FCC 47 CFR PART 15 SUBPART C AND ANSI C63.10: 2013 TEST REPORT

For

Water sensor

Model: WS900

Data Applies To: N/A

Brand Name:

Issued for

Nextgenagain
12274 oakview way, San Diego, California, United States, 92128

Issued By

Compliance Certification Services Inc.
Tainan Lab.
No.8, Jiucengling, Xinhua Dist.,
Tainan City, Taiwan
Issued Date: December 01, 2020

REVISION HISTORY

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	November 02, 2020	Initial Issue	ALL	Polly Wang
01	November 19, 2020	See the following note rev.01	P.5.7.18.25-27. 33.34.38.47-51	Polly Wang
02	November 24, 2020	See the following note rev.02	P.33.36	Polly Wang
03	December 01, 2020	See the following note rev.03	ALL	Polly Wang

Note:

※ Rev.00 Issue Date: November 02, 2020

Original Report

※ Rev.01 Issue Date: November 19, 2020

Revise the typo and update EUT information, spurious, dwell time, radiated emissions >1GHz data.
Add Hopping channel separation data.

※ Rev.02 Issue Date: November 24, 2020

Update DWELL TIME limit description and data.

※ Rev.03 Issue Date: December 01, 2020

Rearrange the report layout.

TABLE OF CONTENTS

1. TEST REPORT CERTIFICATION

Applicant	:	**Nextgenagain** 12274 oakview way, San Diego, California, United States, 92128
Manufacturer	:	**Vision Automobile Electronics Industrial Co., Ltd.** No. 78, Gongye 3rd Rd.,Technology Industrial Park, Tainan City 70955, Taiwan (R.O.C.)
Equipment Under Test	:	Water sensor
Model Number	:	WS900
Data Applies To	:	N/A
Brand Name	:	NEXTGENAGAIN
Date of Test	:	September 24, 2020 ~ November 03, 2020

APPLICABLE STANDARD	
STANDARD	**TEST RESULT**
FCC Part 15 Subpart C AND ANSI C63.10: 2013	PASS

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in **ANSI C63.10: 2013** and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.
The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:

Eric Huang
Section Manager

2. TEST RESULT SUMMARY

FCC Standard Section	Report Section	Test Item	Result
15.203	3	ANTENNA REQUIREMENT	Pass
15.247(a)(1)(i)	8.1	20dB BANDWIDTH	Pass
15.247(b)(1)	8.2	MAXIMUM PEAK OUTPUT POWER	Pass
15.247(a)(1	8.3	HOPPING CHANNEL SEPARATION	Pass
15.247(a)(1)(i)	8.4	NUMBER OF HOPPING FREQUENCY USED	Pass
-	8.5	DUTY CYCLE	-
15.247(a)(1)(i)	8.6	DWELL TIME	Pass
15.247(d)	8.7	CONDUCTED SPURIOUS EMISSION	Pass
15.247(d)	8.8	RADIATED EMISSIONS	Pass
15.207(a)	8.9	POWERLINE CONDUCTED EMISSIONS	N/A

3. EUT DESCRIPTION

3.1 DESCRIPTION OF EUT & POWER

Product	Water sensor
Model Number	WS900
Data Applies To	N/A
Brand Name	NEXTGENAGAIN
Identify Number	T200818N03
Received Date	August 18, 2020
Frequency Range	902.4MHz ~ 927.6MHz
Transmit Peak Power	GFSK : 15.01dBm / 31.696mW
Channel Spacing	0.8MHz、1.2MHz
Transmit Data Rate	FSK Mode：1 Mbps
Modulation Type	FSK
Number of Channels	25 Channels

	<table><tr><th>Index</th><th>Frequency (KHz)</th></tr><tr><td>1</td><td>914801</td></tr><tr><td>2</td><td>912801</td></tr><tr><td>3</td><td>910801</td></tr><tr><td>4</td><td>912000</td></tr><tr><td>5</td><td>903602</td></tr><tr><td>6</td><td>921119</td></tr><tr><td>7</td><td>902398</td></tr><tr><td>8</td><td>914000</td></tr><tr><td>9</td><td>908801</td></tr><tr><td>10</td><td>907602</td></tr><tr><td>11</td><td>920398</td></tr><tr><td>12</td><td>906398</td></tr><tr><td>13</td><td>926398</td></tr><tr><td>14</td><td>925602</td></tr><tr><td>15</td><td>917199</td></tr><tr><td>16</td><td>927602</td></tr><tr><td>17</td><td>923199</td></tr><tr><td>18</td><td>924398</td></tr><tr><td>19</td><td>904398</td></tr><tr><td>20</td><td>919199</td></tr><tr><td>21</td><td>918000</td></tr><tr><td>22</td><td>905602</td></tr><tr><td>23</td><td>916000</td></tr><tr><td>24</td><td>922398</td></tr><tr><td>25</td><td>909602</td></tr></table>
EUT Power Supply	3Vdc (Powered from battery)
Antenna Type	Manufacturer: N/A Type: Loop Antenna Model: WS900 Gain: -23 dBi
Hardware Version	Rev.0 0
Software Version	Rev.0
Temperature Range	-20°C ~ +60°C

Remark:

1. The sample selected for test was production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for **FCC ID: 2AWIU-NGA** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.
3. For more details, please refer to the User's manual of the EUT.
4. 1) Pseudorandom frequency hopping sequence, 2) Equal hopping frequency use, 3) System receiver input bandwidth, 4) System receiver hopping capability.
5. Specifically, the device shall comply with the equal frequency use and pseudorandom hopping sequence requirement when transmitting in short bursts, and shall be designed to comply when presented with continuous data (or information) stream.
6. The EUT complies with the requirement that it not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

4. DESCRIPTION OF TEST MODES

The EUT had been tested under operating condition.

There are three channels have been tested as following :

Channel	Frequency (MHz)
Low	902.4
Middle	914.8
High	927.6

Radiated Emission Test (Below 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type
Low, Mid, High	FHSS	FSK

Radiated Emission Test (Above 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type
Low, Mid, High	FHSS	FSK

Bandedge Measurement :

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type
Low, Mid, High	FHSS	FSK

Antenna Port Conducted Measurement :

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type
Low, Mid, High	FHSS	FSK

5. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10 : 2013 and FCC CFR 47 15.207, 15.209 and 15.247.

6. FACILITIES AND ACCREDITATIONS

6.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

☒ No.8,Jiucengling, Xinhua Dist., Tainan City 712, Taiwan (R.O.C.)

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

6.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

6.3 LABORATORY ACCREDITATIONS LISTINGS

The test facilities used to perform radiated and conducted emissions tests are accredited by Taiwan Accreditation Foundation for the specific scope of accreditation under Lab Code: 1109 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by TAF or any agency of the Government. In addition, the test facilities are listed with Federal Communications Commission (registration no: TW1109).

6.4 TABLE OF ACCREDITATIONS AND LISTINGS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Taiwan	TAF

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	INDUSTRY CANADA
Germany	TUV NORD
Taiwan	BSMI
USA	FCC

Copies of granted accreditation certificates are available for downloading from our web site, http:///www.ccsrf.com

6.5 MEASUREMENT EQUIPMENT USED

For §8.7

Chamber 966 Room (Radiation Test)					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Active Loop Antenna	ETS-LINDREN	6502	8905-2356	08/02/2019	08/01/2021
Bilog Antenna With 6dB Attenator	SUNOL SCIENCES & EMCI	JB1 & AT-N0681	A070506-1 & AT-N0681	09/14/2020	09/13/2021
Cable	Suhner	SUCOFLEX104PEA	20520/4PEA&O6	01/30/2020	01/29/2021
Double Ridged Guide Horn Antenna	ETS-LINDGREN	3116	00078900	03/26/2020	03/25/2021
EMI Test Receiver	R&S	ESCI 7	100856	06/30/2020	06/29/2021
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	07/20/2020	07/19/2021
Horn Antenna	Com-Power	AH-118	071032	04/29/2020	04/28/2021
Pre-Amplifier	EMCI	EMC012645	980098	01/30/2020	01/29/2021
Pre-Amplifier	HP	8447F	2443A01683	01/22/2020	01/21/2021
Pre-Amplifier	Com-Power	PAM-840A	461378	07/20/2020	07/19/2021
Type N coaxial cable	Suhner	CHA9513	6	01/21/2020	01/20/2021
Notch Filter	MICRO-TRONICS	BRM50702-01	018	N.C.R	N.C.R

For §8.1~8.6

Chamber 966 Room (Conducted Test)					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	07/20/2020	07/19/2021
Power Meter	Anritsu	ML2487A	6K00003888	11/20/2019	05/19/2021
Power Sensor	Anritsu	MA2491A	033265	11/20/2019	05/19/2021
SMA Cable + 10dB Attenuator	CCS	SMA+10dB ATT	SMA/10dB	01/30/2020	01/29/2021

For §8.8

Conducted Emission room #1					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
Test S/W	-				

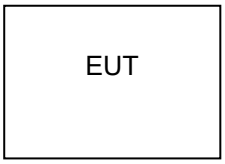
7. SETUP OF EQUIPMENT UNDER TEST

7.1 SETUP CONFIGURATION OF EUT

EMI

N/A

RF



7.2 SUPPORT EQUIPMENT

For EMI test

No.	Product	Manufacturer	Model No.	Certify No.	Signal cable
1	-	-	-	-	-

No.	Signal cable description	
A	-	-

For RF test

No.	Product	Manufacturer	Model No.	Certify No.	Signal cable
1	-	-	-	-	-

No.	Signal cable description	
A	-	-

Note:
1) All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2) Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3) shd. = shielded; unshd. = unshielded

EUT OPERATING CONDITION

RF Setup

1. Set up a whole system as the setup diagram.
2. Turn on power.
3. Push the "PROBE" button can change channel. (902.4MHz、914.8 MHz、927.6MHz)
4. Start test.

8. APPLICABLE LIMITS AND TEST RESULTS

8.1 20dB BANDWIDTH FOR HOPPING

LIMIT

§15.247(a)(i)(1)The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST SETUP

TEST PROCEDURE

The 20dB band width was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and Marker Delta functions, the 20dB band width of the emission was determined.

TEST RESULTS

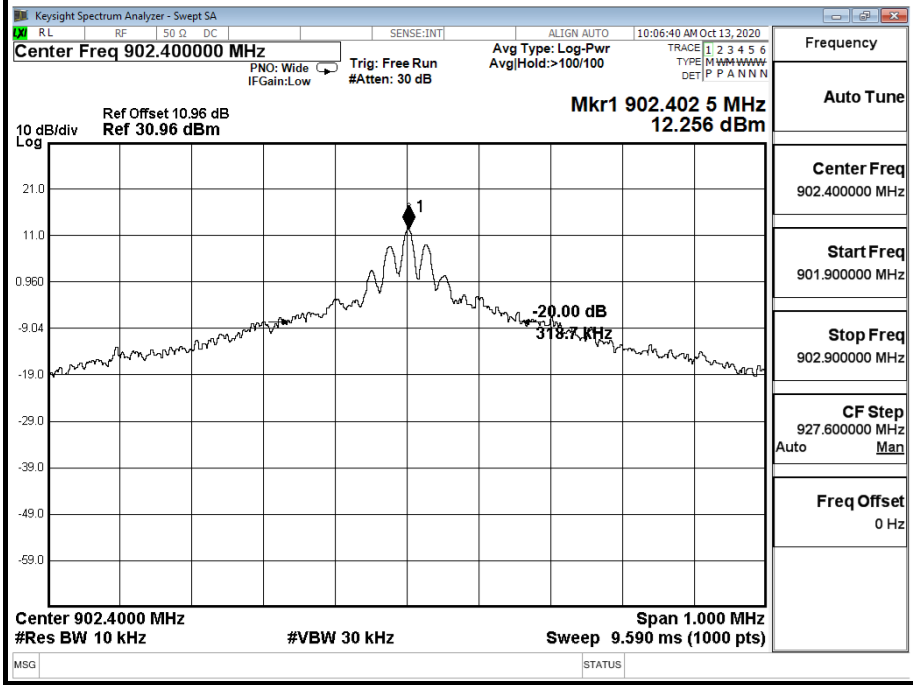
Model Name	WS900	Test By	Ted Huang
Temp & Humidity	26.5°C, 64%	Test Date	2020/10/13

