



**SGS-CSTC Standards Technical Services
(Shanghai) Co., Ltd.**

Report No.: SHEM210800951501
Page: 1 of 24

1 Cover Page

TEST REPORT

Application No.: SHEM2108009515CR
FCC ID: 2A3AS-HY915T20S
Applicant: Shanghai Smart Control Co., Ltd.
Address of Applicant: Tower A, No.470, JiuJing Rd., Shanghai, China
Manufacturer: Shanghai Smart Control Co., Ltd.
Address of Manufacturer: Tower A, No.470, JiuJing Rd., Shanghai, China
Factory: Shanghai Smart Control Co., Ltd.
Address of Factory: Tower A, No.470, JiuJing Rd., Shanghai, China
Equipment Under Test (EUT):
EUT Name: Wireless Communication Module
Model No.: HY915T20S
Standard(s) : 47 CFR Part 15, Subpart C 15.249
Date of Receipt: 2021-06-25
Date of Test: 2021-08-17 to 2021-09-27
Date of Issue: 2021-09-29

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

Parlam Zhan

Parlam Zhan
Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.



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SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.
Testing Center EMC Laboratory

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Revision Record			
Version	Description	Date	Remark
00	Original	2021-09-29	/

Authorized for issue by:				
		Bill Wu		
		Bill Wu / Project Engineer		
		Parlam Zhan		
		Parlam Zhan /Reviewer		



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2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.249	N/A	47 CFR Part 15, Subpart C 15.203	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
20dB Bandwidth	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.9	47 CFR Part 15, Subpart C 15.215	Pass
Field Strength of the Fundamental Signal (15.249(a))	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.5&6.6	47 CFR Part 15, Subpart C 15.249(a)	Pass
Restricted Band Around Fundamental Frequency	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.4&6.5&6.6	47 CFR Part 15, Subpart C 15.205 & 15.249(d) & 15.209	Pass
Radiated Emissions	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.4&6.5&6.6	47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)	Pass





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4 General Information

4.1 General Description of E.U.T.

Product Description:	Fixed product with 915MHz function
EUT Power Supply:	DC 5V from USB
Test Voltage:	DC 5V

4.2 Technical Specifications

Operation Frequency:	915MHz
Modulation Technique:	LoRa
Number of Channel:	1 channel at 915MHz
Antenna Type	Dipole Antenna
Antenna Gain:	1dBi (Provided by manufacturer)

4.3 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Laptop	Lenovo	ThinkPad X100e	/
SecureCRT	VanDyke	V 6.2.0	/
Serial port adapter plate	/	Test Plate 3	/

4.4 Test Mode

Test Mode	Description of Test Mode
Engineering mode	Using test software to control EUT working in continuous transmitting, and select channel and modulation type

4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

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4.6 Test Facility

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

• **CNAS (No. CNAS L0599)**

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

• **FCC (Designation Number: CN1301)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

• **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory Company Number: 8617A

• **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.7 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4×10^{-8}
2	Timeout	2s
3	Duty Cycle	0.37%
4	Occupied Bandwidth	3%
5	RF Radiated Power	5.1dB (Below 1GHz) 4.9dB (Above 1GHz)
6	Radiated Spurious Emission Test	4.2dB (Below 30MHz) 4.5dB (30MHz-1GHz) 5.1dB (1GHz-18GHz) 5.4dB (Above 18GHz)
7	Temperature Test	1°C
8	Humidity Test	3%
9	Supply Voltages	1.5%
10	Time	3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.





5 Equipments Used during Test

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2020-12-20	2021-12-19
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2018-09-25	2021-09-24
AC Power Stabilizer	APC	KDF-31020T-V0-F0	SHEM216-1	2020-12-20	2021-12-19
DC Power Supply	MCH	MCH-303A	SHEM210-1	2020-12-20	2021-12-19
Conducted test Cable	/	RF01~RF04	/	2020-12-20	2021-12-19
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2020-12-20	2021-12-19
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2020-12-20	2021-12-19
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2019-10-14	2021-10-13
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2018-10-24	2021-10-23
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2018-10-31	2021-10-30
Pre-Amplifier	HP	8447D	SHEM236-1	2021-05-27	2022-05-26
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2020-12-20	2021-12-19
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2020-05-25	2023-05-24
RE test Cable	/	RE01, RE02, RE06	/	2020-12-20	2021-12-19
Test software	ESE	E3	Version: 6.111221a	/	/





6 Test Results

6.1 E.U.T. test conditions

Test Voltage: DC 5V

Requirements: 15.31(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Operating Environment:

Temperature:	20.0 -25.0 °C
Humidity:	35-75 % RH
Atmospheric Pressure:	99.2 -102.0 kPa

6.2 Antenna Requirement

Standard requirement:

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

EUT Antenna:

The antenna is dipole antenna and no consideration of replacement. The gain of the antenna is less than 1dBi.

