FCC RF Test Report

Applicant:	Hangzhou Roombanker Technology Co., Ltd.
Address of Applicant:	A#801 Wantong center, Hangzhou, China
Equipment Under Test (EUT)	
Product Name:	Multi Protocol Host Gateway
Model No.:	DSGW-291, DSGW-291-X (X:1~18)
FCC ID:	2AUXBDSGW-291
Applicable Standards:	FCC CFR Title 47 Part 15C (§15.249)
Date of Sample Receipt:	27 Feb., 2023
Date of Test:	28 Feb., to 26 May, 2023
Date of Report Issue:	29 May, 2023
Test Result:	PASS

Tested by:	June Li ***Test Engineer***	***Date:***	*29 May, 2023*
Reviewed by:	Janet Wu ***Project Engineer***	***Date:***	*29 May, 2023*
Approved by:	Eric Zhang ***Manager***	***Date:***	*29 May, 2023*

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in above the application standard version. Test results reported herein relate only to the item(s) tested.

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2 Version

Version No.	Date	Description
00	*29 May, 2023*	*Original*

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4 General Information

4.1 Client Information

Applicant:	Hangzhou Roombanker Technology Co., Ltd.
Address:	A#801 Wantong center, Hangzhou, China
Manufacturer:	Hangzhou Roombanker Technology Co., Ltd.
Address:	A#801 Wantong center, Hangzhou, China

4.2 General Description of E.U.T.

Product Name:	Multi Protocol Host Gateway
Model No.:	DSGW-291, DSGW-291-X (X:1~18)
Operation Frequency:	908.4 MHz
Channel Numbers:	1
Modulation Type:	GFSK
Antenna Type:	Internal Antenna
Antenna Gain:	-2.20 dBi
Power Supply:	DC 12V, 3.0A
Test Sample Condition:	The test samples were provided in good working order with no visible defects.
Remark:	DSGW-291, DSGW-291-X (X:1~18) were identical inside, the electrical circuit design, layout, components used and internal wiring, with only difference being model name.

4.3 Test Mode and Environment

Test Mode:	
Transmitting mode:	Keep the EUT in transmitting mode with modulation
Remark: *The EUT was placed on three different polar directions tested: i.e. X axis, Y axis, Z axis, and found the test results are both the "worst case" and "worst setup": Y axis, so the report only reflects the test data of worst mode.*	
Operating Environment:	
Temperature:	15℃ ~ 35℃
Humidity:	20 % ~ 75 % RH
Atmospheric Pressure:	1010 mbar

4.4 Description of Support Units

N/A

4.5 Measurement Uncertainty

Parameter	Expanded Uncertainty (Confidence of 95%(U = 2Uc(y)))
Radiated Emission (1GHz ~ 18GHz) (3m SAC)	3.6 dB
Radiated Emission (18GHz ~ 40GHz) (3m SAC)	5.34 dB
Radiated Emission (30MHz ~ 1GHz) (10m SAC)	3.7 dB
Remark: *All the measurement uncertainty value were shown with a coverage k=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.*	

4.6 Additions to, Deviations, or Exclusions From the Method

No

4.7 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **FCC - Designation No.: CN1211**

JianYan Testing Group Shenzhen Co., Ltd. has been accredited as a testing laboratory by FCC(Federal Communications Commission). The test firm Registration No. is 727551.

- **ISED – CAB identifier.: CN0021**

The 3m Semi-anechoic chamber and 10m Semi-anechoic chamber of JianYan Testing Group Shenzhen Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

- **CNAS - Registration No.: CNAS L15527**

JianYan Testing Group Shenzhen Co., Ltd. is accredited to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L15527.

- **A2LA - Registration No.: 4346.01**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. The test scope can be found as below link: https://portal.a2la.org/scopepdf/4346-01.pdf

4.8 Laboratory Location

JianYan Testing Group Shenzhen Co., Ltd.
Address: No.101, Building 8, Innovation Wisdom Port, No.155 Hongtian Road, Huangpu Community, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, People's Republic of China.
Tel: +86-755-23118282, Fax: +86-755-23116366
Email: info-JYTee@lets.com, Website: http://jyt.lets.com

