Report No.: ZEWM2306000826RG02

Page: 1 of 65

TEST REPORT

Application No.: ZEWM2306000826RG

Applicant: Quectel Wireless Solutions Co., Ltd.

Address of Applicant: Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road,

Minhang District, Shanghai 200233, China

Manufacturer: Quectel Wireless Solutions Co., Ltd.

Address of Manufacturer: Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road,

Minhang District, Shanghai 200233, China

EUT Description: Smart Module

Model No.: SG368Z-WF

Trade Mark: Quectel

FCC ID: XMR2023SG368ZWF

Standards: FCC 47 CFR Part 2, Subpart J

FCC 47 CFR Part 15, Subpart C

Date of Receipt: 2023/06/20

Date of Test: 2023/06/20 to 2023/07/07

Date of Issue: 2023/07/07

Test Result : PASS *

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

Authorized Signature:

Ervh II

Ervin Li Regulatory Manager



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Report No.: ZEWM2306000826RG02

Page: 2 of 65

1 Version

Revision Record							
Version Chapter Date Modifier Remark							
01		2023/07/07		Original			

Prepared By	Dee.Zheng (Dee Zheng) / Test Engineer
Checked By	Daniel Wang (Daniel Wang) / Reviewer





Report No.: ZEWM2306000826RG02

Page: 3 of 65

2 Test Summary

Test Item	FCC Rule No.	Test Method	Test Result	Result	Test Lab ^[1]
Antenna Requirement	15.203/15.247(b)		Clause 4.1	PASS	
AC Power Line Conducted Emission	15.207	ANSI C63.10-2020 Section 6.2	Clause 4.2	PASS	В
Conducted Output Power	15.247 (b)(3)	ANSI C63.10-2020 Section11.9.1.2	Clause 4.4	PASS	Α
DTS (6 dB) Bandwidth & 99% Occupied Bandwidth	15.247 (a)(2)	ANSI C63.10-2020 Section 11.8 Option 2 / 6.9.3	Clause 4.5	PASS	А
Power Spectral Density	15.247 (e)	ANSI C63.10-2020 Section 11.10.2	Clause 4.6	PASS	А
Band-edge for RF Conducted Emissions	15.247(d)	ANSI C63.10-2020 Section 11.11	Clause 4.7	PASS	А
RF Conducted Spurious Emissions	15.247(d)	ANSI C63.10-2020 Section 11.11	Clause 4.8	PASS	Α
Radiated Spurious Emissions	15.205/15.209	ANSI C63.10-2020 Section 11.12	Clause 4.9	PASS	Α
Restricted bands around fundamental frequency (Radiated Emission)	15.205/15.209	ANSI C63.10-2020 Section 11.12	Clause 4.10	PASS	А

Remark:



^{1.} Lab A SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch Lab B SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.



Report No.: ZEWM2306000826RG02

Page: 4 of 65

Contents

1	Versio	n	2
2	Test S	Summary	3
3	Gener	al Information	5
	3.1	Details of Client	5
	3.2	Test Location	5
	3.3	Test Facility	6
	3.4	General Description of EUT	7
	3.5	Test Environment	9
	3.6	Description of Support Units	9
4	Test re	esults and Measurement Data	10
	4.1	Antenna Requirement	10
	4.2	AC Power Line Conducted Emissions	11
	4.3	Duty Cycle	15
	4.4	Conducted Output Power	16
	4.5	DTS (6 dB) Bandwidth & 99% Occupied Bandwidth	17
	4.6	Power Spectral Density	18
	4.7	Band-edge for RF Conducted Emissions	19
	4.8	RF Conducted Spurious Emissions	20
	4.9	Radiated Spurious Emissions	21
	4.10	Restricted bands around fundamental frequency	24
5	Measu	urement Uncertainty (95% confidence levels, k=2)	26
6	Equipr	ment List	27
7	Photo	graphs - Setup Photos	30



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Report No.: ZEWM2306000826RG02

Page: 5 of 65

General Information 3

3.1 Details of Client

Applicant:	Quectel Wireless Solutions Co., Ltd.
Address of Applicant:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Manufacturer:	Quectel Wireless Solutions Co., Ltd.
Address of Manufacturer:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

3.2 Test Location

0.2 . 001 2004	
Lab A:	
Company:	SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch
Address:	No. 1 Workshop, M-10, Middle section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China
Post code:	518057
Test engineer:	Xing Guo
Lab B:	
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:	King-p Li



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Report No.: ZEWM2306000826RG02

Page: 6 of 65

3.3 Test Facility

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

Lab A:

• A2LA (Certificate No. 3816.01)

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

Innovation, Science and Economic Development Canada

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

FCC –Designation Number: CN1336

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch has been recognized as an accredited testing laboratory.

Designation Number: CN1336.

Test Firm Registration Number: 787754

Lab B:

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

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Test Firm Registration Number: 717327



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Report No.: ZEWM2306000826RG02

Page: 7 of 65

3.4 General Description of EUT

EUT Description:	Smart Module				
Model No.:	SG368Z-WF				
Trade Mark:	Quectel				
Hardware Version:	R1.0				
Software Version:	SG368ZWFNAR60A04				
	RF Conducted	Sample 1: E1C23DR40000116			
SN:	RSE	Sample 1: E1C23DS03000122 Sample 2: E1C23DR40000116			
	AC power line	Sample 1: E1C23DS03000130			
Operation Frequency:	2400MHz~2483.5MHz fc = 2402 MHz + N * 2 MHz, where: -fc = "Operating Frequency" in MHz, -N = "Channel Number" with the range from 0 to 39.				
Bluetooth version:	Bluetooth V4.2				
Modulation Type:	GFSK	GFSK			
Number of Channel:	40				
Datas Type*i	⊠Provided by client				
Rates Type*:	1M PHY				
Antenna Type:	⊠ External, ☐ Integrate	ed			
	-0.5dBi (Ant0)				
Antenna Gain:	Note: The antenna gain are derived from the gain information report provided by the manufacturer.				
RF Cable:	2000MHz ~ 3000MHz(1	.1dB)			

Note: *Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information, SGS is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.

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Report No.: ZEWM2306000826RG02

Page: 8 of 65

	Operation Frequency of each channel								
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency		
0	2402MHz	10	2422MHz	20	2442MHz	30	2462MHz		
1	2404MHz	11	2424MHz	21	2444MHz	31	2464MHz		
2	2406MHz	12	2426MHz	22	2446MHz	32	2466MHz		
3	2408MHz	13	2428MHz	23	2448MHz	33	2468MHz		
4	2410MHz	14	2430MHz	24	2450MHz	34	2470MHz		
5	2412MHz	15	2432MHz	25	2452MHz	35	2472MHz		
6	2414MHz	16	2434MHz	26	2454MHz	36	2474MHz		
7	2416MHz	17	2436MHz	27	2456MHz	37	2476MHz		
8	2418MHz	18	2438MHz	28	2458MHz	38	2478MHz		
9	2420MHz	19	2440MHz	29	2460MHz	39	2480MHz		

Remark:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The Lowest channel(CH0)	2402MHz
The Middle channel(CH19)	2440MHz
The Highest channel(CH39)	2480MHz



Report No.: ZEWM2306000826RG02

Page: 9 of 65

3.5 Test Environment

Environment Parameter	101.0 kPa Selected Values During Tests				
Relative Humidity	44-46 % RH Ambient				
Value	Temperature(°C) Voltage(V)				
NTNV	22~23 3.4				
Remark:					

NV: Normal Voltage NT: Normal Temperature

3.6 Description of Support Units

The EUT has been tested as an independent unit.



