

# TEST REPORT

Product Name: UHF RFID portal reader  
FCC ID: 2A742BRC-04BL  
Trademark: N/A  
Model Number: BRC-04BL, BRC-04BL Pro, BRC-04C, BRC-04CT, BRC-04F, BRC-04FL, BRC-04E, BRC-04L, BRC-04H, BRC-08H, BRC-04A  
Prepared For: Shenzhen BroadRadio RFID Technology Co.,LTD  
Address: B222, Building 2, HONGPAI Industrial Zone, Qiaotou community, Fuhai street, Bao'an District, Shenzhen  
Manufacturer: Shenzhen BroadRadio RFID Technology Co.,LTD  
Address: B222, Building 2, HONGPAI Industrial Zone, Qiaotou community, Fuhai street, Bao'an District, Shenzhen  
Prepared By: Shenzhen CTB Testing Technology Co., Ltd.  
Address: 1&2/F., Building A, No.26, Xinhe Road, Xinqiao, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, China  
Sample Received Date: Sep. 04, 2023  
Sample tested Date: Sep. 04, 2023 to Sep. 21, 2023  
Issue Date: Sep. 21, 2023  
Report No.: CTB230912044RF  
Test Standards: FCC Part15.247  
ANSI C63.10:2013  
Test Results: PASS  
Remark: This is RFID radio test report.

Compiled by:

Reviewed by:

Approved by:

Zhou kui

Arron Liu



Zhou Kui

Arron Liu

Bin Mei / Director

Note: If there is any objection to the inspection results in this report, please submit a written report to the company within 15 days from the date of receiving the report. The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client. "\*" indicates the testing items were fulfilled by subcontracted lab. "#" indicates the items are not in CNAS accreditation scope.

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(Note: N/A means not applicable)



## 1. VERSION

Report No.	Issue Date	Description	Approved
CTB230912044RF	Sep. 21, 2023	Original	Valid

## 2. TEST SUMMARY

The Product has been tested according to the following specifications:

Test Item	Test Requirement	Test method	Result
<b>AC Power Line Conducted Emission</b>	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	PASS
<b>Radiated Spurious emissions</b>	47 CFR Part 15 Subpart C Section 15.205/15.209/15.247(d)	ANSI C63.10-2013	PASS
<b>Band edge and RF Conducted Spurious Emissions</b>	47 CFR Part 15 Subpart C Section 15.247(d)/15.205(a)	ANSI C63.10-2013	PASS
<b>Conducted Peak Output Power</b>	47 CFR Part 15 Subpart C Section 15.247 (b)(2)	ANSI C63.10-2013	PASS
<b>20dB Occupied Bandwidth</b>	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
<b>Carrier Frequencies Separation</b>	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
<b>Hopping Channel Number</b>	47 CFR Part 15 Subpart C Section 15.247 (b)	ANSI C63.10-2013	PASS
<b>Dwell Time</b>	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
<b>Antenna Requirement</b>	47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	PASS

Remark:

Test according to ANSI C63.4-2014 & ANSI C63.10-2013.

### 3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Item	Uncertainty
Occupancy bandwidth	$U=\pm 54.3\text{Hz}$
Conducted output power Above 1G	$U=\pm 1.0\text{dB}$
Conducted output power below 1G	$U=\pm 0.9\text{dB}$
Power Spectral Density , Conduction	$U=\pm 1.0\text{dB}$
Conduction spurious emissions	$U=\pm 2.8\text{dB}$
Out of band emission	$U=\pm 54\text{Hz}$
3m chamber Radiated spurious emission(30MHz-1GHz)	$U=\pm 4.3\text{dB}$
3m chamber Radiated spurious emission(1GHz-18GHz)	$U=\pm 4.5\text{dB}$
humidity uncertainty	$U=\pm 5.3\%$
Temperature uncertainty	$U=\pm 0.59^{\circ}\text{C}$
Supply voltages	$U=\pm 3\%$
Time	$U=\pm 5\%$

