

Report No.: SEWM2211000238RG02
 Rev.: 01
 Page: 1 of 38

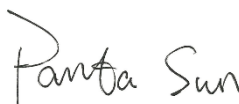
TEST REPORT

Application No.: SEWM2211000238RG
Applicant: Smawave Technology Co., Ltd
Address of Applicant: 3/F, Building 8, 1001 North Qinzhou Road, Xuhui District, Shanghai, China
Manufacturer: Smawave Technology Co., Ltd
Address of Manufacturer: 3/F, Building 8, 1001 North Qinzhou Road, Xuhui District, Shanghai, China
EUT Description: LTE Indoor CPE
Model No.: SRT421
Trade Mark: Smawave
FCC ID: 2AU8HSRT421-CBRS
Standards: FCC 47 CFR Part 2, Subpart J
 FCC 47 CFR Part 15, Subpart E
Date of Receipt: 2022/11/09
Date of Test: 2022/11/24 to 2022/11/29
Date of Issue: 2022/11/29

Test Result :	PASS *
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* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Authorized Signature:




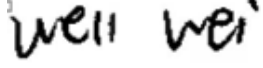
Panta Sun
 Wireless Laboratory Manager



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1 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2022/11/29		Original

Prepared By		 <hr/> (Ives Cheng) / Test Engineer
Checked By		 <hr/> (Well Wei) / Reviewer



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2 Test Summary

Test Item	Band ^[1]	FCC rules No.	Test Requirements	Test Result	Result
Antenna Requirement	--	15.203/15.407(a)	--	Clause 4.1	PASS
26dB Emission Bandwidth	Band I	15.407(a)(1)	No limit.	Reference report SZCR210402049803	
6dB Emission Bandwidth	Band III	15.407(e)	≥ 500 kHz.	Reference report SZCR210402049803	
99% Occupied Bandwidth	Band I	KDB 789033 D02§ D	No limit.	Reference report SZCR210402049803	
	Band III				
Duty Cycle	Band I Band III	--	No limit.	Reference report SZCR210402049803	
Maximum Conducted Output Power	Band I	15.407(a)	< 250mW	Clause 4.4	PASS
	Band III	15.407(a)(3)	< 1W		
Maximum Power Spectral Density	Band I	15.407(a)	<11dBm/MHz	Reference report SZCR210402049803	
	Band III	15.407(a)(3)	<30dBm/500KHz		
Unwanted Emissions that fall Out of the Restricted Bands (Radiated)	Band I	15.209 15.407(b)	F<1GHz: §15.209/§7.2.5 limit (QP). F≥1GHz & out-restricted: <-27dBm/MHz PK e.i.r.p. (exl. 5.15-5.35 GHz). F≥1GHz & in-restricted: §15.209/§7.2.5 limit (AV&PK).	Clause 4.9	PASS
	Band III	15.407(b) 15.209	F<1GHz: §15.209/§7.2.5 limit (QP) F≥1GHz & out-restricted:(QP) a) 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges; b) 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges; c) 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and d) -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges. F≥1GHz & in-restricted: §15.209/§7.2.5 limit (AV&PK).		PASS
Unwanted Emissions in the Restricted Bands	Band I Band III	15.209	---	Clause 4.10	PASS



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(Radiated)					
AC Power Line Conducted Emissions	Band I Band III	15.207	---	Clause 4.2	PASS
Frequency Stability	Band I Band III	15.407(g)	Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual	Reference report SZCR210402049803	
<p>Note 1: Band I: 5150-5250MHz Band III: 5725-5850MHz</p>					

Remark:

The items of AC Power Line Conducted Emission and Conducted Output Power were fully retested, Radiated Spurious Emissions and Restricted bands around fundamental frequency were checked on 802.11ac80_Channel 42, and other items data please refer to the test report SZCR210402049803 issue on 2021/05/18.



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Report No.: SEWM2211000238RG02
 Rev.: 01
 Page: 6 of 38

3 General Information

3.1 Details of Client

Applicant:	Smawave Technology Co. ,Ltd
Address of Applicant:	3/F, Building 8, 1001 North Qinzhou Road, Xuhui District, Shanghai, China
Manufacturer:	Smawave Technology Co. ,Ltd
Address of Manufacturer:	3/F, Building 8, 1001 North Qinzhou Road, Xuhui District, Shanghai, China

3.2 Test Location

Company:	SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.
Address:	South of No. 6 Plant, No. 1, Runsheng Road, Suzhou Industrial Park, Suzhou Area, China (Jiangsu) Pilot Free Trade Zone
Post code:	215000
Test engineer:	Ives Cheng, King-p Li

3.3 Test Facility

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

<ul style="list-style-type: none"> • A2LA (Certificate No. 6336.01) SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6336.01. • Innovation, Science and Economic Development Canada SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized by ISED as an accredited testing laboratory. CAB identifier: CN0120. IC#: 27594. • FCC –Designation Number: CN1312 SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized as an accredited testing laboratory. Designation Number: CN1312. Test Firm Registration Number: 717327
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3.4 General Description of EUT

EUT Description:	LTE Indoor CPE	
Model No.:	SRT421	
Trade Mark:	Smawave	
Hardware Version:	V1.0	
Software Version:	ST_CBRS_V2.0.0	
IMEI:	RF Conducted	862165041541640
	RSE & AC power line	862165041541358
WLAN Mode Supported:	802.11a:	20 MHz channel bandwidth
	802.11n:	20 MHz / 40 MHz channel bandwidth
	802.11ac:	20 MHz / 40 MHz / 80 MHz channel bandwidth
Operation Frequency:	5150MHz to 5250MHz 5725MHz to 5850MHz	
Modulation Type:	802.11a:	OFDM (BPSK, QPSK, 16QAM, 64QAM)
	802.11n:	OFDM (BPSK, QPSK, 16QAM, 64QAM)
	802.11ac:	OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
Channel Spacing:	20MHz:	802.11a/n(HT20)/ac(VHT20)
	40MHz:	802.11n(HT40)/ac(VHT40)
	80MHz:	802.11ac(VHT80)
Antenna Type:	Internal Antenna	
Antenna Gain:	5150MHz to 5250MHz: 2.52dBi (Ant0);3.14dBi (Ant1)	
	5725MHz to 5850MHz: 2.52dBi (Ant0);3.14dBi (Ant1)	
	Note: The antenna gain are derived from the gain information report provided by the manufacturer.	
Smart System:	<input type="checkbox"/> SISO	802.11a/n/ac
	<input checked="" type="checkbox"/> MIMO	802.11n/ac: 2Tx & 2Rx
	<input checked="" type="checkbox"/> Diversity	802.11a: 2Tx & 2Rx
RF Cable:	1dB	
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Remark:

In FCC 15.31, for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table, and the selected channel to perform the test as below:

Frequency Range of Operation Operating Frequency Range (in each Band)	Number of Measurement Frequencies Required	Location of Measurement Frequency in Band of Operation
1 MHz or less	1	centre
1 MHz to 10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near centre

For UNII Band I:

Mode	Channel	Frequency(MHz)
IEEE 802.11a/n/ac 20MHz	The Lowest channel	5180
	The Middle channel	5200
	The Highest channel	5240
IEEE 802.11n/ac 40MHz	The Lowest channel	5190
	The Highest channel	5230
IEEE 802.11ac 80MHz	The Middle channel	5210

For UNII Band III:

Mode	Channel	Frequency(MHz)
IEEE 802.11a/n/ac 20MHz	The Lowest channel	5745
	The Middle channel	5785
	The Highest channel	5825
IEEE 802.11n/ac 40MHz	The Lowest channel	5755
	The Highest channel	5795
IEEE 802.11ac 80MHz	The Middle channel	5775



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3.5 Test Environment and Mode

Environment Parameter	101.0kPa Selected Values During Tests	
Relative Humidity	44-46 % RH Ambient	
Value	Temperature(°C)	Voltage(V)
NTNV	22~23	12
Remark: NV: Normal Voltage NT: Normal Temperature		

3.6 Description of Support Units

The EUT has been tested as an independent unit.

3.7 Worst-case configuration and mode

Low data rate was used to test on antenna port conducted tests and radiated spurious emissions since it has the highest maximum power. Following are the worst-case data rates set for test:

Modulation Type	SISO - Data Rate	CDD/MIMO - Data Rate
802.11a	/	12 Mbps
802.11n (HT 20)	/	MCS0 (13 Mbps)
802.11n (HT 40)	/	MCS0 (27 Mbps)
802.11ac (VHT 20)	/	MCS0 (13 Mbps)
802.11ac (VHT 40)	/	MCS0 (27 Mbps)
802.11ac (VHT 80)	/	MCS0 (58.5 Mbps)



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4 Test results and Measurement Data

4.1 Antenna Requirement

Standard requirement:	47 CFR Part 15 Section 15.203
<p>The antenna is Internal Antenna and no consideration of replacement. The best case gain of the antenna is 5150MHz to 5250MHz: 2.52dBi (Ant0);3.14dBi (Ant1)* 5725MHz to 5850MHz: 2.52dBi (Ant0);3.14dBi (Ant1)*</p> <p><i>*Note:</i> <i>The antenna gain are derived from the gain information report provided by the manufacturer.</i></p> <p><i>Remark:</i> <i>As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.</i></p>	



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Cyclic Delay Diversity (CDD) System:

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

If all antennas have the same gain, G_{ANT} , Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on all devices,
 $Array\ Gain = 10 \log(N_{ANT}/N_{SS}=1) \text{ dB}$.
- For power measurements on IEEE 802.11 devices:
 $Array\ Gain = 0 \text{ dB}$ (i.e., no array gain) for $N_{ANT} \leq 4$;
 $Array\ Gain = 0 \text{ dB}$ (i.e., no array gain) for channel widths $\geq 40 \text{ MHz}$ for any N_{ANT} ;
 $Array\ Gain = 5 \log(N_{ANT}/N_{SS}=1) \text{ dB}$ or 3 dB , whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

Unequal antenna gains, with equal transmit powers. For antenna gains given by $G_1, G_2, \dots, G_N \text{ dBi}$

- If transmit signals are correlated, then
 $Directional\ gain = 10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{ANT}] \text{ dBi}$ [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]
- If all transmit signals are completely uncorrelated, then
 $Directional\ gain = 10 \log[(10^{G_1/10} + 10^{G_2/10} + \dots + 10^{G_N/10}) / N_{ANT}] \text{ dBi}$

The Power and PSD limit should be modified if the directional gain of eut is over 6dbi.

The EUT supports CDD System.

Unequal antenna gain:

Operation Frequency	ANT Gain0 (dBi)	ANT Gain1 (dBi)	Directional gain For Power (dBi)	Directional gain For PSD (dBi)	Power Limit Reduction (dBm)	PSD Limit Reduction (dBm)
5150MHz to 5250MHz	2.52	3.14	2.84	5.85	0	0
5725MHz to 5850MHz	2.52	3.14	2.84	5.85	0	0

5150MHz to 5250MHz:

Power Limit Reduction = Directional gain – 6dBi, (Directional gain < 6dBi) =0

PSD Limit Reduction = Directional gain – 6dBi, (Directional gain < 6dBi) =0

5725MHz to 5850MHz:

Power Limit Reduction = Directional gain – 6dBi, (Directional gain < 6dBi) =0

PSD Limit Reduction = Directional gain – 6dBi, (Directional gain < 6dBi) =0



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4.2 AC Power Line Conducted Emissions

Test Requirement:	47 CFR Part 15 Section 15.407(b)		
Test Method:	ANSI C63.10: 2013 Section 6.2		
Test Frequency Range:	150kHz to 30MHz		
Receiver Setup:	RBW = 9kHz, VBW = 30kHz		
Limit:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
* Decreases with the logarithm of the frequency.			
Test Procedure:	<ol style="list-style-type: none"> 1) The mains terminal disturbance voltage test was conducted in a shielded room. 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded. 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2. 5) 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: 2013 on conducted measurement. 		