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Report No.: ZEWM2306000826RG02

Page: 10 of 65

4 Test results and Measurement Data

4.1 Antenna Requirement

Standard requirement: 47 CFR Part 15C Section 15.203 /247(b)

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.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The antenna is External Antenna on the main PCB and no consideration of replacement. The best case gain of the antenna is -0.5dBi (Ant0).*

*Note:

The antenna gain are derived from the gain information report provided by the manufacturer.

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Report No.: ZEWM2306000826RG02

11 of 65 Page:

4.2 AC Power Line Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.207						
Test Method:	ANSI C63.10-2020 Section 6.2						
Test Frequency Range:	150kHz to 30MHz	150kHz to 30MHz					
Receiver Setup:	RBW = 9kHz, VBW = 30	kHz					
Limit:	Fraguency range/MHz)	Limit (d	BuV)				
	Frequency range(MHz)	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 log	arithm of the frequency.					
Test Procedure:	room. 2) The EUT was connect Impedance Stabilizat impedance. The pow connected to a secon plane in the same was multiple socket outlet single LISN provided 3) The tabletop EUT was ground reference planely placed on the horizor 4) The test was performed the EUT shall be 0.4 vertical ground reference plane. The unit under test and be mounted on top of the the closest points of and associated equip 5) In order to find the mand all of the interface.	sturbance voltage test was contend to AC power source through ion Network) which provides are cables of all other units of and LISN 2, which was bonded by as the LISN 1 for the unit by a strip was used to connect must the rating of the LISN was not a placed upon a non-metallicate. And for floor-standing arranged with a vertical ground reference plane was bonded to the LISN 1 was placed 0.8 m from the LISN 1 was placed 0.8 m from the LISN 1 and the EUT. All of the LISN 1 and the EUT. All of the LISN 1 and the EUT. All of the cables must be changed an conducted measurement.	gh a LISN 1 (Line a 50Ω/50μH + 5Ω linear the EUT were to the ground reference eing measured. A ultiple power cables to a of exceeded. table 0.8m above the angement, the EUT was rence plane. The rear of ference plane. The horizontal ground m the boundary of the plane for LISNs is distance was between ther units of the EUT in the LISN 2.				



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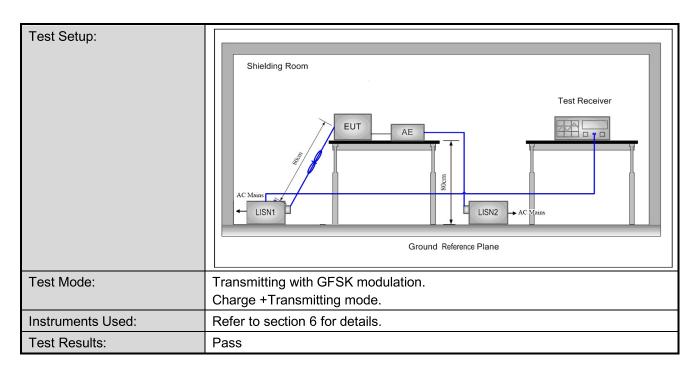
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Page: 12 of 65





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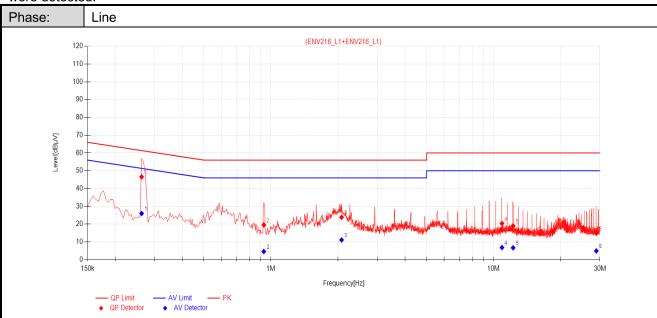
Report No.: ZEWM2306000826RG02

Page: 13 of 65

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



Data	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	0.2625	11.63	34.94	46.57	61.35	14.78	14.37	26.00	51.35	25.35	PASS
2	0.9285	11.71	7.84	19.55	56.00	36.45	-7.08	4.63	46.00	41.37	PASS
3	2.0760	11.73	12.16	23.89	56.00	32.11	-0.60	11.13	46.00	34.87	PASS
4	10.9050	11.88	8.53	20.41	60.00	39.59	-5.00	6.88	50.00	43.12	PASS
5	12.2325	11.89	7.12	19.01	60.00	40.99	-5.17	6.72	50.00	43.28	PASS
6	28.9185	12.08	2.82	14.90	60.00	45.10	-7.12	4.96	50.00	45.04	PASS

- 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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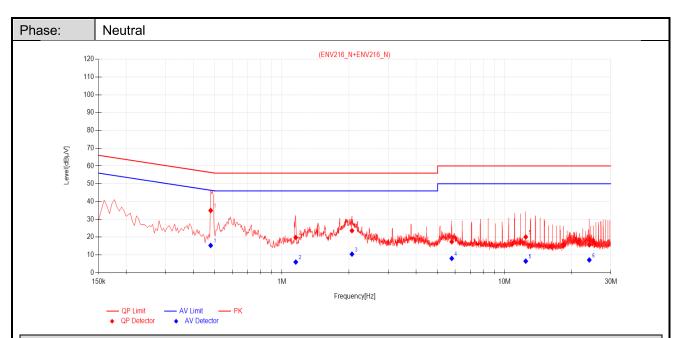
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Report No.: ZEWM2306000826RG02

Page: 14 of 65



Data	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	0.4785	11.60	23.38	34.98	56.37	21.39	3.74	15.34	46.37	31.03	PASS
2	1.1535	11.72	8.10	19.82	56.00	36.18	-5.70	6.02	46.00	39.98	PASS
3	2.0625	11.73	11.93	23.66	56.00	32.34	-1.26	10.47	46.00	35.53	PASS
4	5.7885	11.84	5.59	17.43	60.00	42.57	-3.80	8.04	50.00	41.96	PASS
5	12.4395	11.89	8.20	20.09	60.00	39.91	-5.38	6.51	50.00	43.49	PASS
6	24.0000	12.01	3.67	15.68	60.00	44.32	-4.82	7.19	50.00	42.81	PASS

Remark:

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



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Page: 15 of 65

4.3 Duty Cycle

The detailed test data see: Appendix



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中国・广东・深圳市南山区科技园中区M-10栋1号厂房

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Report No.: ZEWM2306000826RG02

Page: 16 of 65

4.4 Conducted Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(3)			
Test Method:	ANSI C63.10-2020 Section 11.9.1.2			
Test Setup:	Power probe E.U.T Ground Reference Plane			
	* Test with power meter (Detector function: Peak)			
Test Instruments:	Refer to section 6 for details			
Test Mode:	Transmitting with GFSK modulation.			
Limit:	30dBm			
Test Results:	Pass			
The detailed test data see: A	ppendix			



Report No.: ZEWM2306000826RG02

Page: 17 of 65

4.5 DTS (6 dB) Bandwidth & 99% Occupied Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)			
Test Method:	ANSI C63.10-2020 Section 11.8 Option 2 / 6.9.3			
Test Setup:	PC Spectrum Analyzer O O O O O O O O O			
Instruments Used:	Refer to section 6 for details			
Test Mode:	Transmitting with GFSK modulation.			
Limit:	≥ 500 kHz			
Test Results:	Pass			
The detailed test data see: A	ppendix			



