



FCC TEST REPORT

Application No: HR/2019/90003
Applicant: Unimax communications
Address of Applicant: 18201 McDermott St. West Suite E, Irvine, CA 92614.
Manufacturer: Unimax communications
Address of Manufacturer: 18201 McDermott St. West Suite E, Irvine, CA 92614.
Factory: Unimax communications
Address of Factory: 18201 McDermott St. West Suite E, Irvine, CA 92614.
EUT Description: Smartphone
Model No.: U693CL
Trade Mark: UMX
FCC ID: P46-U693CL
Standards: 47 CFR FCC Part 2, Subpart J
47 CFR Part 15, Subpart C
Test Method: KDB558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10 (2013)
Date of Receipt: 2019/11/5
Date of Test: 2019/11/6 to 2019/11/20
Date of Issue: 2021/5/15

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

Derek Yang

Derek Yang

Wireless Laboratory Manager



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Shenzhen Branch Testing Center FCC Laboratory

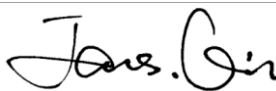
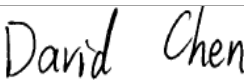
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1 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
00		2019/11/20		Original
01		2021/5/15	James Qin	1.Add test site Information 2.Modify data conversion error of antenna height 3.Update equipment list

*This test report supersedes the original report (report No.: HR/2019/9000303, issue date: 2019-11-20), original report shall be invalid.

Authorized for issue by:		
Prepared By		(James Qin) / Engineer
Checked By		(David Chen) / Reviewer





2 Test Summary

Test Item	Test Requirement	Test method	Test Result	Result	Test Lab*
AC Power Line Conducted Emission	15.207	ANSI C63.10 2013	Clause 4.2	PASS	B
Conducted Output Power	15.247 (b)(3)	ANSI C63.10 2013	Clause 4.3	PASS	A
DTS (6 dB) Bandwidth & 99% Occupied Bandwidth	15.247 (a)(2)	ANSI C63.10 2013	Clause 4.4	PASS	A
Power Spectral Density	15.247 (e)	ANSI C63.10 2013	Clause 4.5	PASS	A
Band-edge for RF Conducted Emissions	15.247(d)	ANSI C63.10 2013	Clause 4.6	PASS	A
RF Conducted Spurious Emissions	15.247(d)	ANSI C63.10 2013	Clause 4.7	PASS	A
Radiated Spurious Emissions	15.205/15.209	ANSI C63.10 2013	Clause 4.8	PASS	B
Restricted bands around fundamental frequency (Radiated Emission)	15.205/15.209	ANSI C63.10 2013	Clause 4.9	PASS	B

All test were performed by Lab A and B.

Parts of test items above were subcontracted to Lab B.

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

Lab B: SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD



SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch Test Center (CSTC Laboratory)

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3 General Information

3.1 Client Information

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Factory:	Unimax communications
Address of Factory:	18201 McDermott St.West Suite E,Irvine,CA 92614.

3.2 Test Location

Lab A:

Company:	SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch
Address:	No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China
Post code:	518057
Test engineer:	Adam Liang, Mike Hu

Lab B:

Company:	SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD.
Address:	1/F, Unit D, Building 1, Kanghong Orange Technology Park, No.137, Keyuan 3rd Road, Fengdong New City, Xi'an, Shaanxi China
Post code:	710086
Test engineer:	Ben Huang



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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 EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• VCCI

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.

• FCC –Designation Number: CN1178

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

Designation Number: CN1178. Test Firm Registration Number: 406779.

• Innovation, Science and Economic Development Canada

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

CAB identifier: CN0006.

IC#: 4620C.

Lab B:

A2LA (Certificate No. 4854.01)

SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4854.01.

Designation Number: CN1271.



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3.4 General Description of EUT

EUT Description:	Smartphone
Model No.:	U693CL
Trade Mark:	UMX
Hardware Version:	Q5009-V1.0
Software Version:	U693CL_01.01.01.182518
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 V4.1 LE
Modulation Type:	GFSK
Number of Channel:	40
Sample Type:	☒ Portable Device, ☐ Module
Antenna Type:	☐ External, ☒ Integrated
Antenna Gain:	0.8dBi
Power Supply:	☐ AC/DC Adapter; ☒ Battery; ☐ PoE; ☐ Other:

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



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The middle channel (CH19)	2440MHz
The highest channel (CH39)	2480MHz

3.5 Test Environment

Operating Environment	
Temperature:	25.0 °C
Humidity:	50 % RH
Atmospheric Pressure:	101.32 KPa

3.6 Description of Support Units

The EUT has been tested independent unit.

4 Test results and Measurement Data

4.1 Antenna Requirement

Standard requirement:	47 CFR Part 15C Section 15.203 /247(c)
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 integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0.8dBi.	



4.2 AC Power Line Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.207		
Test Method:	ANSI C63.10: 2013		
Test Range: Frequency	150kHz to 30MHz		
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:	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.		





Test Setup:	
Test Mode:	Transmitting with GFSK modulation. Charge +Transmitting mode.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

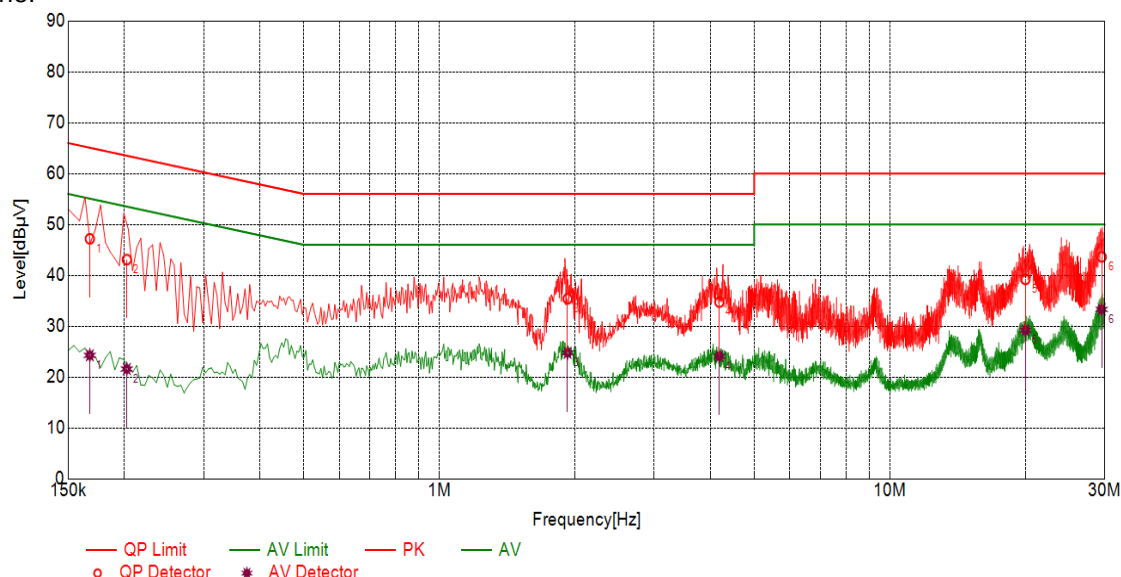


Measurement Data

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.

Live line:



Final Data List

NO.	Freq. [MHz]	Factor [dB]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Type
1	0.1676	10.10	47.17	65.08	17.91	24.27	55.08	30.81	L
2	0.2025	10.10	43.09	63.51	20.42	21.58	53.51	31.93	L
3	1.9260	10.10	35.38	56.00	20.62	24.75	46.00	21.25	L
4	4.1837	10.10	34.74	56.00	21.26	24.09	46.00	21.91	L
5	19.9998	10.11	39.21	60.00	20.79	29.23	50.00	20.77	L
6	29.5285	10.11	43.62	60.00	16.38	33.30	50.00	16.70	L

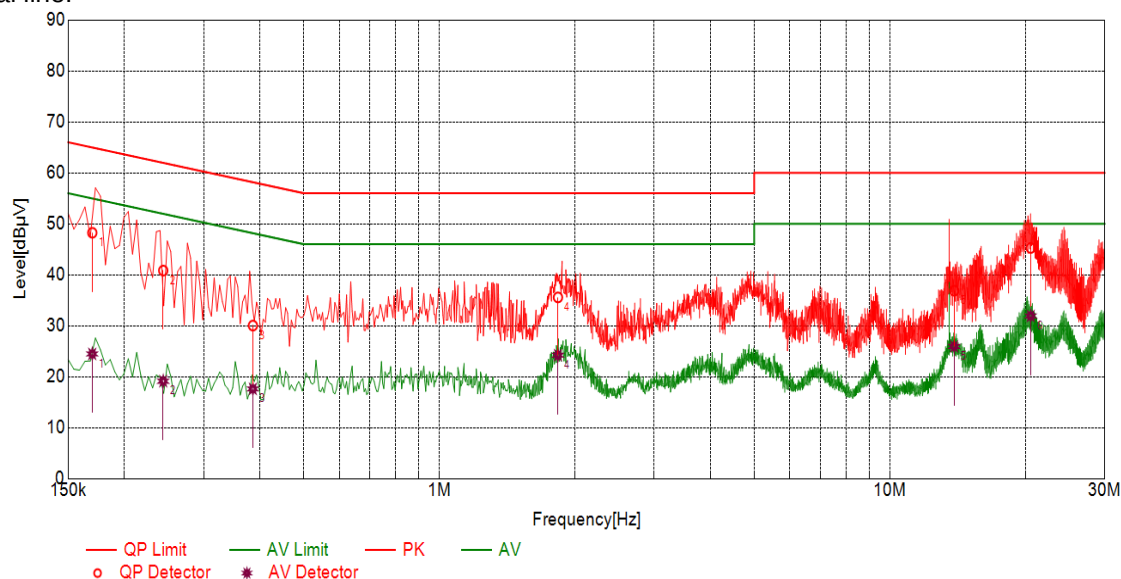


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Neutral line:



Test Graph

Final Data List

NO.	Freq. [MHz]	Factor [dB]	QP Value [dBμV]	QP Limit [dBμV]	QP Margin [dB]	AV Value [dBμV]	AV Limit [dBμV]	AV Margin [dB]	Type
1	0.1697	10.10	48.24	64.98	16.74	24.47	54.98	30.51	N
2	0.2439	10.10	40.83	61.96	21.13	19.12	51.96	32.84	N
3	0.3857	10.10	30.04	58.16	28.12	17.60	48.16	30.56	N
4	1.8336	10.10	35.57	56.00	20.43	24.22	46.00	21.78	N
5	13.8890	10.11	36.87	60.00	23.13	25.93	50.00	24.07	N
6	20.5412	10.11	45.26	60.00	14.74	31.92	50.00	18.08	N

Remarks:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level = Receiver Reading + LISN Factor + Cable Loss.