Modulation Type: FSK

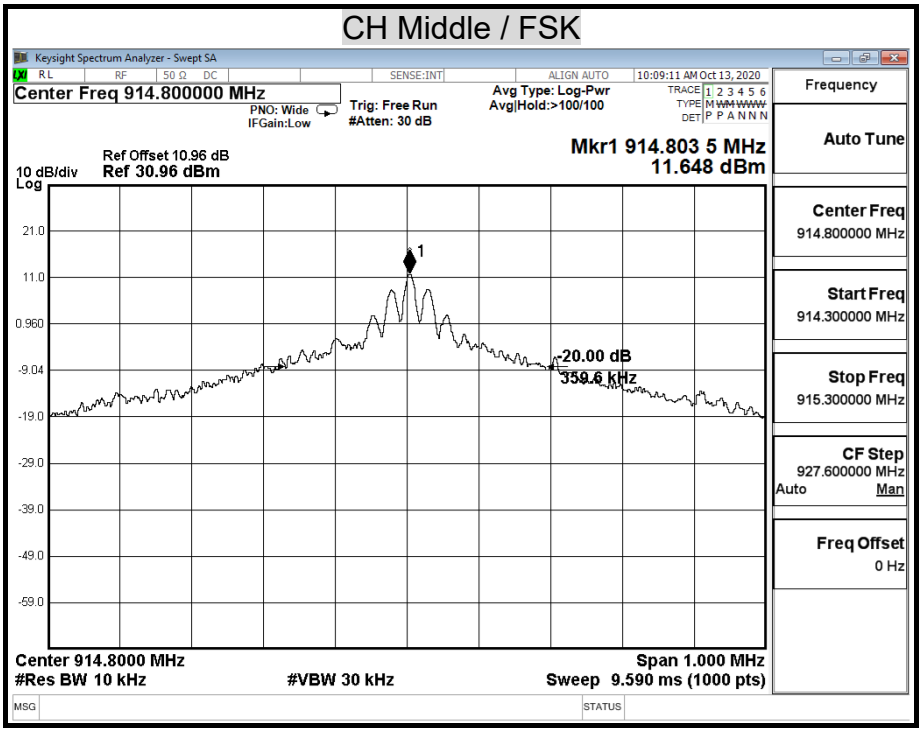
Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Pass / Fail
Low	902.4	318.7	500	pass
Middle	914.8	359.6	500	pass
High	927.6	295.8	500	pass

20dB BANDWIDTH

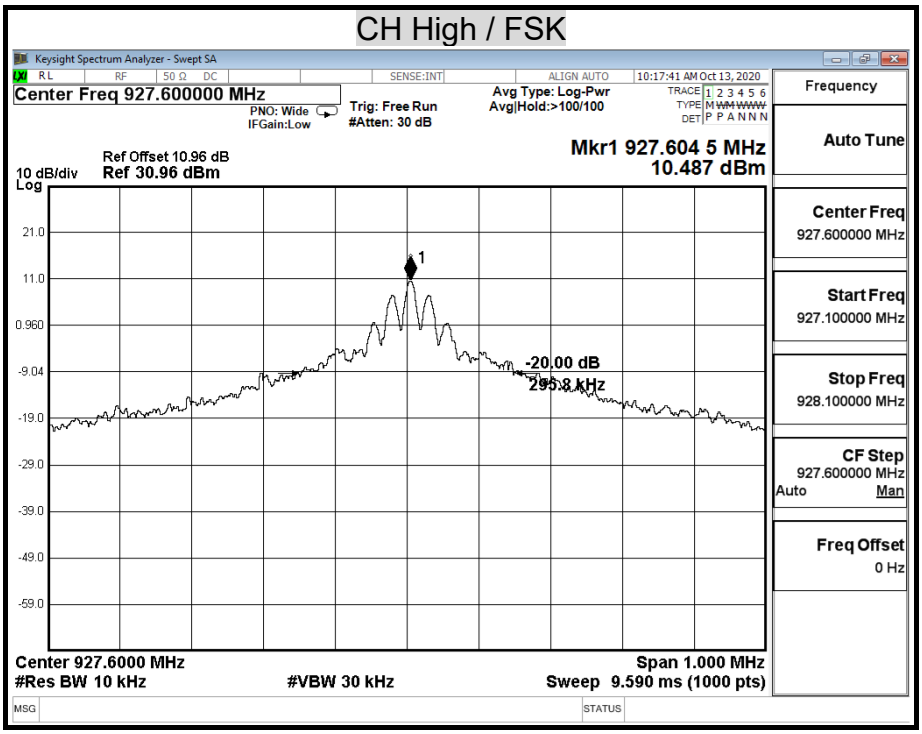
CH Low / FSK



CH Middle / FSK



CH High / FSK



8.2 MAXIMUM PEAK OUTPUT POWER

LIMIT

§15.247(b)(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Test Configuration

TEST PROCEDURE

The RF power output was measured with a Spectrum Analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A power meter was used to record the shape of the transmit signal.

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

TEST RESULTS

Model Name	WS900	Test By	Ted Huang
Temp & Humidity	26.5°C, 64%	Test Date	2020/10/13

Modulation Type: FSK

Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Output (mW)	Limit (mW)	Result
Low	902.4	15.01	31.696	250	PASS
Mid	914.8	13.96	24.889		PASS
High	927.6	13.03	20.091		PASS

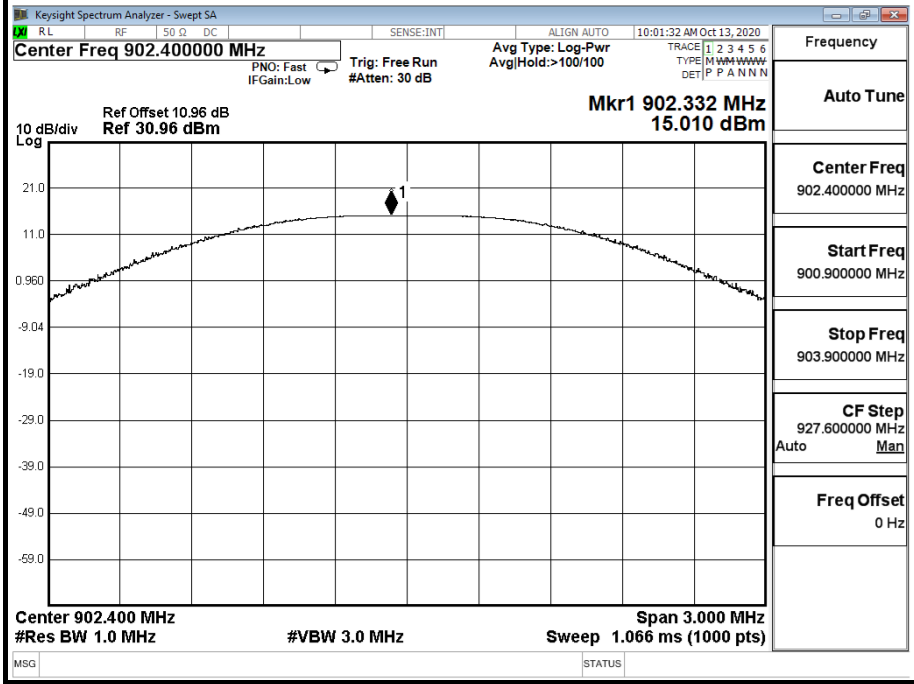
Average Power Data

Modulation Type: FSK

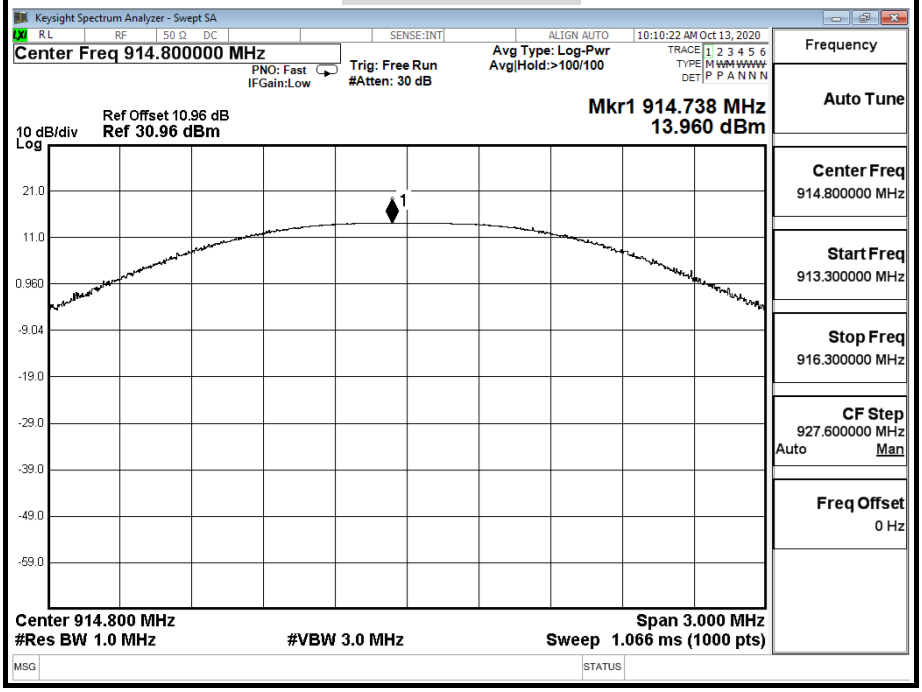
Channel	Channel Frequency (MHz)	Average Power (dBm)
Low	902.4	12.19
Mid	914.8	11.78
High	927.6	11.35