Report No.: ZEWM2306000826RG02

Page: 18 of 65

4.6 Power Spectral Density

Test Requirement:	47 CFR Part 15C Section 15.247 (e)		
Test Method:	ANSI C63.10-2020 Section 11.10.2		
Test Setup:	PC Spectrum Analyzer Spectrum Analyzer		
Test Instruments:	Refer to section 6 for details		
Test Mode:	Transmitting with GFSK modulation.		
Limit:	≤8.00dBm/3kHz		
Test Results:	Pass		
The detailed test data see: A	ppendix		



Report No.: ZEWM2306000826RG02

Page: 19 of 65

4.7 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)		
Test Method:	ANSI C63.10-2020 Section 11.11		
Test Setup:	PC Spectrum Analyzer O O O O O O O O O		
Instruments Used:	Refer to section 6 for details		
Test Mode:	Transmitting with GFSK modulation.		
Limit:	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 band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.		
Test Results:	Pass		
The detailed test data see: A	ppendix		



邮编: 518057

Report No.: ZEWM2306000826RG02

Page: 20 of 65

4.8 RF Conducted Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)		
Test Method:	ANSI C63.10-2020 Section 11.11		
Test Setup:	PC Spectrum Analyzer O O O O O O O O O		
Instruments Used:	Refer to section 6 for details		
Test Mode:	Transmitting with GFSK modulation.		
Limit:	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 band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.		
Test Results:	Pass		
The detailed test data see: A	ppendix		





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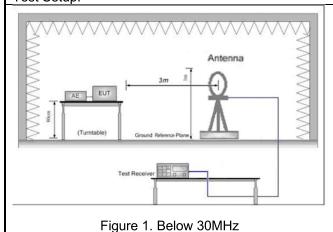
Report No.: ZEWM2306000826RG02

Page: 21 of 65

4.9 Radiated Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205					
Test Method:	ANSI C63.10-2020 Section 11.12					
Test Site:	Measurement Distance:	3m (Semi-Anecho	ic Chamber)	1		
Test Frequency:	9kHz ~ 25GHz					
Limit:	Frequency Remark				Measurement distance (m)	
	0.009MHz-0.490MHz 2400/F(kHz)				300	
	0.490MHz-1.705MHz 24000/F(kHz)				30	
	1.705MHz-30MHz 30				30	
	30MHz-88MHz 100 40.0 Quasi-peak				3	
	88MHz-216MHz 150 43.5 Quasi-peak			Quasi-peak	3	
	216MHz-960MHz	200	46.0	Quasi-peak	3	
	960MHz-1GHz 500 54.0 Quasi-peak 3				3	
	Above 1GHz 500 54.0 Average 3					
	Remark: 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 Setup:



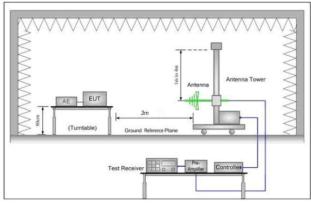


Figure 2. 30MHz to 1GHz



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Report No.: ZEWM2306000826RG02

Page: 22 of 65

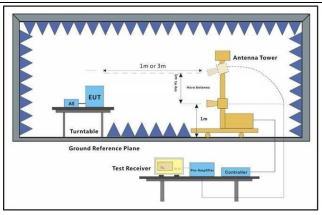


Figure 3. Above 1 GHz

Test Procedure:

- For below 1GHz, 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 camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. 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.
- 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.
- Test the EUT in the lowest channel, the middle channel, the Highest channel.
- 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.
- Repeat above procedures until all frequencies measured was complete.
- 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
- 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.
- At a measurement distance of 1 meter the limit line was increased by 20*LOG(3/1) = 9.54 dB.

Test Configuration:

Measurements below 30MHz

- RBW = 10 kHz
- VBW = 30 kHz
- Detector = Peak & Average & Quasi-peak



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Report No.: ZEWM2306000826RG02

Page: 23 of 65

	Trace mode = max hold
	Measurements Below 1000MHz
	• RBW = 120 kHz
	• VBW = 300 kHz
	Detector = Quasi-peak
	Trace mode = max hold
	Peak Measurements Above 1000 MHz
	• RBW = 1 MHz
	• VBW ≥ 3 MHz
	Detector = Peak
	Sweep time = auto
	Trace mode = max hold
	Average Measurements Above 1000MHz
	• RBW = 1 MHz
	 VBW = 10 Hz, when duty cycle is no less than 98 percent.
	 VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum
	transmission duration over which the transmitter is on and is transmitting at its
	maximum power control level for the tested mode of operation.
Exploratory Test	Transmitting with GFSK modulation.
Mode:	Charge + Transmitting mode.
Final Test Mode:	Transmitting with GFSK modulation.
	Pretest the EUT at Charge + Transmitting mode,
	For below 1GHz part, through pre-scan, the worst case is the lowest channel. Only
	the worst case is recorded in the report.
Instruments Used:	Refer to section 6 for details
Test Results:	Pass
The detailed test data	see: Appendix



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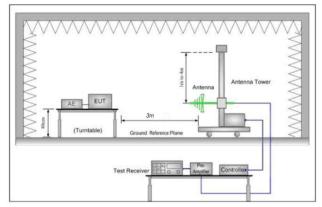
Report No.: ZEWM2306000826RG02

Page: 24 of 65

4.10 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10-2020 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		
	Above IGHZ	74.0	Peak Value		

Test Setup:



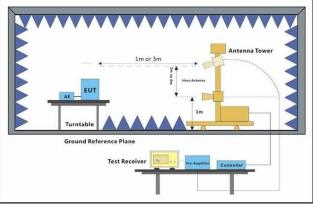


Figure 1. 30MHz to 1GHz

Figure 2. Above 1 GHz

Test Procedure:

- For below 1GHz, 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 camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.



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Report No.: ZEWM2306000826RG02

Page: 25 of 65

Test Configuration:	 g. 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 h. Test the EUT in the lowest channel , the Highest channel i. 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. j. Repeat above procedures until all frequencies measured was complete. Measurements Below 1000MHz RBW = 120 kHz VBW = 300 kHz Detector = Quasi-peak Trace mode = max hold Peak Measurements Above 1000 MHz RBW = 1 MHz VBW ≥ 3 MHz Detector = Peak Sweep time = auto Trace mode = max hold Average Measurements Above 1000MHz RBW = 1 MHz VBW = 10 Hz, when duty cycle is no less than 98 percent. VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum
	 VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
Exploratory Test Mode:	Transmitting with GFSK modulation. Charge + Transmitting mode.
Final Test Mode:	Transmitting with GFSK modulation. Pretest the EUT at Charge + Transmitting mode. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 6 for details
Test Results:	Pass
The detailed test data see	e: Appendix



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Report No.: ZEWM2306000826RG02

Page: 26 of 65

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

	Lab A						
No.	Item	Measurement Uncertainty					
1	Radio Frequency	± 9.84Hz					
2	Duty cycle	± 0.185%					
3	Occupied Bandwidth	± 0.20%					
4	RF conducted power	± 0.42dB					
5	RF power density	± 1.97dB					
6	Conducted Spurious emissions	± 0.42dB					
		±4.8dB (30MHz-1GHz)					
7	Dadiated Emission	±4.68dB (1GHz-6GHz)					
7	Radiated Emission	±4.52dB (6GHz-18GHz)					
		±5.26dB (18GHz-40GHz)					

The U_{lab} (lab Uncertainty) is less than U_{cisprieTSI} (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.