4.9 Test Instruments List

Radiated Emission(3m SAC):					
Test Equipment	**Manufacturer**	**Model No.**	**Manage No.**	**Cal.Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
3m SAC	ETS	9m*6m*6m	WXJ001-1	04-14-2021	04-13-2024
BiConiLog Antenna	Schwarzbeck	VULB9163	WXJ002	02-09-2023	02-08-2024
Biconical Antenna	Schwarzbeck	VUBA9117	WXJ002-1	07-01-2021	07-01-2024
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-2	02-09-2023	02-08-2024
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-3	01-09-2023	01-08-2024
Loop Antenna	Schwarzbeck	FMZB 1519 B	WXJ002-4	02-09-2023	02-08-2024
Pre-amplifier (30MHz ~ 1GHz)	Schwarzbeck	BBV9743B	WXJ001-2	01-10-2023	01-09-2024
Pre-amplifier (1GHz ~ 18GHz)	SKET	LNPA_0118G-50	WXJ001-3	01-10-2023	01-09-2024
Pre-amplifier (18GHz ~ 40GHz)	RF System	TRLA-180400G45B	WXJ002-7	01-11-2023	01-10-2024
EMI Test Receiver	Rohde & Schwarz	ESRP7	WXJ003-1	01-11-2023	01-10-2024
Spectrum Analyzer	KEYSIGHT	N9010B	WXJ004-2	10-17-2022	10-16-2023
Band Reject Filter Group	Tonscend	JS0806-F	WXJ089	N/A	
Coaxial Cable (30MHz ~ 1GHz)	JYTSZ	JYT3M-1G-NN-8M	WXG001-4	01-18-2023	01-17-2024
Coaxial Cable (1GHz ~ 18GHz)	JYTSZ	JYT3M-18G-NN-8M	WXG001-5	01-18-2023	01-17-2024
Coaxial Cable (18GHz ~ 40GHz)	JYTSZ	JYT3M-40G-SS-8M	WXG001-7	01-18-2023	01-17-2024
Coaxial Cable (9kHz ~ 30MHz)	JYT	JYT3M-1G-BB-5M	WXG001-6	01-18-2023	01-17-2024
Test Software	Tonscend	TS+	Version: 3.0.0.1		

Radiated Emission(10m SAC):					
Test Equipment	**Manufacturer**	**Model No.**	**Manage No.**	**Cal. Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
10m SAC	ETS	RFSD-100-F/A	WXJ090	04-28-2021	04-27-2024
BiConiLog Antenna	SCHWARZBECK	VULB 9168	WXJ090-1	01-17-2023	01-16-2024
BiConiLog Antenna	SCHWARZBECK	VULB 9168	WXJ090-2	01-10-2023	01-09-2024
EMI Test Receiver	R&S	ESR 3	WXJ090-3	01-10-2023	01-09-2024
EMI Test Receiver	R&S	ESR 3	WXJ090-4	01-11-2023	01-09-2024
Low Pre-amplifier	Bost	LNA 0920N	WXJ090-6	01-10-2023	01-09-2024
Low Pre-amplifier	Bost	LNA 0920N	WXJ090-7	01-10-2023	01-09-2024
Cable	Bost	JYT10M-1G-NN-10M	WXG002-7	01-18-2023	01-17-2024
Cable	Bost	JYT10M-1G-NN-10M	WXG002-8	01-18-2023	01-17-2024
Test Software	R&S	EMC32	Version: 10.50.40		

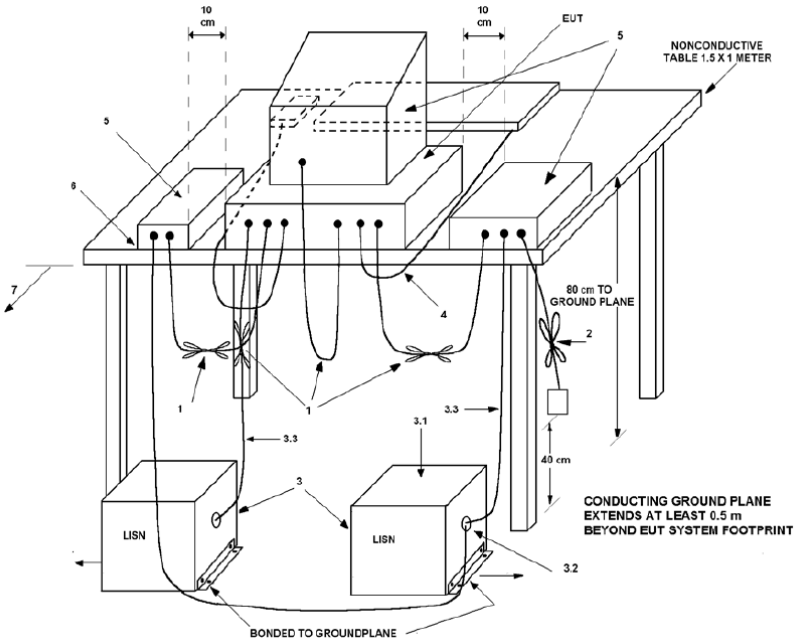
Conducted Emission:					
Test Equipment	**Manufacturer**	**Model No.**	**Manage No.**	**Cal. Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
EMI Test Receiver	Rohde & Schwarz	ESR3	WXJ003-2	07-12-2022	07-11-2023
LISN	Schwarzbeck	NSLK 8127	QCJ001-13	01-10-2023	01-09-2024
LISN	Rohde & Schwarz	ESH3-Z5	WXJ005-1	01-11-2023	01-10-2024
LISN Coaxial Cable (9kHz ~ 30MHz)	JYTSZ	JYTCE-1G-NN-2M	WXG003-1	02-22-2023	02-21-2024
RF Switch	TOP PRECISION	RSU0301	WXG003	N/A	
Test Software	AUDIX	E3	Version: 6.110919b		