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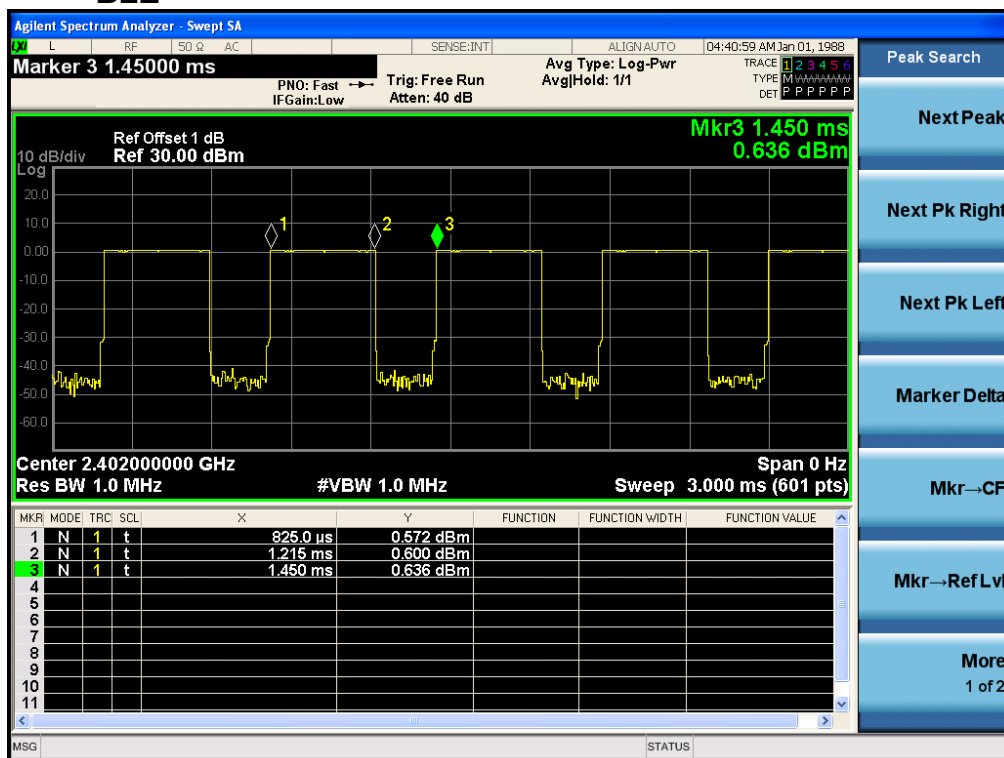
4.3 Duty Cycle

4.3.1 Test Results

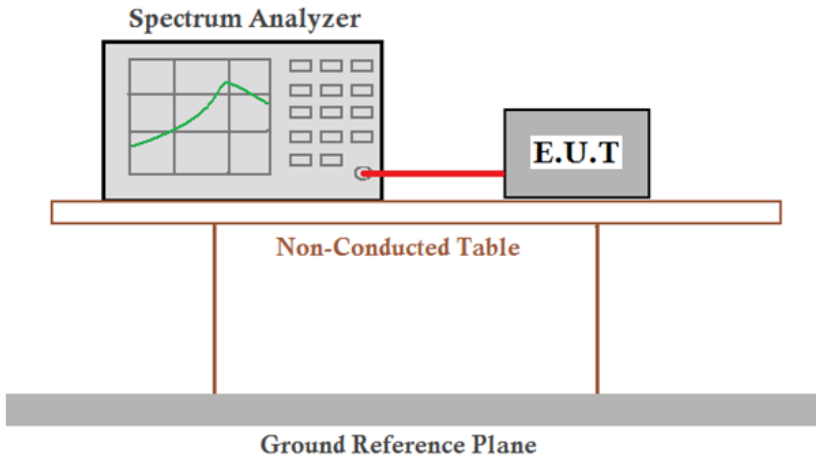
Test Mode	TX Freq. [MHz]	Duty cycle [%]
BLE	CHO	62.40

4.3.1 Test Plots

4.3.1.1 BLE



4.4 Conducted Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(3)
Test Method:	ANSI C63.10 :2013 Section 11.9.1.1
Test Setup:	
Limit:	30dBm
Test Mode:	Transmitting with GFSK modulation.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

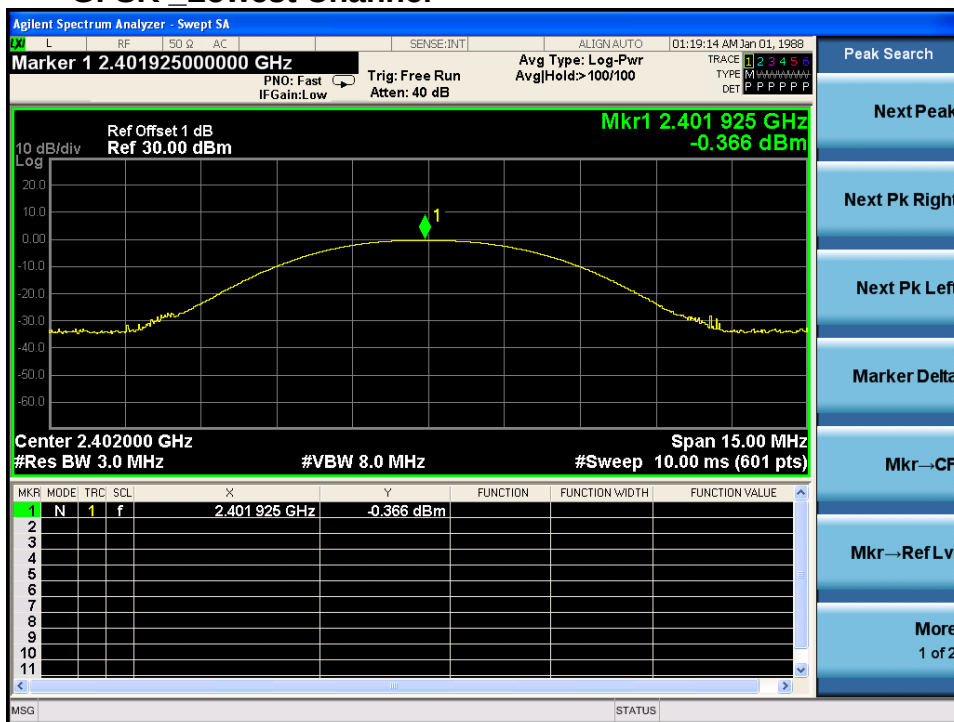
Measurement Data of Peak Power:

GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	-0.37	30.00	Pass
Middle	0.35	30.00	Pass
Highest	-0.12	30.00	Pass

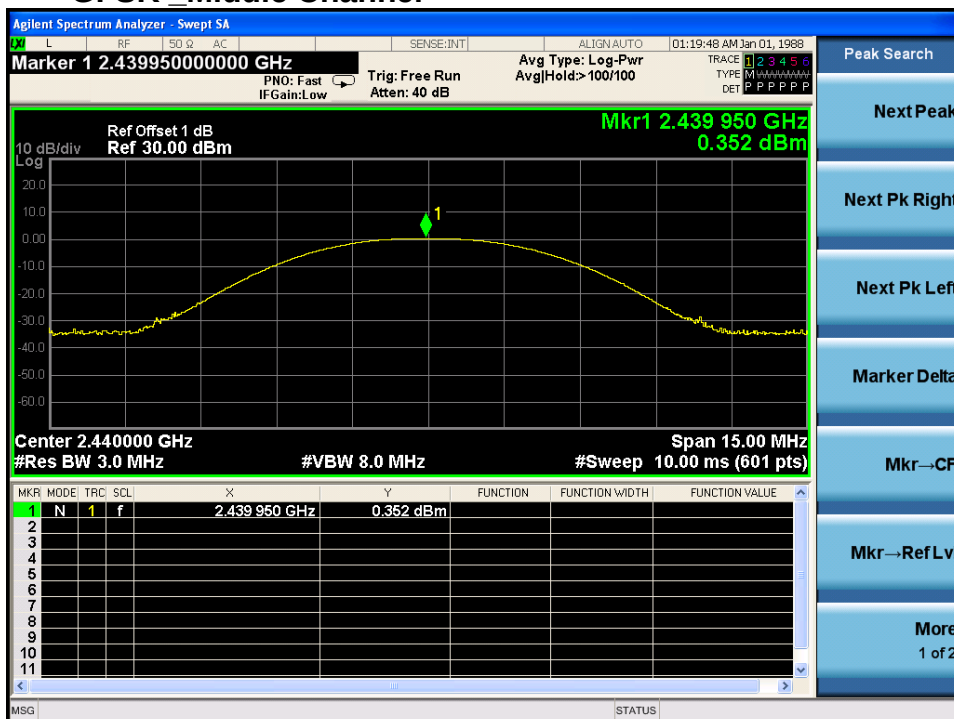




4.4.1 Test plots:
4.4.1.1 GFSK Lowest Channel



4.4.1.2 GFSK Middle Channel

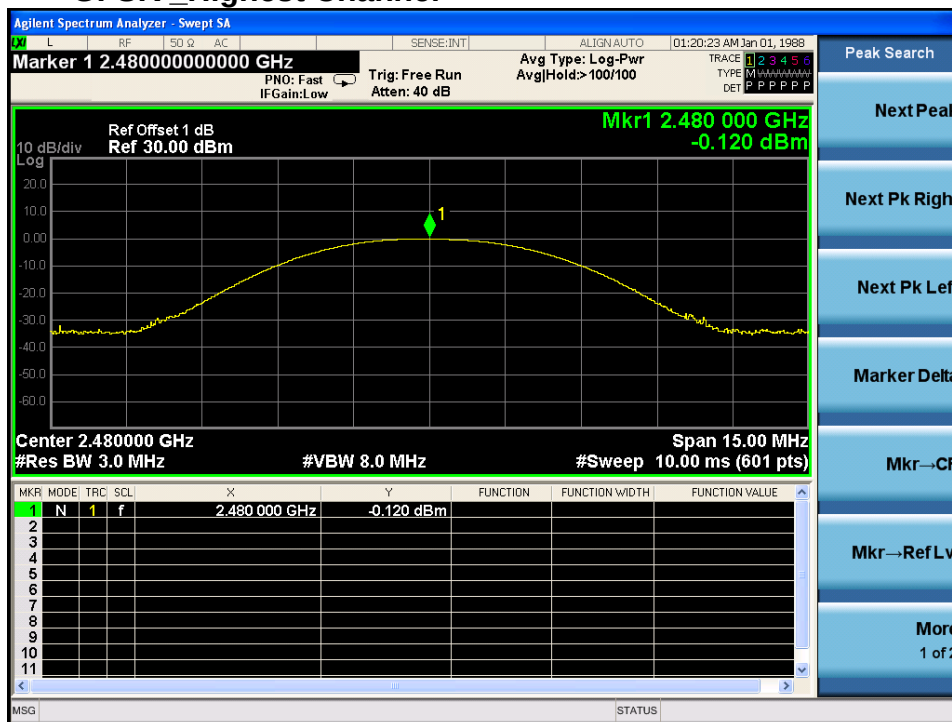


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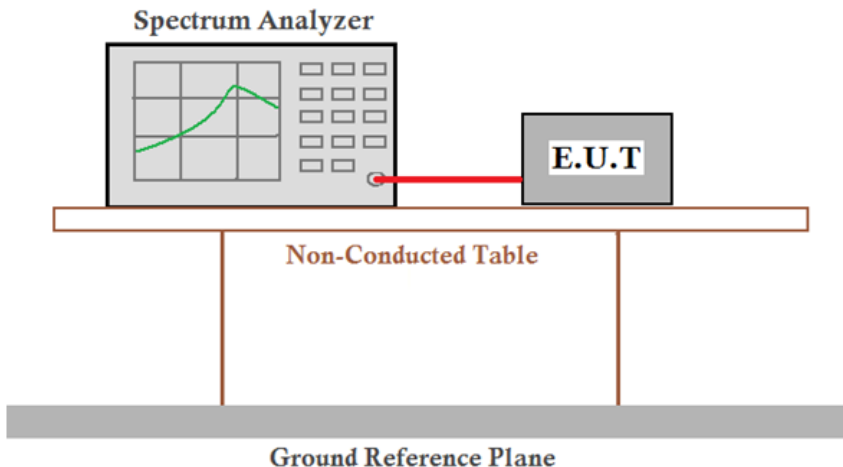


4.4.1.3 GFSK _Highest Channel





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: 2013 Section 11.8 Option 2
Test Setup:	
Limit:	≥ 500 kHz
Test Mode:	Transmitting with GFSK modulation.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

4.5.1 Test Results

Mode	Test Channel	99% Occupied Bandwidth (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)	Result
GFSK	Lowest	1.07	1.09	≥ 500	Pass
	Middle	1.07	1.09	≥ 500	Pass
	Highest	1.08	1.09	≥ 500	Pass





4.5.2

Test plots

4.5.2.1

GFSK _Lowest Channel



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4.5.2.2 GFSK_Middle Channel



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4.5.2.3 GFSK_Highest Channel

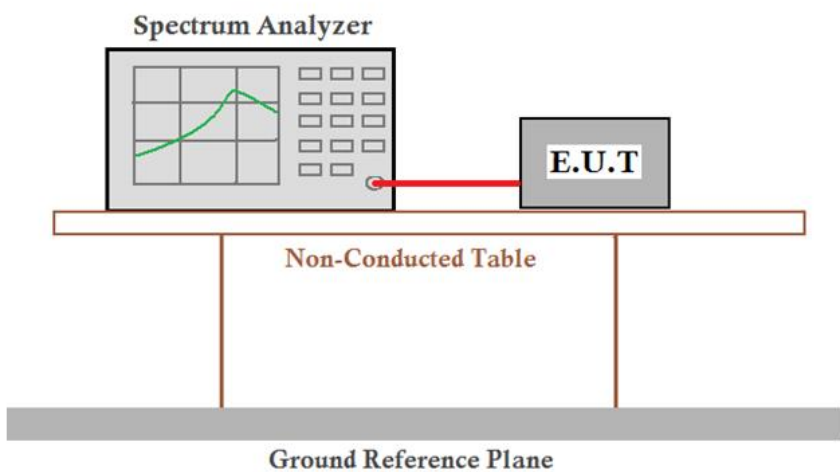


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4.6 Power Spectral Density

Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	ANSI C63.10 :2013 Section 11.10.2
Test Setup:	
Limit:	$\leq 8.00 \text{ dBm/3kHz}$
Test Mode:	Transmitting with GFSK modulation.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