MAXIMUM PEAK OUTPUT POWER

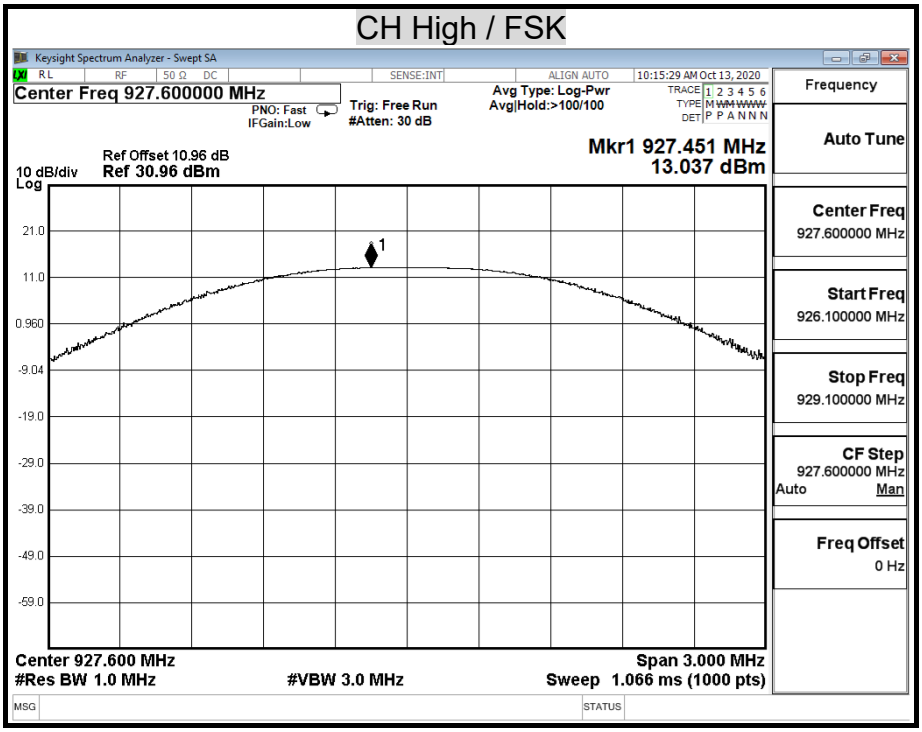
CH Low / FSK



CH Middle / FSK

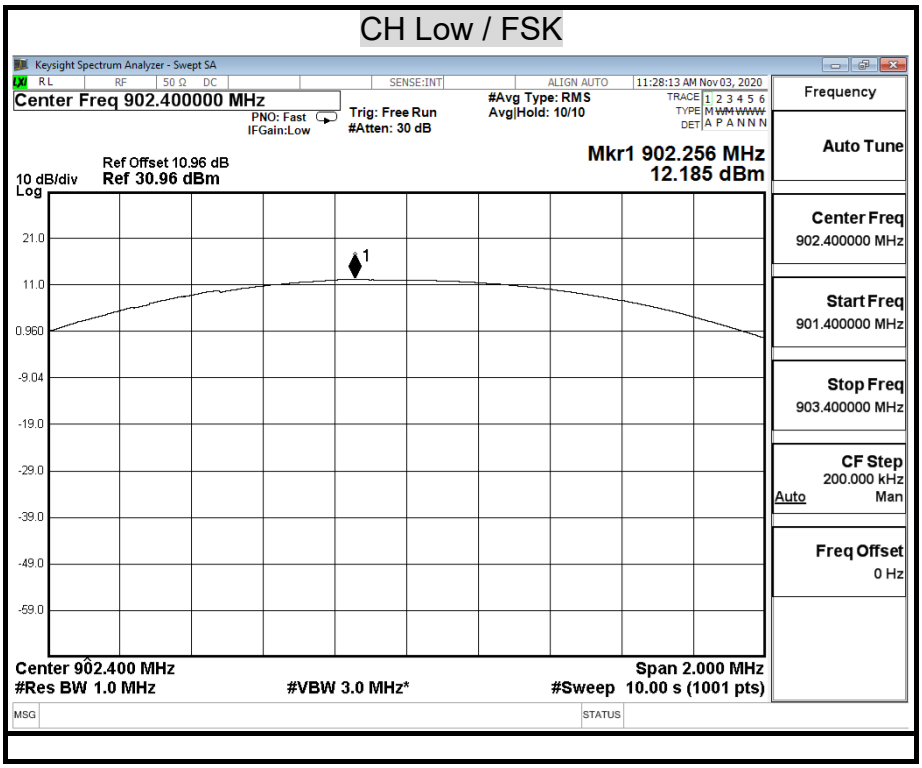


CH High / FSK

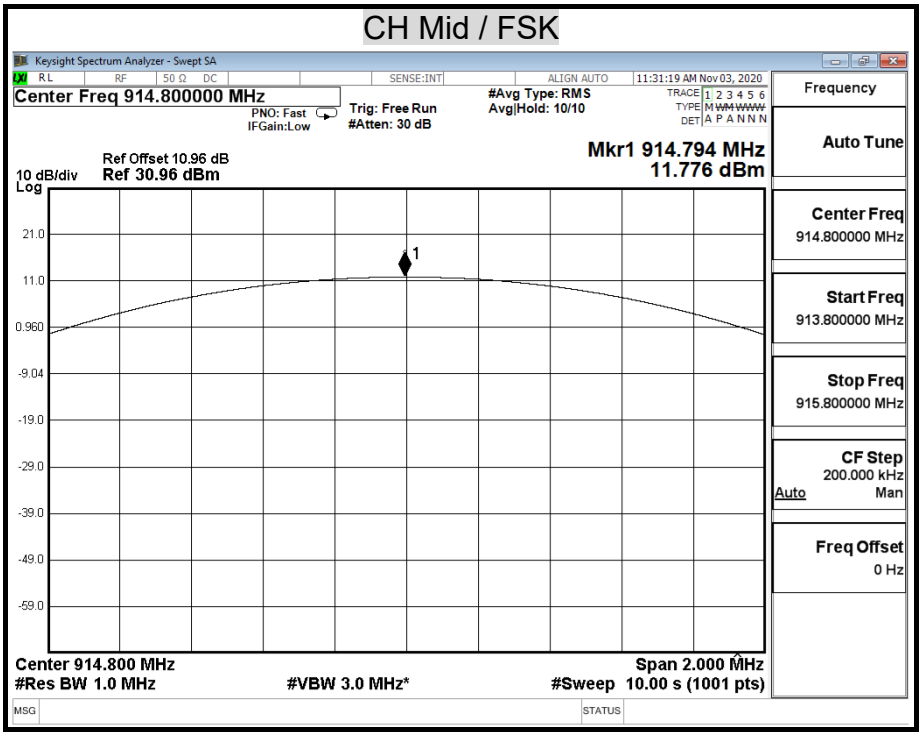


AVERAGE POWER

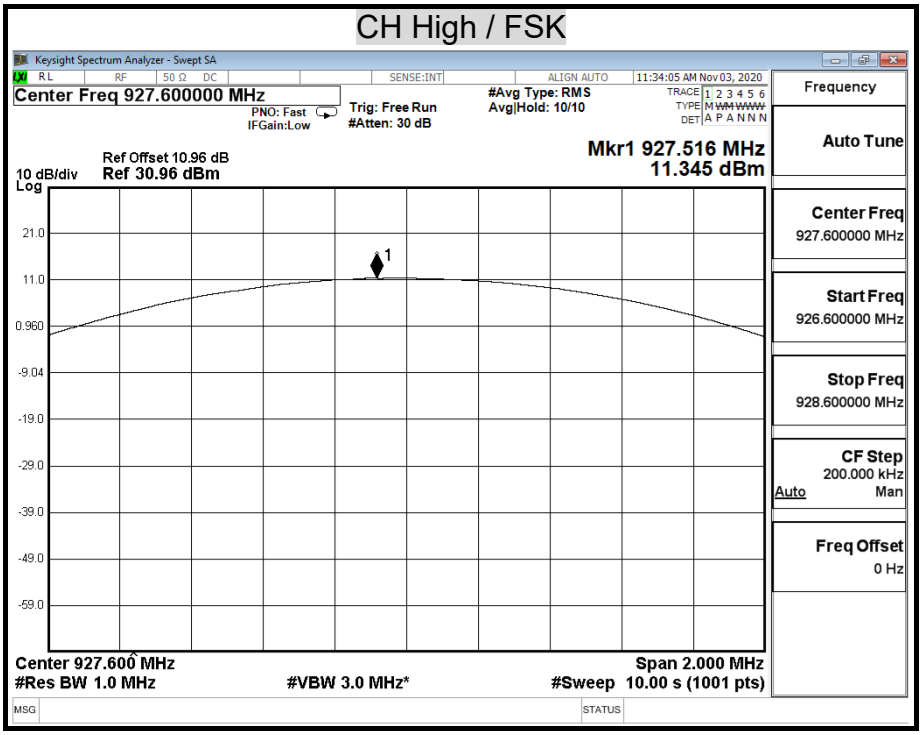
CH Low / FSK



CH Mid / FSK



CH High / FSK

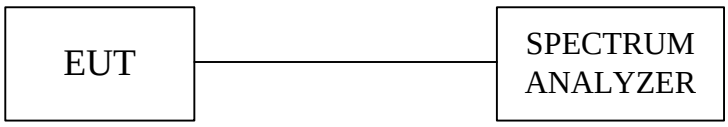


8.3 HOPPING CHANNEL SPEARATION

LIMIT

§15.247(a) (1) 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

TEST SETUP



TEST PROCEDURE

1 Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2 Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating rang.
3 By using the MaxHold function record the separation of adjacent channels
4 Measure the frequency difference of these two adjacent channels by spectrum analyzer MARK function.And then plot the esult on spectrum analyzer scan.
5 Repeat above procedures until all frequencies measured were complete.

TEST RESULTS

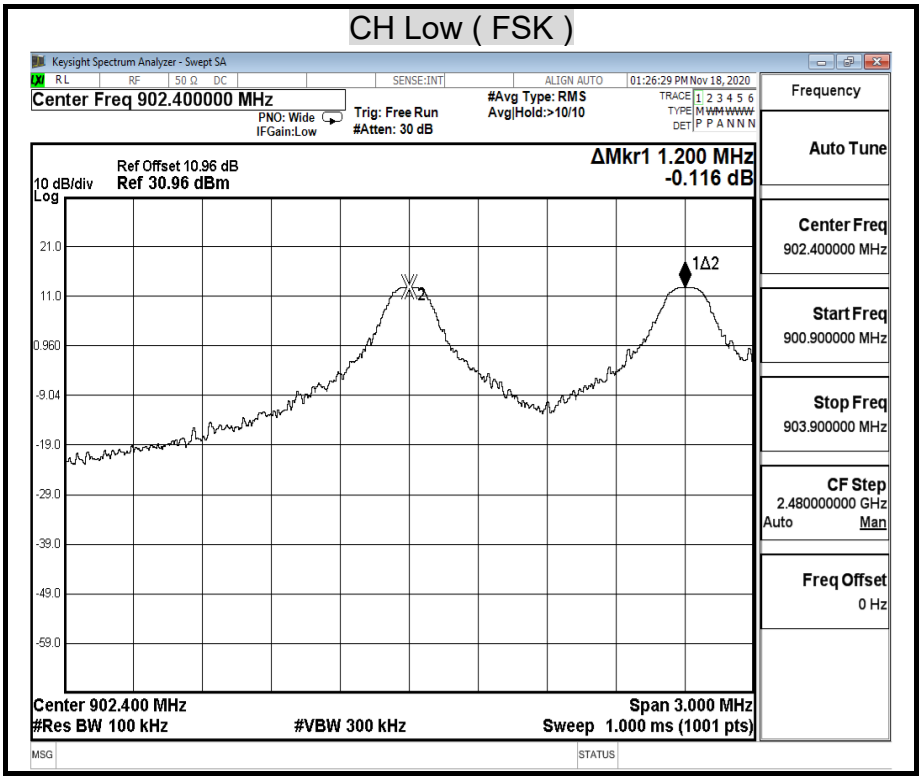
Refer to section 8.1, 20dB bandwidth measurement, the measured channel separation should be greater than two-third of 20dB bandwidth or Minimum bandwidth.

Model Name	WS900	Test By	Ted Huang
Temp & Humidity	26.5°C, 64%	Test Date	2020/10/13

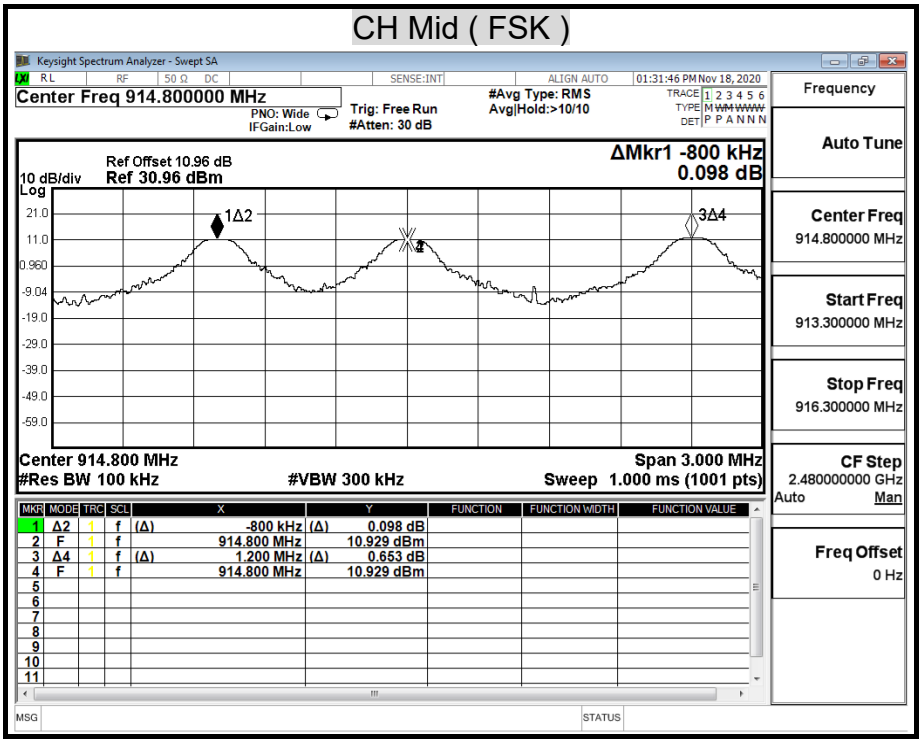
Modulation Type: FSK

Channel (MHz)	Adjacent Hopping Channel Separation (MHz)	20dB bandwidth (MHz)	Minimun Bandwidth	Result
902.4	1.2	0.32	25 KHz	PASS
914.8	0.8，1.2	0.36	25 KHz	PASS
927.6	1.2	0.30	25 KHz	PASS