Conducted Method:					
Test Equipment	**Manufacturer**	**Model No.**	**Manage No.**	**Cal. Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
EMI Test Receiver	Rohde & Schwarz	ESCI3	WXJ003	01-10-2023	01-09-2024

5 Measurement Setup and Procedure

5.1 Test Setup

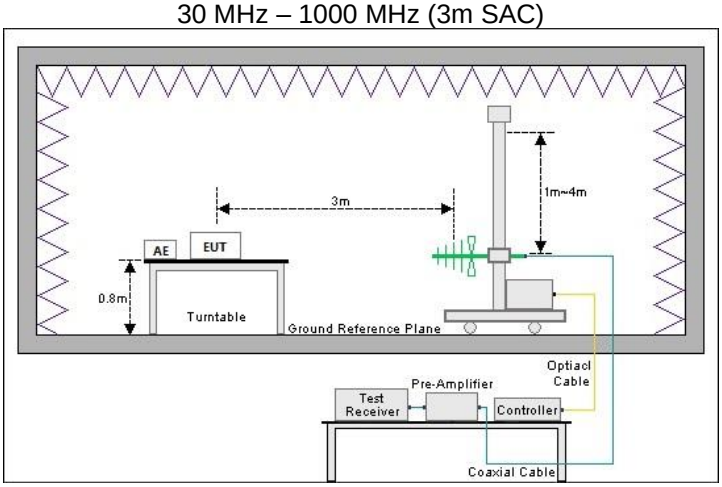
Conducted emission measurement:



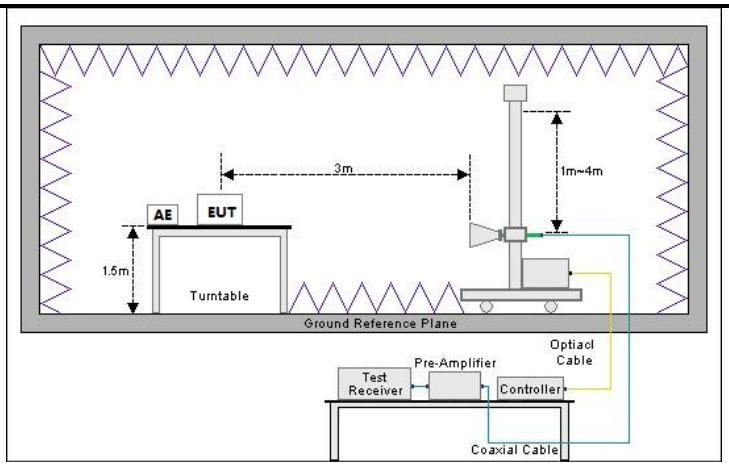
Note: The detailed descriptions please refer to Figure 8 of ANSI C63.4:2014.

Radiated emission measurement:

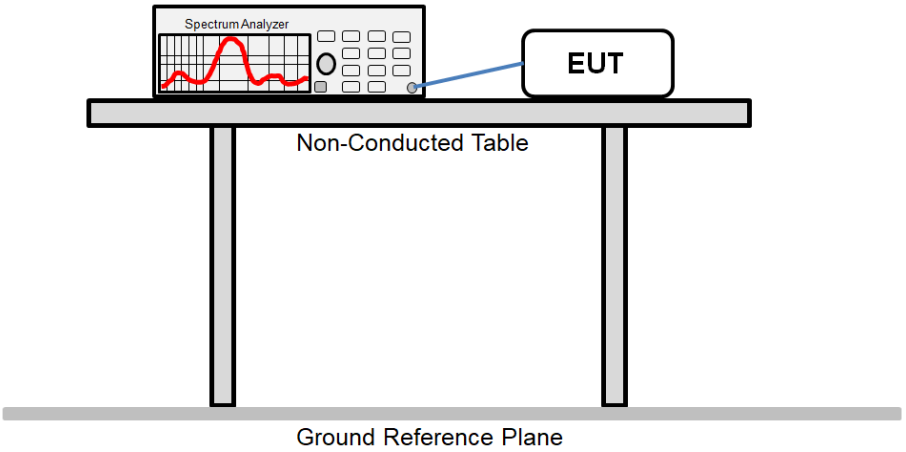
30 MHz – 1000 MHz (3m SAC)



Above 1 GHz (3m SAC)



Conducted test method:



5.2 Test Procedure

Test method	Test step
Conducted emission	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.
Radiated emission	1. The EUT was placed on the tabletop of a rotating table 0.8 m the ground at a 3 m semi anechoic chamber. The measurement distance from the EUT to the receiving antenna is 3 m. 2. EUT works in each mode of operation that needs to be tested， and having the EUT continuously working, respectively on 3 axis (X, Y & Z) and considered typical configuration to obtain worst position. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations. 3. Open the test software to control the test antenna and test turntable. Perform the test, save the test results, and export the test data.
Conducted test method	1. The antenna port of EUT was connected to the RF port of the spectrum analyzer through an RF cable. 2. The EUT is keeping in continuous transmission mode and tested in all modulation modes. 3. The test data is saved by the screenshot function of the spectrum analyzer.