#### 4. PRODUCT INFORMATION AND TEST SETUP

##### 4.1 Product Information

Model(s):	BRC-04BL, BRC-04BL Pro, BRC-04C, BRC-04CT, BRC-04F, BRC-04FL, BRC-04E, BRC-04L, BRC-04H, BRC-08H, BRC-04A
Model Description:	All the model are the same circuit and RF module, only for model name. Test sample model: BRC-04BL
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	902-928MHz
Max. RF output power:	23.555dBm
Type of Modulation:	ASK
Antenna installation:	Internal antenna
Antenna Gain:	ANT1: 9dBi ANT2: 9dBi ANT3: 9dBi ANT4: 9dBi
Ratings:	AC 120V/60Hz

##### 4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

##### 4.3 Support Equipment

No.	Device Type	Brand	Model	Series No.	Data Cable	Power Cord
1	Laptop	DELL	Vostro 5490	N/A	N/A	N/A

##### Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

#### 4.4 Channel List

Channel List							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	902.75	14	909.25	27	915.75	40	922.25
2	903.25	15	909.75	28	916.25	41	922.75
3	903.75	16	910.25	29	916.75	42	923.25
4	904.25	17	910.75	30	917.25	43	923.75
5	904.75	18	911.25	31	917.75	44	924.25
6	905.25	19	911.75	32	918.25	45	924.75
7	905.75	20	912.25	33	918.75	46	925.25
8	906.25	21	912.75	34	919.25	47	925.75
9	906.75	22	913.25	35	919.75	48	926.25
10	907.25	23	913.75	36	920.25	49	926.75
11	907.75	24	914.25	37	920.75	50	927.25
12	908.25	25	914.75	38	921.25		
13	908.75	26	915.25	39	921.75		

#### 4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting (ASK)	902.75MHz	914.75MHz	927.25MHz
Receiving (ASK)	902.75MHz	914.75MHz	927.25MHz

#### 4.6 Test Environment

Humidity(%):	54
Atmospheric Pressure(kPa):	101
Normal Voltage(AC):	120V
Normal Temperature(°C)	23
Low Temperature(°C)	0
High Temperature(°C)	40

## 5. TEST FACILITY AND TEST INSTRUMENT USED

### 5.1 Test Facility

All measurement facilities used to collect the measurement data are located at 1&2F., Building A, No. 26, Xinh Road, Xinqiao, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

### 5.2 Test Instrument Used

Item	Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	2024.07.05
2	Power Sensor	Agilent	U2021XA	MY56120032	2024.07.05
3	Power Sensor	Agilent	U2021XA	MY56120034	2024.07.05
4	Communication test set	R&S	CMW500	108058	2024.07.05
5	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	2024.07.05
6	Signal Generator	Agilent	N5181A	MY50140365	2024.07.05
7	Vector signal generator	Agilent	N5182A	MY47420195	2024.07.05
8	Communication test set	Agilent	E5515C	MY50102567	2024.07.06
9	2.4 GHz Filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	2024.07.05
10	5 GHz Filter	Shenxiang	MSF5150-5850 MS-1155	20181015001	2024.07.06
11	Filter	Xingbo	XBLBQ-DZA120	190821-1-1	2024.07.06
12	BT&WI-FI Automatic test software	Microwave	MTS8000	Ver. 2.0.0.0	/
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	2023.10.30
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	2024.07.05
15	234G Automatic test software	Microwave	MTS8200	Ver. 2.0.0.0	/
16	966 chamber	C.R.T.	966	/	2024.08.11
17	Receiver	R&S	ESPI	100362	2024.07.05
18	Amplifier	HP	8447E	2945A02747	2024.07.05
19	Amplifier	Agilent	8449B	3008A01838	2024.07.05
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	2024.07.08

21	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA9120D	01911	2024.07.08
22	EMI test software	Fala	EZ-EMC	FA-03A2 RE	/
23	Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-224	2024.07.08
24	loop antenna	ZHINAN	ZN30900A	GTS534	/
25	40G Horn antenna	A/H/System	SAS-574	588	2023.10.30
26	Amplifier	AEROFLEX	Aeroflex	097	2023.10.30