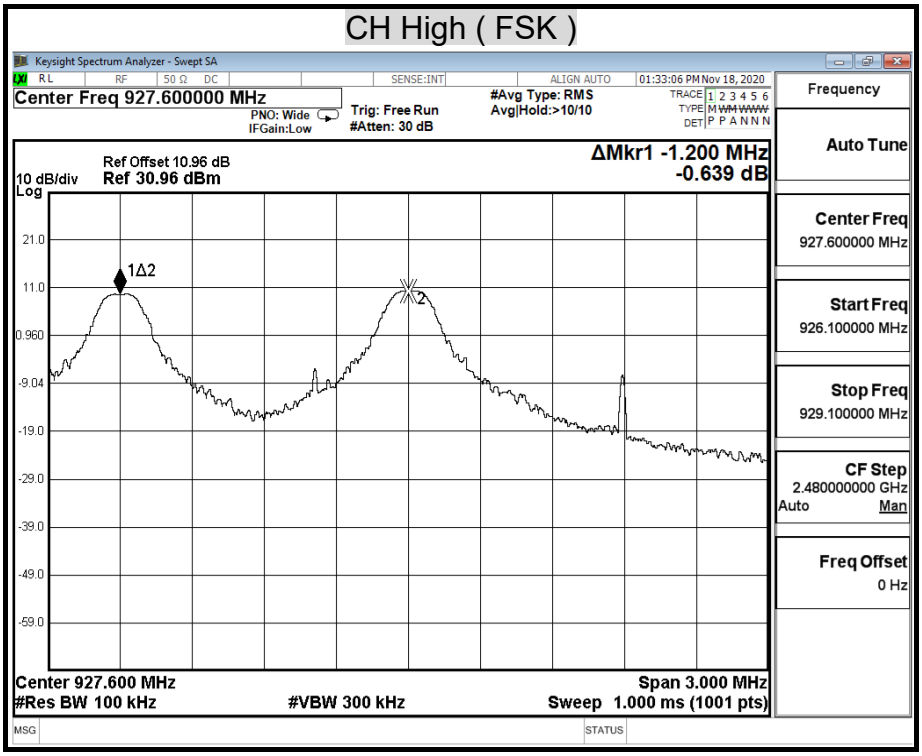
CH Low (FSK)



CH Mid (FSK)



CH High (FSK)

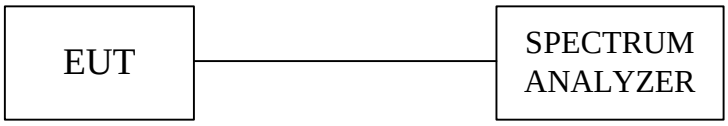


8.4 NUMBER OF HOPPING FREQUENCY USED

LIMIT

§15.247(a)(1)(i) For frequency hopping systems operating in the 902-928 MHz band : if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies,if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

TEST SETUP



TEST PROCEDURE

1 Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2 Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3 Set the spectrum analyzer on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4 Set the spectrum analyzer on View mode and then plot the result on spectrum analyzer screen.
5 Repeat above procedures until all frequencies measured were complete.

TEST RESULTS

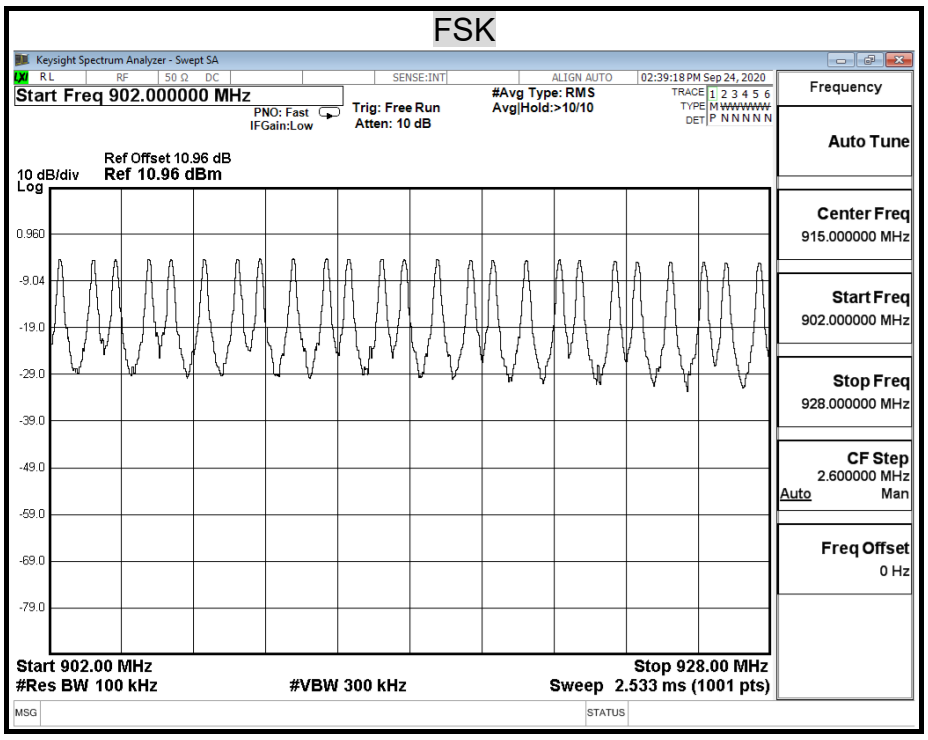
Model Name	WS900	Test By	Ted Huang
Temp & Humidity	26.5°C, 64%	Test Date	2020/10/13

Modulation Type: FSK

Result(No.of CH)	Limit(No.of CH)	Result
25	≧ 25，<50	PASS

NUMBER OF HOPPING FREQUENCY USED

FSK

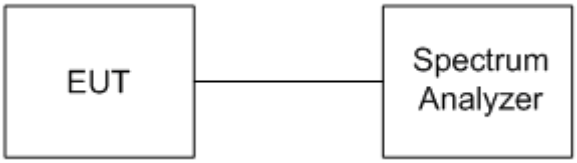


8.5 DUTY CYCLE

LIMIT

Nil (No dedicated limit specified in the Rules)

TEST SETUP



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

TEST RESULTS

No non-compliance noted.

TEST DATA

Model Name	WS900	Test By	Ted Huang
Temp & Humidity	26.5°C, 64%	Test Date	2020/10/13

Modulation Type: FSK

	us	Times	Ton	Total Ton time(ms)
Ton1	22200.000	1	22200	
Ton2		0	0	
Ton3			0	22.2
Tp				100

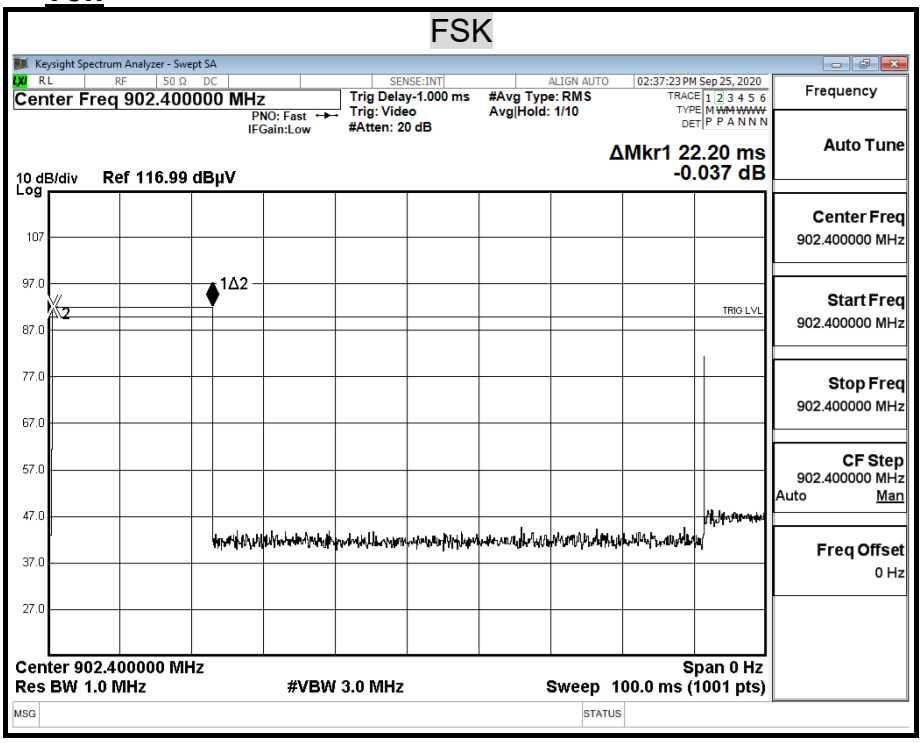
Ton	22.200
Tp(Ton+Toff)	100.000
Duty Cycle	0.222
Duty Factor	-13.07

TEST PLOT

Duty Cycle

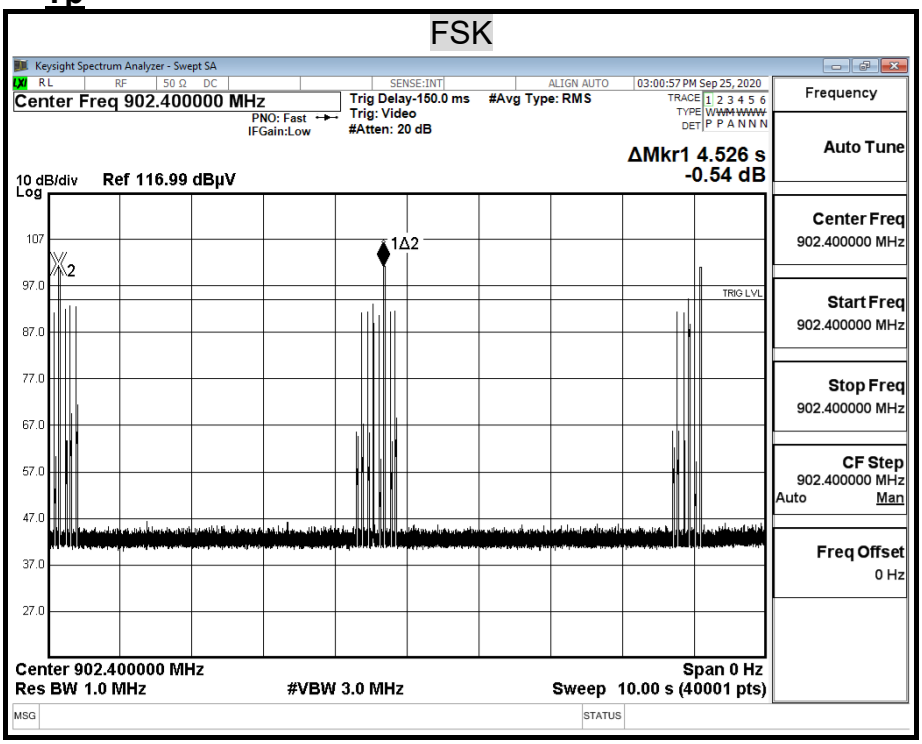
Ton

FSK



Tp

FSK



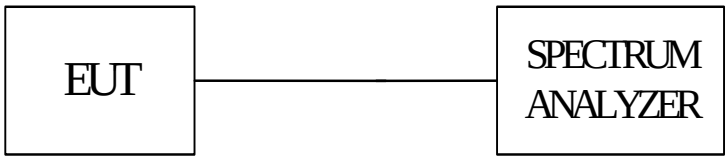
8.6 DWELL TIME ON EACH CHANNEL

LIMIT

§15.247(a)(1)(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Frequency(MHz)	Number of channels	Measurement Period(s)	Limit(s)
902 - 928	≧50	20	0.4
	49≧25	10	

TEST SETUP



TEST PROCEDURE

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of spectrum analyzer on any frequency be measured and set spectrum analyzer to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

TEST RESULTS

Model Name	WS900	Test By	Ted Huang
Temp & Humidity	26.5°C, 64%	Test Date	2020/10/13

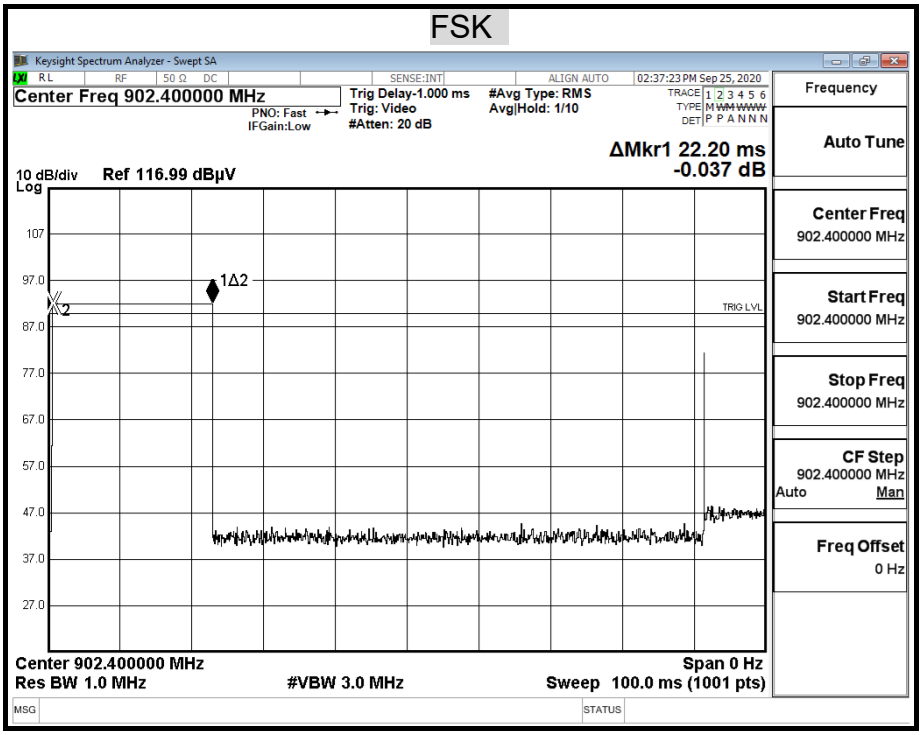
Modulation Type: FSK

Transmitting Frequency	Dwell time (ms)	Time of occupancy on the TX channel in 10sec (ms)	Limit for Time of occupancy on the TX channel in 10sec (ms)	Results
902.4 MHz	22.2	66.6	400	PASS