4.6.1 Test Results

Mode	Test Channel	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
GFSK	Lowest	-14.38	≤ 8.00	Pass
	Middle	-13.75	≤ 8.00	Pass
	Highest	-14.16	≤ 8.00	Pass





4.6.2

Test plots

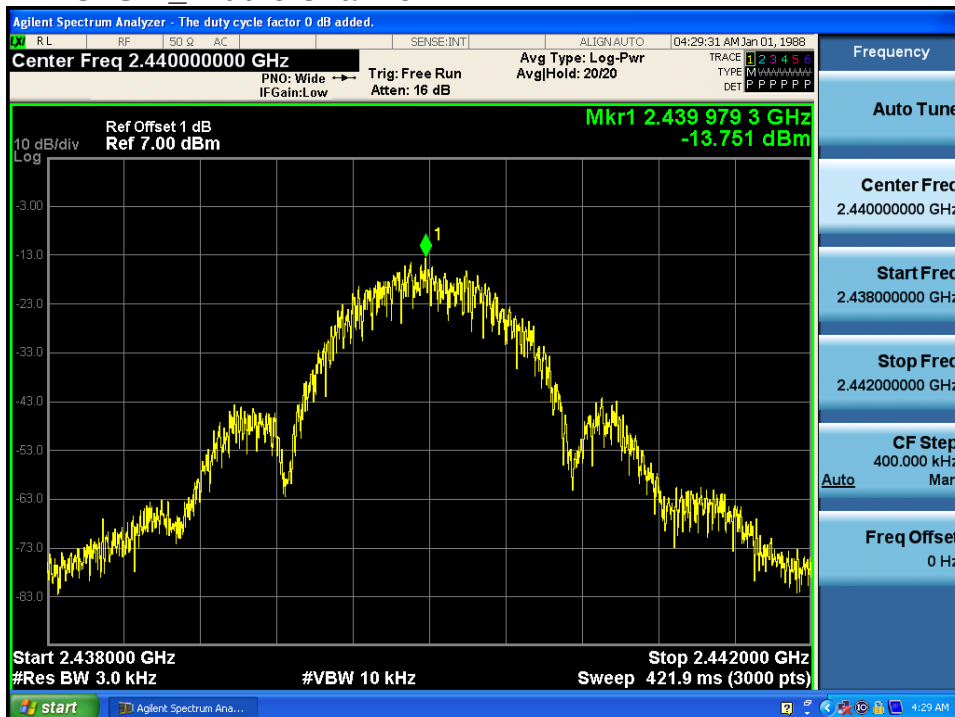
4.6.2.1

GFSK_Lowest Channel



4.6.2.2

GFSK_Middle Channel

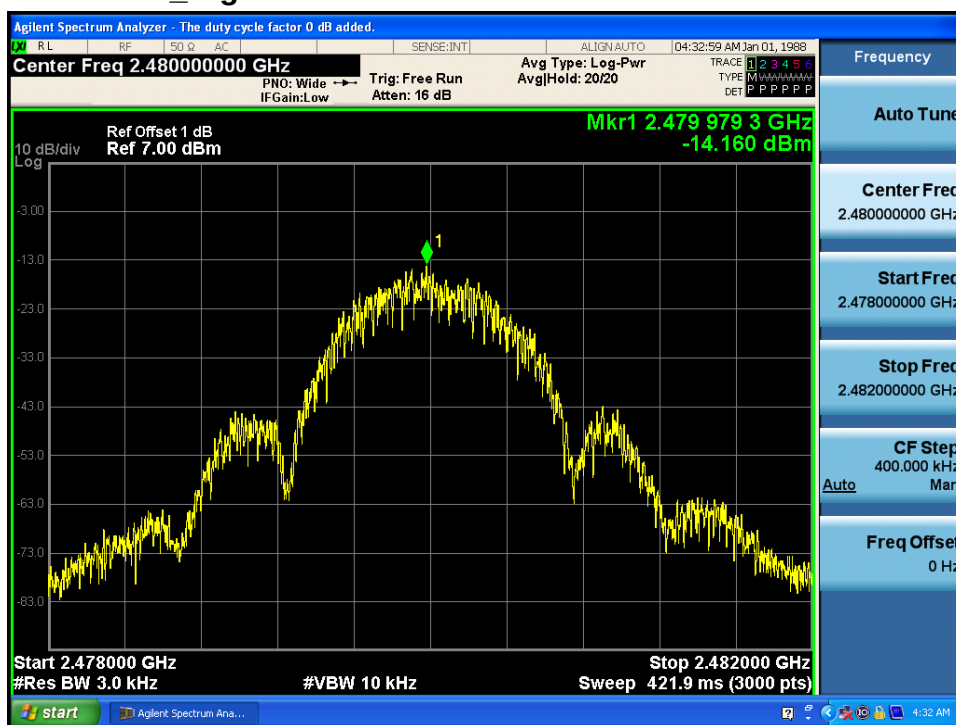


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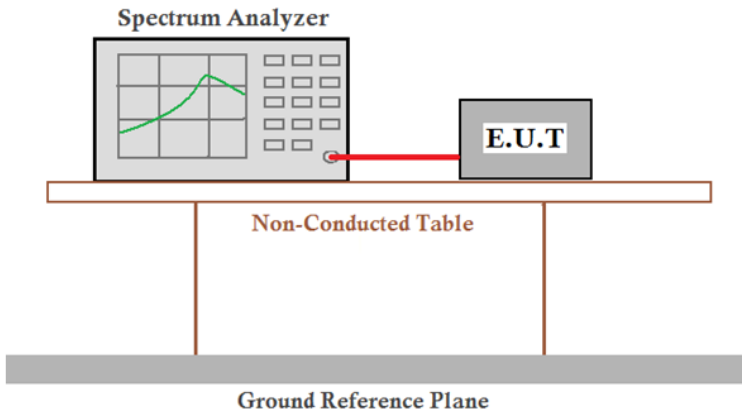


4.6.2.3 GFSK _Highest Channel





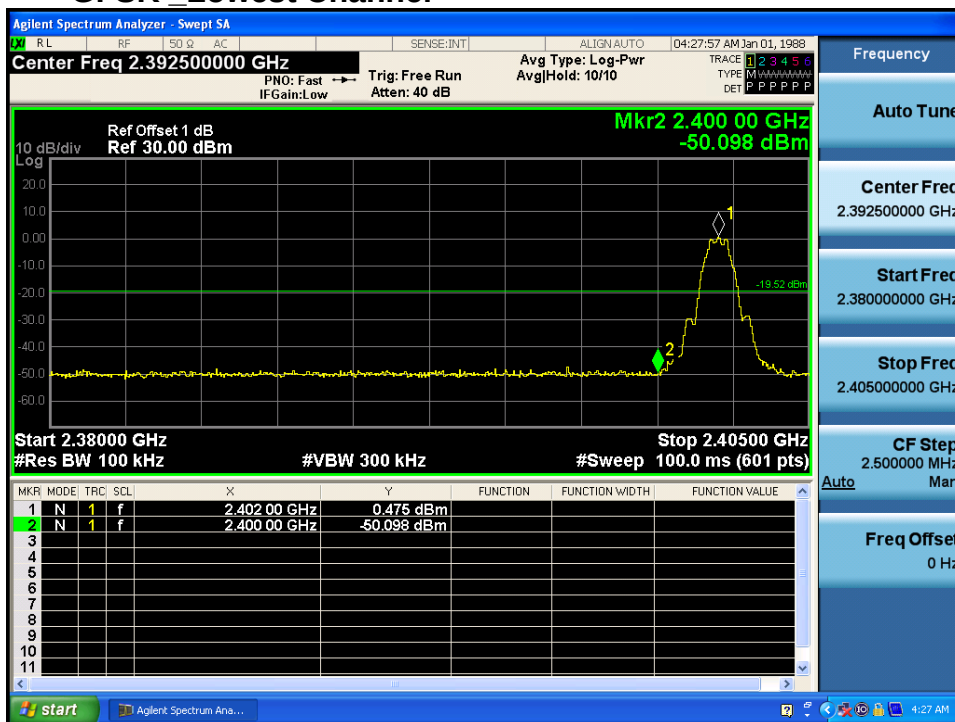
4.7 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.13
Test Setup:	
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 Mode:	Transmitting with GFSK modulation.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

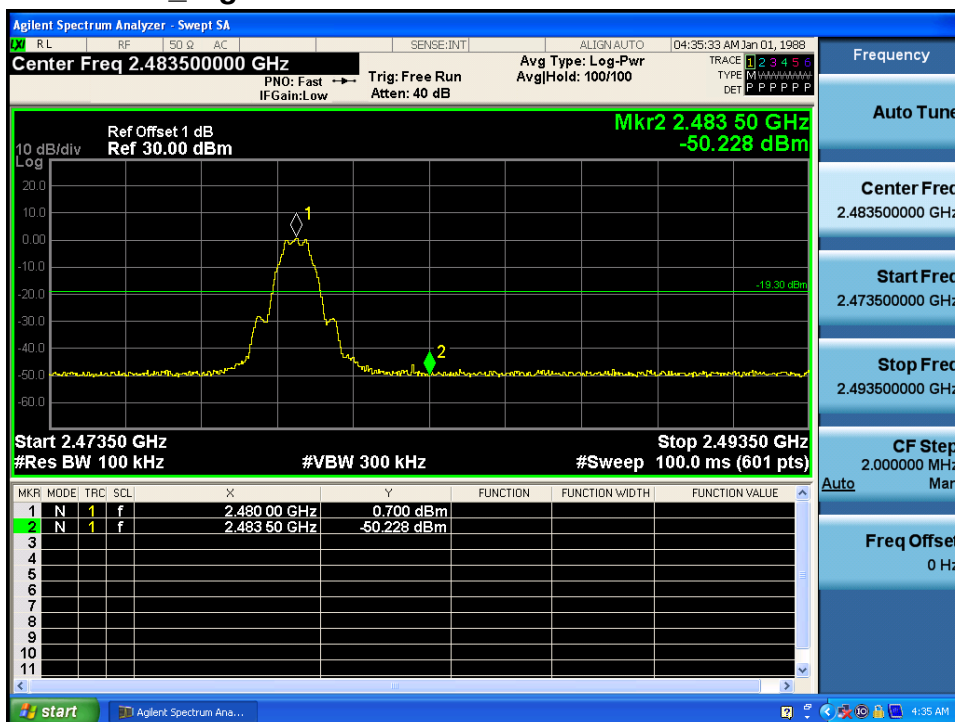




4.7.1 Test plots
4.7.1.1 GFSK_Lowest Channel

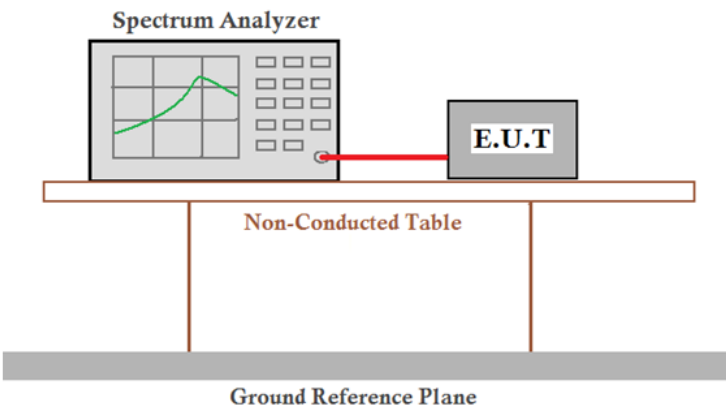


4.7.1.2 GFSK_Highest Channel



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4.8 Spurious RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.11
Test Setup:	
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 Mode:	Transmitting with GFSK modulation.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass





4.8.1

Test plots:

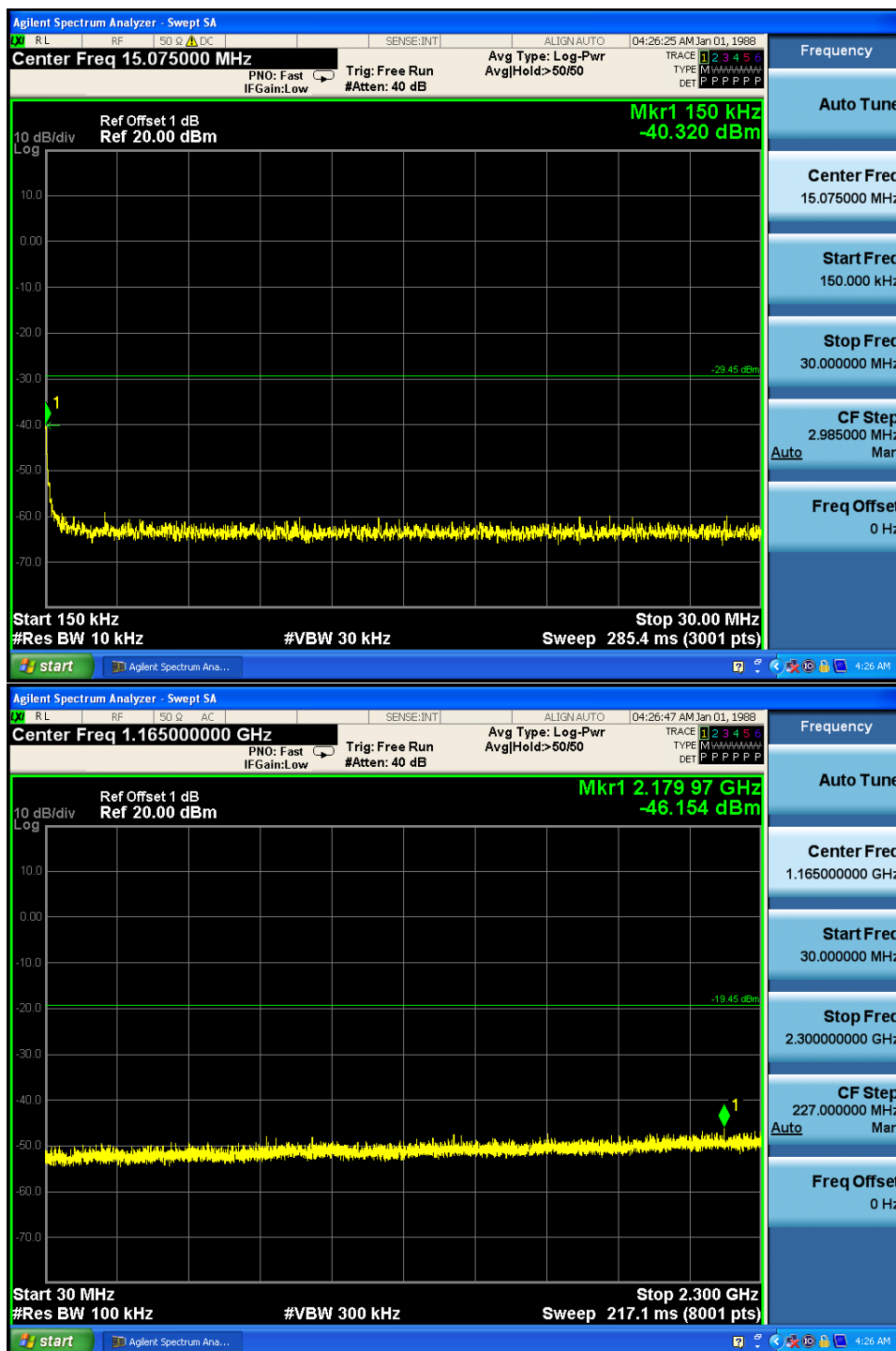
4.8.1.1

GFSK _Lowest Channel



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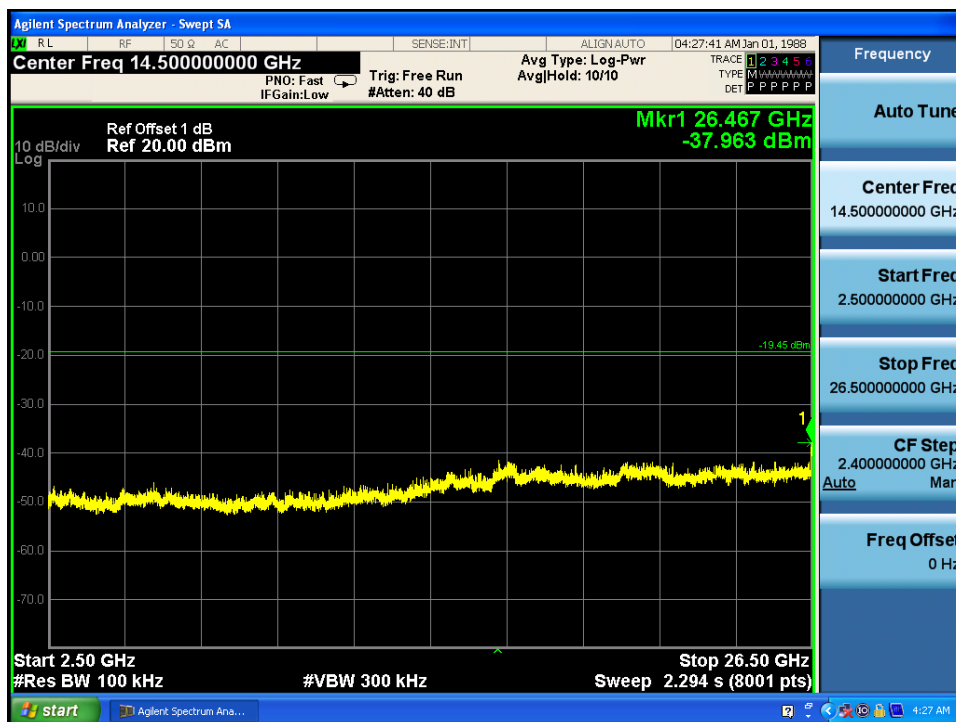
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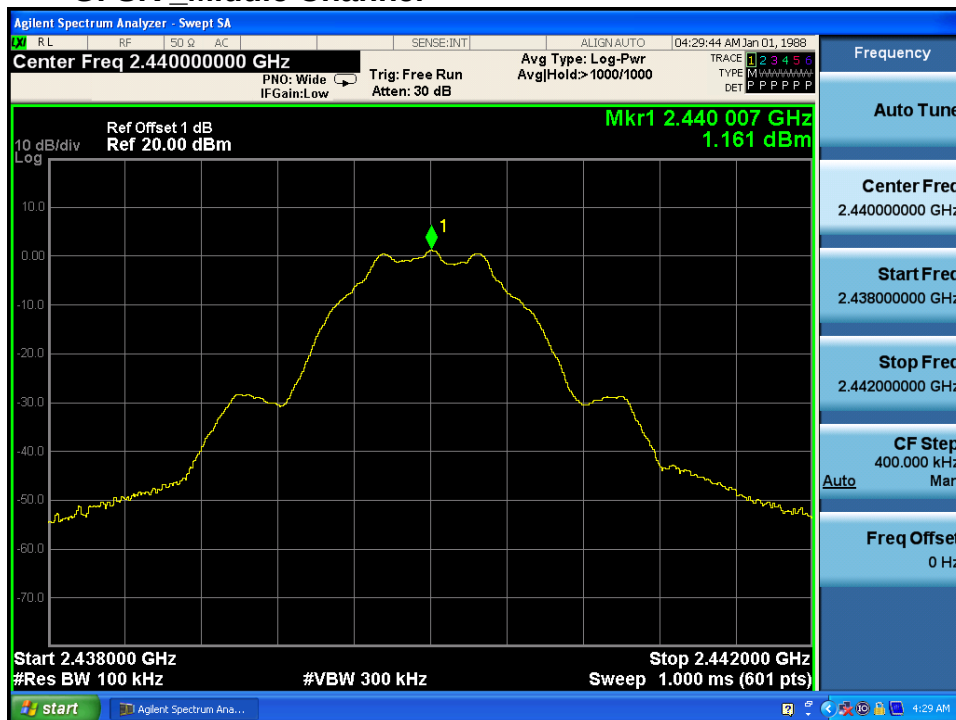


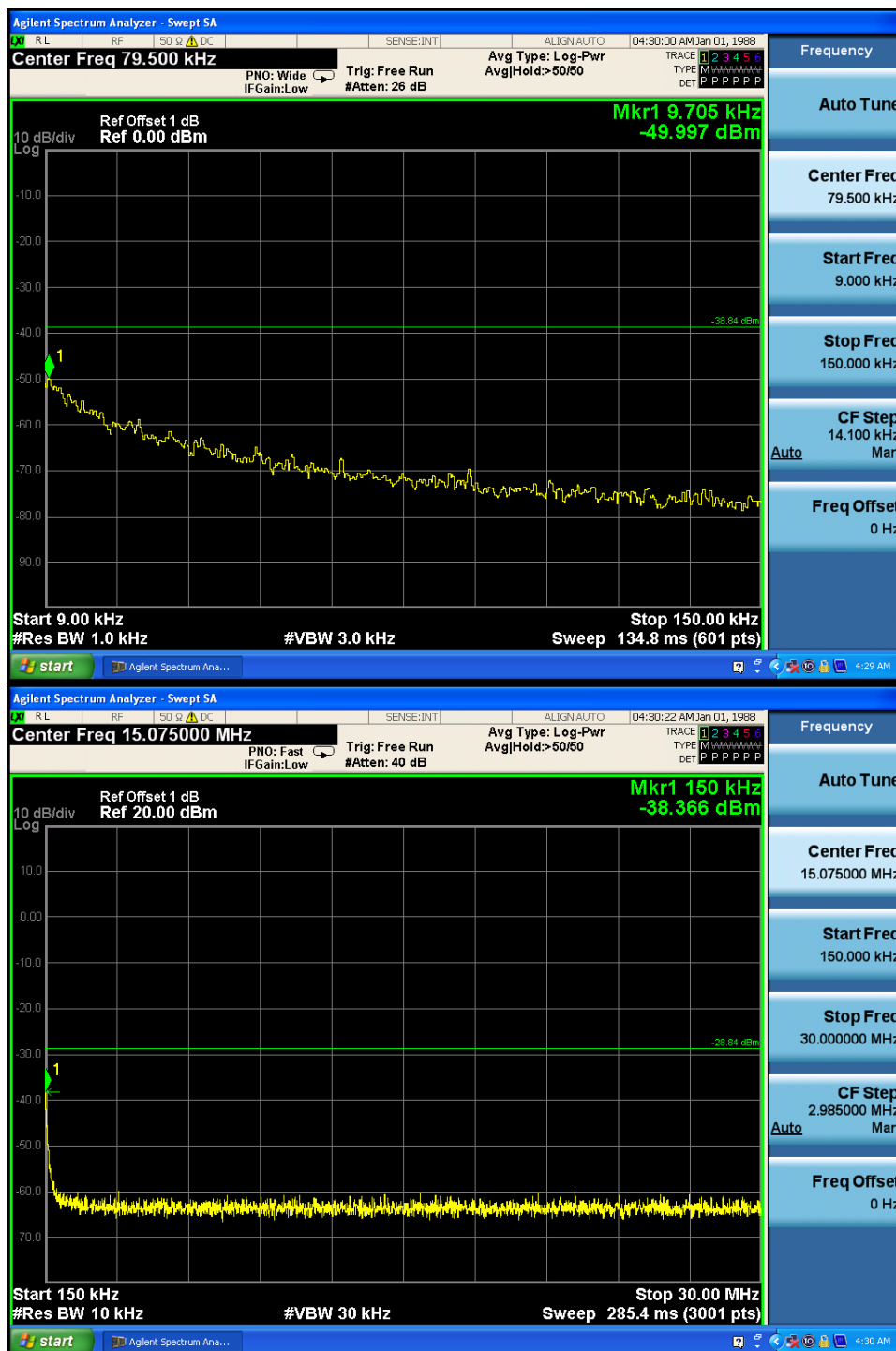
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4.8.1.2 GFSK_Middle Channel