6 Test Results

6.1 Summary

6.1.1 Clause and Data Summary

Test items	Standard clause	Test data	Result
Antenna Requirement	15.203	See Section 6.2	Pass
AC Power Line Conducted Emission	15.207	See Section 6.3	Pass
20dB Bandwidth	15.215	See Section 6.4	Pass
Field Strength of Fundamental	15.249	See Section 6.5	Pass
Field Strength of Spurious Emissions	15.209, 15.249	See Section 6.6	Pass
Remark: *1. Pass: The EUT complies with the essential requirements in the standard.*			
Test Method:	*ANSI C63.10-2013*		

6.1.2 Test Limit

<table>
<tr><th>Test items</th><th>Limit</th></tr>
<tr><td>AC Power Line Conducted Emission</td><td>
<table>
<tr><th rowspan="2">Frequency (MHz)</th><th colspan="2">Limit (dBμV)</th></tr>
<tr><th>Quasi-Peak</th><th>Average</th></tr>
<tr><td>0.15 – 0.5</td><td>66 to 56 Note 1</td><td>56 to 46 Note 1</td></tr>
<tr><td>0.5 – 5</td><td>56</td><td>46</td></tr>
<tr><td>5 – 30</td><td>60</td><td>50</td></tr>
<tr><td colspan="3">Note 1: The limit level in dBμV decreases linearly with the logarithm of frequency.
Note 2: The more stringent limit applies at transition frequencies.</td></tr>
</table>
</td></tr>
<tr><td>20dB Bandwidth</td><td>Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specifi ed in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.</td></tr>
</table>

Field Strength of Fundamental

Field Strength of Spurious Emissions

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

(1) The above field strength limits are specified at a distance of 3 meters.

(2) As shown in § 15.35(b), for frequencies above 1000 MHz, the fi eld strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in § 15.209, whichever limit permits a higher field strength:

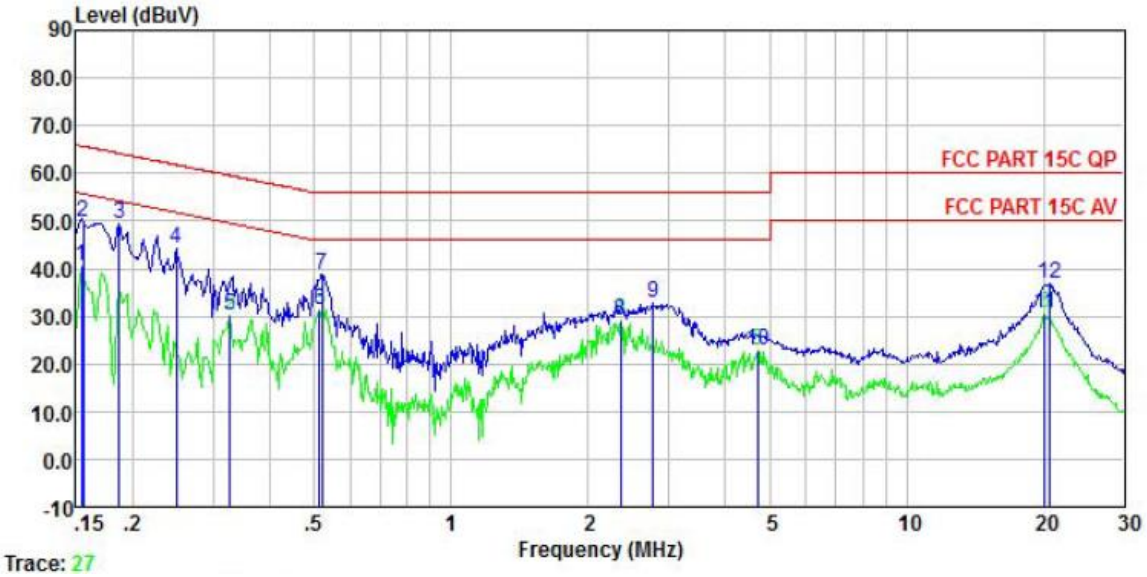
Frequency (MHz)	Limit (dBμV/m) @ 3m	Detector
30 – 88	40.0	Quasi-peak
88 – 216	43.5	Quasi-peak
216 – 960	46.0	Quasi-peak
960 – 1000	54.0	Quasi-peak
Note: The more stringent limit applies at transition frequencies.		
Frequency	**Limit (dBμV/m) @ 3m**	
	Average	**Peake**
Above 1 GHz	54.0	74.0
Note: The measurement bandwidth shall be 1 MHz or greater.		