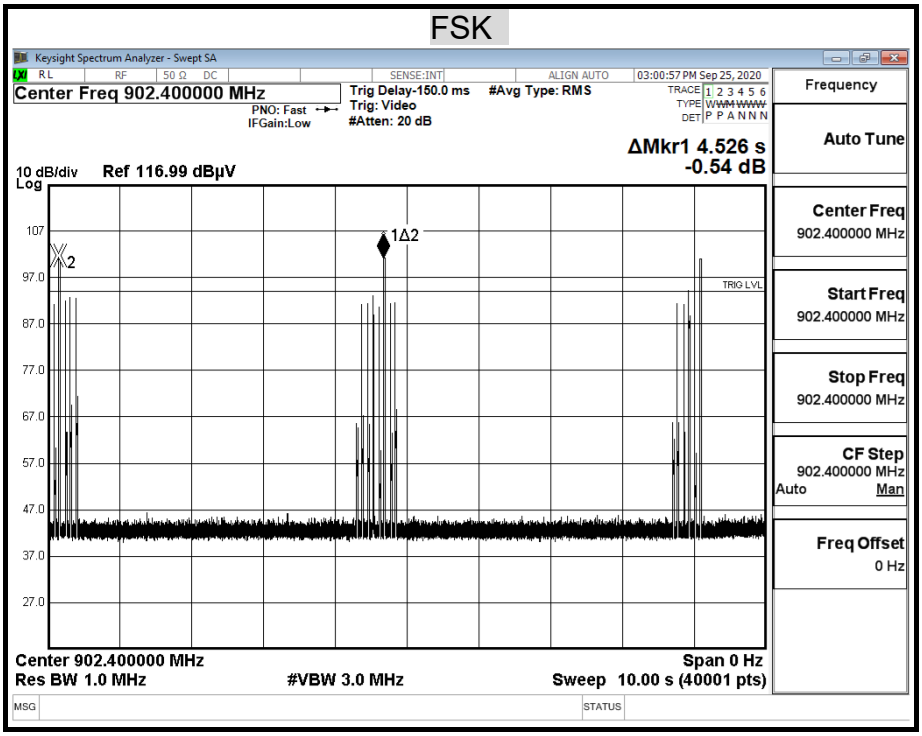
Total time = 22.2(ms)*3 = 66.6(ms)

DWELL TIME ON EACH PAYLOAD

FSK



FSK

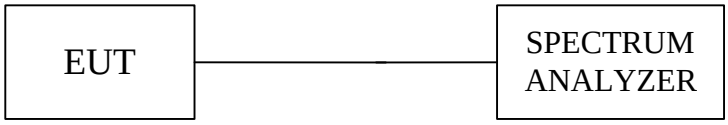


8.7 CONDUCTED SPURIOUS EMISSION

LIMITS

§ 15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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 and that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, 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) (see § 15.205(c)).

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

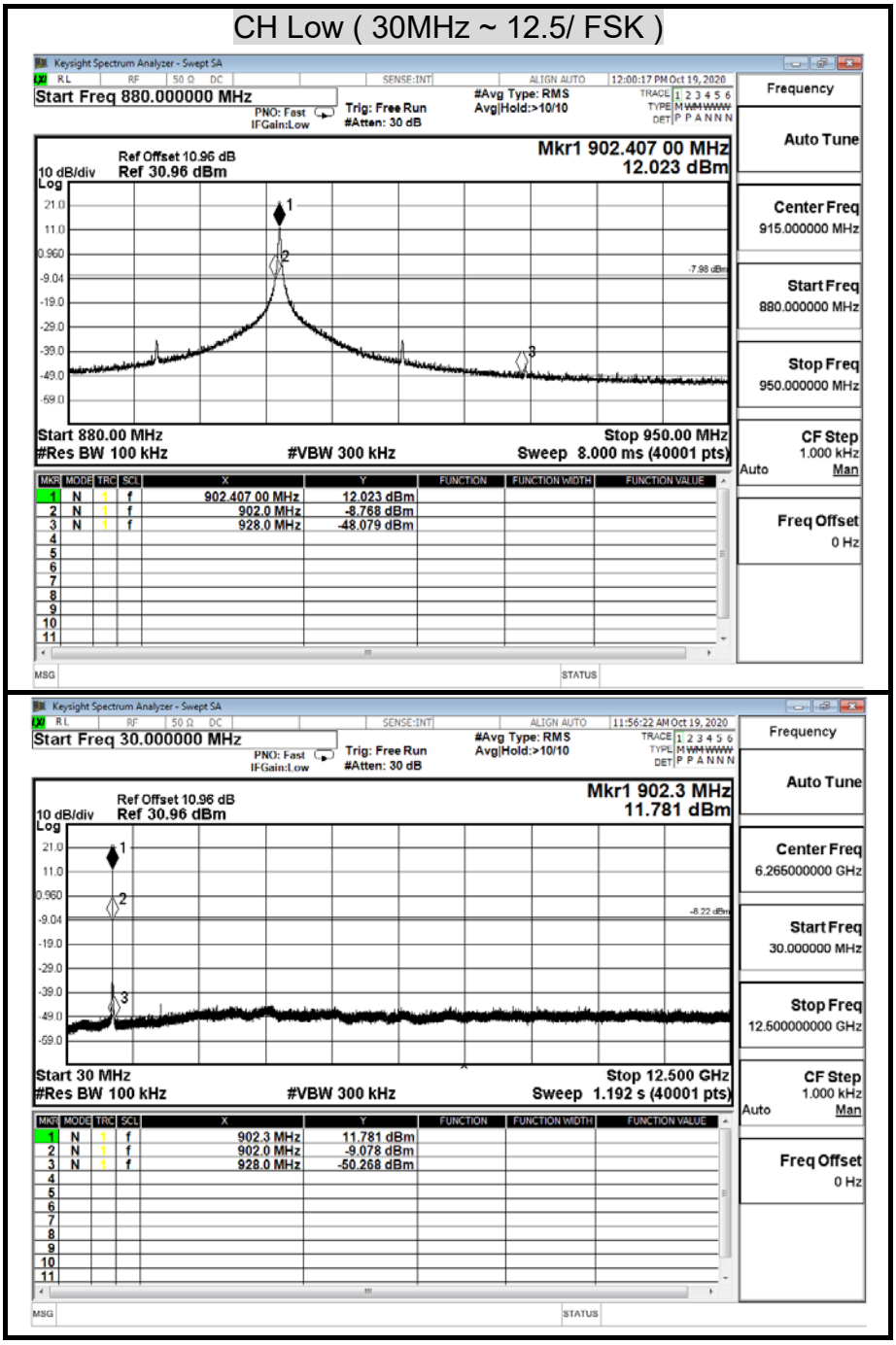
The spectrum from 30 MHz to 26.5 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

TEST RESULTS

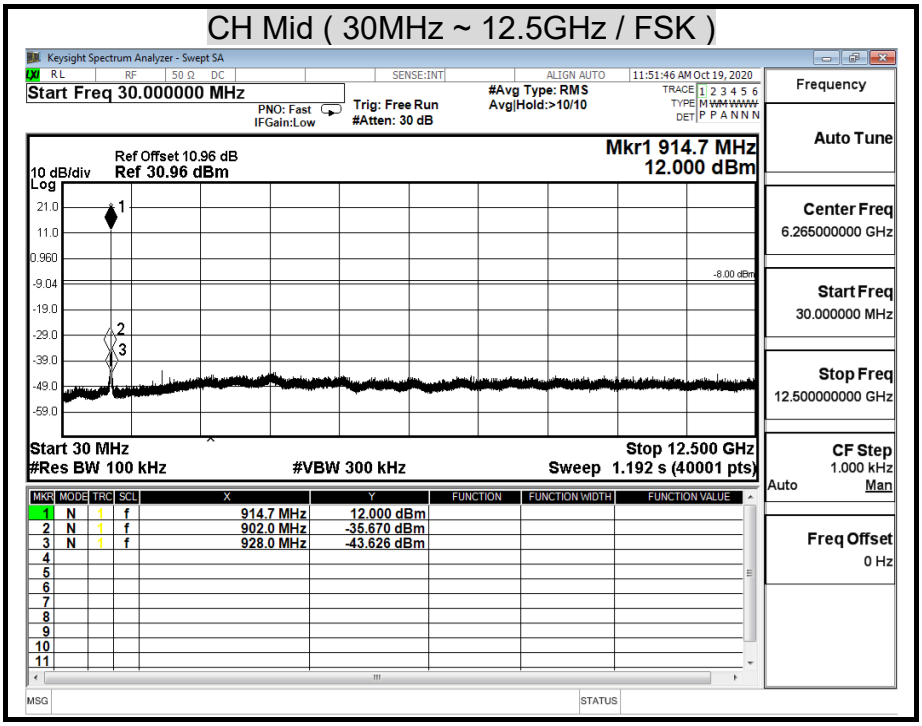
Model Name	WS900	Test By	Ted Huang
Temp & Humidity	26.5°C, 64%	Test Date	2020/10/13

OUT-OF-BAND SPURIOUS EMISSIONS-CONDUCTED MEASUREMENT

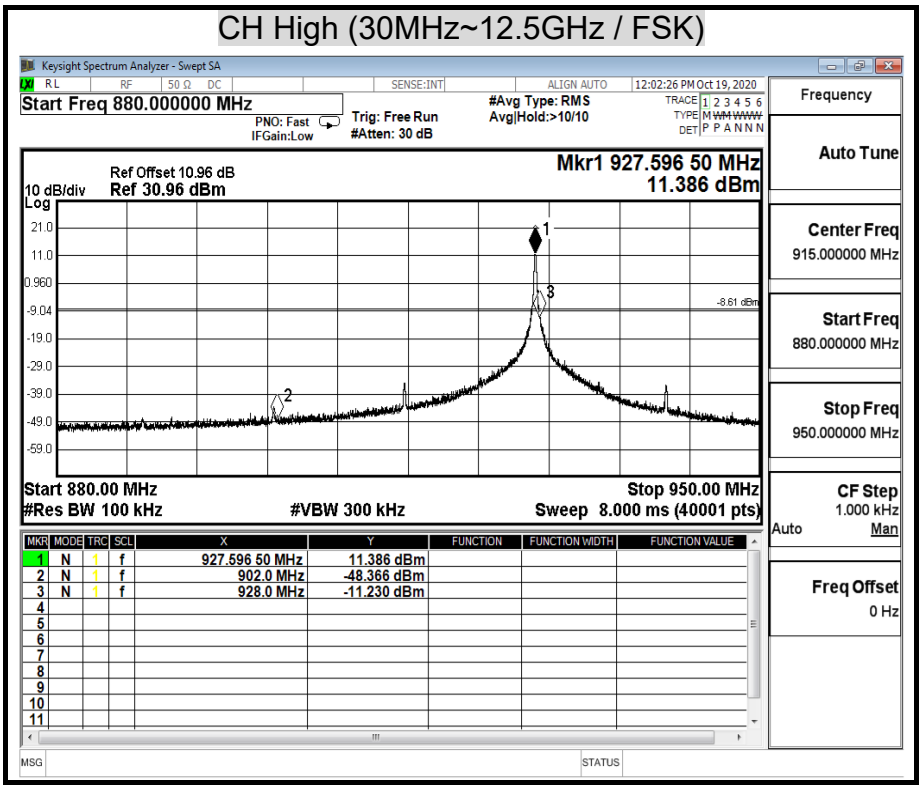
CH Low (30MHz ~ 12.5/ FSK)