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4.8.1.3

GFSK_Highest Channel



Derek yang

Derek Yang

Wireless Laboratory Manager



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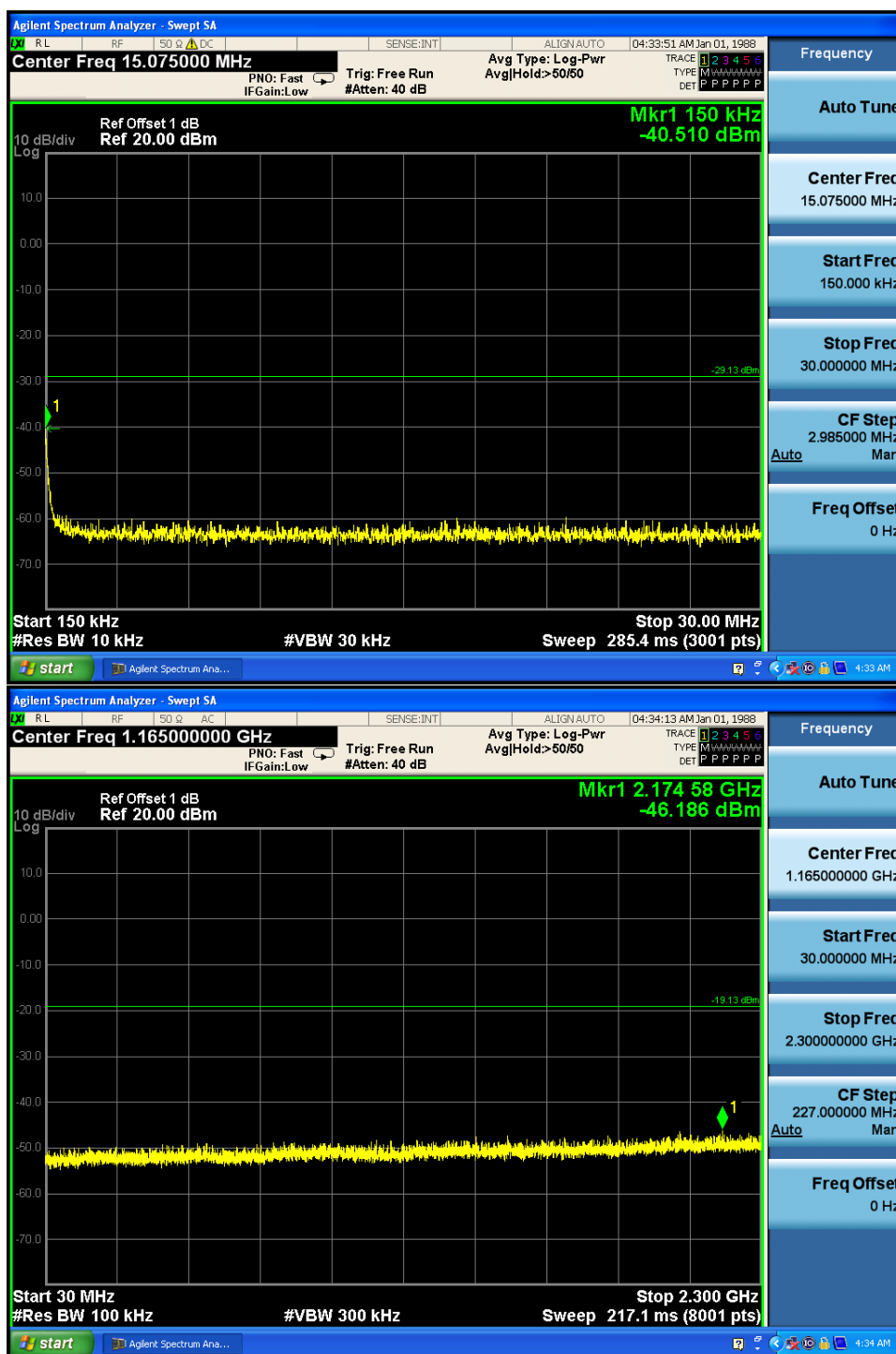
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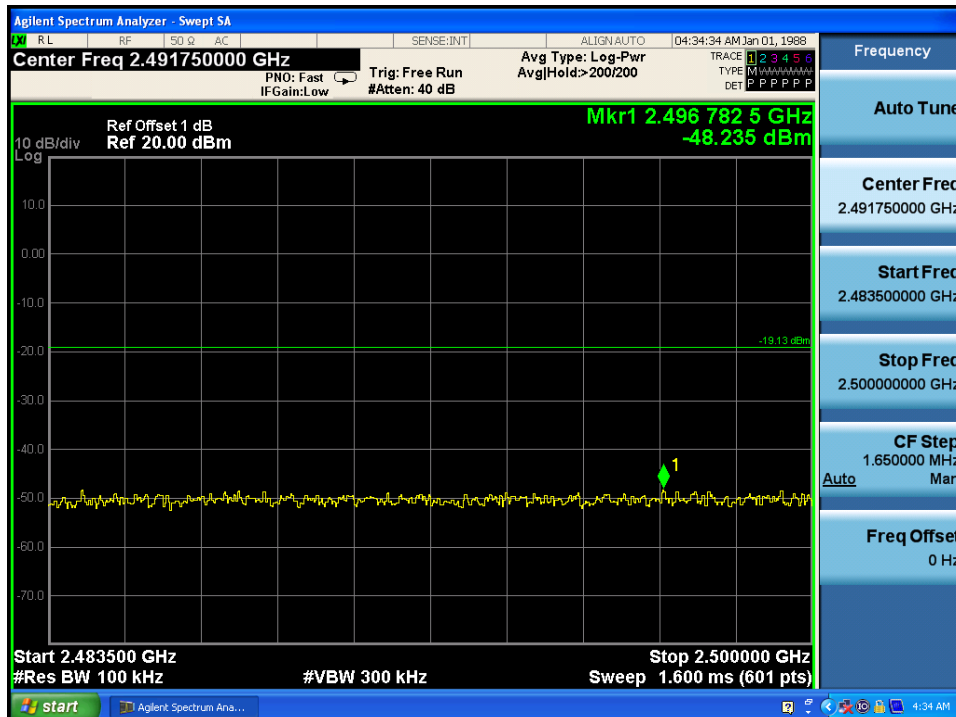
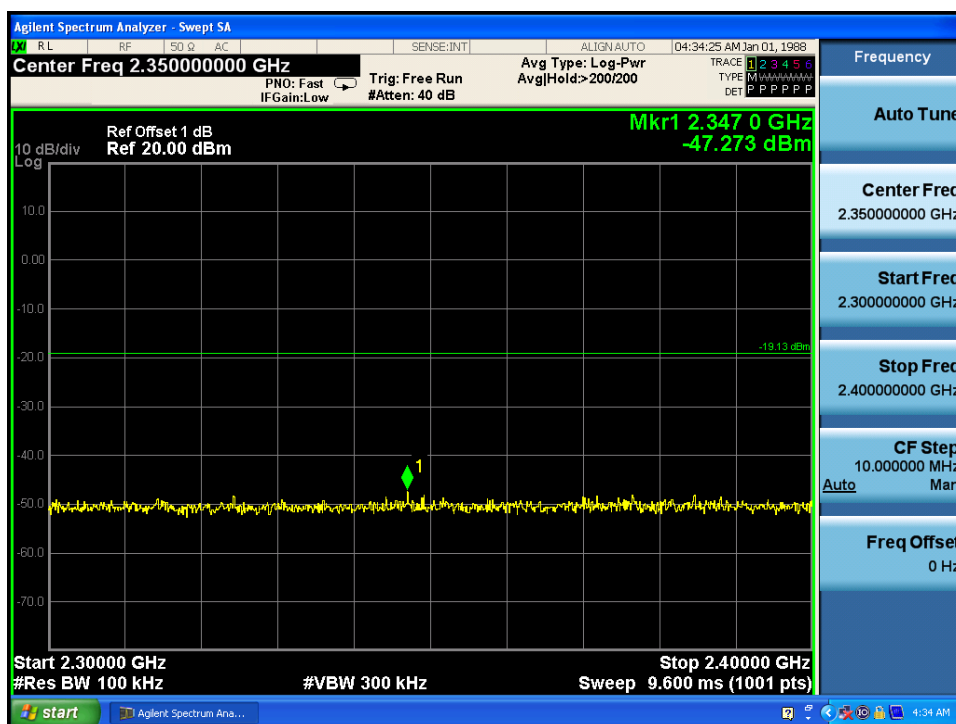
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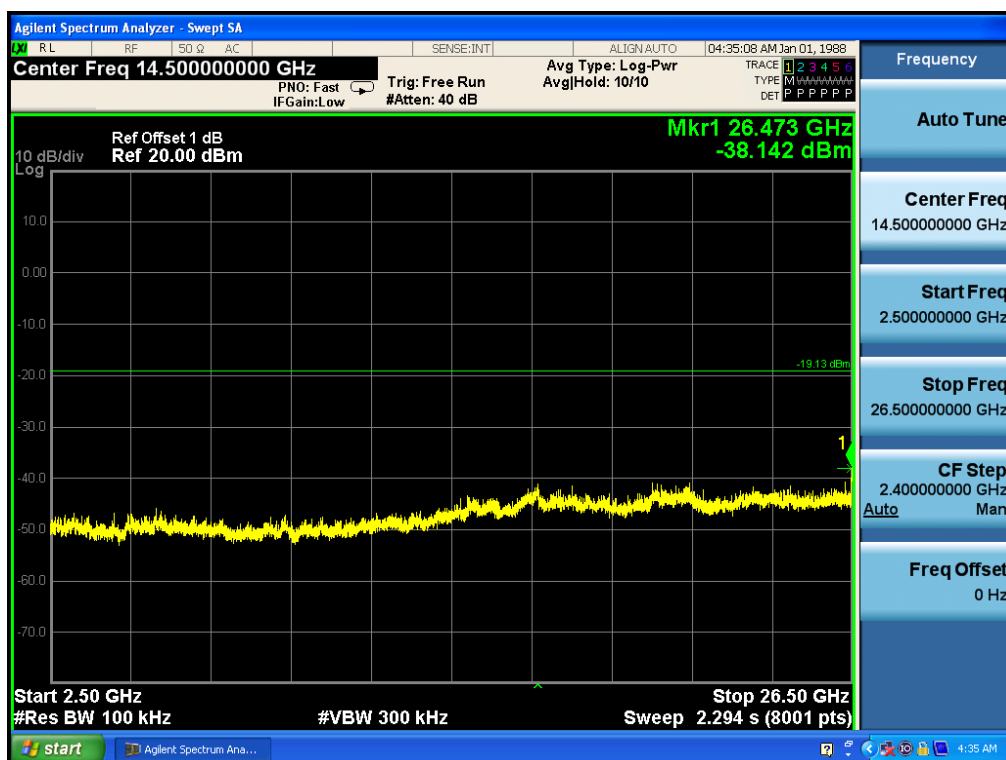
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Remark:

Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.



4.9 Radiated Spurious Emission

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10 :2013 Section 11.12				
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
Limit:	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	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	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1GHz	500	54.0	Quasi-peak	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.					



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Test Setup:

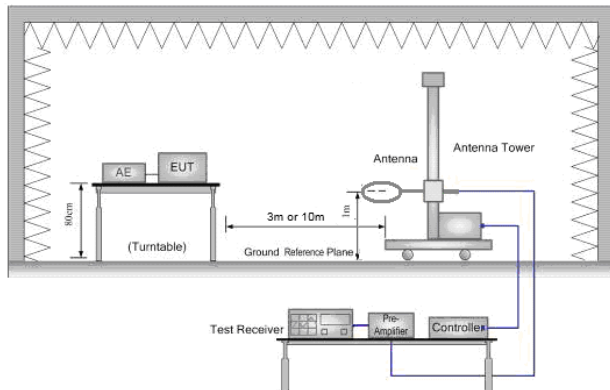


Figure 1. Below 30MHz

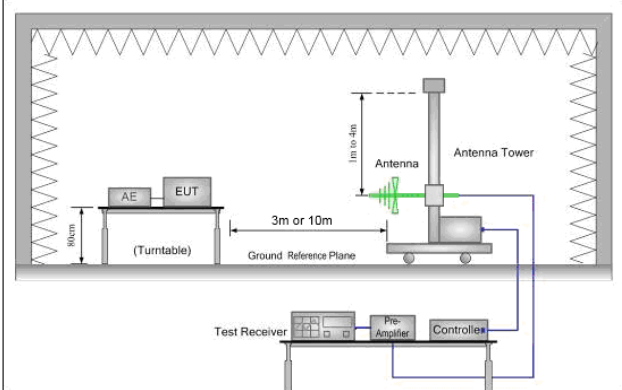


Figure 2. 30MHz to 1GHz

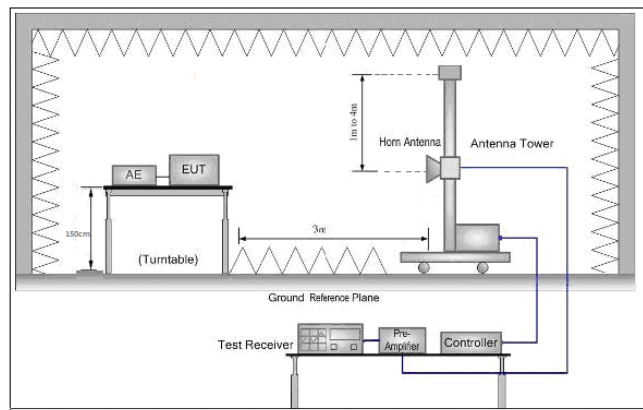


Figure 3. Above 1 GHz

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 chamber. 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 chamber. 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.
- 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.