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<p>Test Setup:</p>	
<p>Exploratory Test Mode:</p>	<p>Transmitting with all kind of modulations, data rates at lowest, middle and highest channel.</p>
<p>Final Test Mode:</p>	<p>Refer to section 3.7 for details. Only the worst case is recorded in the report.</p>
<p>Instruments Used:</p>	<p>Refer to section 6 for details.</p>
<p>Test Results:</p>	<p>Pass</p>



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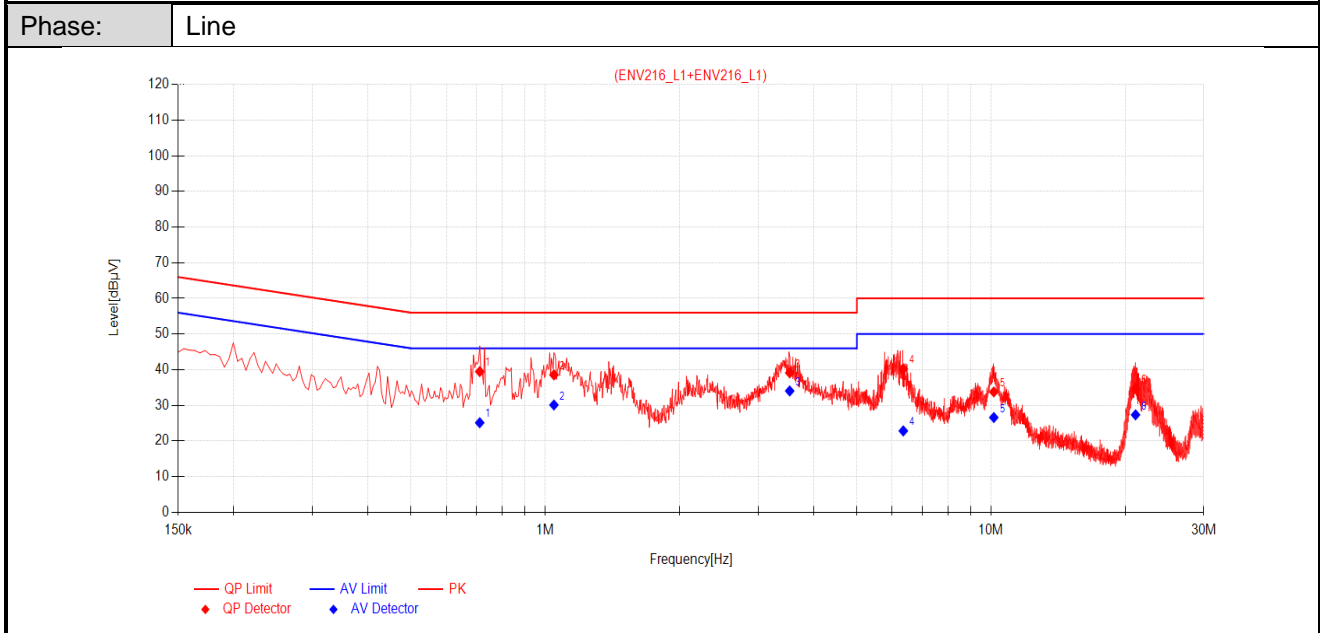
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Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.



Final Data List

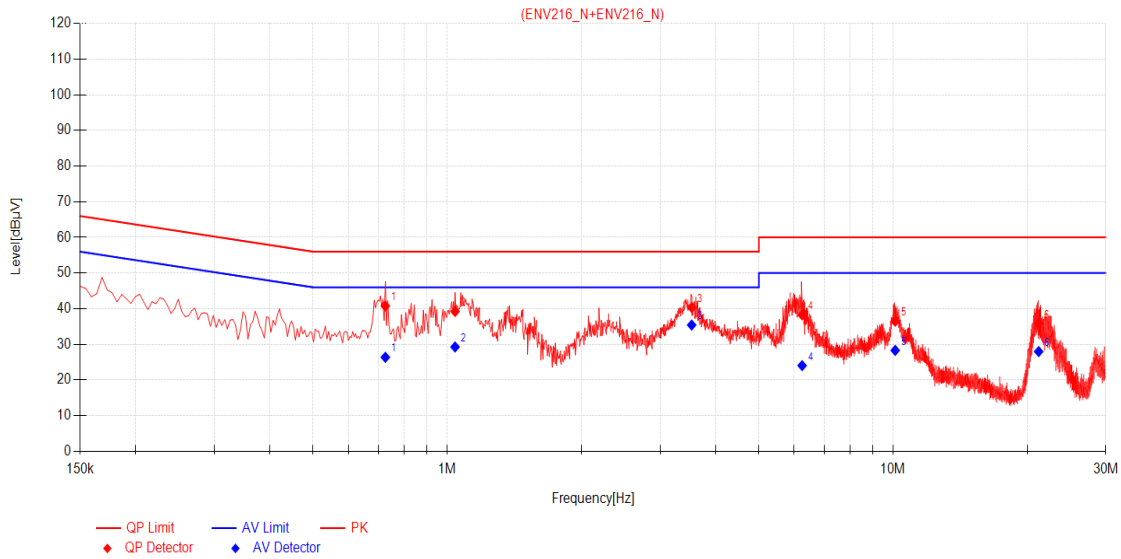
NO.	Frequency [MHz]	Factor [dB]	QP Reading [dBµV]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Reading [dBµV]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Verdict
1	0.7125	10.57	28.90	39.47	56.00	16.53	14.55	25.12	46.00	20.88	PASS
2	1.0455	10.56	28.00	38.56	56.00	17.44	19.54	30.10	46.00	15.90	PASS
3	3.5340	10.70	28.42	39.12	56.00	16.88	23.34	34.04	46.00	11.96	PASS
4	6.3555	10.68	29.58	40.26	60.00	19.74	12.15	22.83	50.00	27.17	PASS
5	10.1445	10.63	23.14	33.77	60.00	26.23	15.97	26.60	50.00	23.40	PASS
6	21.0975	10.39	24.32	34.71	60.00	25.29	16.95	27.34	50.00	22.66	PASS