Lab B						
No.	Item	Measurement Uncertainty				
1	Conduction Emission	± 2.90dB (150kHz to 30MHz)				

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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Report No.: ZEWM2306000826RG02

Page: 27 of 65

6 Equipment List

Lab A							
RF Test System							
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy/mm/dd)	Cal.Due date (yyyy/mm/dd)		
Spectrum Analyzer	Keysight	N9020A	SZ-WRG-M-002	2022/11/18	2023/11/17		
Signal Generator	Keysight	N5181A	SZ-WRG-M-005	2022/11/18	2023/11/17		
DC power supply	Tonscend	TS0806-4ADC	SZ-WRG-A-007	NCR	NCR		
RF Control Unit	Tonscend	JS0806-2	SZ-WRG-M-008	2022/11/18	2023/11/17		
Radio Communication Tester	Rohde & Schwarz	CMW270	SZ-WRG-M-009	2023/02/16	2024/02/15		
Radio Communication Tester	Rohde & Schwarz	CMW-Z800A	SZ-WRG-M-010	NCR	NCR		
Signal Generator	Rohde & Schwarz	SMM100A	SZ-WRG-M-011	2023/02/22	2024/02/21		
Test Software	Tonscend	JS1120 V3.2.22	N/A	NCR	NCR		
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	HTC-1	SZ-WRG-M-077	2023/05/26	2024/05/25		
Spectrum Analyzer	Rohde & Schwarz	FSV	SZ-WRG-M-012	2023/02/16	2024/02/15		



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Report No.: ZEWM2306000826RG02

Page: 28 of 65

Lab A								
Radiated spurious emissions Cal. date Cal. Due date								
Test Equipment	Manufacturer	Model No.	Model No. Inventory No.		Cal.Due date (yyyy/mm/dd)			
EMI TEST RECEIVER	Rohde & Schwarz	ESR	SZ-WRG-M-047	2023/02/16	2024/02/15			
Signal &Spectrum Analyzer	Rohde & Schwarz	FSV	SZ-WRG-M-048	2023/02/16	2024/02/15			
Low Noise Amplifier 9K- 3GHz	Tonscend	TAP9K3G32	SZ-WRG-M-049	2023/02/16	2024/02/15			
Low Noise Amplifier 30M- 8GHz	Tonscend	TAP30M8G30	SZ-WRG-M-050	2023/02/16	2024/02/15			
Low Noise Amplifier 1G- 18GHz	Tonscend	TAP01018050	SZ-WRG-M-051	2023/02/16	2024/02/15			
Low Noise Amplifier 18G- 40GHz	Tonscend	TAP18040048	SZ-WRG-M-052	2023/02/16	2024/02/15			
Active Loop Antenna 9kHz- 30MHz	SCHWARZBECK	FMZB 1519B	SZ-WRG-M-053	2022/01/16	2024/01/15			
TRILOG Breitband Antenne 30MHz- 1GHz	SCHWARZBECK	VULB 9168	SZ-WRG-M-054	2022/01/16	2024/01/15			
Double Ridge Horn Antenna 1GHz-18GHz	SCHWARZBECK	BBHA 9120 D	SZ-WRG-M-055	2022/01/16	2024/01/15			
SHF-EHF Horn 15GHz-40GHz	SCHWARZBECK	BBHA 9170	SZ-WRG-M-056	2022/01/16	2024/01/15			
RSE Test Software	Tonscend	JS32-RSE V4.0.0	SZ-WRG-M-058	NCR	NCR			
Chamber	CRTSGSSAC966	N/A	SZ-WRG-C-063	2022/01/05	2025/01/04			
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	HTC-1	SZ-WRG-M-022	2023/02/17	2024/02/16			
Spectrum Analyzer	Keysight	N9020A	SZ-WRG-M-002	2022/11/18	2023/11/17			



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Report No.: ZEWM2306000826RG02

Page: 29 of 65

Lab B Conduction Test Equipment							
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy/mm/dd)	Cal.Due date (yyyy/mm/dd)		
Test receiver	ROHDE&SCHWARZ	ESR7	SUWI-01-10-01	2023/02/08	2024/02/07		
Temperature and humidity meter	MingGao	TH101B	SUWI-01-01-06	2023/02/07	2024/02/06		
Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-03	2023/02/08	2024/02/07		
Artificial network	ROHDE&SCHWARZ	ENV216	SUWI-01-19-04	2023/02/08	2024/02/07		
Measurement Software	Tonscend	JS32-CE V4.0.0.2	SUWI-02-09-05	NCR	NCR		



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Page: 30 of 65

7 Photographs - Setup Photos

Refer to Appendix A.2 WLAN Setup Photos.



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Report No.: ZEWM2306000826RG02

Page: 31 of 65

Appendix



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Report No.: ZEWM2306000826RG02

Page: 32 of 65

DTS Bandwidth Test Result

TestMode	Antenna	Frequency[MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
		2402	0.73	2401.62	2402.35	0.5	PASS
BLE_1M	Ant0	2440	0.73	2439.62	2440.35	0.5	PASS
		2480	0.74	2479.62	2480.36	0.5	PASS



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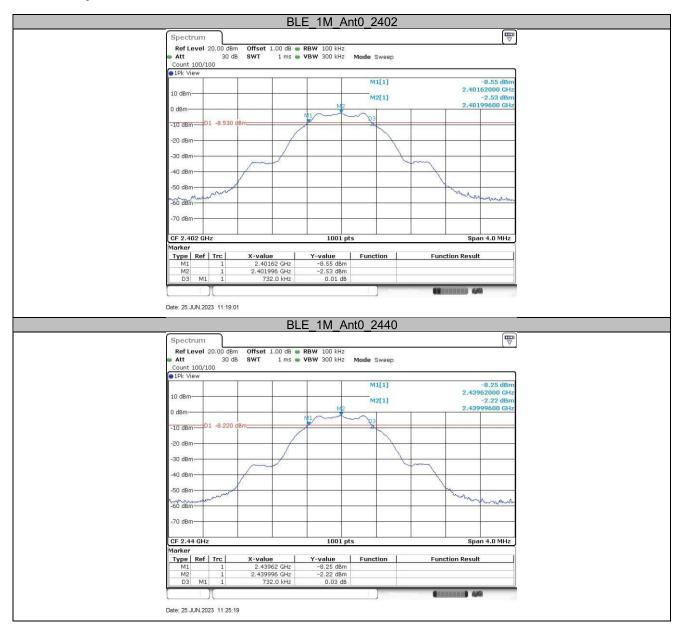


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Report No.: ZEWM2306000826RG02

Page: 33 of 65

Test Graphs





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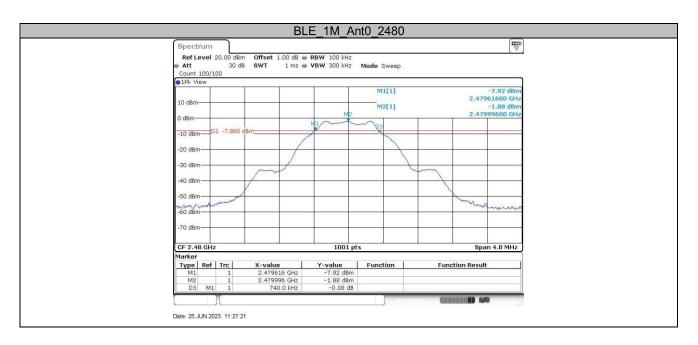
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Report No.: ZEWM2306000826RG02

Page: 34 of 65





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Report No.: ZEWM2306000826RG02

