and models.

The model (TG2.4XP) use 2.4GHz signals for communication. It supports wide-band, frequency-agile 2.4GHz signal protocol to improve the reliability and efficiency.

Submitted documents

Circuit Diagram
Block Diagram
Bill of material
User manual

Remark

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Independent Operation Modes

The basic operation modes are:

- provide bi-directional communication between the remote control host and the receiver.

For further information refer to User Manual

Related Submittal(s) Grants

This is a single application for certification of the transmitter.

Test Set-up and Operation Mode

Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

Test Operation and Test Software

Test operation should refer to test methodology.

- The remote control host is built with test control software for setup of the DSSS mode and frequency hopping mode.

Special Accessories and Auxiliary Equipment

Special accessories and auxiliary equipment

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

Remote control host
Brand Name: JAPAN REMOTE CONTROL CO., LTD.
Model number: 11Xzero
Nominal voltage: NiMH, 8cell, 9.6V



Countermeasures to achieve EMC Compliance

- none

Test Methodology

Radiated Emission

The radiated emission measurements were performed according to the procedures in ANSI C63.4-2003.

The equipment under test (EUT) was placed at the middle of the 80 cm height turntable, and the turntable is 3 meters far from the measuring antenna. During the testing, the EUT was operated standalone and arranged for maximum emissions. The EUT was tested in three orthogonal planes.

The investigation is performed with the EUT rotated 360 °, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained.

All radiated tests were performed at an antenna to EUT with 3 meters distance, unless stated otherwise in particular parts of this test report.

Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

$$FS = R + AF + CF + FA - PA$$

Where FS = Field Strength in dB_{uV/m} at 3 meters.
R = Reading of Spectrum Analyzer in dB_{uV}.
AF = Antenna Factor in dB.
CF = Cable Attenuation Factor in dB.
FA = Filter Attenuation Factor in dB.
PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

List of Test and Measurement Instruments

Hong Kong Productivity Council (Registration number: 90656)

Equipment	Manufacturer	Type	S/N	Cal. Date	Cal. Due Date
Semi-anechoic Chamber	Frankonia	Nil	Nil	14 Apr 2014	14 Apr 2015
Cable	Hubersuhner	SUCOFLEX 104	72799 /6	31 Mar 2014	31 Mar 2016
Test Receiver	R & S	ESU40	100190	20 Jun 2014	20 Jun 2015
Bi-conical Antenna	R & S	HK116	100241	11 Jun 2013	11 Jun 2015
Log Periodic Antenna	R & S	HL223	841516/017	10 Jun 2013	10 Jun 2015
Coaxial cable	Harbour	LL335	N/A	10 Jun 2014	10 Jun 2016
Microwave amplifier 0.5-26.5GHz, 25dB gain	HP	83017A	3950M00241	17 Jul 2014	17 Jul 2016
High Pass Filter (cutoff freq. =1000MHz)	Trilithic	23042	9829213	28 Oct 2013	28 Oct 2015
Horn Antenna	EMCO	3115	9002-3347	11 Jun 2013	11 Jun 2015
Active Loop Antenna	EMCO	6502	9107-2651	17 May 2014	17 May 2015
Spectrum Analyzer	Rohde & Schwarz	FSP30	100007	03 Dec 2012	03 Dec 2014

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: b) Manufacturer and model no: c) Gain with reference to an isotropic radiator:	Monopole N.A. 2.14 dBi	
Verdict:	Pass		
Subclause 15.207 – Disturbance Voltage on AC Mains		N/A	
The EUT cannot operate during battery charging.			
Subclause 15.247 (a) – 20 dB Bandwidth		Pass	
Requirement:	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.		
Test Specification	: FCC Public Notice DA 00-705		
Mode of operation	: Tx mode (2404MHz, 2440MHz, 2479MHz)		
Port of testing	: Temporary antenna port		
Detector	: Peak		
RBW/VBW	: 300 kHz / 1 MHz		
Supply voltage	: 9.6VDC from Host		
Temperature	: 23°C		
Humidity	: 50%		
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. For test protocols refer to Appendix 1, page 2-3.		
Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2404	1.116	2.070	3.186
2440	1.098	2.070	3.168
2479	1.062	2.142	3.204

Subclause 15.247 (a) – Hopping Sequence	Pass
Requirement: The hopping sequence is generated and provided with an example.	
<p>Hopping sequence</p> <p>Transmitter will determine the hopping sequence as below.</p> <ul style="list-style-type: none"> - Check around RF environment - Check chip around temperature (and this information will be used as a part of rnd seed.) - RF module CPU will combine these information and generate appropriate hopping sequence.. 	
<p>Example data:</p> <p>where as:</p> <p>rand() is a typical random generator function defined in ANSI C. mt_rand() is a mersenne twister random generator function.</p> <p>example:</p> <pre> do { seed1 = temperature * rand() * 128392733U * (rand() * mt_rand() >> 30) + 3; seed2 = (the detected RF signal around the RF modules when the TX powered on) * rand() * 33234 * (mt_rand() >> 3) + 34; ch_map_temp = (seed1 * seed2) & 26; ... (It repeats the above equation until the map completion.) ... } while (i < 26); /* '26' is a channel hopping number */ </pre>	