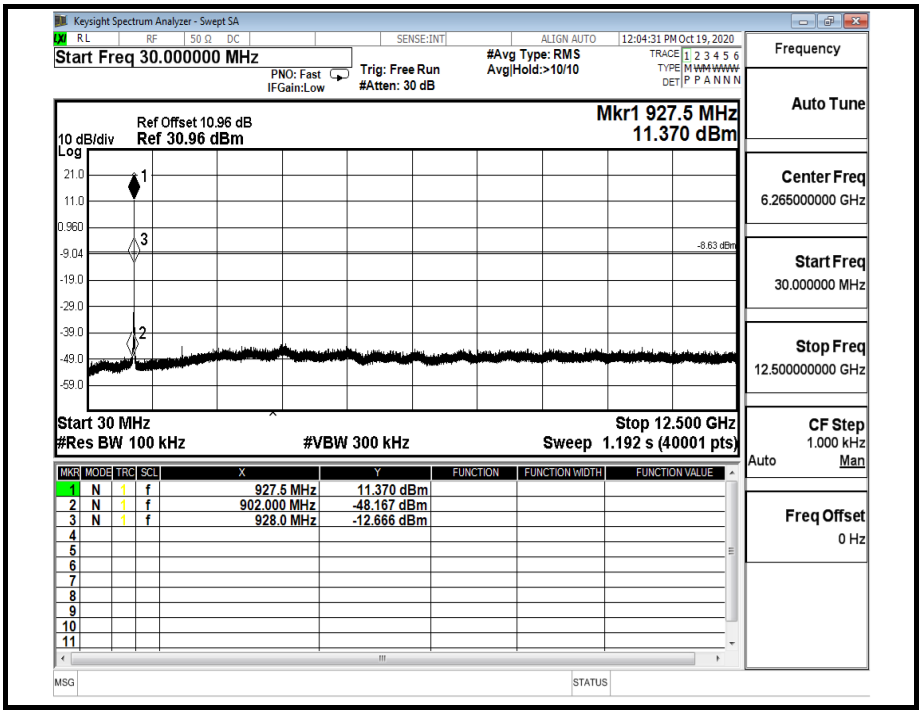


CH Mid (30MHz ~ 12.5GHz / FSK)

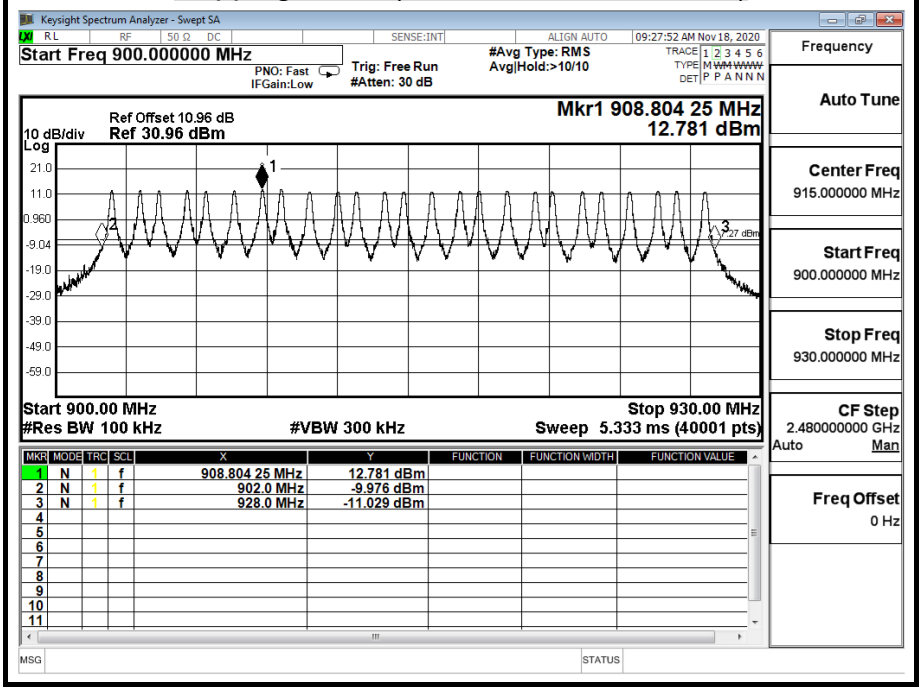


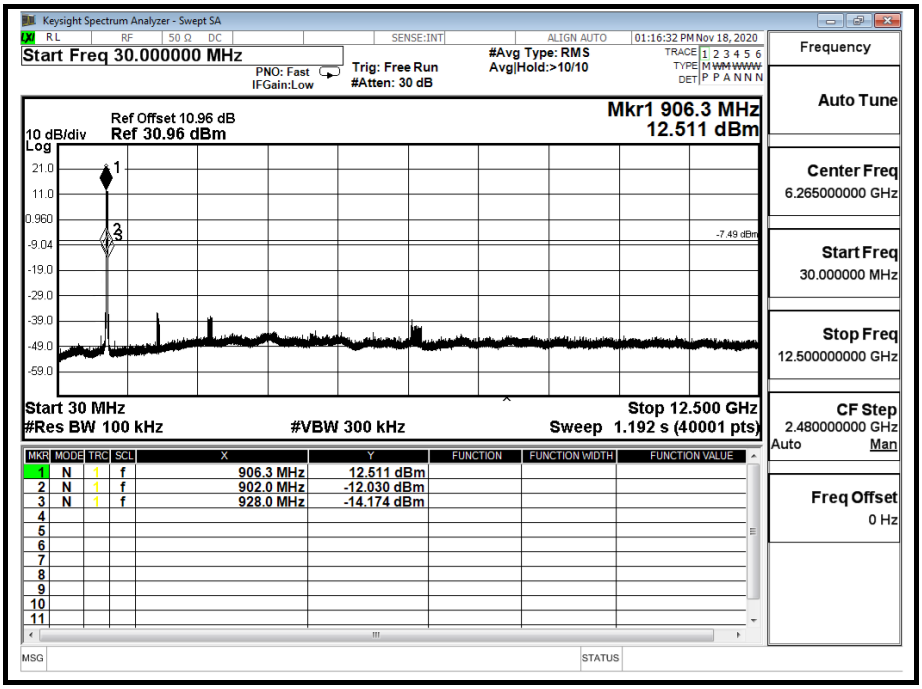
CH High (30MHz~12.5GHz / FSK)





Hopping mode (30MHz~12.5GHz / FSK)





8.8 RADIATED EMISSIONS

8.8.1 TRANSMITTER RADIATED SUPURIOUS EMSSIONS

LIMITS

§ 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 -1710	10.6 -12.7
6.26775 - 6.26825	108 -121.94	1718.8 - 1722.2	13.25 -13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 – 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 -16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3338	36.43 - 36.5
12.57675 - 12.57725	322 -335.4	3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown is Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§ 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

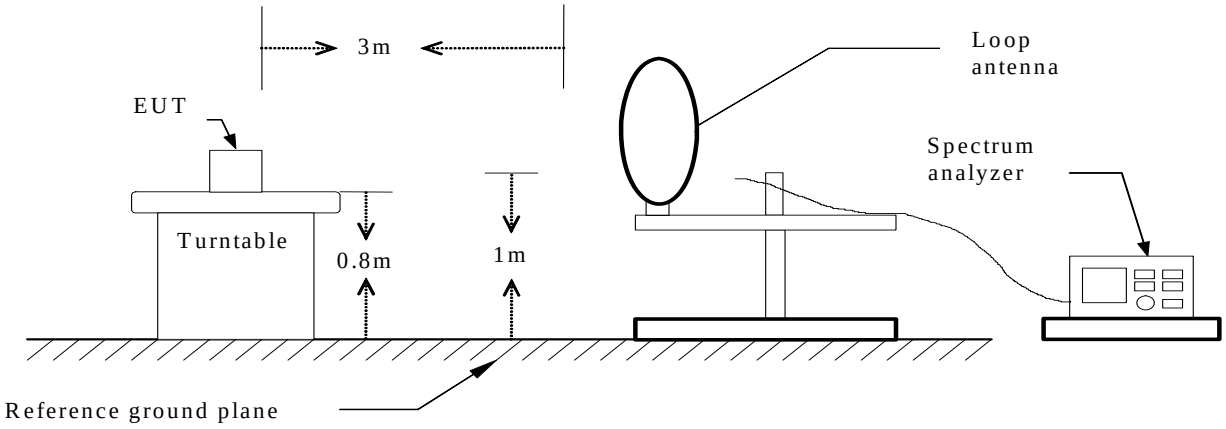
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz, However, operation within these frequency bands is permitted under other sections of this Part, e-g, Sections 15.231 and 15.241.

§ 15.209 (b) In the emission table above, the tighter limit applies at the band edges.

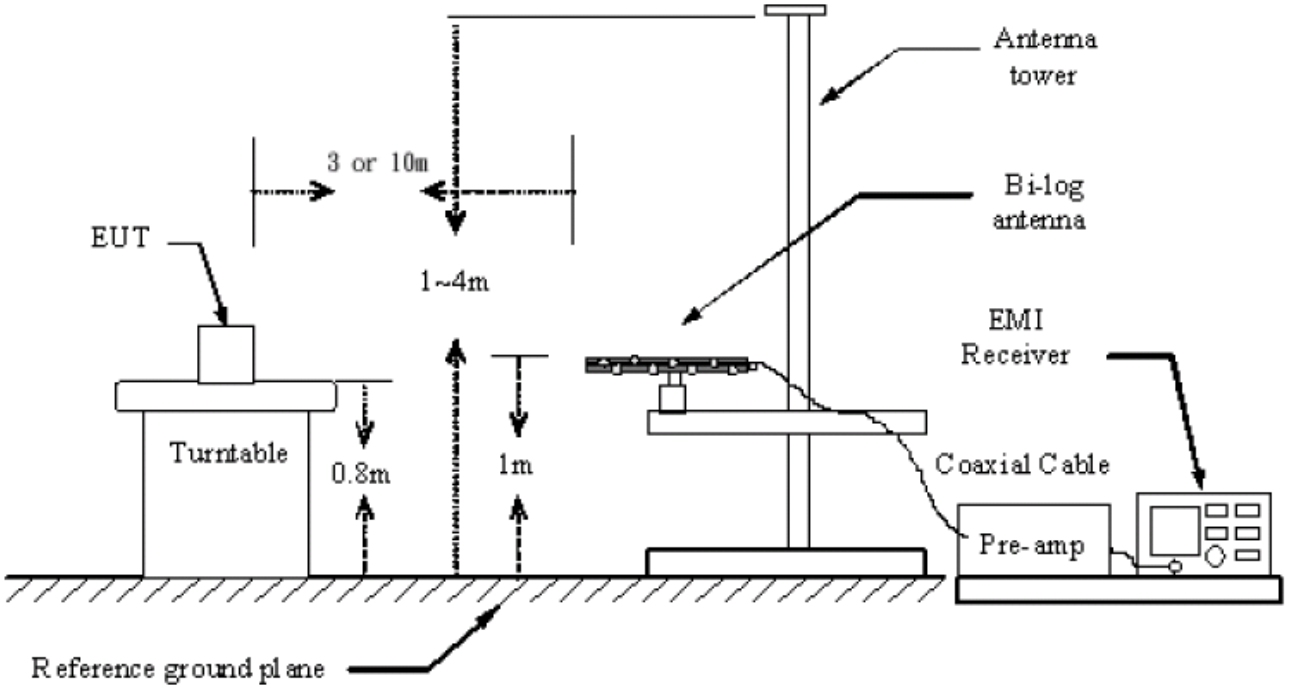
TEST SETUP

The diagram below shows the test setup that is utilized to make the measurements for emission from below 1GHz.