Page: 35 of 65

Occupied Channel Bandwidth Test Result

TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Verdict	
BLE_1M	Ant0	2402	1.035	2401.4805	2402.5155	For Donort	
		2440	1.035	2439.4805	2440.5155	For Report Purpose	
		2480	1.035	2479.4805	2480.5155	Fulpose	



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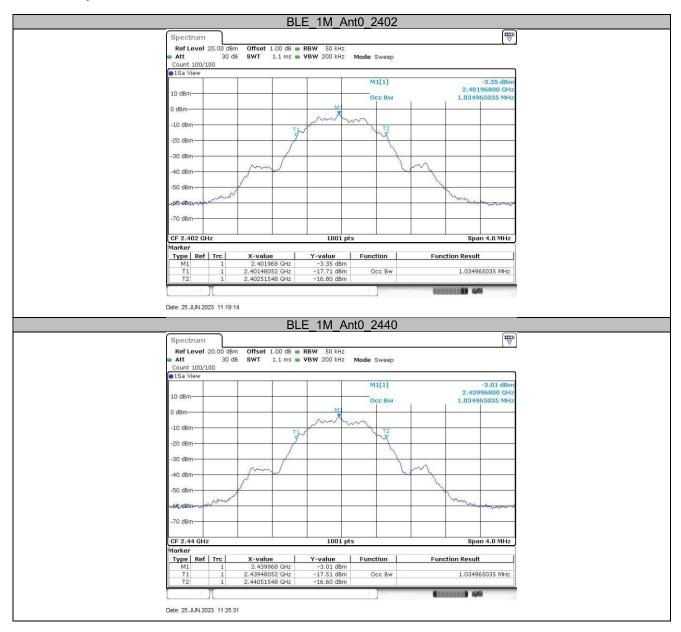


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Page: 36 of 65

Test Graphs





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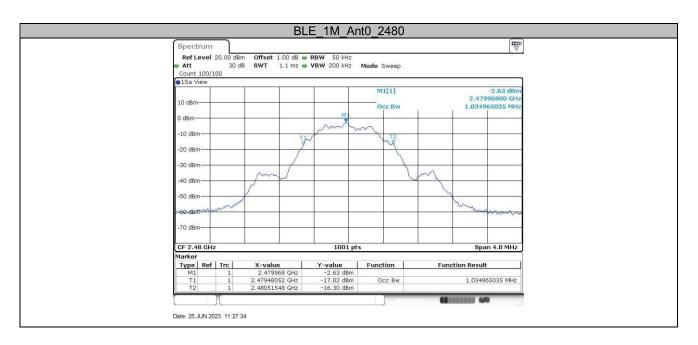
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Report No.: ZEWM2306000826RG02

Page: 38 of 65

Maximum conducted output power Test Result Peak

TestMode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
		2402	-1.5	≤30	PASS
BLE_1M	Ant0	2440	-1.22	≤30	PASS
		2480	-0.88	≤30	PASS



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Report No.: ZEWM2306000826RG02

Page: 39 of 65

Maximum power spectral density **Test Result**

TestMode	Antenna	Frequency[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
		2402	-16.67	≤8.00	PASS
BLE_1M	Ant0	2440	-16.32	≤8.00	PASS
		2480	-15.88	≤8.00	PASS



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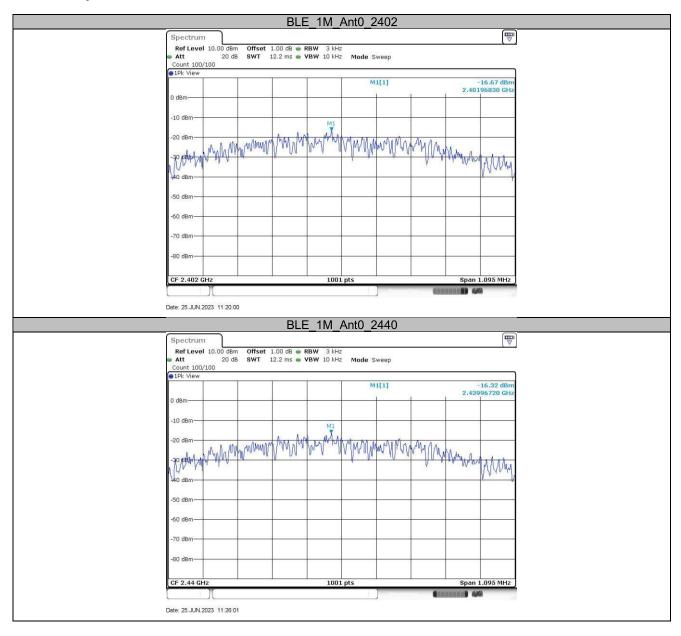


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Page: 40 of 65

Test Graphs





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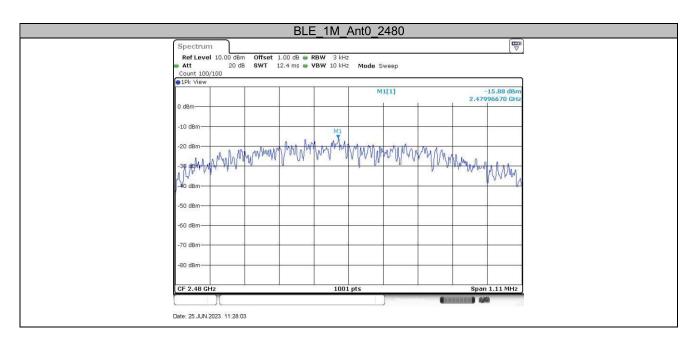
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Page: 42 of 65

Band edge measurements Test Graphs





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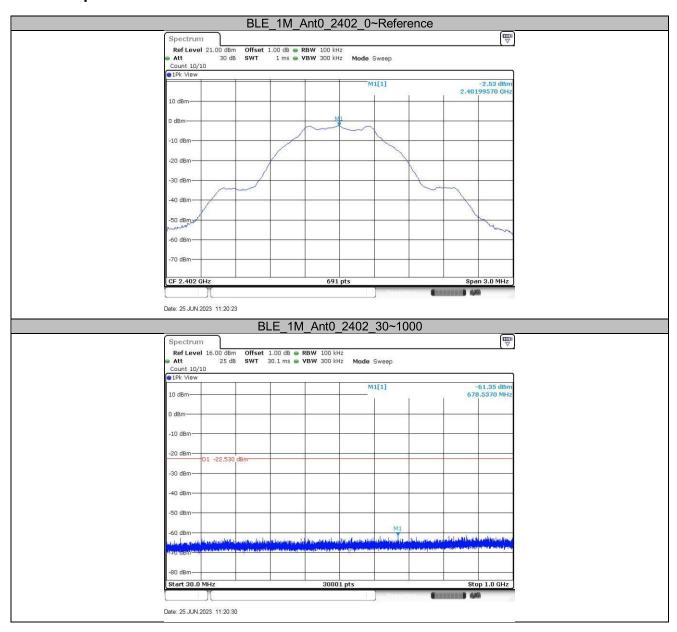


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Conducted Spurious Emission Test Graphs