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Value = Reading[dBµV] + Factor(Lin factor[dB] + cable loss[dB]).
3. Margin = Limit[dBµV] – Value[dBµV]



Phase:	Neutral
--------	---------



Final Data List

NO.	Frequency [MHz]	Factor [dB]	QP Reading [dBµV]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Reading [dBµV]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Verdict
1	0.7260	10.81	29.96	40.77	56.00	15.23	15.57	26.38	46.00	19.62	PASS
2	1.0410	10.66	28.56	39.22	56.00	16.78	18.61	29.27	46.00	16.73	PASS
3	3.5340	10.67	29.68	40.35	56.00	15.65	24.75	35.42	46.00	10.58	PASS
4	6.2520	10.57	27.69	38.26	60.00	21.74	13.47	24.04	50.00	25.96	PASS
5	10.1130	10.67	25.82	36.49	60.00	23.51	17.64	28.31	50.00	21.69	PASS
6	21.2190	10.43	25.43	35.86	60.00	24.14	17.55	27.98	50.00	22.02	PASS

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Value = Reading [dBµV] + Factor (Lisn factor [dB] + cable loss [dB]).
3. Margin = Limit [dBµV] – Value [dBµV]



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4.3 Duty Cycle

The detailed test data see: **Reference report SZCR210402049803**



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4.4 Conducted Output Power

Test Requirement:	47 CFR Part 15 Section 15.407(a)	
Test Method:	ANSI C63.10 :2013 Section11.9.2.3	
Test Setup:	<p style="text-align: center;">* Test with power meter (Detector function: Average)</p>	
Test Instruments:	Refer to section 6 for details.	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates	
Final Test Mode:	Refer to section 3.7 for details.	
Limit:	Frequency Band	Limit
	5150-5250MHz	Not exceed 250mW(24dBm)
	5725-5850MHz	Not exceed 1W(30dBm)
	*Where B is the 26dB emission bandwidth in MHz	
Test Results:	Pass	
The detailed test data see: Appendix		



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4.5 26dB Emission Bandwidth

Test Requirement:	47 CFR Part 15 Section 15.407(a)
Test Method:	ANSI C63.10: 2013 Section 11.8 Option 2
Test Setup:	
Instruments Used:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	No restriction limits
Test Results:	Pass
The detailed test data see: Reference report SZCR210402049803	



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4.6 6dB Emission Bandwidth

Test Requirement:	47 CFR Part 15 Section 15.407(e)	
Test Method:	ANSI C63.10: 2013 Section 11.8 Option 2	
Test Setup:		
Test Instruments:	Refer to section 6 for details.	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates	
Final Test Mode:	Refer to section 3.7 for details.	
Limit:	Frequency Band	Limit
	5725-5850MHz	At least 500kHz
Test Results:	Pass	
The detailed test data see: Reference report SZCR210402049803		



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4.7 99% Occupied Bandwidth

Test Requirement:	KDB 789033 D02§ D
Test Method:	ANSI C63.10: 2013 Section 6.9.3
Test Setup:	
Instruments Used:	Refer to section 6 for details.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Refer to section 3.7 for details.
Limit:	No restriction limits
Test Results:	Pass
The detailed test data see: Reference report SZCR210402049803	



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4.8 Power Spectral Density

Test Requirement:	47 CFR Part 15 Section 15.407(a)	
Test Method:	ANSI C63.10: 2013 Section 11.10.2 KDB 789033 D02 v02r01, Section F.	
Test Setup:		
Instruments Used:	Refer to section 6 for details.	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates	
Final Test Mode:	Refer to section 3.7 for details.	
Limit:	Frequency Band	Limit
	5150-5250MHz	The power spectral density less than 11dBm/1MHz
	5725-5850MHz	The power spectral density less than <30dBm/500KHz
Test Results:	Pass	
The detailed test data see: Reference report SZCR210402049803		



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4.9 Radiated Spurious Emissions

Test Requirement:	47 CFR Part 15 Section 15.205 and 15.209
Test Method:	ANSI C63.10: 2013 Section 6.4 / 6.5 / 6.6
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)
Test frequency:	9kHz ~ 40GHz(or 10 Harmonic)

Test Setup:

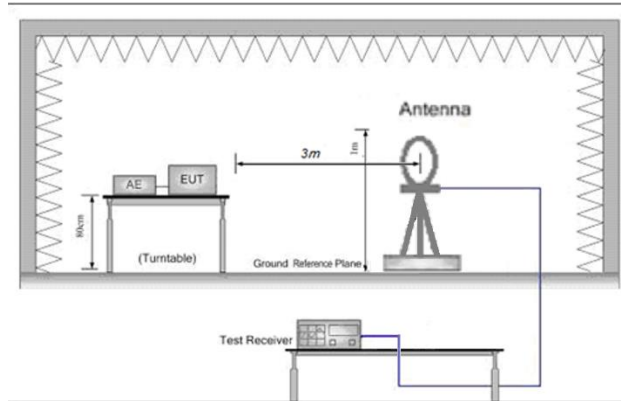


Figure 1. 9kHz to 30MHz

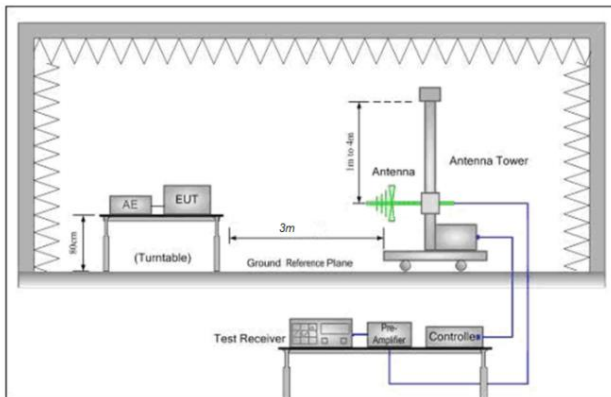


Figure 1. 30MHz to 1GHz

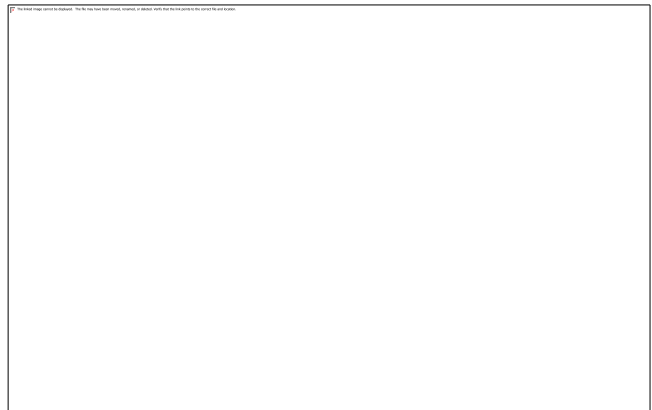


Figure 2. Above 1 GHz

Test Procedure:

- For below 1GHz test, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz test, the EUT was placed on the top of a rotating table 1.5 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. (Distance from antenna to EUT is 1m for measurements >18GHz).
- 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.
- 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.



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	<p>e. 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 rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.</p> <p>f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>g. Test the EUT in the outermost channels.</p> <p>h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is worse case.</p> <p>i. Repeat above procedures until all frequencies measured was complete.</p> <p>j. The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported</p> <p>k. The disturbance above 18GHz was very low, and the harmonics were the highest point could be found when testing, so only the harmonics had been displayed.</p> <p>l. At a measurement distance of 1 meter the limit line was increased by $20 \cdot \text{LOG}(3/1) = 9.54 \text{ dB}$.</p>
<p>Test Configuration:</p>	<p>Measurements Below 1000MHz</p> <ul style="list-style-type: none"> • RBW = 120 kHz • VBW = 300 kHz • Detector = Peak • Trace mode = max hold <p>Peak Measurements Above 1000 MHz</p> <ul style="list-style-type: none"> • RBW = 1 MHz • VBW $\geq 3 \text{ MHz}$ • Detector = Peak • Sweep time = auto • Trace mode = max hold <p>Average Measurements Above 1000MHz</p> <ul style="list-style-type: none"> • RBW = 1 MHz • VBW $\geq [3 \cdot \text{RBW}]$ • Detector = RMS (power averaging), if span / (# of points in sweep) $\leq (\text{RBW} / 2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak. • Sweep time = auto • Perform a trace average of at least 100 traces.
<p>Exploratory Test Mode:</p>	<p>Transmitting with all kind of modulations, data rates.</p>
<p>Final Test Mode:</p>	<p>Refer to section 3.7 for details.</p>
<p>Instruments Used:</p>	<p>Refer to section 6 for details.</p>
<p>Test Results:</p>	<p>Pass</p>
<p>The detailed test data see: Appendix</p>	



4.10 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15 Section 15.407(b)		
Test Method:	ANSI C63.10: 2013 Section 11.12		
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)		
Limit:	Frequency	Limit (dBuV/m)	Remark
	30MHz-88MHz	40.0	Quasi-peak
	88MHz-216MHz	43.5	Quasi-peak
	216MHz-960MHz	46.0	Quasi-peak
	960MHz-1GHz	54.0	Quasi-peak
	Above 1GHz	54.0	Average Value
		74.0	Peak Value
Test Setup:			
Test Procedure:	<p>a. The EUT was placed on the top of a rotating table 1.5 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.</p> <p>b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.</p> <p>c. 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.</p> <p>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 rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.</p> <p>e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>f. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel</p> <p>g. Test the EUT in the outermost channels.</p> <p>h. The radiation measurements are performed in X, Y, Z axis positioning for</p>		



	Transmitting mode, And found the X axis positioning which it is worse case. i. Repeat above procedures until all frequencies measured was complete.
Test Configuration:	<p>Measurements Below 1000MHz</p> <ul style="list-style-type: none"> • RBW = 120 kHz • VBW = 300 kHz • Detector = Peak • Trace mode = max hold <p>Peak Measurements Above 1000 MHz</p> <ul style="list-style-type: none"> • RBW = 1 MHz • VBW ≥ 3 MHz • Detector = Peak • Sweep time = auto • Trace mode = max hold <p>Average Measurements Above 1000MHz</p> <ul style="list-style-type: none"> • RBW = 1 MHz • VBW ≥ [3 *RBW] • Detector = RMS (power averaging), if span / (# of points in sweep) ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak. • Sweep time = auto • Perform a trace average of at least 100 traces.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates.
Final Test Mode:	Refer to section 3.7 for details.
Instruments Used:	Refer to section 6 for details.
Test Results:	Pass
The detailed test data see: Appendix	



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5 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	±0.54dB
2	Conduction Emission	± 2.90dB (150kHz to 30MHz)
3	Radiated Emission	± 3.13dB (9k -30MHz)
		± 4.80dB (30M -1GHz)
		± 4.80dB (1GHz to 18GHz)
		± 4.80dB (Above 18GHz)

Remark:

The U_{lab} (lab Uncertainty) is less than $U_{CISPR/ETSI}$ (CISPR/ETSI Uncertainty), so the test results
 – compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
 – non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.