Antenna location: Refer to Appendix (Internal Photos)

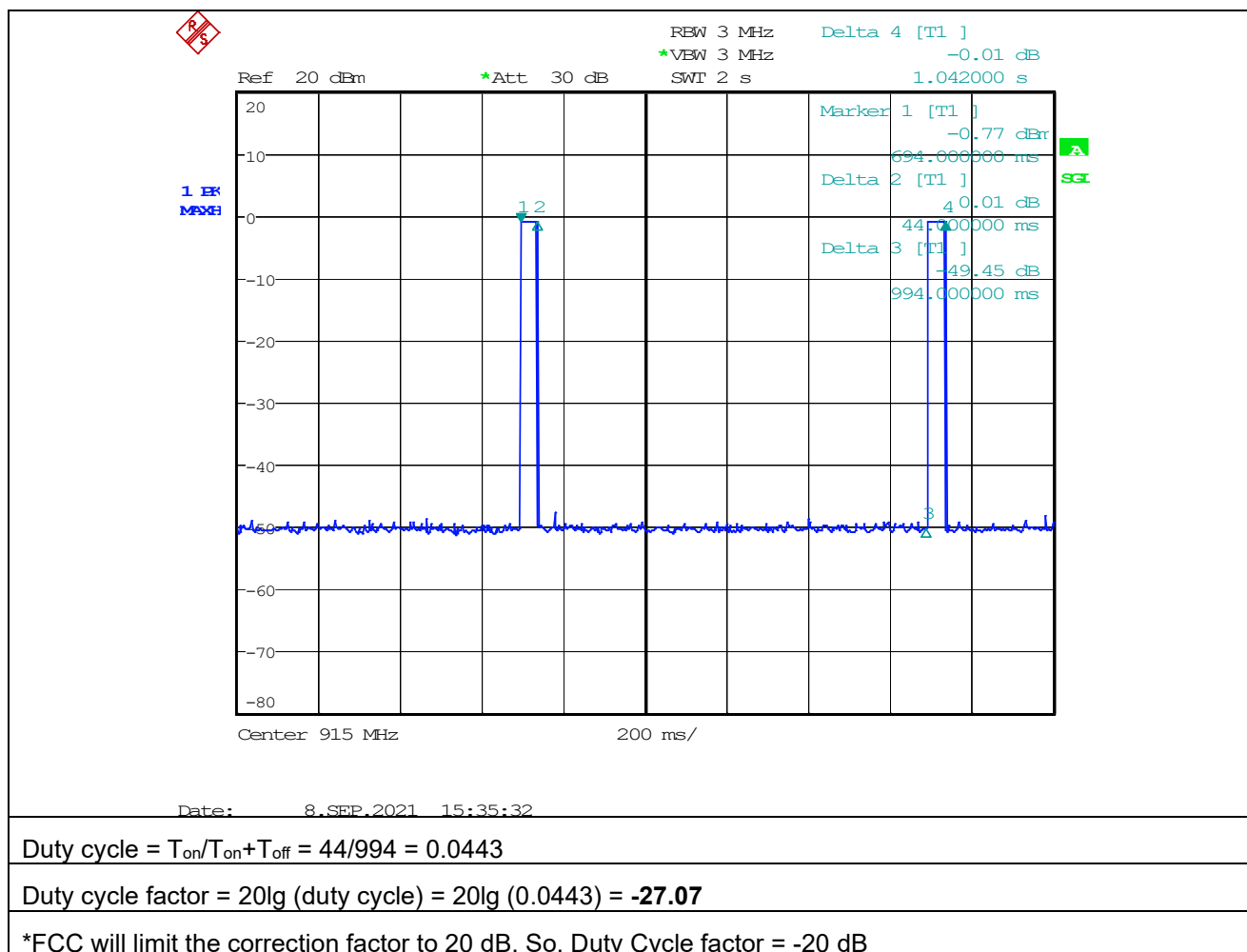


6.3 Duty Cycle

In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

Duty cycle= T on time / Period

Duty factor = 20 * log (Duty cycle)