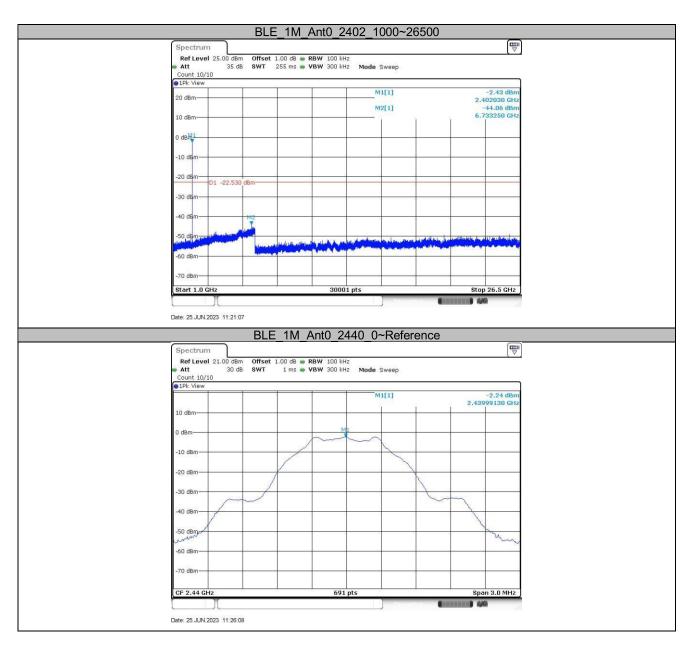




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44 of 65 Page:



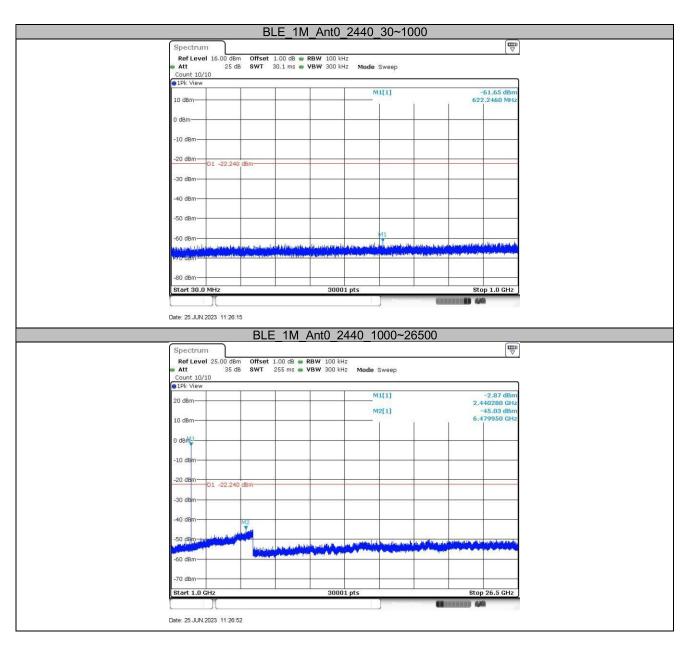




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Report No.: ZEWM2306000826RG02

Page: 45 of 65



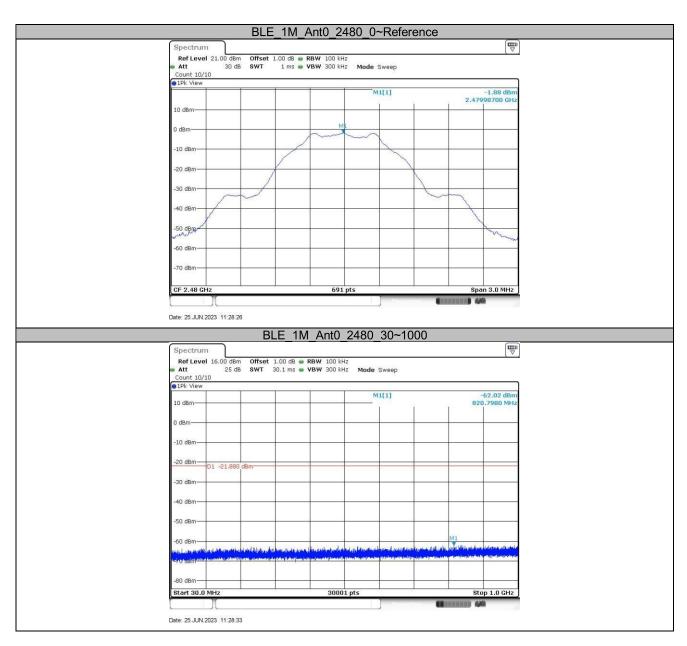




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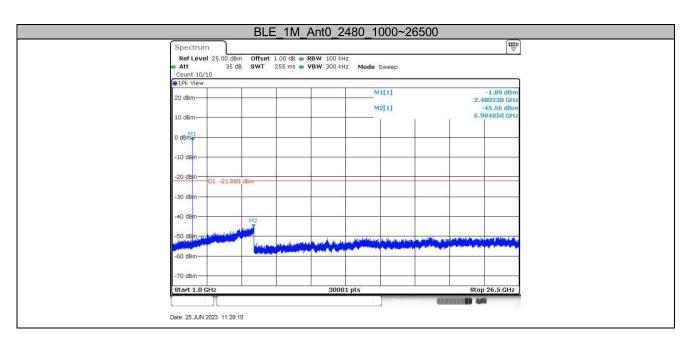
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Report No.: ZEWM2306000826RG02

47 of 65 Page:





Report No.: ZEWM2306000826RG02

Page: 48 of 65

Duty Cycle Test Result

TestMode	Antenna	Frequency[MHz]	ON Time [ms]	Period [ms]	Duty Cycle [%]	Duty Cycle Factor[dB]
BLE 1M	Ant0	2402	0.39	0.62	62.90	2.01

Note:

Radiated Emission Average VBW = 1 / T

TestMode	T[ms]	Period[ms]	Duty Cycle[%]	1/T[kHz]	VBW Setting
BLE_1M	0.39	0.62	62.90	2.56410	3kHz

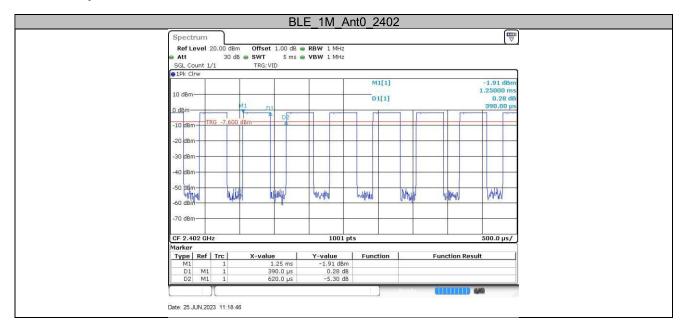




Report No.: ZEWM2306000826RG02

Page: 49 of 65

Test Graphs



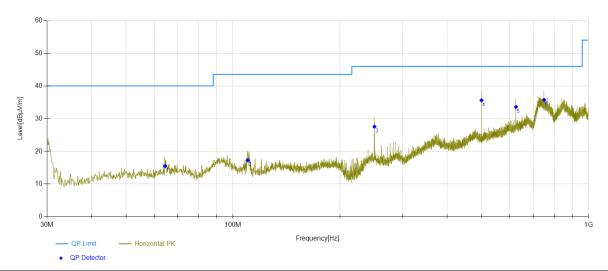
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Page: 50 of 65

Radiated Spurious Emissions

Radiated emission below 1GHz

Worst case Mode: BLE 1M Channel 39



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	64.4384	28.68	-24.62	11.47	15.53	40.00	24.47	308	196	Horizontal
2	110.033	30.29	-24.42	11.41	17.28	43.50	26.22	354	138	Horizontal
3	250.018	36.59	-23.26	14.23	27.56	46.00	18.44	118	266	Horizontal
4	500.012	38.33	-21.94	19.22	35.61	46.00	10.39	104	360	Horizontal
5	625.0575	32.76	-21.07	21.89	33.58	46.00	12.42	237	205	Horizontal
6	750.006	27.9	-20.56	28.42	35.76	46.00	10.24	159	323	Horizontal