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.	
<p>Receiver input bandwidth</p> <p>The receiver bandwidth is equal to the transmitter bandwidth in the 26 hopping channel mode, which is 2MHz. The receiver bandwidth was verified during RF conformance testing.</p>	

Subclause 15.247 (a) – Receiver Hopping Capability	Pass
Requirement: The associated receiver has the ability to shift frequencies in synchronisation with the transmitted signals.	
Receiver hopping Capability The receiver is waiting the signal from TX with dedicated packet address (8bytes). Once the receiver received the signal from TX, RX starts to parse the packet and fetch the 2 kinds of data. The former data describes the timing data, and the latter is random seeds to generate the hopping pattern. Then RX starts generating hopping patter at first, and wait the TX signal again to sync the hopping. After the above procedure, RX can easily sync the hopping pattern.	
Subclause 15.247 (a)(1) – Carrier Frequency Separation	Pass
Requirement: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.	
Test Specification : FCC Public Notice DA 00-705 Mode of operation : Tx mode (hopping on) Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 300 KHz / 1 MHz Supply voltage : 9.6VDC from Host Temperature : 23°C Humidity : 50%	
Results: The centre frequencies of the hopping channels are separated by more than the two-third of the 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 channels.		
Test Specification : FCC Public Notice DA 00-705 Mode of operation : Tx mode (hopping on) Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1 MHz / 3 MHz Supply voltage : 9.6VDC from Host Temperature : 23°C Humidity : 50%		
Results: The total number of hopping channels 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 Public Notice DA 00-705 Mode of operation : Tx mode (hopping on), Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1 MHz / 3 MHz Supply voltage : 9.6VDC from Host Temperature : 23°C Humidity : 50%		
Results: Time period calculation = $0.4 \times 26 = 10.4\text{s}$ Dwell time = $29 \times 2.632 \times 10^{-3} = 76.328 \times 10^{-3} \text{ s}$ $\leq 400 \times 10^{-3} \text{ s}$		
For test protocols please refer to Appendix 1, page 6.		
Verdict: Pass		

Subclause 15.247 (b)(1) – Maximum Peak Output Power		Pass				
Requirement: For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping 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.						
Test Specification : FCC Public Notice DA 00-705 Mode of operation : Tx mode, hopping off Port of testing : Temporary antenna port Detector : Peak RBW/VBW : > 20dB bandwidth / >= RBW Span : approximately 5 times the 20 dB bandwidth Supply voltage : 9.6VDC from Host Temperature : 23°C Humidity : 50%						
Results: For test protocols please refer to Appendix 1, page 7-8.						
Channel	Channel frequency (MHz)	Reading (dBm)	Cable loss & Attenuator (dB)	Peak Power Output (dBm)	Limit (dBm)	Verdict
1	2404	-13.75	10.2	-3.55	30	Pass
13	2440	-13.32	10.2	-3.12	30	Pass
26	2479	-12.74	10.2	-2.54	30	Pass
Verdict: Pass						

Subclause 15.247 (d) – Band Edge Emissions		Pass
Test Specification : FCC Public Notice DA 00-705 Mode of operation : Tx mode, hopping on Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 9.6VDC from Host 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 15.		

Subclause 15.247 (a)(2) – 6dB Bandwidth Measurement		Pass				
Requirement: Systems using digital modulation techniques may operate in the 902 – 928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500kHz.						
DTS Bandwidth						
Test Specification : KDB Publication No. 558074 Mode of operation : Tx mode, DSSS, hopping off Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100kHz / $\geq 3 \times \text{RBW}$ Supply voltage : 9.6VDC from Host Temperature : 23°C Humidity : 50%						
Results: For test protocols please refer to Appendix 1, page 9-10.						
Channel	Channel frequency (MHz)	DTS Bandwidth (kHz)	Limit (kHz)	Verdict		
1	2404	1640	≥ 500	Pass		
13	2440	1632	≥ 500	Pass		
26	2479	1632	≥ 500	Pass		
Subclause 15.247 (b)(3) – Maximum Peak Output Power		Pass				
Requirement: For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850MHz bands: 1 Watt (30dBm)						
Test Specification : KDB Publication No. 558074, maximum peak conducted output power method Mode of operation : Tx mode, DSSS, hopping off Port of testing : Temporary antenna port Detector : Peak RBW/VBW : $\geq \text{DTS bandwidth} / \geq 3 \times \text{RBW}$ Span : $\geq 3 \times \text{RBW}$ Supply voltage : 9.6VDC from Host Temperature : 23°C Humidity : 50%						
Results: For test protocols please refer to Appendix 1, page 11-12.						
Channel	Channel frequency (MHz)	Reading (dBm)	Cable loss & Attenuator (dB)	Peak Power Output (dBm)	Limit (dBm)	Verdict
1	2404	-14.71	10.2	-4.51	30	Pass
13	2440	-14.38	10.2	-4.18	30	Pass
26	2479	-14.10	10.2	-3.90	30	Pass
Verdict: Pass						