6.4 Field Strength of the Fundamental Signal

Test Site: Measurement Distance: 3m

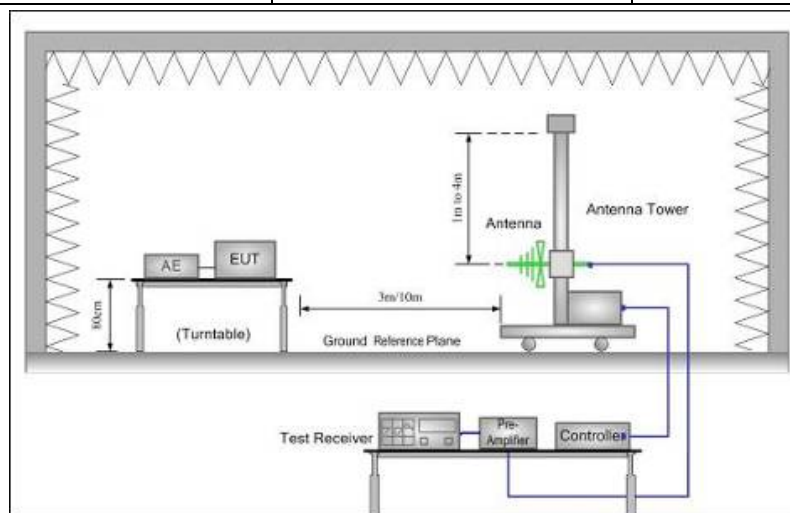
Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:

Frequency	Limit (dBuV/m)	Remark
915 MHz	114	Peak
	94	Quasi-Peak

Test Setup:



Test Procedure:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna 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 polarizations of the antenna are set to make the measurement.
- 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 (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB 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 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Test Results:

Pass



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Measurement Data

Peak value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Detector	Polarization
915	110.77	-3.37	107.40	114	-6.6	Peak	Horizontal
	113.61	-3.37	110.24	114	-3.76	Peak	Vertical

AVG value:

Frequency (MHz)	Peak Level (dBuV/m)	Duty cycle factor	AVG Level (dBuV/m)	AVG Limit Line (dBuV/m)	Over Limit (dB)	Detector	Polarization
915	107.40	-20.00	87.40	94	-6.60	/	Horizontal
	110.24	-20.00	90.24	94	-3.76	/	Vertical

Remark:

- 1) The basic equation with a sample calculation is as follows: Level = Read Level + Factor.
(The Factor is calculated by adding the Antenna Factor, Cable Loss and Preamp Factor)
- 2) If the Peak value below the Average Limit, the Average test doesn't perform for this submission.
- 3) FCC limit the max correction factor to 20 dB.



**6.5 Radiated Spurious Emissions and Band-edge**

Frequency Range: 9KHz to 10GHz

Test site/setup: Measurement Distance: 3m
Test instrumentation set-up:

Frequency Range	Detector	RBW	VBW
0.009MHz-0.090MHz	Peak	10kHz	30kHz
0.009MHz-0.090MHz	Average	10kHz	30kHz
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz
0.110MHz-0.490MHz	Peak	10kHz	30kHz
0.110MHz-0.490MHz	Average	10kHz	30kHz
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz
30MHz-1GHz	Quasi-peak	100kHz	300kHz
Above 1GHz	Peak	RBW=1MHz	VBW≥RBW
	Average		VBW=10Hz

Sweep=Auto

15.209 Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)
0.009MHz-0.490MHz	2400/F(KHz)	128.5 ~ 93.8
0.490MHz-1.705MHz	24000/F(KHz)	73.8 ~63.0
1.705MHz-30MHz	30	69.5
30MHz-88MHz	100	40.0
88MHz-216MHz	150	43.5
216MHz-960MHz	200	46.0
960MHz-1GHz	500	54.0
Above 1GHz	500	54.0

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.