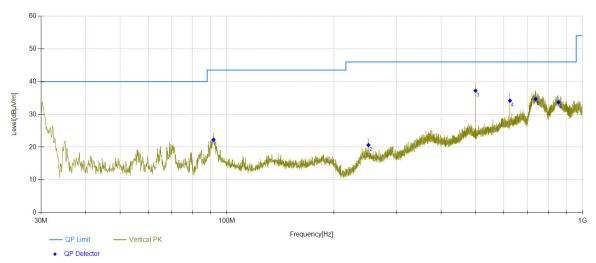




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Report No.: ZEWM2306000826RG02

Page: 51 of 65



Data	a 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	91.6982	32.38	-24.47	14.37	22.28	43.50	21.22	277	37	Vertical
2	250.018	29.67	-23.26	14.23	20.64	46.00	25.36	151	136	Vertical
3	500.012	39.94	-21.94	19.22	37.22	46.00	8.78	338	154	Vertical
4	625.0575	33.35	-21.07	21.89	34.17	46.00	11.83	156	62	Vertical
5	738.2678	26.72	-20.78	28.72	34.66	46.00	11.34	228	222	Vertical
6	855.9406	27.03	-20.78	27.44	33.69	46.00	12.31	189	247	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($dB\mu V$) + AF(dB/m) + Factor(dB):

AF = Antenna Factor(dB/m)

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

Margin = Limit($dB\mu V/m$) – Value($dB\mu V/m$)

- 2) All channels have been tested, but only the worst case data displayed in this report.
- 3) Both peak and average measured complies with the limit line, so test result is "PASS"

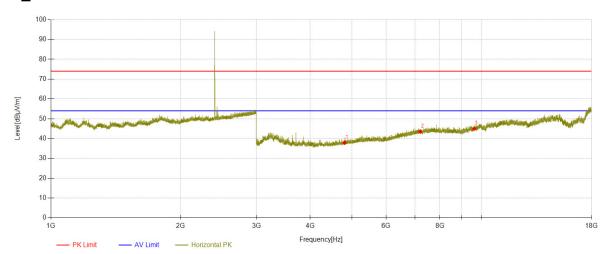


Report No.: ZEWM2306000826RG02

Page: 52 of 65

Transmitter emission Above 1GHz

BLE 1M Channel 00



Data	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	4804	54.01	30.93	-47.10	37.84	74.00	36.16	337	64	Horizontal			
2	7206	52.82	36.05	-45.37	43.50	74.00	30.50	213	326	Horizontal			
3	9608	49.49	37.50	-41.97	45.02	74.00	28.98	166	114	Horizontal			



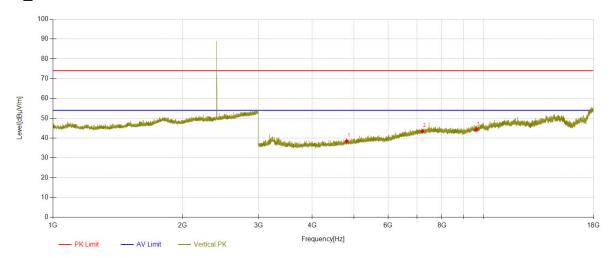


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Report No.: ZEWM2306000826RG02

Page: 53 of 65

BLE_1M Channel 00



Data	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	4804	54.60	30.93	-47.10	38.43	74.00	35.57	145	33	Vertical			
2	7206	52.75	36.05	-45.37	43.43	74.00	30.57	226	192	Vertical			
3	9608	48.61	37.50	-41.97	44.14	74.00	29.86	275	162	Vertical			



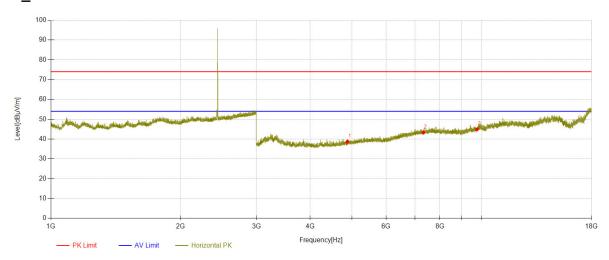


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 54 of 65

BLE_1M Channel 19



Data	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	4880	54.59	31.11	-47.01	38.69	74.00	35.31	338	286	Horizontal			
2	7320	52.55	36.18	-45.41	43.32	74.00	30.68	155	114	Horizontal			
3	9760	48.47	37.85	-41.36	44.96	74.00	29.04	186	106	Horizontal			



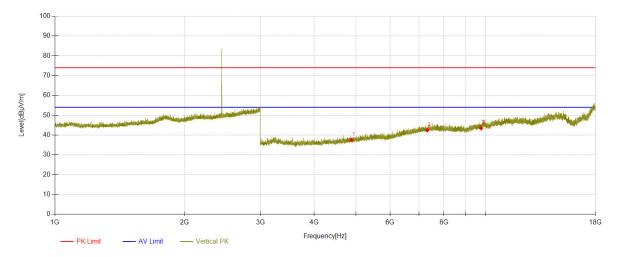


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 55 of 65

BLE_1M Channel 19



Data	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	4880	53.44	31.11	-47.01	37.54	74.00	36.46	159	86	Vertical			
2	7320	51.70	36.18	-45.41	42.47	74.00	31.53	231	95	Vertical			
3	9760	46.95	37.85	-41.36	43.44	74.00	30.56	187	86	Vertical			



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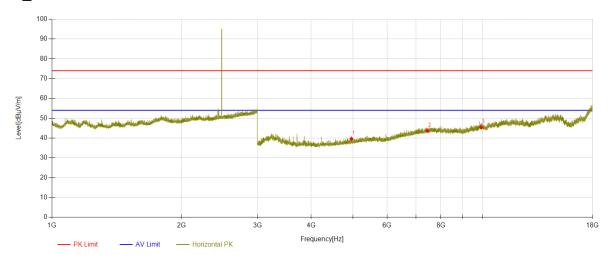


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 56 of 65

BLE_1M Channel 39



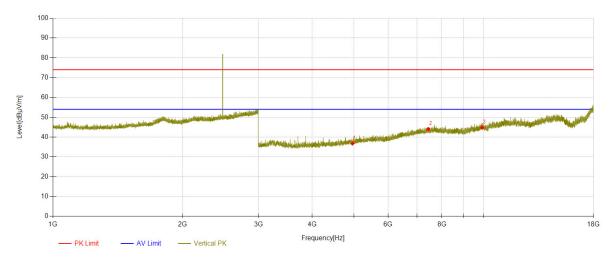
Data	Data List												
NO.	Frequency [MHz]	Reading [dBµV]	AF [dB/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity			
1	4960	55.39	31.31	-47.11	39.59	74.00	34.41	306	64	Horizontal			
2	7440	52.48	36.33	-45.08	43.73	74.00	30.27	192	318	Horizontal			
3	9920	47.89	38.22	-40.79	45.32	74.00	28.68	121	169	Horizontal			



Report No.: ZEWM2306000826RG02

Page: 57 of 65

BLE_1M Channel 39



Data	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	4960	52.57	31.31	-47.11	36.77	74.00	37.23	128	0	Vertical			
2	7440	52.78	36.33	-45.08	44.03	74.00	29.97	255	256	Vertical			
3	9920	47.30	38.22	-40.79	44.73	74.00	29.27	269	115	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($dB\mu V$) + AF(dB/m) + Factor(dB):

AF = Antenna Factor(dB/m)

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

Margin = Limit($dB\mu V/m$) – Level($dB\mu V/m$)

2) All channels have been tested, but only the worst case data displayed in this report.