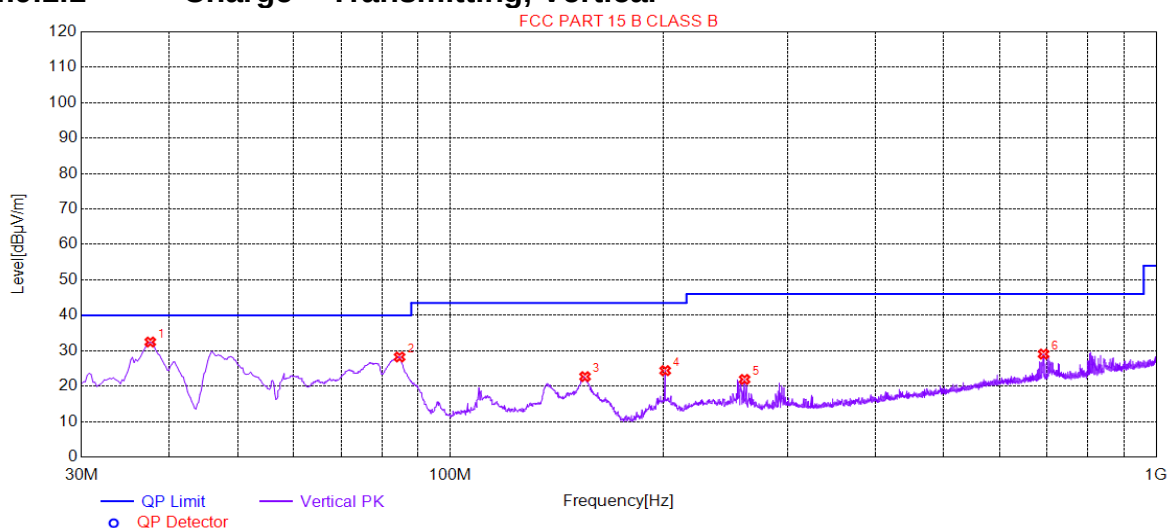


	g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. h. Test the EUT in the lowest channel (2402MHz), the middle channel (2440MHz), the Highest channel (2480MHz) i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. j. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting with GFSK modulation. 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 5.10 for details.
Test Results:	Pass



4.9.1 Radiated Emission below 1GHz

4.9.1.1 Charge + Transmitting, Vertical



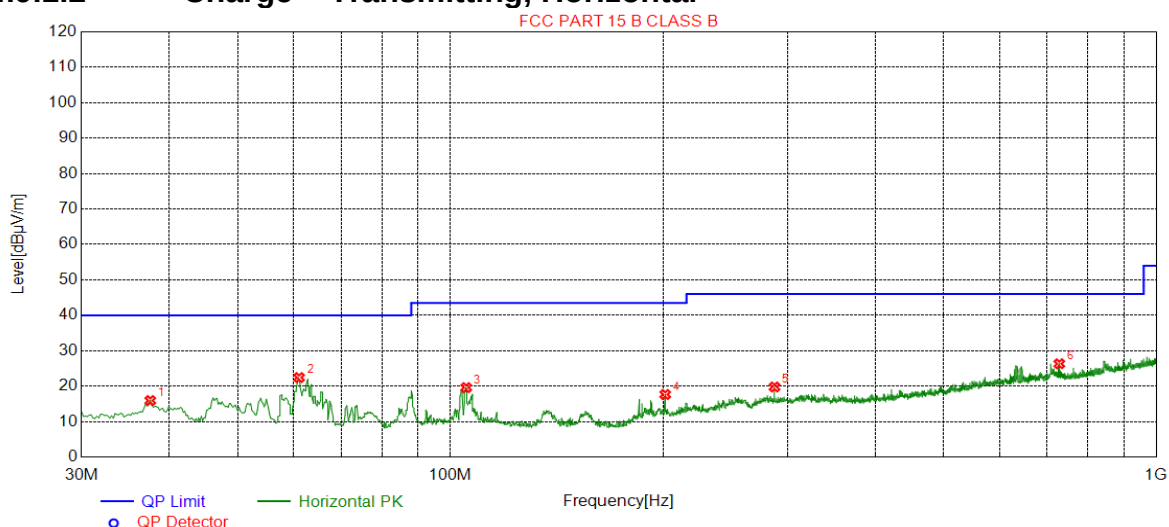
Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	37.5675	32.46	-29.13	40.00	7.54	194	352	Vertical
2	84.7189	28.23	-35.01	40.00	11.77	261	235	Vertical
3	155.1550	22.69	-34.85	43.50	20.81	280	84	Vertical
4	201.5303	24.38	-31.15	43.50	19.12	220	349	Vertical
5	261.1002	21.91	-29.35	46.00	24.09	169	87	Vertical
6	692.4485	29.06	-19.59	46.00	16.94	213	31	Vertical



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4.9.1.2 Charge + Transmitting, Horizontal

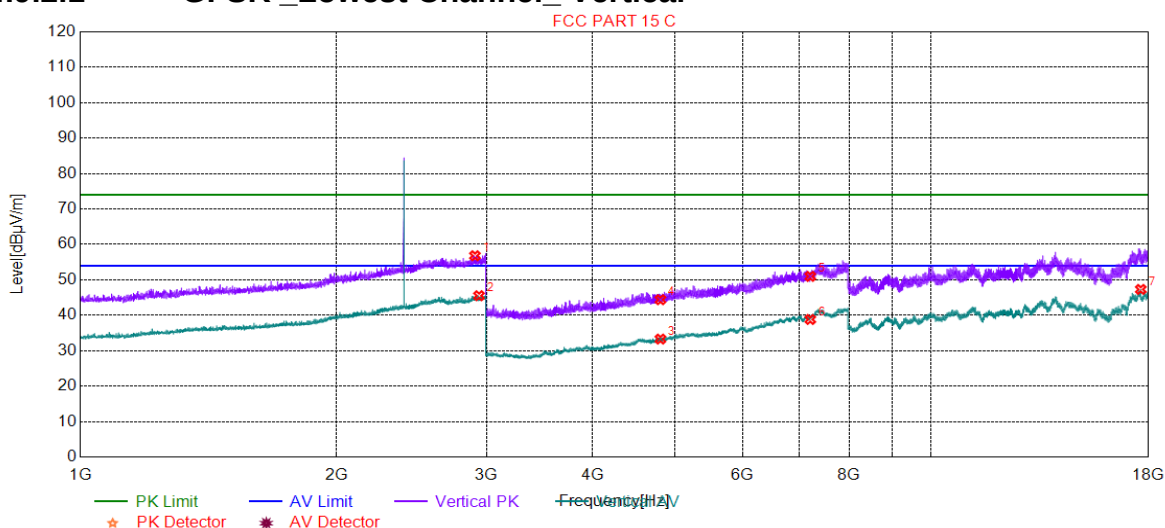


Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	37.5675	15.94	-29.13	40.00	24.06	145	266	Horizontal
2	61.0462	22.43	-32.13	40.00	17.57	215	9	Horizontal
3	105.2871	19.59	-32.00	43.50	23.91	115	15	Horizontal
4	201.5303	17.65	-31.15	43.50	25.85	217	266	Horizontal
5	287.8776	19.78	-28.72	46.00	26.22	163	275	Horizontal
6	728.9278	26.32	-18.83	46.00	19.68	129	82	Horizontal



4.9.2 Transmitter Emission above 1GHz

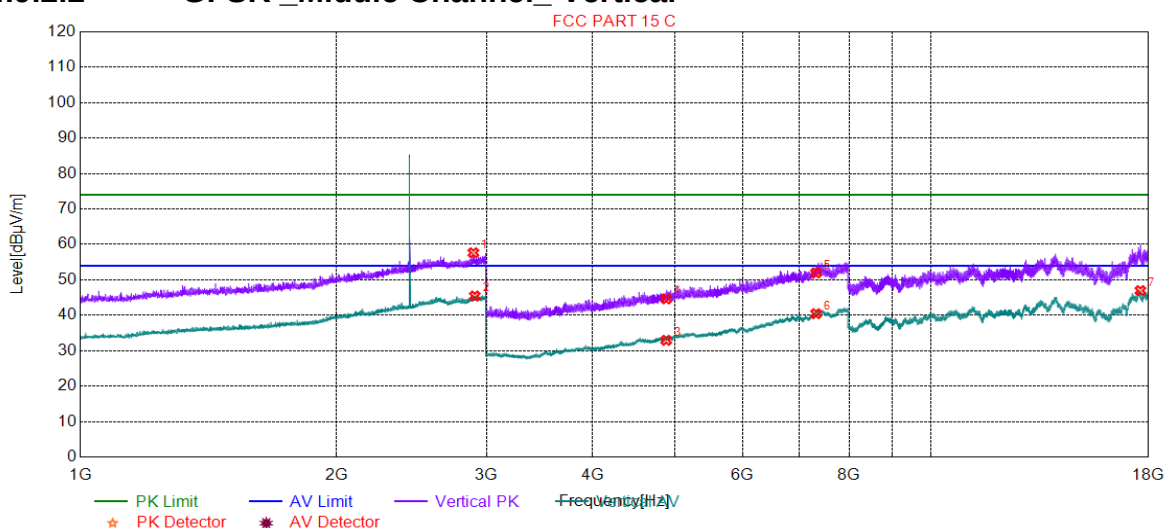
4.9.2.1 GFSK _Lowest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2908.4771	56.81	11.41	74.00	17.19	232	206	Vertical
2	2940.4851	45.53	11.39	54.00	8.47	295	342	Vertical
3	4804.0000	33.29	-14.99	54.00	20.71	257	262	Vertical
4	4804.0000	44.40	-14.99	74.00	29.60	209	99	Vertical
5	7206.0000	50.98	-7.05	74.00	23.02	299	45	Vertical
6	7206.0000	38.82	-7.05	54.00	15.18	263	208	Vertical
7	17620.9810	47.31	1.08	54.00	6.69	245	242	Vertical



4.9.2.2 GFSK _Middle Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2895.9740	57.65	11.38	74.00	16.35	218	179	Vertical
2	2907.4769	45.45	11.41	54.00	8.55	216	342	Vertical
3	4880.0000	32.94	-14.65	54.00	21.06	189	208	Vertical
4	4880.0000	44.63	-14.65	74.00	29.37	224	262	Vertical
5	7320.0000	51.96	-6.17	74.00	22.04	269	208	Vertical
6	7320.0000	40.45	-6.17	54.00	13.55	283	181	Vertical
7	17601.9801	46.97	1.58	54.00	7.03	259	93	Vertical