### Continuous disturbance

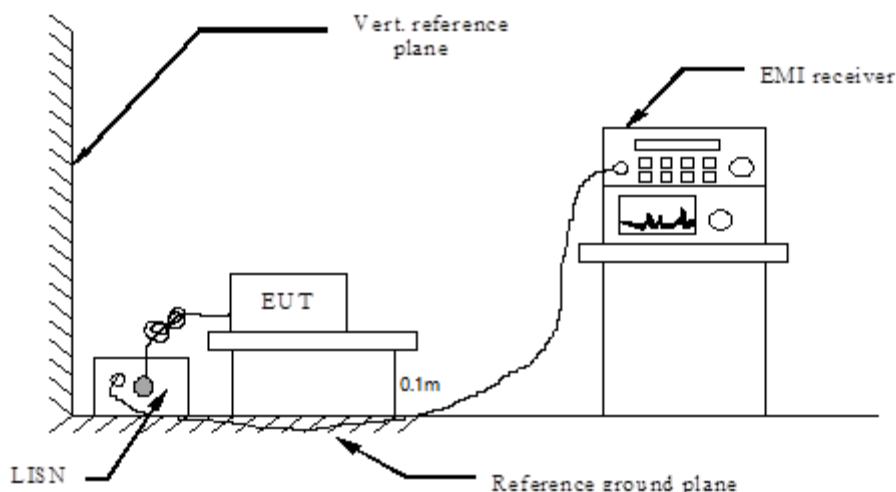
No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	LISN	ROHDE&SCHWARZ	ESH3-Z5	100318	2024.07.05
2	Pulse limiter	ROHDE&SCHWARZ	ESH3Z2	357881052	2024.07.05
3	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100428/003	2024.07.05
4	Coaxial cable	ZDECL	Z302S-NJ-SMA J-12M	18091905	2024.07.05
5	ISN	Schwarzbeck	NTFM8158	183	2024.07.05
6	Communication test set	Agilent	E5515C	MY50102567	2024.07.05
7	Communication test set	R&S	CMW500	108058	2024.07.05
8	EZ-EMC	Frad	EMC-con3A1.1	/	/

### Radiated emission

No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120 D	01911	2024.07.08
2	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	2024.07.08
3	Amplifier	Agilent	8449B	3008A01838	2024.07.05
4	Amplifier	HP	8447E	2945A02747	2024.07.05
5	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100428/003	2024.07.05
6	Coaxial cable	ETS	RFC-SNS-100-NMS-80 NI	/	2024.07.05
7	Coaxial cable	ETS	RFC-SNS-100-NMS-20 NI	/	2024.07.05
8	Coaxial cable	ETS	RFC-SNS-100-SMS-20 NI	/	2024.07.05
9	Coaxial cable	ETS	RFC-NNS-100-NMS-300 NI	/	2024.07.05
10	Communication test set	Agilent	E5515C	MY50102567	2024.07.05
11	Communication test set	R&S	CMW500	108058	2024.07.05
12	EZ-EMC	Frad	EMC-con3A1.1	/	/

## 6. AC POWER LINE CONDUCTED EMISSION

### 6.1 Block Diagram Of Test Setup



### 6.2 Limit

Frequency (MHz)	Maximum RF Line Voltage (dB $\mu$ V)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

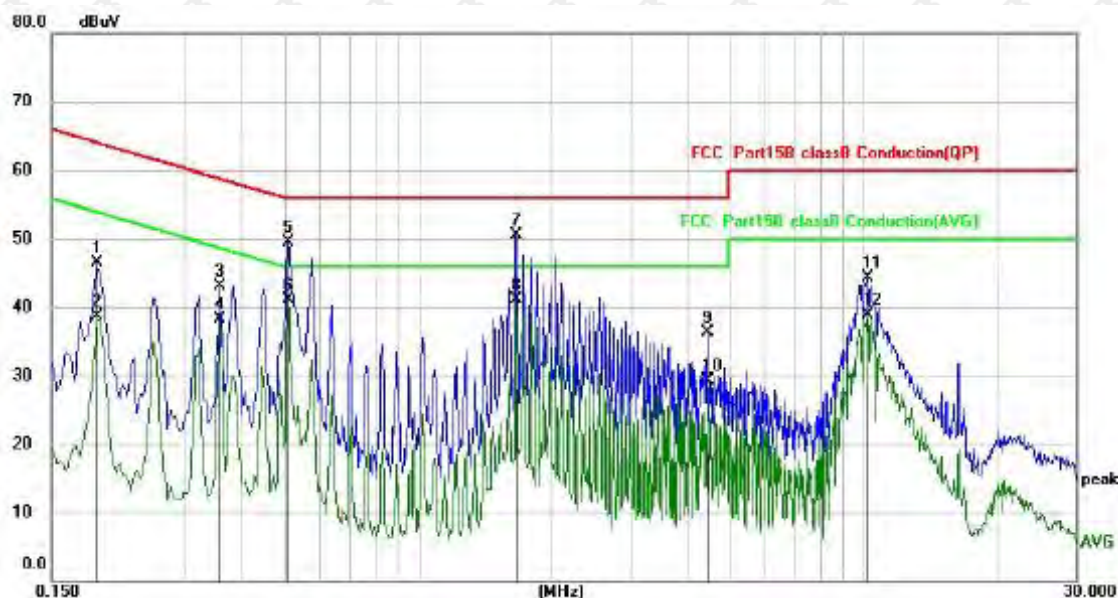
\* Decreasing linearly with the logarithm of the frequency