Subclause 15.247 (d) – Spurious Conducted Emissions		Pass			
Test Specification : KDB Publication No. 558074, maximum peak conducted output power method					
Mode of operation : Tx mode (2404MHz, 2440MHz, 2479MHz), DSSS, hopping off					
Port of testing : Temporary antenna port					
Detector	: Peak				
RBW/VBW	: 100 kHz / 300 kHz				
Supply voltage	: 9.6VDC from Host				
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 13-14.				
Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2404	No Peak Found	-	-7.21	-	Pass
2440	No Peak Found	-	-7.73	-	Pass
2479	No Peak Found	-	-8.05	-	Pass

Subclause 15.247 (d) – Spurious Radiated Emissions		Pass
Test Specification	: ANSI C63.4 – 2003	
Mode of operation	: Tx mode (2404MHz, 2440MHz, 2479MHz), DSSS, hopping off	
Port of testing	: Enclosure	
Detector	: Peak	
RBW/VBW	: 100 kHz / 300 kHz for f < 1 GHz 1 MHz / 1 MHz for f > 1 GHz	
Supply voltage	: 9.6VDC from Host	
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 15.209(a).	
Results:	<p>Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.</p> <p>All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.</p>	
Tx frequency 2404MHz	Vertical Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
143.370	31.9	43.5/ QP
265.358	29.5	46/ QP
4808.044	53.42	74.0 / P
4807.964	49.73	54.0 / A
Tx frequency 2404MHz	Horizontal Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
145.883	32.9	43.5/ QP
272.900	37.3	46/ QP
4807.916	49.97	74.0 / P
4807.932	39.11	54.0 / A
Tx frequency 2440MHz	Vertical Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
188.640	28.5	43.5/ QP
262.841	31.2	46/ QP
4879.887	50.78	74.0 / P
4879.967	45.35	54.0 / A
Tx frequency 2440MHz	Horizontal Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
154.688	30.3	43.5/ QP
272.901	36.7	46/ QP
4880.256	50.85	74.0 / P
4879.919	35.20	54.0 / A

Tx frequency 2479MHz		Vertical Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	
145.883	31.5	43.5/ QP	
211.280	27.3	43.5/ QP	
4957.948	49.45	74.0 / P	
4957.980	43.08	54.0 / A	
Tx frequency 2479MHz		Horizontal Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	
143.370	31.1	43.5/ QP	
211.280	27.0	43.5/ QP	
4957.996	49.00	74.0 / P	
4957.964	41.36	54.0 / A	

Subclause 15.247 (d) – Band Edge Emissions	Pass
Test Specification	: KDB Publication No. 558074, maximum peak conducted output power method
Mode of operation	: Tx mode (2404MHz, 2479MHz), DSSS, hopping off
Port of testing	: Temporary antenna port
Detector	: Peak
RBW/VBW	: 100 kHz / 300 kHz
Supply voltage	: 9.6VDC from Host
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 16.

Subclause 15.209 – Band edge compliance of radiated emissions		Pass
Test Specification	: FCC Part 15 Subpart A – Subclause 15.31	
Mode of operation	: Tx mode (2404MHz, 2479MHz)	
Port of testing	: Enclosure	
Detector	: Peak	
RBW/VBW	: 1 MHz / 1 MHz	
Supply voltage	: 9.6VDC from Host	
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 17-24.	

Subclause 15.247 (e) – Power Spectral Density		Pass			
Requirement:	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.				
Test Specification	: KDB Publication No. 558074, maximum peak conducted output power method				
Mode of operation	: Tx mode, DSSS, hopping off				
Port of testing	: Temporary antenna port				
Detector	: Peak				
RBW/VBW	: 100 KHz / 300 KHz				
Supply voltage	: 9.6VDC from Host				
Temperature	: 23°C				
Humidity	: 50%				
Results:	For test protocols please refer to Appendix 1, page 25-26.				
Operating frequency (MHz)	Reading (dBm)	Cable loss & Attenuator (dB)	Power density (dBm)	Limit (dBm)	Verdict
2404	-18.88	10.2	-8.68	8.00	Pass
2440	-18.66	10.2	-8.46	8.00	Pass
2479	-18.23	10.2	-8.03	8.00	Pass
Verdict:	Pass				