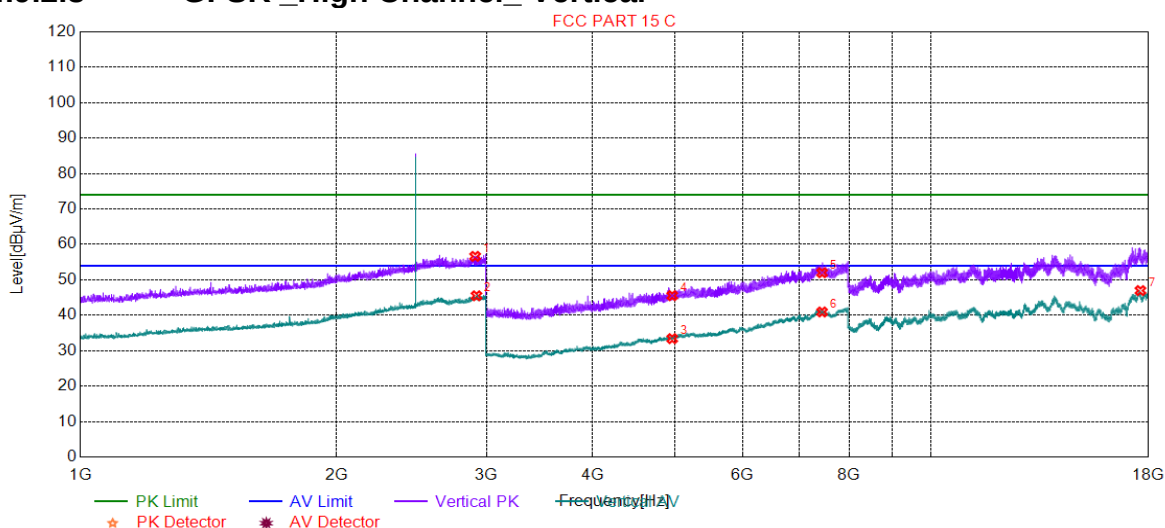


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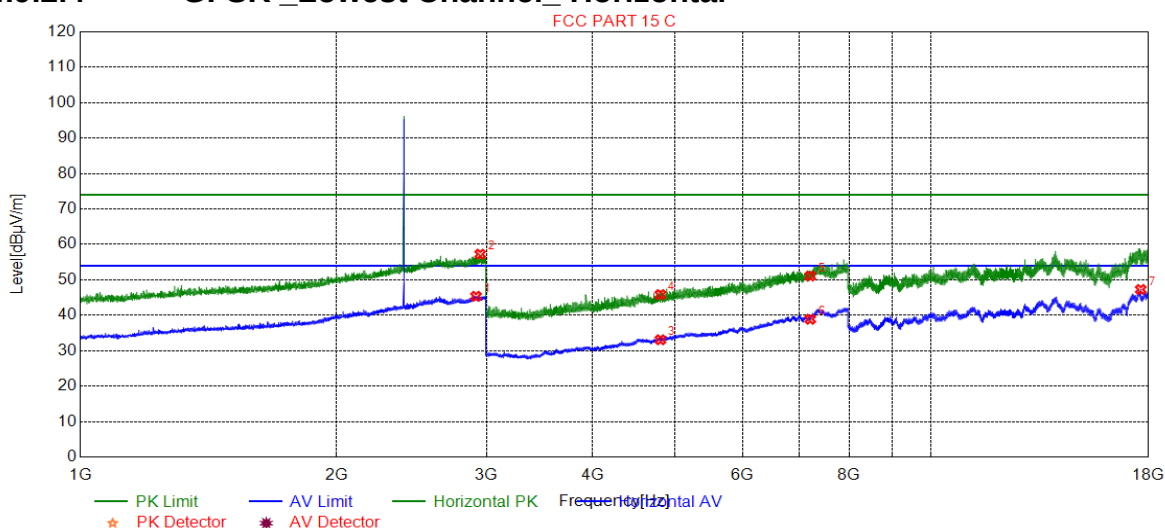
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4.9.2.3 GFSK _High Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2909.9775	56.63	11.41	74.00	17.37	246	70	Vertical
2	2920.4801	45.51	11.40	54.00	8.49	186	316	Vertical
3	4960.0000	33.41	-14.23	54.00	20.59	159	360	Vertical
4	4960.0000	45.55	-14.23	74.00	28.45	297	45	Vertical
5	7440.0000	52.01	-5.89	74.00	21.99	258	18	Vertical
6	7440.0000	40.94	-5.89	54.00	13.06	241	345	Vertical
7	17605.4803	46.97	1.49	54.00	7.03	217	292	Vertical

4.9.2.4 GFSK _Lowest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2916.9792	45.36	11.40	54.00	8.64	177	195	Horizontal
2	2949.9875	57.25	11.39	74.00	16.75	179	85	Horizontal
3	4804.0000	33.10	-14.99	54.00	20.90	126	344	Horizontal
4	4804.0000	45.84	-14.99	74.00	28.16	228	317	Horizontal
5	7206.0000	51.09	-7.05	74.00	22.91	215	344	Horizontal
6	7206.0000	38.89	-7.05	54.00	15.11	195	290	Horizontal
7	17619.9810	47.28	1.11	54.00	6.72	200	242	Horizontal



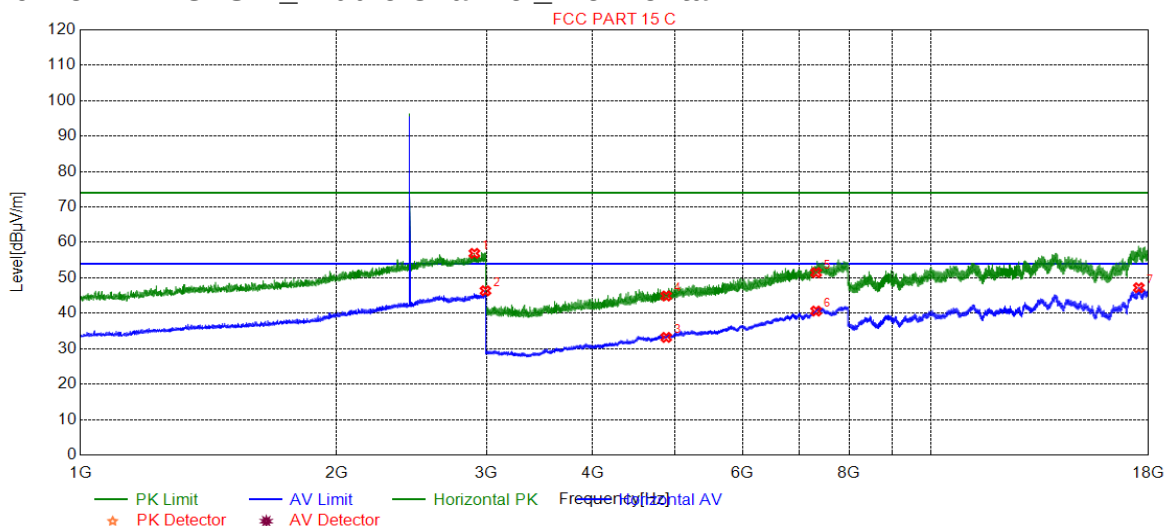
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4.9.2.5 GFSK _Middle Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2903.9760	56.91	11.41	74.00	17.09	190	73	Horizontal
2	2992.4981	46.36	11.36	54.00	7.64	122	59	Horizontal
3	4880.0000	33.20	-14.65	54.00	20.80	180	18	Horizontal
4	4880.0000	44.89	-14.65	74.00	29.11	211	214	Horizontal
5	7320.0000	51.47	-6.17	74.00	22.53	204	350	Horizontal
6	7320.0000	40.63	-6.17	54.00	13.37	198	99	Horizontal
7	17527.9764	47.22	0.71	54.00	6.78	248	142	Horizontal



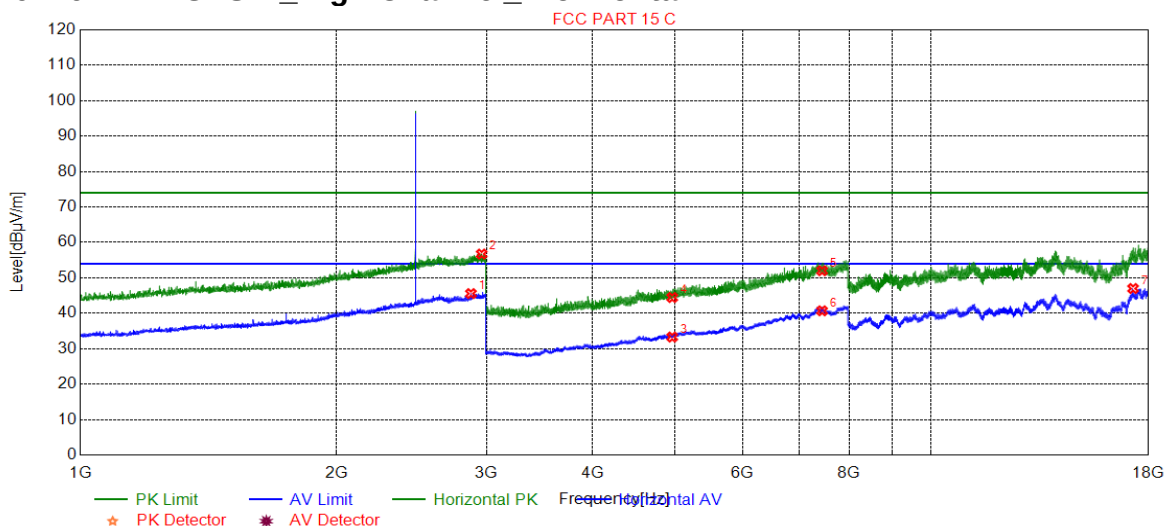
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4.9.2.6 GFSK _High Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2876.9692	45.56	11.23	54.00	8.44	130	359	Horizontal
2	2961.4904	56.72	11.38	74.00	17.28	139	138	Horizontal
3	4960.0000	33.30	-14.23	54.00	20.70	125	274	Horizontal
4	4960.0000	44.46	-14.23	74.00	29.54	183	328	Horizontal
5	7440.0000	52.01	-5.89	74.00	21.99	154	162	Horizontal
6	7440.0000	40.70	-5.89	54.00	13.30	218	274	Horizontal
7	17258.4629	46.99	-1.37	54.00	7.01	239	192	Horizontal

Remark:

- 1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 2) Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 3) As shown in this section, for frequencies above 1GHz, the 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. So, only the peak measurements were shown in the report.
- 4) All Modes have been tested, but only the worst case data displayed in this report.

4.10 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205		
Test Method:	ANSI C63.10: 2013 Section 11.12		
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)		
Limit:	Frequency	Limit (dBuV/m @3m)	Remark
	30MHz-88MHz	40.0	Quasi-peak Value
	88MHz-216MHz	43.5	Quasi-peak Value
	216MHz-960MHz	46.0	Quasi-peak Value
	960MHz-1GHz	54.0	Quasi-peak Value
	Above 1GHz	54.0	Average Value
		74.0	Peak Value
Test Setup:			

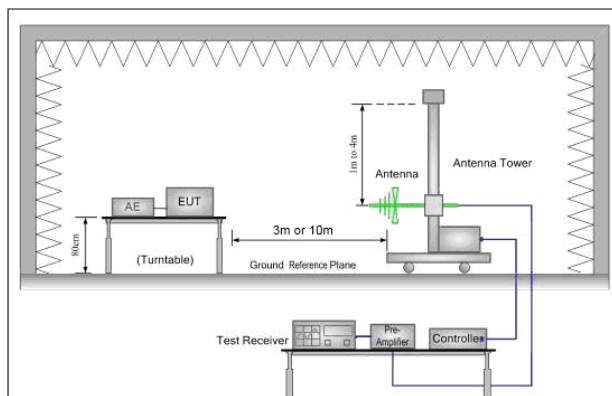


Figure 1. 30MHz to 1GHz

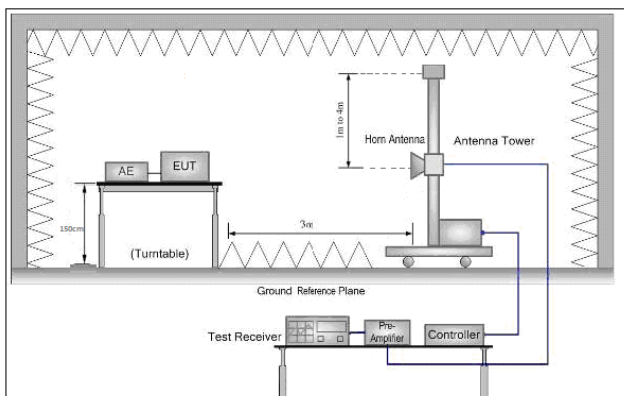


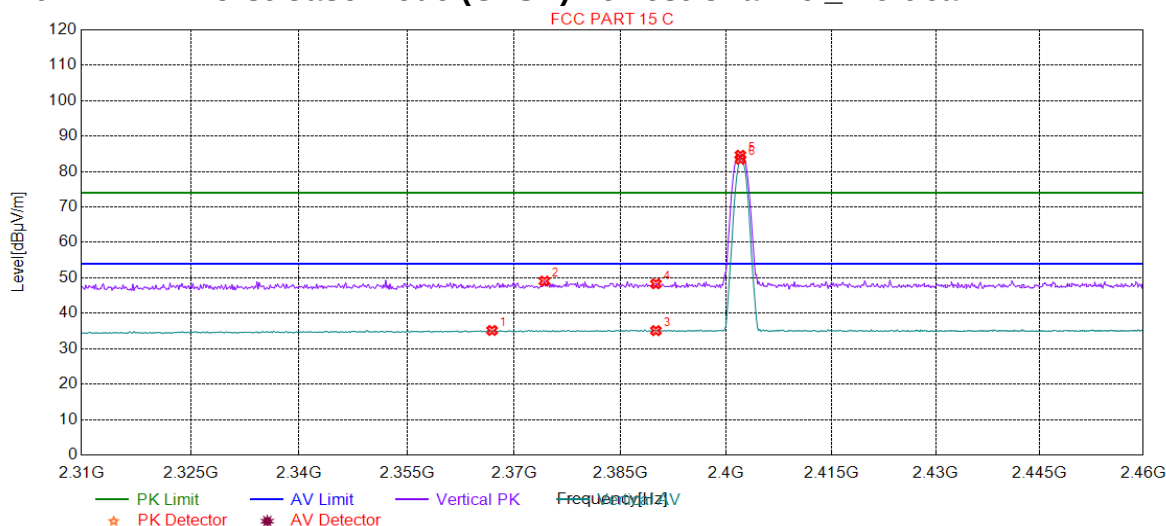
Figure 2. Above 1 GHz

Test Procedure:	a. 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 chamber. The table was rotated 360 degrees to determine the position of the highest radiation. b. 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 chamber. The table was rotated 360 degrees to determine the position of the highest radiation. c. 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. d. 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. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 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 the worst case. j. Repeat above procedures until all frequencies measured was complete.
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 5.10 for details.
Test Results:	Pass