Test Configuration: Receive antenna scan height 1 m - 4 m. polarization Vertical / Horizontal

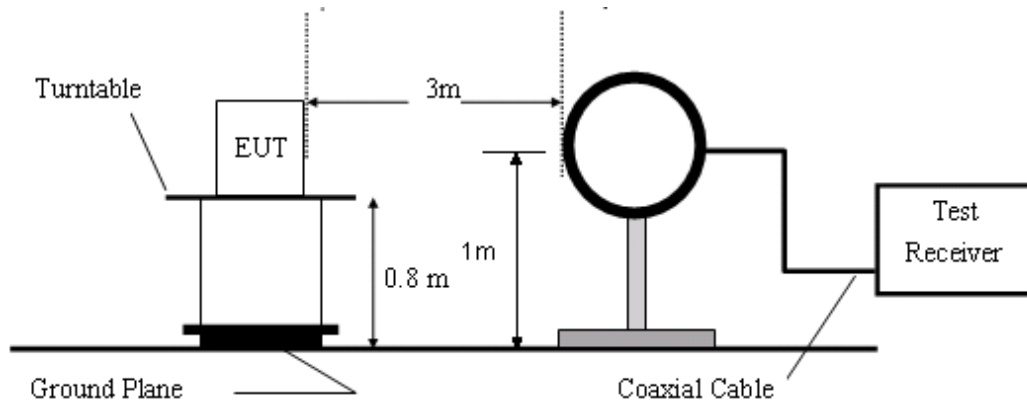


Figure1. Below 30MHz radiated emissions test configuration

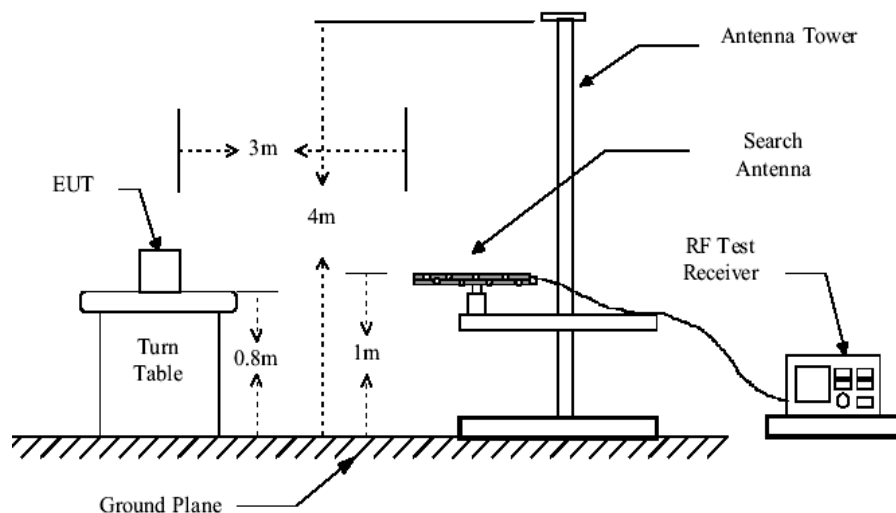


Figure2. 30MHz to 1GHz radiated emissions test configuration

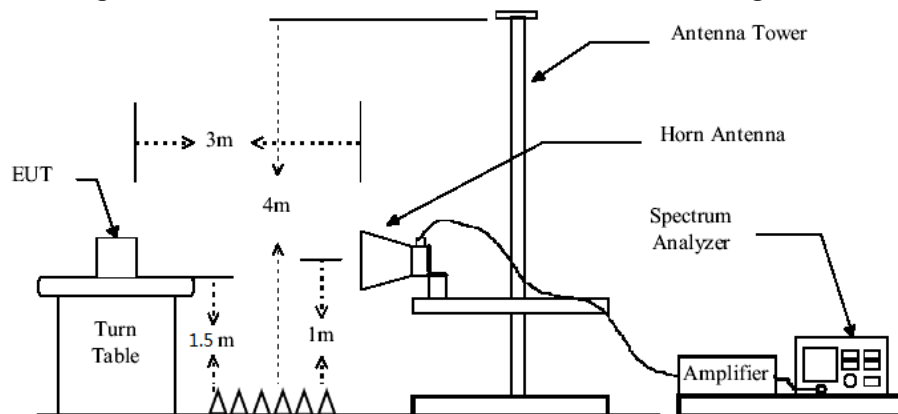


Figure3. Above 1GHz radiated emissions test configuration



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Test Procedure: The procedure used was ANSI Standard C63.10. The receiver was scanned from 9KHz to 10GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

Low noise amplifier was used below 1GHz, High pass Filter was used above 3GHz.

Between 1G and 3GHz, we did not use any amplifier or filter.

Pre-test was performed on Antenna A and Antenna B mode, Compliance test was performed on worse case (Antenna A mode).

Test were performed for their spatial orthogonal(X, Y, Z), the worst test data (X orthogonal) was submitted.

- 1) For this intentional radiator operates below 25 GHz. the spectrum shall be investigated to the tenth harmonic of the highest fundamental frequency. And above the third harmonic of this intentional radiator, the disturbance is very low. So the test result only displays to 5rd harmonic.
- 2) As shown in Section, for frequencies above 1000MHz. the above field strength limits 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.