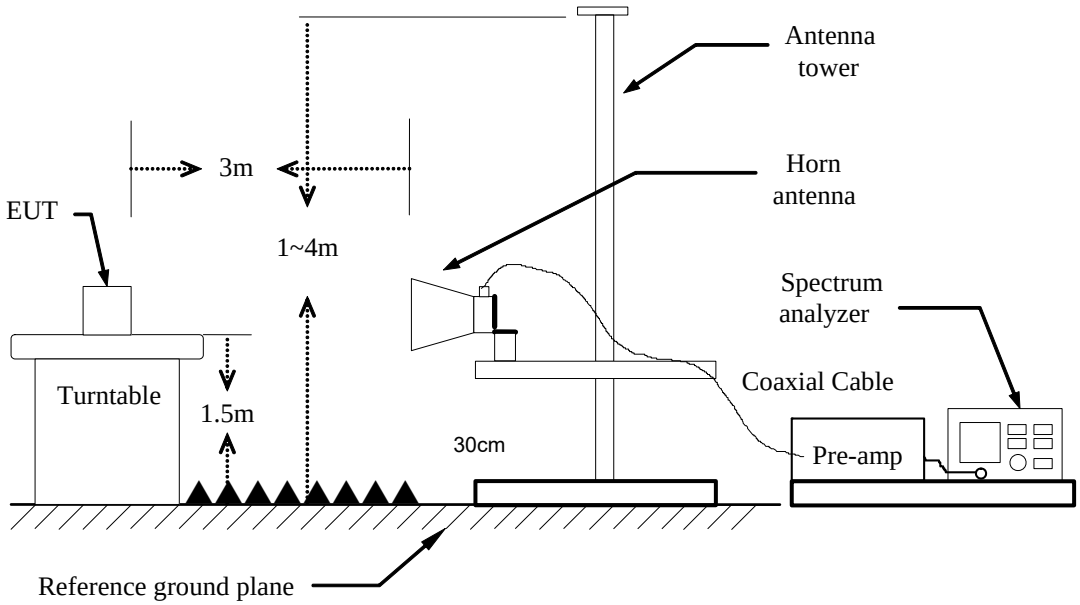
9kHz ~ 30MHz



30MHz ~ 1GHz



The diagram below shows the test setup that is utilized to make the measurements for emission above 1GHz.



TEST PROCEDURE

a. The EUT was placed on the top of a rotating table 0.8/1.5 meters above the ground at a 10/3 meter open site/chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. White measuring the radiated emission below 1GHz, the EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. White measuring the radiated emission above 1GHz, the EUT was set 3 or 10 meters away from the interference-receiving antenna
c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarization of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Note：

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 510 Hz for Average detection (AV) at frequency above 1GHz.

8.8.2 WORST-CASE RADIATED EMISSION BELOW 1 GHz

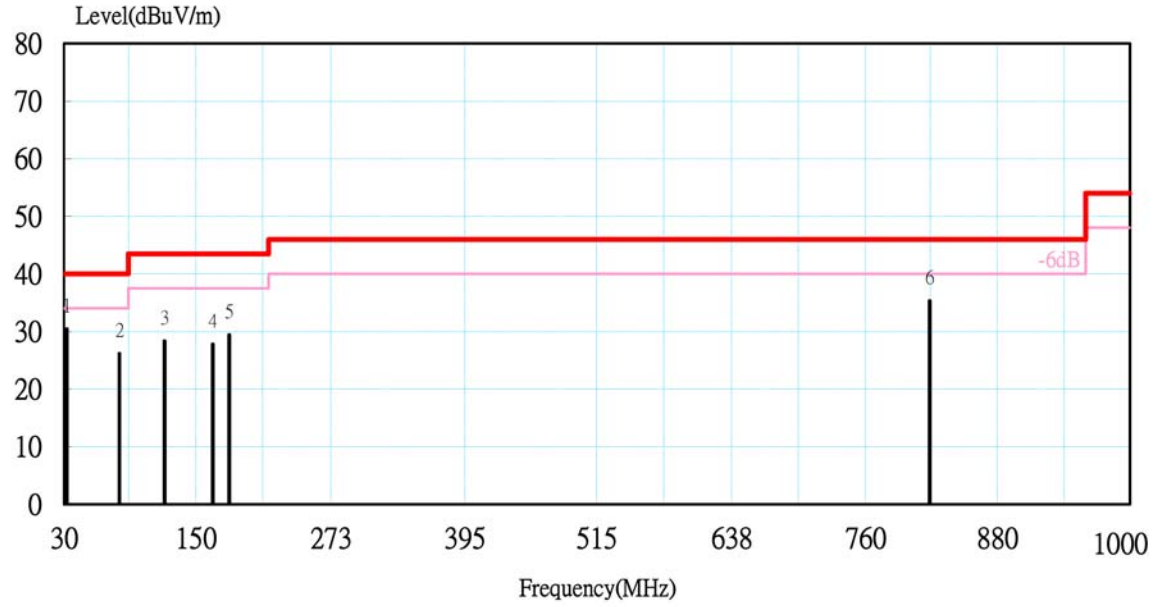
BELOW 1 GHz (9kHz ~ 30MHz)

No emission found between lowest internal used/generated frequency to 30MHz.

BELOW 1 GHz (30MHz ~ 1GHz)

Product Name	Water sensor	Test Date	2020/09/24
Model Name	WS900	Test By	Ted Huang
Test Mode	TX	Temp & Humidity	27°C, 53%

Vertical



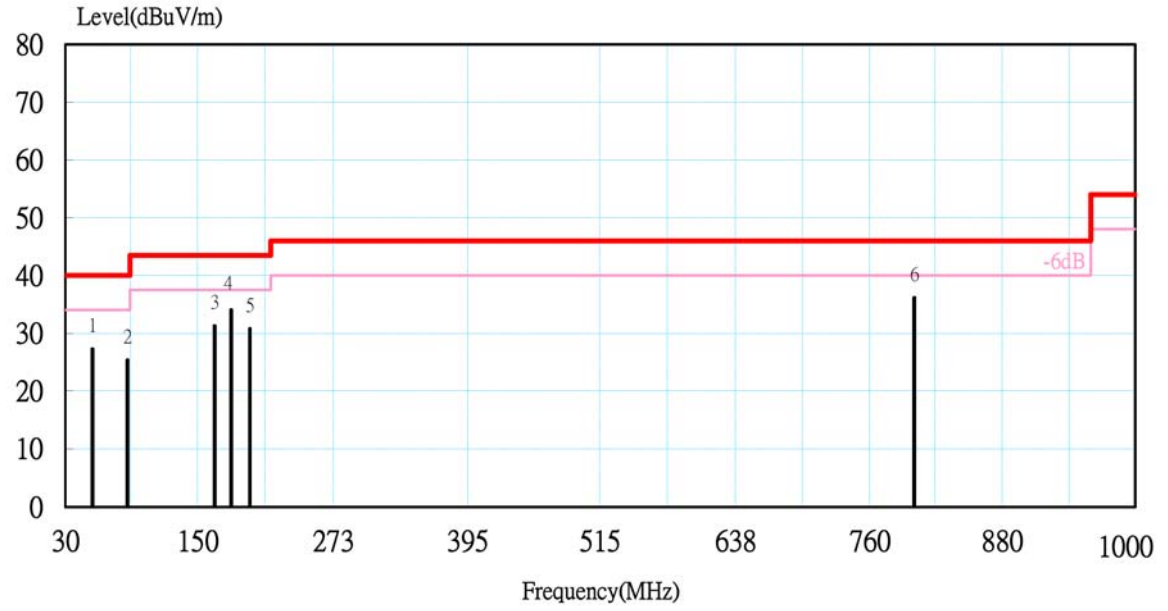
No.	Freq-Uency (MHz)	Meter Reading at 3 m Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Emission at 3 m Level (dBµV/m)	Limits (dBµV/m)	Margin (dB)	Detector Mode PK/QP
1	32.34	3.97	25.57	0.92	30.46	40.00	**-9.54**	QP
2	80.14	11.14	13.70	1.35	26.19	40.00	**-13.81**	QP
3	121.40	6.75	19.89	1.73	28.37	43.50	**-15.13**	QP
4	165.44	7.68	18.13	2.02	27.83	43.50	**-15.67**	QP
5	180.33	10.08	17.21	2.17	29.46	43.50	**-14.04**	QP
6	818.00	0.94	28.52	5.91	35.36	46.00	**-10.64**	QP

Remark:

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).
2. Radiated emissions measured were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

Product Name	Water sensor	Test Date	2020/09/24
Model Name	WS900	Test By	Ted Huang
Test Mode	TX	Temp & Humidity	27°C, 53%

Horizontal



No.	Freq-Uency (MHz)	Meter Reading at 3 m Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Emission at 3 m Level (dBµV/m)	Limits (dBµV/m)	Margin (dB)	Detector Mode PK/QP
1	54.25	12.36	13.89	1.11	27.35	40.00	-12.65	QP
2	86.81	10.28	13.70	1.42	25.40	40.00	-14.60	QP
3	165.10	11.18	18.15	2.02	31.35	43.50	-12.15	QP
4	180.35	14.71	17.21	2.17	34.09	43.50	-9.41	QP
5	197.20	10.01	18.51	2.31	30.83	43.50	-12.67	QP
6	800.24	2.07	28.30	5.85	36.22	46.00	-9.78	QP

Remark:

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).
2. Radiated emissions measured were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

8.8.3 TRANSMITTER RADIATED EMISSION ABOVE 1 GHz

Product Name	Water sensor	Test Date	2020/10/13
Model Name	WS900	Test By	Ted Huang
Test Mode	CH Low TX / FSK	Temp & Humidity	26.5°C, 64%

Horizontal

	TX mode / CH Low				Measurement Distance at 3m		Horizontal polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1804.82	71.10	28.94	2.66	45.59	0.78	57.89	74.00	-16.11	P
	1804.82	-	-	-	-	-	44.81	54.00	-9.19	A
*	2707.11	74.55	30.26	3.20	44.82	0.89	64.07	74.00	-9.93	P
*	2707.11	-	-	-	-	-	51.00	54.00	-3.00	A
*	3609.50	69.35	30.50	3.69	44.68	0.28	59.14	74.00	-14.86	P
*	3609.50	-	-	-	-	-	46.07	54.00	-7.93	A
*	4512.44	74.65	32.24	4.15	44.76	0.20	66.47	74.00	-7.53	P
*	4512.44	-	-	-	-	-	53.40	54.00	-0.60	A
*	5414.11	61.56	33.90	4.59	44.73	0.37	55.69	74.00	-18.31	P
*	5414.11	-	-	-	-	-	42.62	54.00	-11.38	A
	6316.98	68.17	34.88	5.02	44.54	0.24	63.78	74.00	-10.22	P
	6316.98	-	-	-	-	-	50.70	54.00	-3.30	A
	7219.04	64.69	38.79	5.39	44.05	0.27	65.09	74.00	-8.91	P
	7219.04	-	-	-	-	-	52.02	54.00	-1.98	A
*	8121.99	57.70	39.10	5.76	43.10	0.30	59.76	74.00	-14.24	P
*	8121.99	-	-	-	-	-	46.69	54.00	-7.31	A
*	9024.16	60.56	38.41	6.13	42.32	0.30	63.08	74.00	-10.92	P
*	9024.16	-	-	-	-	-	50.01	54.00	-3.99	A

Vertical

	TX mode / CH Low				Measurement Distance at 3m			Vertical polarity		
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1804.79	65.50	28.94	2.66	45.59	0.78	52.29	74.00	-21.71	P
	1804.79	-	-	-	-	-	39.21	54.00	-14.79	A
*	2707.41	67.11	30.26	3.20	44.82	0.89	56.63	74.00	-17.37	P
*	2707.41	-	-	-	-	-	43.56	54.00	-10.44	A
*	3609.55	64.82	30.50	3.69	44.68	0.28	54.61	74.00	-19.39	P
*	3609.55	-	-	-	-	-	41.54	54.00	-12.46	A
*	4512.01	71.38	32.24	4.15	44.76	0.20	63.20	74.00	-10.80	P
*	4512.01	-	-	-	-	-	50.13	54.00	-3.87	A
*	5414.26	63.50	33.90	4.59	44.73	0.37	57.63	74.00	-16.37	P
*	5414.26	-	-	-	-	-	44.56	54.00	-9.44	A
	6316.89	66.68	34.88	5.02	44.54	0.24	62.29	74.00	-11.71	P
	6316.89	-	-	-	-	-	49.21	54.00	-4.79	A
	7219.17	64.26	38.79	5.39	44.05	0.27	64.67	74.00	-9.33	P
	7219.17	-	-	-	-	-	51.59	54.00	-2.41	A
*	8121.98	60.54	39.10	5.76	43.10	0.30	62.60	74.00	-11.40	P
*	8121.98	-	-	-	-	-	49.53	54.00	-4.47	A
*	9023.57	60.40	38.41	6.13	42.32	0.30	62.92	74.00	-11.08	P
*	9023.57	-	-	-	-	-	49.85	54.00	-4.15	A

Remark:
1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz
3. Average level=Peak level + Duty factor
4. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
5. The other emission levels were 20dB below the limit
6. The test limit distance is 3M limit.
7. *=Restricted bands of operation