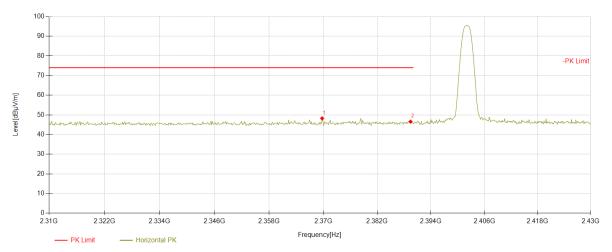


Report No.: ZEWM2306000826RG02

Page: 58 of 65

Restricted bands around fundamental frequency

BLE 1M Channel 00



Data	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	2369.76	46.88	27.09	-25.74	48.23	74.00	25.77	278	264	Horizontal			
2	2389.44	45.14	27.13	-25.70	46.57	74.00	27.43	278	264	Horizontal			



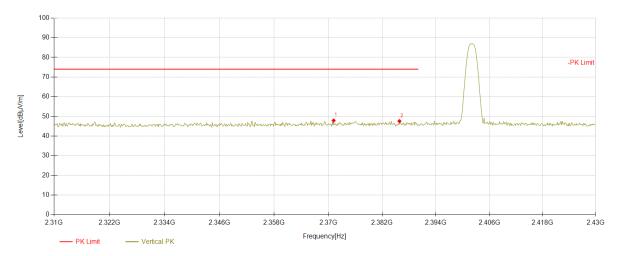


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 59 of 65

BLE_1M Channel 00



Data	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	2371.2	46.55	27.09	-25.74	47.90	74.00	26.10	134	187	Vertical			
2	2385.84	46.17	27.13	-25.71	47.59	74.00	26.41	134	187	Vertical			



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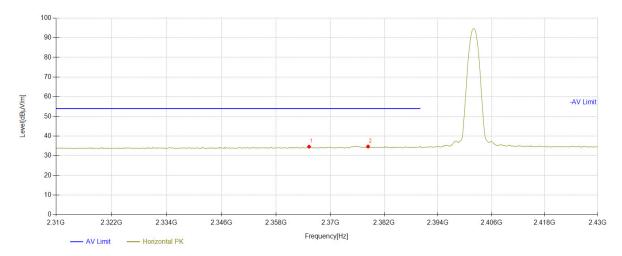


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 60 of 65

BLE_1M Channel 00



Data	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	2365.32	33.25	27.08	-25.75	34.58	54.00	19.42	278	264	Horizontal		
2	2378.4	33.30	27.11	-25.73	34.68	54.00	19.32	278	264	Horizontal		



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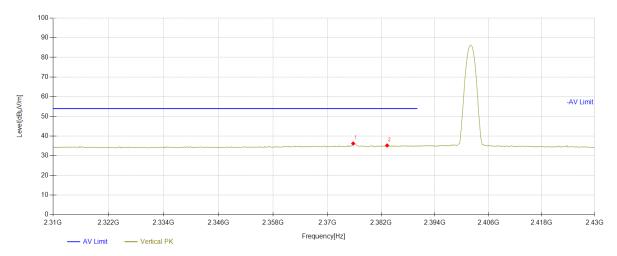


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 61 of 65

BLE_1M Channel 00



Data	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	2375.76	34.83	27.10	-25.73	36.20	54.00	17.80	134	187	Vertical			
2	2383.32	33.83	27.12	-25.72	35.23	54.00	18.77	134	187	Vertical			



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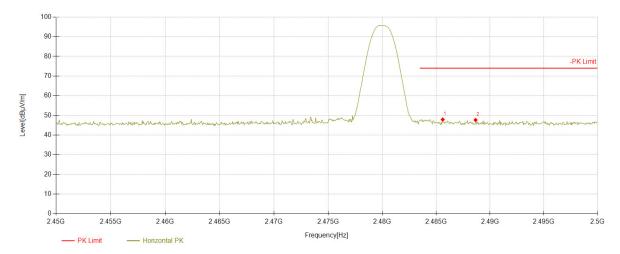


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 62 of 65

BLE_1M Channel 39



Data	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	2485.6	45.66	27.37	-25.13	47.90	74.00	26.10	179	256	Horizontal			
2	2488.65	45.39	27.37	-25.11	47.65	74.00	26.35	179	256	Horizontal			



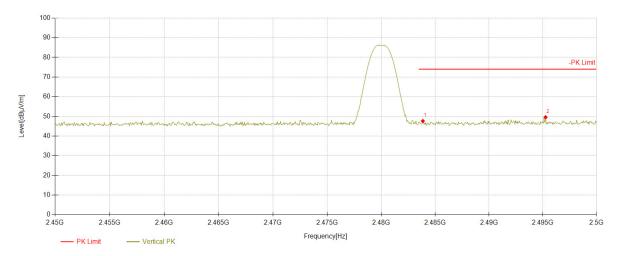


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 63 of 65

BLE_1M Channel 39



Data	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	2483.85	45.42	27.36	-25.14	47.64	74.00	26.36	271	185	Vertical			
2	2495.25	47.24	27.39	-25.07	49.56	74.00	24.44	271	185	Vertical			



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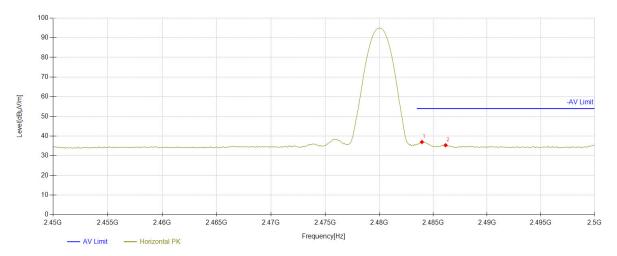


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 64 of 65

BLE_1M Channel 39



Data	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	2483.95	34.75	27.36	-25.14	36.97	54.00	17.03	179	256	Horizontal			
2	2486.15	33.09	27.37	-25.13	35.33	54.00	18.67	179	256	Horizontal			

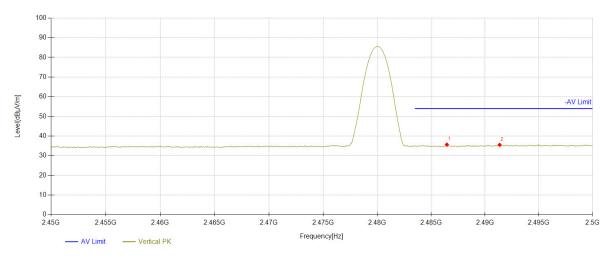


SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Report No.: ZEWM2306000826RG02

Page: 65 of 65

BLE_1M Channel 39



Data	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	2486.45	33.43	27.37	-25.13	35.67	54.00	18.33	271	185	Vertical		
2	2491.35	33.28	27.38	-25.10	35.56	54.00	18.44	271	185	Vertical		

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($dB\mu V$) + AF(dB/m) + Factor(dB):

AF = Antenna Factor(dB/m)

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

Margin = Limit($dB\mu V/m$) – Level($dB\mu V/m$)

2) Both peak and average measured complies with the limit line, so test result is "PASS"

---End of Report---



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