The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.

Test Result: Pass

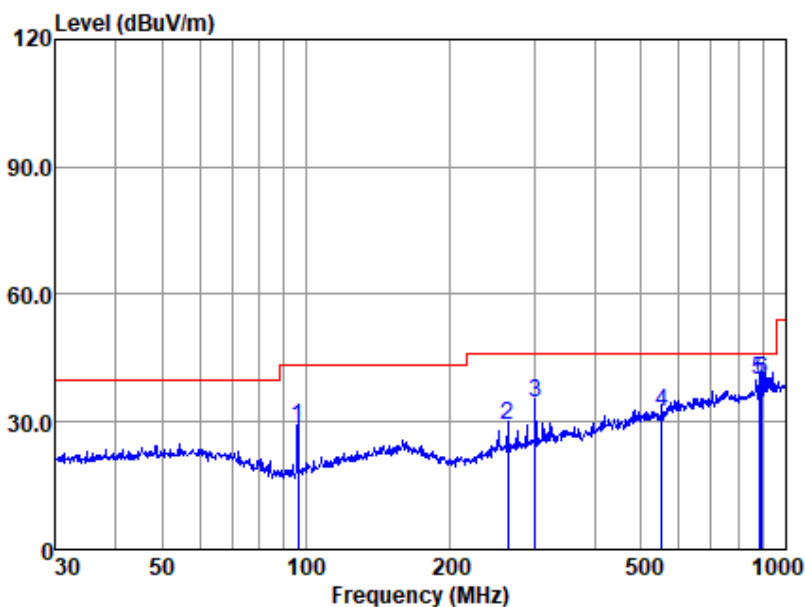


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6.5.1 Radiated Spurious Emissions

30MHz-1GHz:

Vertical:



Antenna Polarity : VERTICAL

EUT/Project : 9515CR

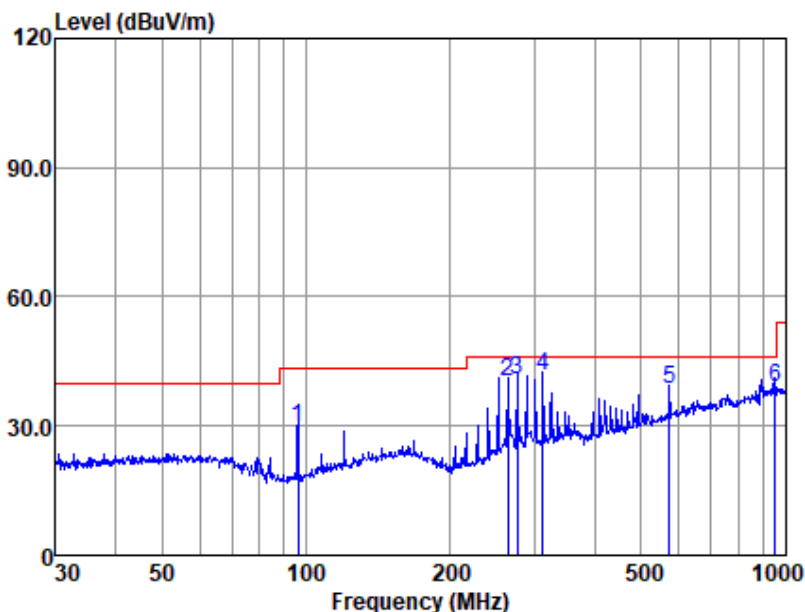
Test mode : a

	Freq	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	96.099	50.81	8.33	1.45	31.59	29.00	43.50	-14.50	QP
2	263.819	45.42	12.26	2.67	31.11	29.24	46.00	-16.76	QP
3	300.367	49.34	13.30	2.83	31.06	34.41	46.00	-11.59	QP
4	552.883	41.11	18.35	3.75	30.95	32.26	46.00	-13.74	QP
5	881.407	45.09	23.10	4.73	33.17	39.75	46.00	-6.25	QP
6	893.857	44.55	23.30	4.77	32.69	39.93	46.00	-6.07	QP

Note: Emission Level = Read Level + Antenna Factor + Cable loss - Preamplifier Factor



Horizontal:



Antenna Polarity :HORIZONTAL

EUT/Project :9515CR

Test mode :a

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	96.099	51.64	8.33	1.45	31.59	29.83	43.50	-13.67	QP
2	263.819	56.32	12.26	2.67	31.11	40.14	46.00	-5.86	QP
3	276.124	56.85	12.72	2.73	31.37	40.93	46.00	-5.07	QP
4	312.179	56.13	13.65	2.87	31.10	41.55	46.00	-4.45	QP
5	572.614	46.27	18.90	3.81	30.60	38.38	46.00	-7.62	QP
6	952.094	43.00	24.00	4.92	32.81	39.11	46.00	-6.89	QP

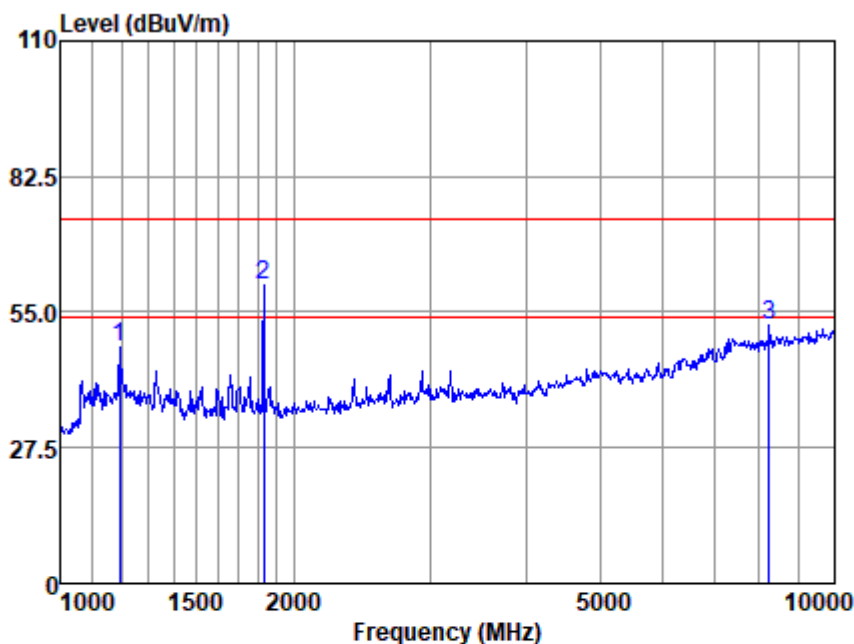
Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor





Above 1GHz:

Vertical:



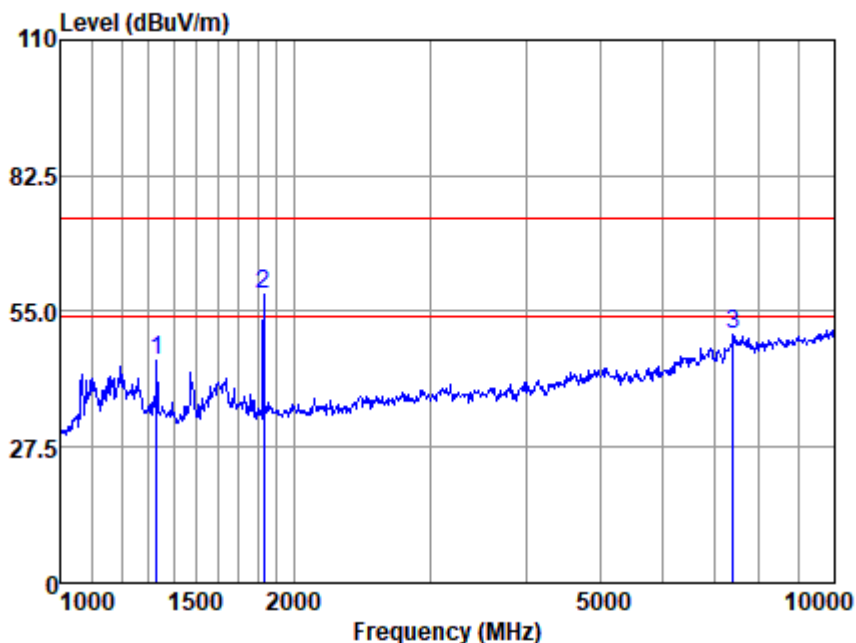
Antenna Polarity :VERTICAL
EUT/Project :9515CR
Test mode :a

	Freq	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	1192.811	59.23	24.42	5.53	41.14	48.04	74.00	-25.96	Peak
2	1829.582	68.94	25.58	7.12	41.30	60.34	74.00	-13.66	Peak
3	8248.005	41.89	37.34	15.51	42.38	52.36	74.00	-21.64	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamplifier Factor