6.2 Antenna Requirement

Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
E.U.T Antenna:	The Z-wave antenna is an Internal antenna which cannot replace by end-user, the best case gain of the antenna is -2.20 dBi. See product internal photos for details.

6.3 AC Power Line Conducted Emission

Product name:	Multi Protocol Host Gateway	**Product model:**	DSGW-291-X (X:1~18)
Test by:	June	**Test mode:**	Transmitting mode
Test frequency:	150 kHz ~ 30 MHz	**Phase:**	Line
Test voltage:	AC 120 V/60 Hz		

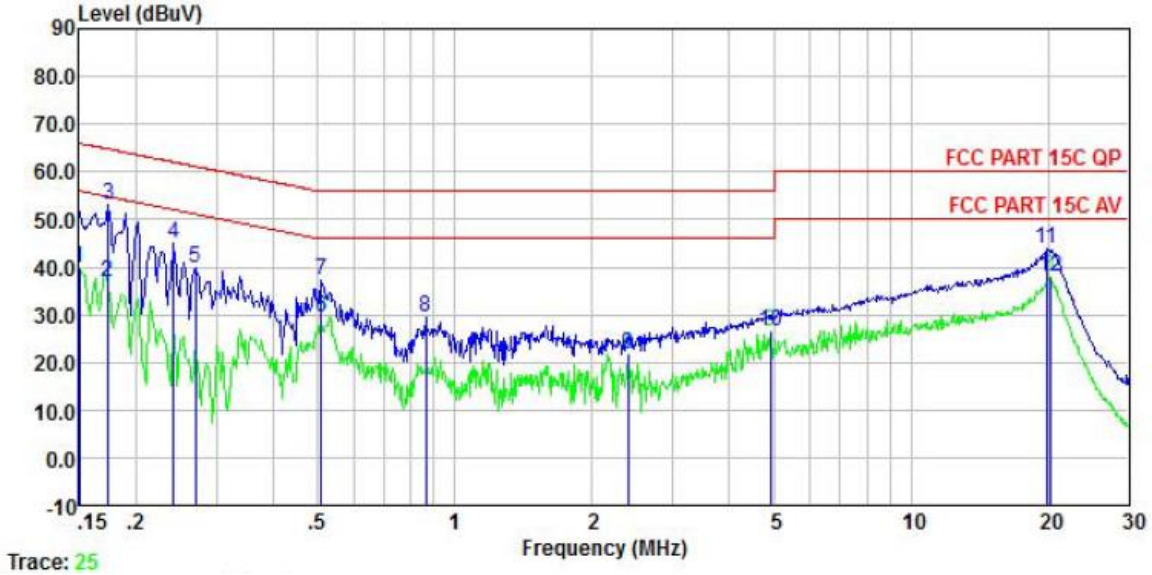


	Freq	Read Level	LISN Factor	Aux2 Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.154	30.04	0.04	10.50	0.01	40.59	55.78	-15.19	Average
2	0.156	39.15	0.04	10.50	0.01	49.70	65.69	-15.99	QP
3	0.186	38.80	0.05	10.50	0.02	49.37	64.20	-14.83	QP
4	0.249	33.63	0.06	10.50	0.01	44.20	61.78	-17.58	QP
5	0.327	19.79	0.06	10.50	0.02	30.37	49.53	-19.16	Average
6	0.513	20.93	0.05	10.50	0.03	31.51	46.00	-14.49	Average
7	0.521	28.24	0.05	10.50	0.03	38.82	56.00	-17.18	QP
8	2.358	18.43	0.08	10.50	0.15	29.16	46.00	-16.84	Average
9	2.779	22.03	0.09	10.50	0.10	32.72	56.00	-23.28	QP
10	4.696	12.31	0.12	10.50	0.09	23.02	46.00	-22.98	Average
11	20.056	19.62	0.34	10.50	0.19	30.65	50.00	-19.35	Average
12	20.594	25.94	0.35	10.50	0.18	36.97	60.00	-23.03	QP

Remark:

1. Level = Read level + LISN Factor + Cable Loss.

Product name:	Multi Protocol Host Gateway	Product model:	DSGW-291-X (X:1~18)
Test by:	June	Test mode:	Transmitting mode
Test frequency:	150 kHz ~ 30 MHz	Phase:	Neutral
Test voltage:	AC 120 V/60 Hz		