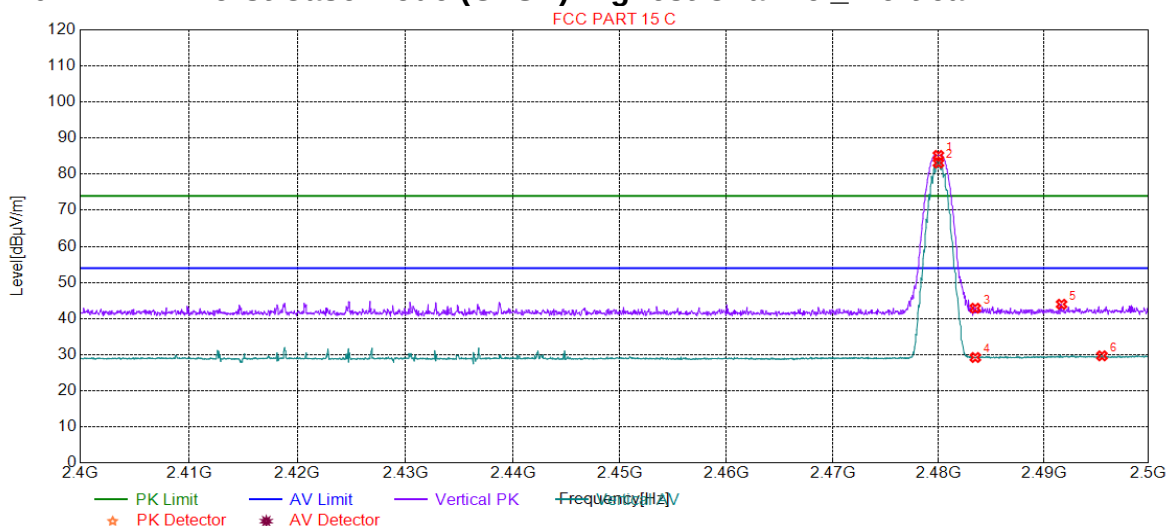
4.10.1 Test plots

4.10.1.1 Worst Case Mode (GFSK) Lowest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2366.9069	35.16	9.12	54.00	18.84	285	66	Vertical
2	2374.2643	49.09	9.15	74.00	24.91	232	212	Vertical
3	2390.0000	35.11	9.20	54.00	18.89	193	176	Vertical
4	2390.0000	48.33	9.20	74.00	25.67	287	281	Vertical
5	2402.0000	84.61	9.24	74.00	-10.61	279	220	Vertical
6	2402.0000	83.49	9.24	54.00	-29.49	200	176	Vertical

4.10.1.2 Worst Case Mode (GFSK) Highest Channel_ Vertical

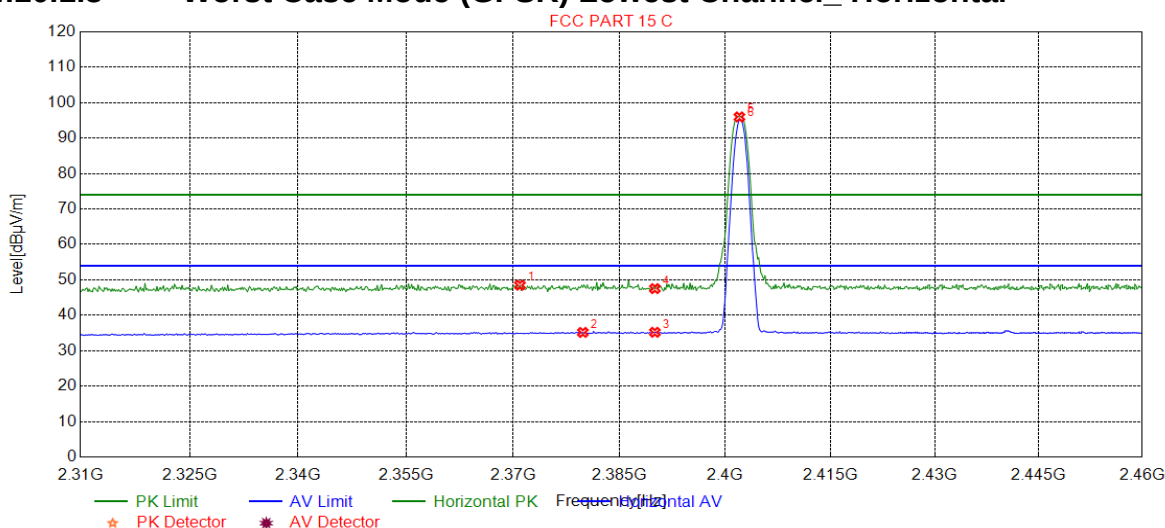


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2480.0000	85.21	9.49	74.00	-11.21	276	194	Vertical
2	2480.0000	83.11	9.49	54.00	-29.11	280	221	Vertical
3	2483.5000	42.88	9.50	74.00	31.12	161	106	Vertical
4	2483.5000	29.22	9.50	54.00	24.78	202	346	Vertical
5	2491.6958	43.97	9.52	74.00	30.03	247	215	Vertical
6	2495.5478	29.68	9.54	54.00	24.32	289	56	Vertical



4.10.1.3 Worst Case Mode (GFSK) Lowest Channel_ Horizontal

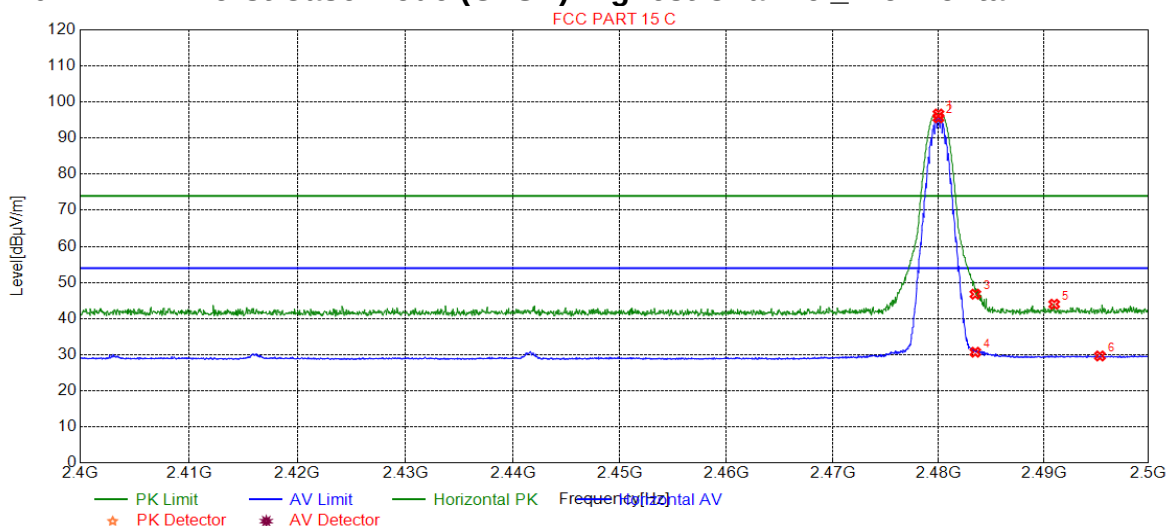


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2370.9610	48.50	9.13	74.00	25.50	157	187	Horizontal
2	2379.8198	35.17	9.16	54.00	18.83	236	307	Horizontal
3	2390.0000	35.21	9.20	54.00	18.79	249	14	Horizontal
4	2390.0000	47.54	9.20	74.00	26.46	219	70	Horizontal
5	2402.0000	95.98	9.24	74.00	-21.98	191	299	Horizontal
6	2402.0000	95.11	9.24	54.00	-41.11	235	304	Horizontal



4.10.1.4 Worst Case Mode (GFSK) Highest Channel_ Horizontal



Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2480.0000	96.67	9.49	74.00	-22.67	182	306	Horizontal
2	2480.0000	95.64	9.49	54.00	-41.64	221	306	Horizontal
3	2483.5000	46.76	9.50	74.00	27.24	139	311	Horizontal
4	2483.5000	30.68	9.50	54.00	23.32	206	306	Horizontal
5	2490.9955	43.98	9.52	74.00	30.02	125	253	Horizontal
6	2495.3477	29.64	9.54	54.00	24.36	156	161	Horizontal

Remark:

The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

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



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

Lab A:

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	$\pm 0.75\text{dB}$
2	RF power density, conducted	$\pm 2.84\text{dB}$
3	Spurious emissions, conducted	$\pm 0.75\text{dB}$
4	Temperature test	$\pm 1^{\circ}\text{C}$
5	Humidity test	$\pm 3\%$
6	DC and low frequency voltages	$\pm 0.5\%$

Lab B:

No.	Item	Measurement Uncertainty
1	Conduction Emission	$\pm 3.0\text{dB}$ (150kHz to 30MHz)
2	Radiated Emission	$\pm 4.8\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (1GHz to 6GHz)
		$\pm 4.5\text{dB}$ (6GHz to 18GHz)
		$\pm 5.02\text{dB}$ (Above 18GHz)





6 Equipment List

RF conducted test					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date	Cal.Duedate
				(yyyy-mm-dd)	(yyyy-mm-dd)
DC Power Supply	Agilent Technologies Inc	66311B	W 009-09	2019/7/15	2020/7/15
Signal Analyzer	Rohde & Schwarz	FSV	W 025-05	2019/1/13	2020/1/12
Coaxial Cable	SGS	N/A	SE M 031-01	2019/6/12	2020/6/11
Attenuator	Weinschel Associates	WA41	SE M 021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SE M 006-05	2019/7/14	2020/7/14
Temperature Chamber	GIANT FORCE	ICT-150-40-CP-AR	W 027-03	2018/11/27	2019/11/27
Power Meter	Rohde & Schwarz	NRVS	SE M 014-02	2019/7/14	2020/7/14

CE Test System					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Shielding Room	Brilliant-emc	N/A	XAW03-35-01	2019-09-11	2022-09-10
Test receiver	ROHDE&SCHWARZ	ESR	XAW01-08-01	2019-09-07	2020-09-06
Artificial network	ROHDE&SCHWARZ	ENV216	XAW01-04-01	2019-07-16	2020-07-15
Temperature and humidity meter	MingGao	TH101B	XAW01-01-01	2018-12-16	2019-12-15
Measurement Software	Tonscend	TS+ CE V2.5	XAW02-05-02	NCR	NCR





RSE Test System					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Semi-Anechoic Chamber	Brilliant-emc	N/A	XAW03-35-01	2019-09-11	2022-09-10
MXA signal analyzer	Keysight	N9020A	XAW01-06-01	2019-06-27	2020-06-26
Test receiver	ROHDE&SCHWARZ	ESR	XAW01-08-01	2019-09-07	2020-09-06
Receiving antenna (30MHz-3GHz)	Schwarzbeck	VULB 9163	XAW01-09-01	2019-10-13	2021-10-12
Receiving antenna (1GHz~18GHz)	Schwarzbeck	BBHA 9120D	XAW01-09-02	2019-10-13	2021-10-12
Receiving antenna (15GHz~40GHz)	Schwarzbeck	BBHA 9170	XAW01-09-03	2019-10-13	2021-10-12
Directional antenna rack controller	Max-Full	MF-7802BS	XAW03-03-01	NCR	NCR
High-speed antenna rack controller	Max-Full	MF-7802	XAW03-04-01	NCR	NCR
Filter bank	Tonscend	JS0806-F	XAW03-05-01	NCR	NCR
Filter bank	Tonscend	JS0806s	XAW03-05-02	NCR	NCR
Amplifier	Tonscend	TAP00903040	XAW01-41-01	2018-12-10	2019-12-09
Amplifier	Tonscend	TAP01018048	XAW01-41-02	2018-12-10	2019-12-09
Amplifier	Tonscend	TAP18040048	XAW01-41-03	2018-12-10	2019-12-09
Amplifier	Shanghai Steed	YX28980930	XAW01-41-06	2018-12-10	2019-12-09
Temperature and humidity meter	MingGao	TH101B	XAW01-01-01	2018-12-16	2019-12-15
Measurement Software	Tonscend	TS+ RSE V3.0.0.2	XAW02-05-01	NCR	NCR
Radio communication analyzer	ROHDE&SCHWARZ	CMW 500	XAW01-03-02	2019-06-27	2020-06-26

7 Photographs - EUT Constructional Details

Refer to Appendix A - Photographs of EUT Constructional Details for HR/2019/90003.

The End



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