Horizontal:



Antenna Polarity :HORIZONTAL

EUT/Project :9515CR

Test mode :a

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	1331.288	55.65	24.75	5.84	41.17	45.07	74.00	-28.93	Peak
2	1829.582	67.16	25.58	7.12	41.30	58.56	74.00	-15.44	Peak
3	7411.461	40.94	36.88	15.33	42.78	50.37	74.00	-23.63	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor





Spurious AVG value:

Frequency (MHz)	Peak Level (dBuV/m)	Duty cycle factor	AVG Level (dBuV/m)	AVG Limit Line (dBuV/m)	Over Limit (dB)	Detector	Polarization
1830	58.56	-20.00	38.56	54	-15.44	/	Horizontal
	60.34	-20.00	40.34	54	-13.66	/	Vertical

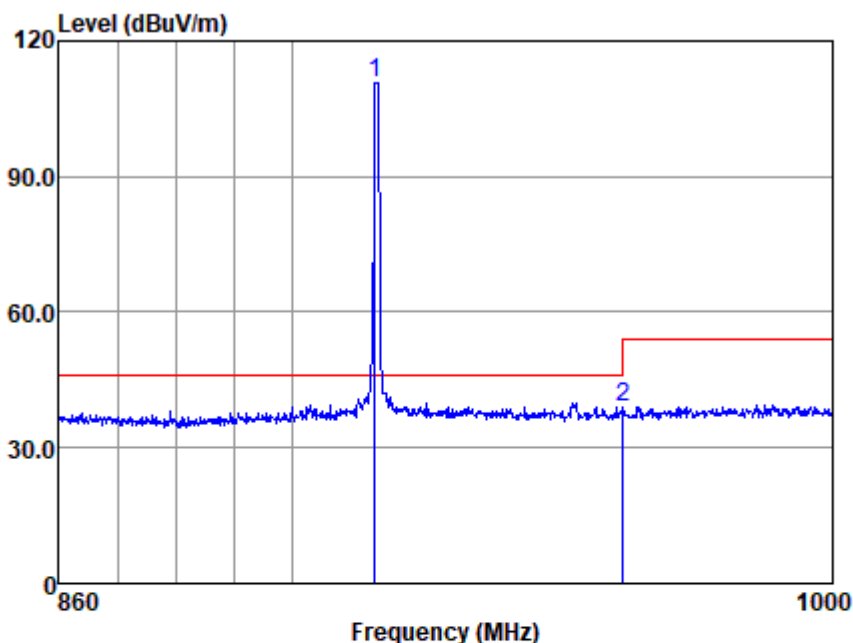
- Remark: 1. Test Level = Receiver Reading + Antenna Factor + Cable Loss- Preamplifier Factor
2. No any other emission which falls in restricted bands can be detected and be reported.
3. If the Peak value below the AV Limit, the AV test doesn't perform for this submission.
4. FCC limit the max correction factor to 20 dB.

All frequencies within the "Restricted bands" have been evaluated to compliance. Section 15.205 Restricted bands of operation.