	Freq	Read Level	LISN Factor	Aux2 Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.150	29.12	0.06	10.50	0.01	39.69	56.00	-16.31	Average
2	0.173	26.19	0.06	10.50	0.01	36.76	54.81	-18.05	Average
3	0.174	42.71	0.05	10.50	0.01	53.27	64.77	-11.50	QP
4	0.242	34.24	0.05	10.50	0.01	44.80	62.04	-17.24	QP
5	0.270	29.26	0.05	10.50	0.02	39.83	61.12	-21.29	QP
6	0.510	19.07	0.04	10.50	0.03	29.64	46.00	-16.36	Average
7	0.510	26.52	0.04	10.50	0.03	37.09	56.00	-18.91	QP
8	0.862	19.06	0.06	10.50	0.04	29.66	56.00	-26.34	QP
9	2.396	10.91	0.08	10.50	0.15	21.64	46.00	-24.36	Average
10	4.926	15.74	0.11	10.50	0.09	26.44	46.00	-19.56	Average
11	19.845	32.88	0.33	10.50	0.15	43.86	60.00	-16.14	QP
12	20.162	26.84	0.33	10.50	0.19	37.86	50.00	-12.14	Average

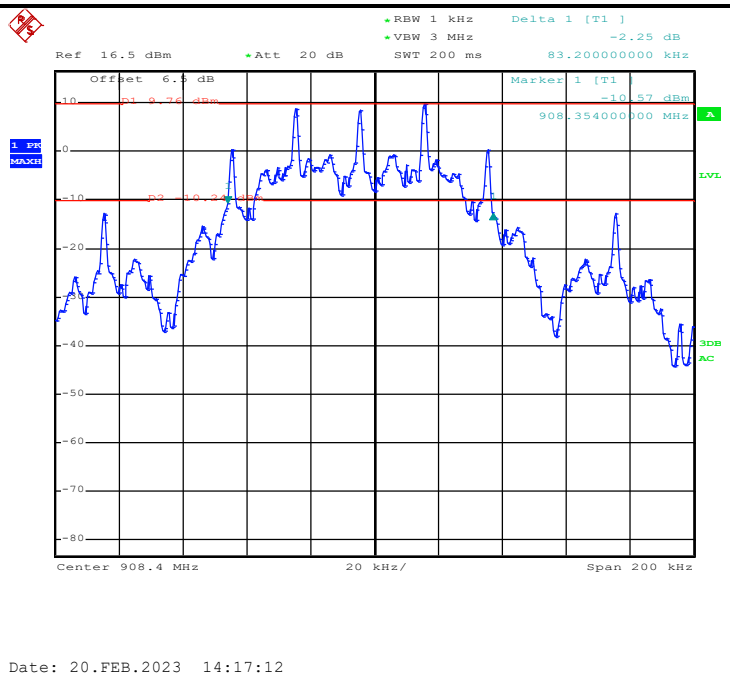
Remark:

1. Level = Read level + LISN Factor + Cable Loss.

6.4 20dB Bandwidth

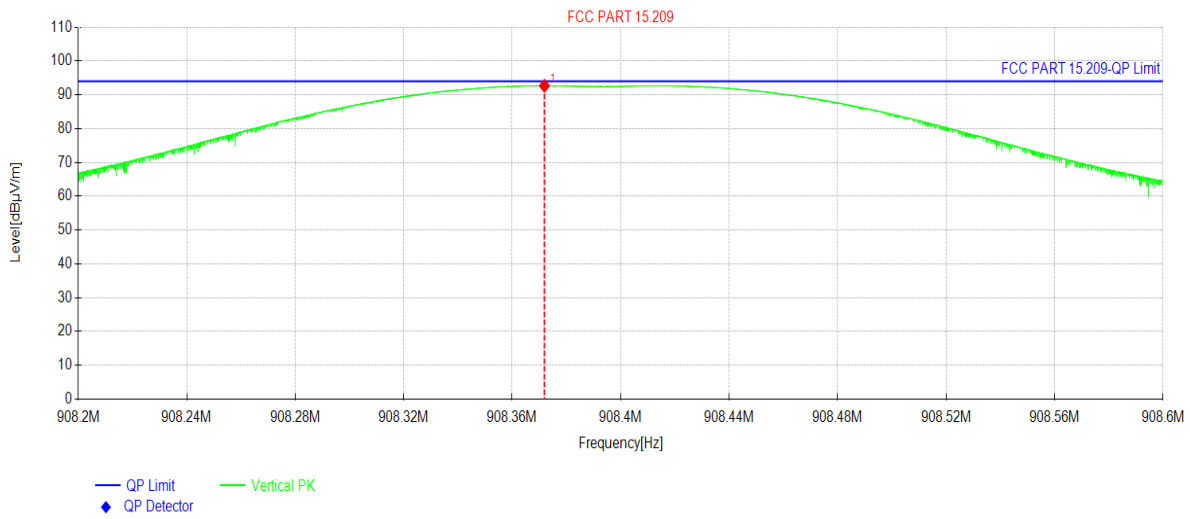
20dB bandwidth (kHz)	Limit (MHz)	Results
83.20	903.3<within<926.7	Pass

Test plot as follows:



6.5 Field Strength of Fundamental

Product Name:	Multi Protocol Host Gateway	**Product Model:**	DSGW-291-X (X:1~18)
Test By:	June	**Test mode:**	Transmitting mode
Test Frequency:	908.4 MHz	**Polarization:**	Vertical
Test Voltage:	DC 12V		

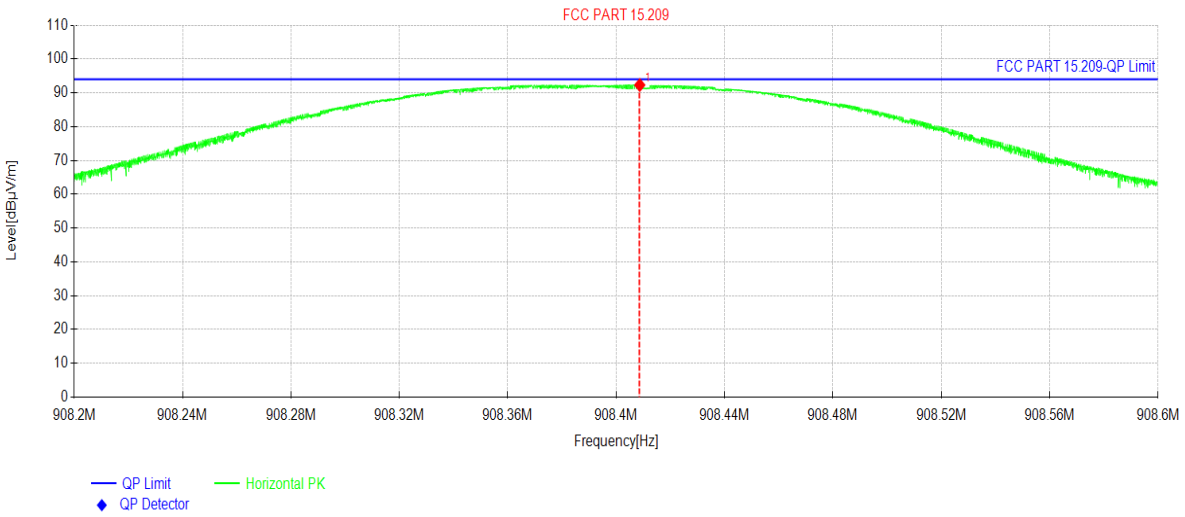


Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	908.371	67.69	92.65	24.96	94.00	1.35	PK	Vertical

Remark:

1. *Level = Read level + Antenna Factor + Cable Loss – Preamplifier Factor.*
2. *PK Level is less than AV limit(94dBuV/m), Pass.*

Product Name:	Multi Protocol Host Gateway	**Product Model:**	DSGW-291-X (X:1~18)
Test By:	June	**Test mode:**	Transmitting mode
Test Frequency:	908.4 MHz	**Polarization:**	Horizontal
Test Voltage:	DC 12V		



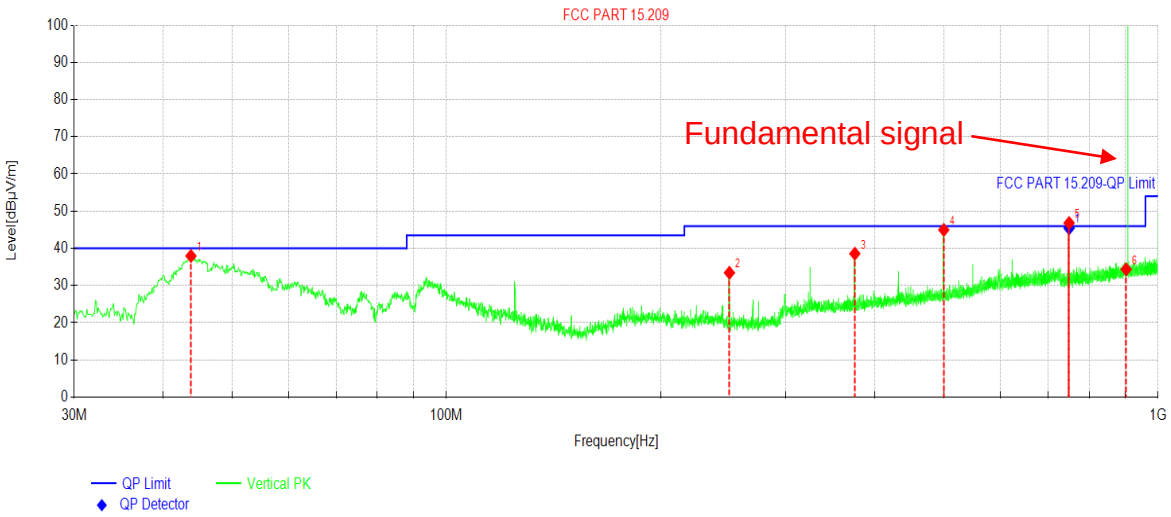
Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	908.408	67.33	92.29	24.96	94.00	1.71	PK	Horizontal

Remark:

1. *Level = Read level + Antenna Factor + Cable Loss – Preamplifier Factor.*
2. *PK Level is less than AV limit(94dBuV/m), Pass.*

6.6 Field Strength of Spurious Emissions

Product Name:	Multi Protocol Host Gateway	**Product Model:**	DSGW-291-X (X:1~18)
Test By:	June	**Test mode:**	Transmitting mode
Test Frequency:	30 MHz – 1000 MHz	**Polarization:**	Vertical
Test Voltage:	DC 12V		



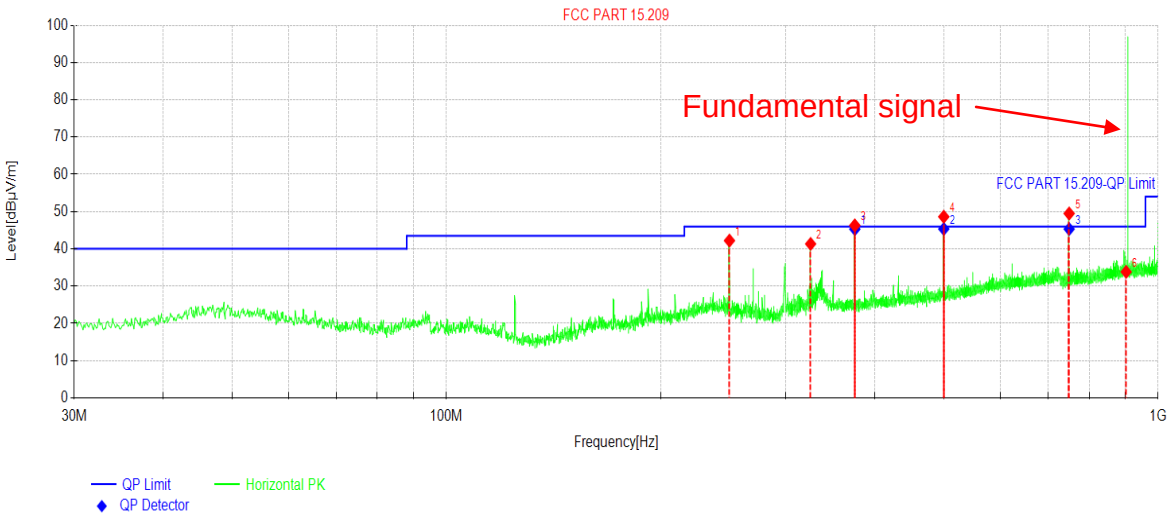
Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	43.7754	50.99	37.96	-13.03	40.00	2.04	PK	Vertical
2	249.921	47.43	33.43	-14.00	46.00	12.57	PK	Vertical
3	374.966	49.65	38.56	-11.09	46.00	7.44	PK	Vertical
4	500.012	53.95	44.96	-8.99	46.00	1.04	PK	Vertical
5	750.006	51.03	46.81	-4.22	46.00	-0.81	PK	Vertical
6	902.000	37.00	34.36	-2.64	46.00	11.64	PK	Vertical

Final Data List								
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	QP Reading [dBµV/m]	Angle [°]	Verdict
1	750.006	-4.22	45.40	46.00	0.60	49.62	3	PASS

Remark:

1. Level = Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).

Product Name:	Multi Protocol Host Gateway	**Product Model:**	DSGW-291-X (X:1~18)
Test By:	June	**Test mode:**	Transmitting mode
Test Frequency:	30 MHz – 1000 MHz	**Polarization:**	Horizontal
Test Voltage:	DC 12V		



Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	249.921	56.20	42.20	-14.00	46.00	3.80	PK	Horizontal
2	325.006	53.56	41.32	-12.24	46.00	4.68	PK	Horizontal
3	374.966	57.38	46.29	-11.09	46.00	-0.29	PK	Horizontal
4	500.012	57.60	48.61	-8.99	46.00	-2.61	PK	Horizontal
5	750.103	53.69	49.47	-4.22	46.00	-3.47	PK	Horizontal
6	902.000	36.46	33.82	-2.64	46.00	12.18	PK	Horizontal

Final Data List

NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV/m]	QP Limit [dBµV/m]	QP Margin [dB]	QP Reading [dBµV/m]	Angle [°]	Verdict
1	374.966	-11.09	45.29	46.00	0.71	56.38	334	PASS
2	500.012	-8.99	45.33	46.00	0.67	54.32	147	PASS
3	750.103	-4.22	45.30	46.00	0.70	49.52	153	PASS

Remark:

1. Level = Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).

Above 1GHz:

Z-Wave Tx						
Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
1816.80	71.36	-20.99	50.37	74.00	23.63	Vertical
1816.80	70.48	-20.99	49.49	74.00	24.51	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
1816.80	66.74	-20.99	45.75	54.00	8.25	Vertical
1816.80	64.63	-20.99	43.64	54.00	10.36	Horizontal

------End of report------