Product Name	Water sensor	Test Date	2020/10/13
Model Name	WS900	Test By	Ted Huang
Test Mode	CH Mid TX / FSK	Temp & Humidity	26.5°C, 64%

Horizontal

	TX mode / CH Mid				Measurement Distance at 3m		Horizontal polarity			
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1829.54	70.83	29.14	2.67	45.56	0.80	57.89	74.00	-16.11	P
	1829.54	-	-	-	-	-	44.81	54.00	-9.19	A
*	2744.41	73.93	30.25	3.23	44.79	0.87	63.48	74.00	-10.52	P
*	2744.41	-	-	-	-	-	50.41	54.00	-3.59	A
*	3659.07	67.38	30.59	3.71	44.69	0.27	57.26	74.00	-16.74	P
*	3659.07	-	-	-	-	-	44.19	54.00	-9.81	A
	4574.32	73.24	32.45	4.18	44.76	0.20	65.31	74.00	-8.69	P
*	4574.32	-	-	-	-	-	52.24	54.00	-1.76	A
	5489.21	62.77	33.90	4.63	44.72	0.40	56.97	74.00	-17.03	P
	5489.21	-	-	-	-	-	43.90	54.00	-10.10	A
	6403.48	69.28	34.98	5.06	44.51	0.24	65.06	74.00	-8.94	P
	6403.48	-	-	-	-	-	51.98	54.00	-2.02	A
*	7318.34	64.13	39.15	5.43	43.94	0.27	65.04	74.00	-8.96	P
*	7318.34	-	-	-	-	-	51.96	54.00	-2.04	A
*	8232.45	57.58	39.01	5.81	43.01	0.28	59.68	74.00	-14.32	P
*	8232.45	-	-	-	-	-	46.61	54.00	-7.39	A
*	9147.91	56.84	38.46	6.17	42.32	0.31	59.46	74.00	-14.54	P
*	9147.91	-	-	-	-	-	46.39	54.00	-7.61	A

Vertical

	TX mode / CH Mid				Measurement Distance at 3m			Vertical polarity		
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1829.28	65.01	29.13	2.67	45.56	0.80	52.06	74.00	-21.94	P
	1829.28	-	-	-	-	-	38.99	54.00	-15.01	A
*	2744.51	66.14	30.25	3.23	44.79	0.87	55.69	74.00	-18.31	P
*	2744.51	-	-	-	-	-	42.62	54.00	-11.38	A
*	3659.30	63.58	30.59	3.71	44.69	0.27	53.46	74.00	-20.54	P
*	3659.30	-	-	-	-	-	40.39	54.00	-13.61	A
*	4574.38	70.38	32.45	4.18	44.76	0.20	62.45	74.00	-11.55	P
*	4574.38	-	-	-	-	-	49.38	54.00	-4.62	A
	5488.48	64.90	33.90	4.62	44.72	0.40	59.10	74.00	-14.90	P
	5488.48	-	-	-	-	-	46.03	54.00	-7.97	A
	6403.60	67.80	34.98	5.06	44.51	0.24	63.58	74.00	-10.42	P
	6403.60	-	-	-	-	-	50.50	54.00	-3.50	A
*	7318.26	64.67	39.15	5.43	43.94	0.27	65.58	74.00	-8.42	P
*	7318.26	-	-	-	-	-	52.50	54.00	-1.50	A
*	82233.34	59.18	0.00	0.00	37.52	0.00	21.66	74.00	-52.34	P
*	82233.34	-	-	-	-	-	8.59	54.00	-45.41	A
*	9147.90	59.73	38.46	6.17	42.32	0.31	62.35	74.00	-11.65	P
*	9147.90	-	-	-	-	-	49.28	54.00	-4.72	A

Remark:

1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz
3. Average level=Peak level + Duty factor
4. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
5. The other emission levels were 20dB below the limit
6. The test limit distance is 3M limit.
7. *=Restricted bands of operation

Product Name	Water sensor	Test Date	2020/10/13
Model Name	WS900	Test By	Ted Huang
Test Mode	CH High TX / GFSK	Temp & Humidity	26.5°C, 64%

Horizontal

	TX mode / CH High				Measurement Distance at 3m Horizontal polarity					
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1855.41	76.56	29.34	2.69	45.53	0.83	63.90	74.00	-10.10	P
	1855.41	-	-	-	-	-	50.83	54.00	-3.17	A
*	2783.04	73.82	30.24	3.25	44.76	0.85	63.40	74.00	-10.60	P
*	2783.04	-	-	-	-	-	50.33	54.00	-3.67	A
*	3710.40	66.49	30.68	3.74	44.70	0.26	56.47	74.00	-17.53	P
*	3710.40	-	-	-	-	-	43.40	54.00	-10.60	A
*	4637.65	68.86	32.67	4.21	44.77	0.21	61.18	74.00	-12.82	P
*	4637.65	-	-	-	-	-	48.11	54.00	-5.89	A
	5565.65	63.66	33.98	4.66	44.71	0.38	57.97	74.00	-16.03	P
	5565.65	-	-	-	-	-	44.90	54.00	-9.10	A
	6493.42	67.45	35.09	5.10	44.47	0.24	63.40	74.00	-10.60	P
	6493.42	-	-	-	-	-	50.33	54.00	-3.67	A
*	7421.05	64.04	39.52	5.48	43.83	0.27	65.47	74.00	-8.53	P
*	7421.05	-	-	-	-	-	52.39	54.00	-1.61	A
*	8348.27	55.89	38.92	5.86	42.90	0.27	58.04	74.00	-15.96	P
*	8348.27	-	-	-	-	-	44.96	54.00	-9.04	A
	9276.56	57.25	38.51	6.21	42.31	0.32	59.97	74.00	-14.03	P
	9276.56	-	-	-	-	-	46.90	54.00	-7.10	A

Vertical

	TX mode / CH High				Measurement Distance at 3m Vertical polarity					
	Freq.	Reading	AF	Cable Loss	Pre-amp	Filter	Level	Limit	Margin	Mark
	(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(P/Q/A)
	1855.14	72.53	29.34	2.69	45.53	0.83	59.87	74.00	-14.13	P
	1855.14	-	-	-	-	-	46.79	54.00	-7.21	A
*	2782.98	67.99	30.24	3.25	44.76	0.85	57.57	74.00	-16.43	P
*	2782.98	-	-	-	-	-	44.50	54.00	-9.50	A
*	3710.38	62.91	30.68	3.74	44.70	0.26	52.89	74.00	-21.11	P
*	3710.38	-	-	-	-	-	39.82	54.00	-14.18	A
*	4637.67	66.60	32.67	4.21	44.77	0.21	58.92	74.00	-15.08	P
*	4637.67	-	-	-	-	-	45.85	54.00	-8.15	A
	5565.79	65.30	33.98	4.66	44.71	0.38	59.61	74.00	-14.39	P
	5565.79	-	-	-	-	-	46.54	54.00	-7.46	A
	6493.12	65.29	35.09	5.10	44.47	0.24	61.24	74.00	-12.76	P
	6493.12	-	-	-	-	-	48.17	54.00	-5.83	A
*	7421.07	64.85	39.52	5.48	43.83	0.27	66.28	74.00	-7.72	P
*	7421.07	-	-	-	-	-	53.20	54.00	-0.80	A
*	8347.83	56.12	38.92	5.86	42.90	0.27	58.26	74.00	-15.74	P
*	8347.83	-	-	-	-	-	45.19	54.00	-8.81	A
	9276.09	59.18	38.51	6.21	42.31	0.32	61.90	74.00	-12.10	P
	9276.09	-	-	-	-	-	48.83	54.00	-5.17	A

Remark:
1. AF: Antenna Factor, Cable: Cable Loss, Pre-Amp: Preamplifier gain, Filter: High Pass Filter Insertion Loss (3.5GHz)
2. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz
3. Average level=Peak level + Duty factor
4. The result basic equation calculation is as follow:
   Level = Reading + AF + Cable – Preamp + Filter, Margin = Level-Limit
5. The other emission levels were 20dB below the limit
6. The test limit distance is 3M limit.
7. *=Restricted bands of operation

8.9 POWERLINE CONDUCTED EMISSIONS

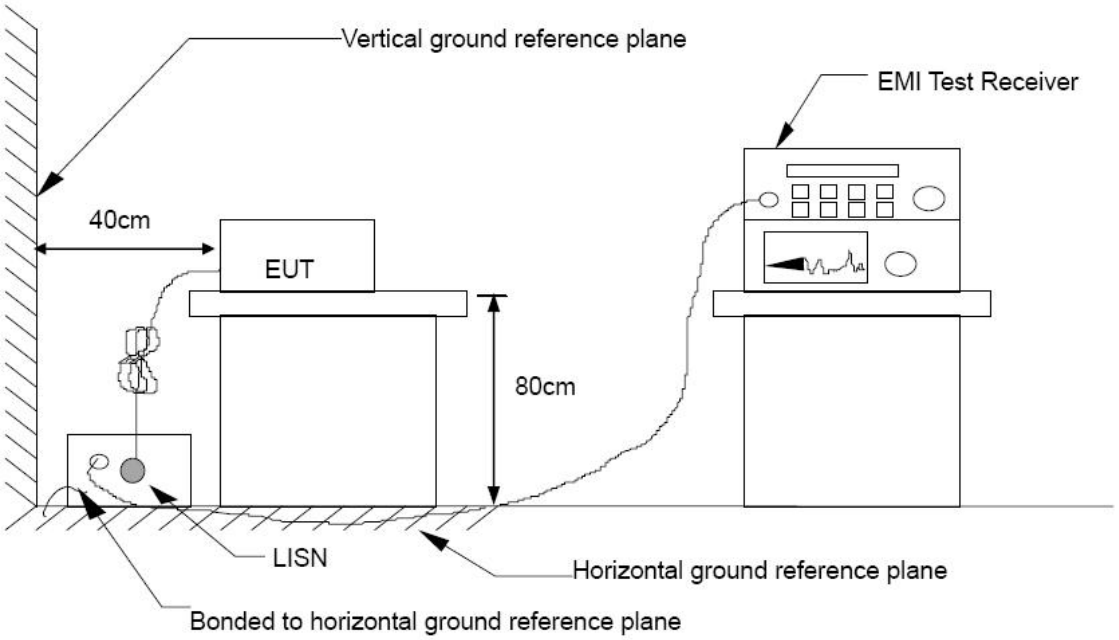
LIMITS

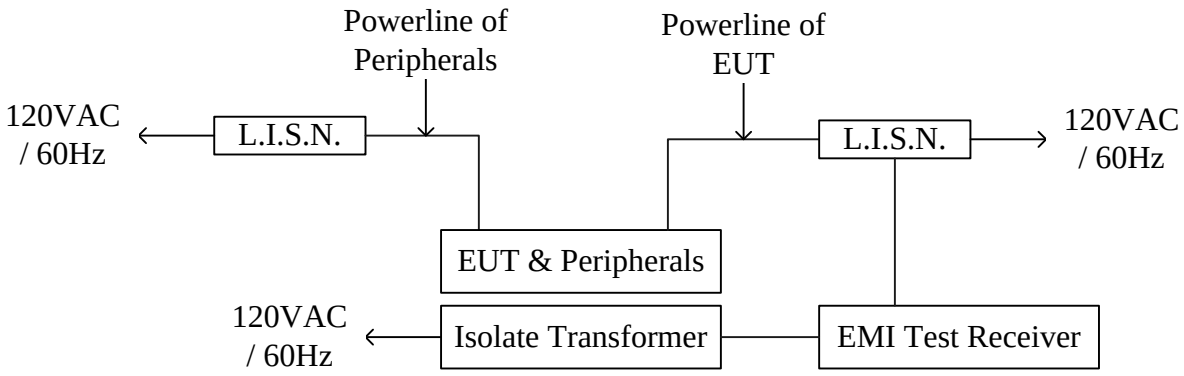
§ 15.207 (a) Except as shown in paragraph (b) and (c) this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted limit (dBμv)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 - 30	60	50

TEST SETUP





TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80cm above the horizontal ground plane. The EUT IS CONFIGURED IN ACCORDANCE WITH ANSI C63.10 : 2013.

The resolution bandwidth is set to 9 kHz for both quasi-peak detection and average detection measurements.

Line conducted data is recorded for both NEUTRAL and LINE.

TEST RESULTS

※ **This EUT is not connected to AC Source directly. Not applicable for this test.**

=== END of Report ===