6.5.2 Radiated Band edge

Horizontal



Antenna Polarity :HORIZONTAL

EUT/Project :9515CR

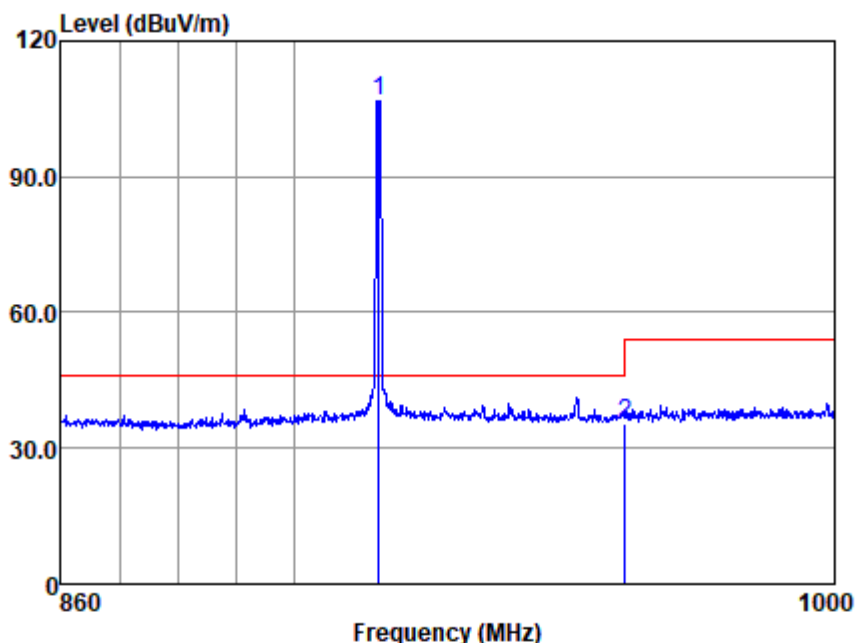
Test mode :a

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	914.721	114.24	23.60	4.85	31.87	110.82	46.00	64.82	Peak
2	960.000	42.66	24.00	4.96	32.74	38.88	46.00	-7.12	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



Vertical



Antenna Polarity :VERTICAL

EUT/Project :9515CR

Test mode :a

	Read	Antenna	Cable	Preamp	Emission	Limit	Over	
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1 914.997	110.32	23.60	4.85	31.87	106.90	46.00	60.90	Peak
2 960.000	39.18	24.00	4.96	32.74	35.40	46.00	-10.60	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor





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

1. FCC Part 15, Subpart C Section 15.205 Restricted bands of operation.

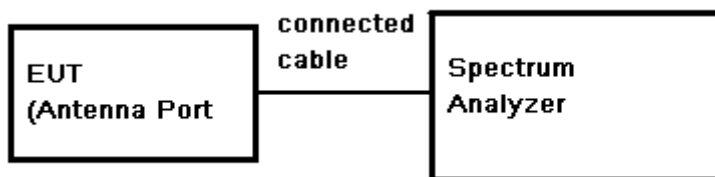
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
10.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.5 - 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 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	
13.36 - 13.41			



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6.6 20dB Bandwidth

Test Configuration:



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. Set the spectrum analyzer as RBW = approximately 1 % to 5 % of the OBW (set 10 kHz), VBW = 3* RBW, Span=2MHz, Sweep=auto
4. Mark the peak frequency and -20dB (upper and lower) frequency.
5. Repeat above procedures until all frequency measured was complete.

Limit:

N/A

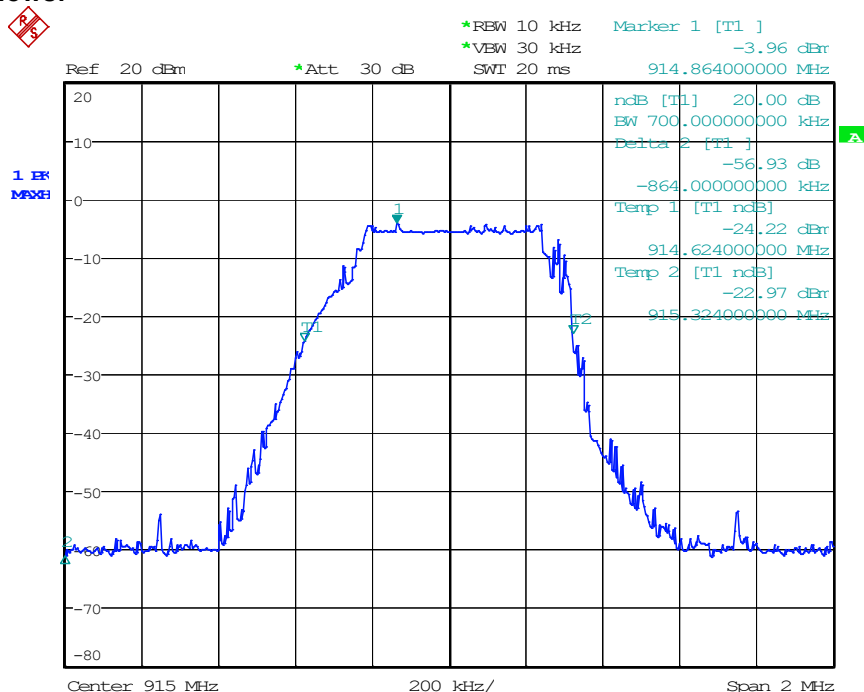
Test Result:

Pass

Test Data:

Frequency (MHz)	Bandwidth (kHz)	Result
915	700.00	PASS

Test plot as follows:



Date: 8.SEP.2021 15:42:35



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7 Test Setup Photographs

Refer to the < Test Setup photos-FCC>.

8 EUT Constructional Details

Refer to the <External Photos & Internal Photos >.

--End of the Report--