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6 Equipment List

RF Test Equipment					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy/mm/dd)	Cal.Due date (yyyy/mm/dd)
Shielding Room	Brilliant-emc	N/A	SUWI-04-01-06	2021/05/08	2024/05/07
Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-07	2022/02/16	2023/02/15
Signal Analyzer	ROHDE&SCHWARZ	FSV3030	SUWI-01-02-02	2022/05/17	2023/05/16
Measurement Software	Tonscend	JS1120-3 Test System V3.1.55	SUWI-02-09-09	NCR	NCR
Signal Analyzer	ROHDE&SCHWARZ	FSW43	SUWI-01-02-04	2022/05/28	2023/05/27
Wideband Radio Communication Tester	ROHDE&SCHWARZ	CMW500	SUWI-01-16-05	2022/02/14	2023/02/13
DC Power Supply	HYELEC	HY3005B	SUWI-01-18-01	2022/02/15	2023/02/14
Power meter	Anritsu	ML2495A	SUWI-01-31-01	2021/12/04	2022/12/03
Pulse power sensor	Anritsu	MA2411B	SUWI-01-32-01	2021/12/04	2022/12/03
MXG Vector signal genitor	KEYSIGHT	N5182B	SUWI-01-38-01	2022/02/14	2023/02/13
Temperature Chamber	ESPEC	SU-242	SUWI-01-13-01	2022/02/15	2023/02/14

CE Test System					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy/mm/dd)	Cal.Due date (yyyy/mm/dd)
Shielding Room	Brilliant-emc	N/A	SUWI-04-03-01	2021/05/08	2024/05/07
Test receiver	ROHDE&SCHWARZ	ESR7	SUWI-01-10-01	2022/02/19	2023/02/18
Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-06	2022/02/16	2023/02/15
Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-01	2022/02/19	2023/02/18
Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-02	2022/02/19	2023/02/18
Measurement Software	Tonscend	JS32-CE 4.0.0.2	SUWI-02-09-05	NCR	NCR



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Wireless Laboratory

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RSE Test System					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy/mm/dd)	Cal.Due date (yyyy/mm/dd)
Semi-Anechoic Chamber	Brilliant-emc	N/A	SUWI-04-02-01	2021/05/08	2024/05/07
Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-05	2022/02/16	2023/02/15
Signal Analyzer	ROHDE&SCHWARZ	FSW43	SUWI-01-02-04	2022/05/28	2023/05/27
Signal Analyzer	KEYSIGHT	N9020A	SUWI-01-02-05	2021/12/04	2022/12/03
Test receiver	ROHDE&SCHWARZ	ESR7	SUWI-01-10-01	2022/02/19	2023/02/18
Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	VULB 9163	SUWI-01-11-01	2021/05/16	2023/05/15
Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	BBHA 9120D	SUWI-01-11-02	2021/05/16	2023/05/15
Receiving antenna	SCHWRZBECK MESS-ELEKTRONIK	BBHA 9170	SUWI-01-11-03	2021/05/14	2023/05/13
Amplifier	Tonscend	TAP9K3G40	SUWI-01-14-01	2022/02/14	2023/02/13
Amplifier	Tonscend	TAP01018050	SUWI-01-14-02	2022/02/14	2023/02/13
Amplifier	Tonscend	TAP18040048	SUWI-01-14-03	2022/02/19	2023/02/18
Active Loop Antenna	SCHWRZBECK MESS-ELEKTRONIK	FMZB 1519B	SUWI-01-21-01	2021/06/10	2023/06/09
Measurement Software	Tonscend	JS32-RE 4.0.0.0	SUWI-02-09-04	NCR	NCR



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7 Photographs - Setup Photos

Refer to Appendix A.2 WLAN Setup Photos.



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Appendix



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Conducted Output Power

For new report:

Test Mode	Frequency (MHz)	Tx Type	Measured Output Power (dBm)			Limit (dBm)	Verdict
			Ant 1	Ant 2	Total		
802.11a	5180	MIMO	13.22	14.21	16.75	≤23.98	PASS
	5200	MIMO	13.45	14.41	16.97	≤23.98	PASS
	5240	MIMO	13.87	14.23	17.06	≤23.98	PASS
	5745	MIMO	14.11	14.71	17.43	≤30.00	PASS
	5785	MIMO	14.10	14.65	17.39	≤30.00	PASS
	5825	MIMO	14.00	13.28	16.67	≤30.00	PASS
802.11n(HT20)	5180	MIMO	13.51	14.22	16.89	≤23.98	PASS
	5200	MIMO	13.10	14.26	16.73	≤23.98	PASS
	5240	MIMO	13.42	14.11	16.79	≤23.98	PASS
	5745	MIMO	14.11	14.63	17.39	≤30.00	PASS
	5785	MIMO	14.00	14.51	17.27	≤30.00	PASS
	5825	MIMO	12.76	14.16	16.53	≤30.00	PASS
802.11n(HT40)	5190	MIMO	12.67	13.71	16.23	≤23.98	PASS
	5230	MIMO	12.85	13.50	16.20	≤23.98	PASS
	5755	MIMO	13.27	13.98	16.65	≤30.00	PASS
	5795	MIMO	13.56	14.15	16.88	≤30.00	PASS
802.11ac(VHT20)	5180	MIMO	13.12	14.00	16.59	≤23.98	PASS
	5200	MIMO	13.01	14.11	16.61	≤23.98	PASS
	5240	MIMO	13.73	14.03	16.89	≤23.98	PASS
	5745	MIMO	13.74	14.56	17.18	≤30.00	PASS
	5785	MIMO	13.84	14.21	17.04	≤30.00	PASS
	5825	MIMO	13.98	13.98	16.99	≤30.00	PASS
802.11ac(VHT40)	5190	MIMO	12.42	13.23	15.85	≤23.98	PASS
	5230	MIMO	12.51	13.31	15.94	≤23.98	PASS
	5755	MIMO	13.11	13.76	16.46	≤30.00	PASS
	5795	MIMO	13.29	13.71	16.52	≤30.00	PASS
802.11ac(VHT80)	5210	MIMO	12.21	13.20	15.74	≤23.98	PASS
	5775	MIMO	12.98	13.54	16.28	≤30.00	PASS



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For original report:

Test Mode	Frequency (MHz)	Tx Type	Measured Output Power (dBm)			Limit (dBm)	Verdict
			Ant 1	Ant 2	Total		
802.11a	5180	MIMO	13.42	14.35	16.92	≤23.98	PASS
	5200	MIMO	13.38	14.45	16.96	≤23.98	PASS
	5240	MIMO	13.59	14.30	16.97	≤23.98	PASS
	5745	MIMO	13.93	14.72	17.35	≤30.00	PASS
	5785	MIMO	14.15	14.67	17.43	≤30.00	PASS
	5825	MIMO	14.29	14.30	17.31	≤30.00	PASS
802.11n(HT20)	5180	MIMO	13.41	14.30	16.89	≤23.98	PASS
	5200	MIMO	13.19	14.25	16.76	≤23.98	PASS
	5240	MIMO	13.45	14.16	16.83	≤23.98	PASS
	5745	MIMO	13.91	14.68	17.32	≤30.00	PASS
	5785	MIMO	14.13	14.52	17.34	≤30.00	PASS
	5825	MIMO	14.08	14.23	17.17	≤30.00	PASS
802.11n(HT40)	5190	MIMO	12.70	13.74	16.26	≤23.98	PASS
	5230	MIMO	12.88	13.52	16.22	≤23.98	PASS
	5755	MIMO	13.32	14.07	16.72	≤30.00	PASS
	5795	MIMO	13.61	14.18	16.91	≤30.00	PASS
802.11ac(VHT20)	5180	MIMO	13.71	14.03	16.63	≤23.98	PASS
	5200	MIMO	13.07	14.18	16.67	≤23.98	PASS
	5240	MIMO	13.24	13.96	16.63	≤23.98	PASS
	5745	MIMO	13.78	14.59	17.21	≤30.00	PASS
	5785	MIMO	13.87	14.41	17.16	≤30.00	PASS
	5825	MIMO	14.02	14.09	17.07	≤30.00	PASS
802.11ac(VHT40)	5190	MIMO	12.49	13.44	16.00	≤23.98	PASS
	5230	MIMO	12.55	13.34	15.97	≤23.98	PASS
	5755	MIMO	13.16	13.80	16.50	≤30.00	PASS
	5795	MIMO	13.37	13.78	16.59	≤30.00	PASS
802.11ac(VHT80)	5210	MIMO	12.28	13.21	15.78	≤23.98	PASS
	5775	MIMO	13.00	13.60	16.32	≤30.00	PASS

Remark:

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Radiated Spurious Emissions

Radiated emission below 1GHz

Worst case Mode: 11ac80_Channel 42

For new report:

Final Data List										
NO.	Frequency [MHz]	Reading [dBμV]	Factor [dB]	AF [dB/m]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	34.365	47.63	-28.36	10.65	29.92	40.00	10.08	102	285	Horizontal
2	38.0025	47.56	-28.18	11.54	30.92	40.00	9.08	185	6	Horizontal
3	44.065	45.75	-28.05	12.91	30.61	40.00	9.39	263	338	Horizontal
4	50.855	40.03	-27.98	13.59	25.65	40.00	14.35	254	307	Horizontal
5	67.1025	42.37	-27.71	9.48	24.14	40.00	15.86	142	22	Horizontal
6	249.9475	31.28	-26.00	11.90	17.18	46.00	28.82	263	53	Horizontal

Final Data List										
NO.	Frequency [MHz]	Reading [dBμV]	Factor [dB]	AF [dB/m]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	37.5175	46.42	-28.20	11.40	29.62	40.00	10.38	100	360	Vertical
2	44.065	49.62	-28.05	12.91	34.48	40.00	5.52	100	348	Vertical
3	49.885	43.54	-28.01	13.78	29.31	40.00	10.69	100	353	Vertical
4	74.62	43.42	-27.83	7.91	23.50	40.00	16.50	100	63	Vertical
5	131.1225	34.26	-27.15	8.12	15.23	43.50	28.27	100	334	Vertical
6	249.9475	30.28	-26.00	11.90	16.18	46.00	29.82	200	135	Vertical

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier gain.

The basic equation with a sample calculation is as follows:

Value = Reading(dBμV) + AF(dB/m) + Factor(dB):

AF = Antenna Factor(dB/m)

Factor = Cable Factor(dB) - Preamplifier gain(dB)

Margin = Limit(dBμV/m) – Value(dBμV/m)



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For original report:

Data List									
NO.	Frequency [MHz]	Cable Loss [dB]	AF [dB/m]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Over Limit [dB]	Polarity
1	30.42	0.60	22.67	27.73	23.78	19.32	40.00	-20.68	Horizontal
2	59.65	0.80	12.87	27.66	34.68	20.69	40.00	-19.31	Horizontal
3	83.52	1.24	12.23	27.63	27.16	13.00	40.00	-27.00	Horizontal
4	195.82	1.20	15.68	27.16	33.05	22.77	43.50	-20.73	Horizontal
5	250.30	1.64	18.20	26.99	32.56	25.41	46.00	-20.59	Horizontal
6	965.54	3.57	29.50	26.83	26.59	32.83	54.00	-21.17	Horizontal

Data List									
NO.	Frequency [MHz]	Cable Loss [dB]	AF [dB/m]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Over Limit [dB]	Polarity
1	48.84	0.70	14.39	27.68	36.75	24.16	40.00	-15.84	Vertical
2	86.50	1.27	12.60	27.63	38.57	24.81	40.00	-15.19	Vertical
3	202.10	1.22	16.69	27.14	30.96	20.73	43.50	-22.77	Vertical
4	489.03	2.48	24.30	27.76	24.94	23.96	46.00	-22.04	Vertical
5	618.54	2.74	26.64	28.09	25.72	27.01	46.00	-18.99	Vertical
6	989.54	3.59	29.64	26.71	26.30	32.82	54.00	-21.18	Vertical

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Transmitter emission Above 1GHz

802.11ac80_Channel 42

For new report:

Data List										
NO.	Frequency [MHz]	Reading [dBμV]	AF [dB/m]	Factor [dB]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	7630.3542	48.79	36.76	-41.13	44.42	74.00	29.58	296	304	Horizontal
2	10420	40.05	38.96	-36.25	42.76	68.30	25.54	265	83	Horizontal
3	15630	39.71	38.38	-33.90	44.19	74.00	29.81	241	28	Horizontal
4	7587.7083	39.80	36.68	-41.23	35.24	54.00	18.76	185	353	Horizontal
5	11459.8542	32.43	39.14	-34.74	36.83	54.00	17.17	233	84	Horizontal
6	15856.2083	32.89	38.09	-33.59	37.39	54.00	16.61	241	224	Horizontal

Data List										
NO.	Frequency [MHz]	Reading [dBμV]	AF [dB/m]	Factor [dB]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	7535.4792	48.69	36.57	-41.21	44.05	74.00	29.95	201	198	Vertical
2	10420	40.98	38.96	-36.25	43.69	68.30	24.61	174	3	Vertical
3	15630	38.26	38.38	-33.90	42.74	74.00	31.26	142	249	Vertical
4	7542.1875	40.38	36.58	-41.21	35.75	54.00	18.25	256	335	Vertical
5	11217.3958	33.19	39.38	-34.36	38.22	54.00	15.78	233	354	Vertical
6	15876.3333	33.19	38.06	-33.52	37.73	54.00	16.27	219	309	Vertical

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier gain.

The basic equation with a sample calculation is as follows:

Level = Reading(dBμV) + AF(dB/m) + Factor(dB):

AF = Antenna Factor(dB/m)

Factor = Cable Factor(dB) - Preamplifier gain(dB)

Margin = Limit(dBμV/m) – Level(dBμV/m)



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For original report:

Data List									
NO.	Frequency [MHz]	Cable Loss [dB]	AF [dB/m]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Over Limit [dB]	Polarity
1	1152.148	2.67	24.37	39.72	46.97	34.29	74.00	-39.71	Horizontal
2	1606.441	3.35	26.28	40.01	46.59	36.21	74.00	-37.79	Horizontal
3	3405.929	5.40	31.56	41.01	47.77	43.72	68.20	-24.48	Horizontal
4	4469.214	6.73	33.55	41.85	48.41	46.84	68.20	-21.36	Horizontal
5	10420.000	10.56	37.73	37.33	39.50	50.46	68.20	-17.74	Horizontal
6	15630.000	14.01	40.78	40.42	38.40	52.77	74.00	-21.23	Horizontal

Data List									
NO.	Frequency [MHz]	Cable Loss [dB]	AF [dB/m]	Factor [dB]	Reading [dBµV]	Level [dBµV/m]	Limit [dBµV/m]	Over Limit [dB]	Polarity
1	1138.904	2.65	24.31	39.71	46.35	33.60	74.00	-40.40	Vertical
2	1439.343	3.17	25.58	39.92	47.33	36.16	74.00	-37.84	Vertical
3	3366.778	5.35	31.50	40.98	46.99	42.86	68.20	-25.34	Vertical
4	4456.315	6.72	33.53	41.84	48.01	46.42	68.20	-21.78	Vertical
5	10420.000	10.56	37.73	37.33	39.61	50.57	68.20	-17.63	Vertical
6	15630.000	14.01	40.78	40.42	38.06	52.43	74.00	-21.57	Vertical

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Restricted bands around fundamental frequency

802.11ac80_Channel 42

For new report:

Data List										
NO.	Frequency [MHz]	Reading [dBμV]	AF [dB/m]	Factor [dB]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	5149	50.16	32.60	-18.09	64.67	74.00	9.33	136	134	Horizontal
2	5352.19	39.13	32.60	-17.39	54.34	74.00	19.66	136	134	Horizontal
3	5149.52	37.94	32.60	-18.09	52.45	54.00	1.55	136	134	Horizontal
4	5353.8525	28.44	32.60	-17.38	43.66	54.00	10.34	136	134	Horizontal

Data List										
NO.	Frequency [MHz]	Reading [dBμV]	AF [dB/m]	Factor [dB]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	5147.12	49.99	32.60	-18.10	64.49	74.00	9.51	106	58	Vertical
2	5352.085	39.26	32.60	-17.39	54.47	74.00	19.53	106	58	Vertical
3	5148.68	37.56	32.60	-18.09	52.07	54.00	1.93	106	58	Vertical
4	5353.7825	28.68	32.60	-17.38	43.90	54.00	10.10	106	58	Vertical

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier gain.

The basic equation with a sample calculation is as follows:

Level = Reading(dBμV) + AF(dB/m) + Factor(dB):

AF = Antenna Factor(dB/m)

Factor = Cable Factor(dB) - Preamplifier gain(dB)

Margin = Limit(dBμV/m) – Level(dBμV/m)



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For original report:

Data List									
NO.	Frequency [MHz]	Cable Loss [dB]	AF [dB/m]	Factor [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Over Limit [dB]	Polarity
1	5138.436	7.55	34.06	42.31	63.21	62.51	74.00	-11.49	Horizontal
2	5210.000	7.68	34.09	42.32	101.22	100.67	68.20	32.47	Horizontal
3	5351.744	7.93	34.14	42.34	59.45	59.18	74.00	-14.82	Horizontal
4	5149.947	7.57	34.06	42.32	52.14	51.45	54.00	-2.55	Horizontal
5	5210.000	7.68	34.09	42.32	91.27	90.72	---	---	Horizontal
6	5359.467	7.94	34.15	42.34	48.62	48.37	54.00	-5.63	Horizontal

Data List									
NO.	Frequency [MHz]	Cable Loss [dB]	AF [dB/m]	Factor [dB]	Reading [dBμV]	Level [dBμV/m]	Limit [dBμV/m]	Over Limit [dB]	Polarity
1	5145.851	7.57	34.06	42.32	64.32	63.63	74.00	-10.37	Vertical
2	5210.000	7.68	34.09	42.32	101.58	101.03	68.20	32.83	Vertical
3	5351.744	7.93	34.14	42.34	59.32	59.05	74.00	-14.95	Vertical
4	5149.690	7.57	34.06	42.32	53.62	52.93	54.00	-1.07	Vertical
5	5210.000	7.68	34.09	42.32	92.94	92.39	---	---	Vertical
6	5350.680	7.93	34.14	42.34	48.34	48.07	54.00	-5.93	Vertical

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---End of Report---



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