### 6.3 Test procedure

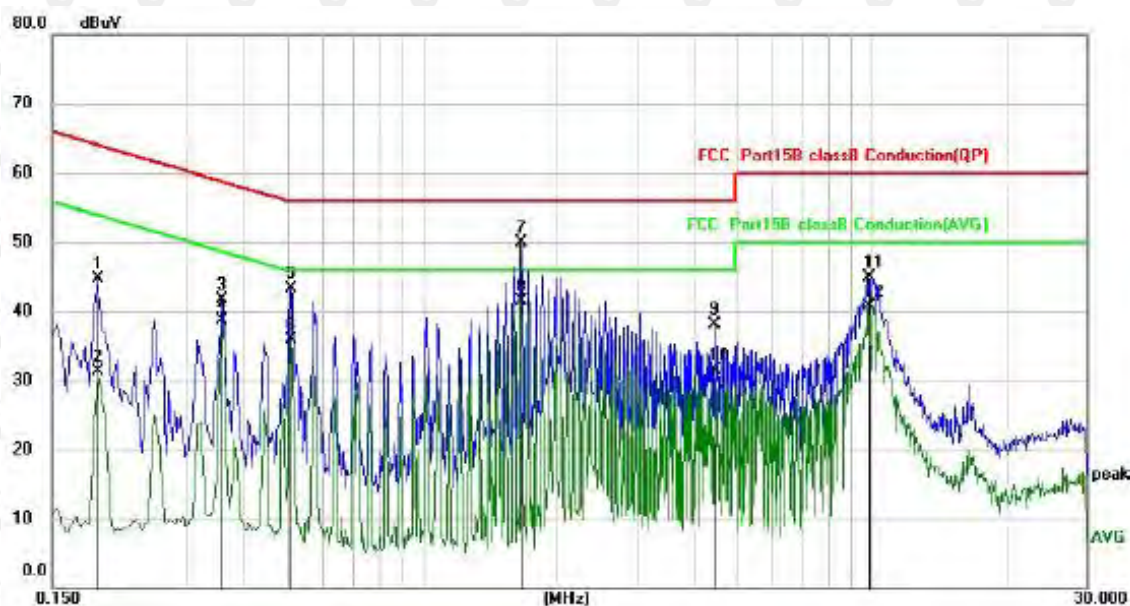
- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50 $\Omega$ /50 $\mu$ H + 5 $\Omega$  linear impedance. The power cables of all other units of the 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 0.1m 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 on conducted measurement.

#### 6.4 Test Result



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1900	36.50	9.95	46.45	64.04	-17.59	QP
2		0.1900	28.85	9.95	38.80	54.04	-15.24	AVG
3		0.3579	33.08	9.97	43.05	58.78	-15.73	QP
4		0.3579	28.41	9.97	38.38	48.78	-10.40	AVG
5		0.5100	39.42	9.99	49.41	56.00	-6.59	QP
6		0.5100	31.06	9.99	41.05	46.00	-4.95	AVG
7		1.6619	40.54	10.06	50.60	56.00	-5.40	QP
8 *		1.6619	31.11	10.06	41.17	46.00	-4.83	AVG
9		4.4739	25.94	10.33	36.27	56.00	-19.73	QP
10		4.4739	19.01	10.33	29.34	46.00	-16.66	AVG
11		10.2258	33.67	10.59	44.26	60.00	-15.74	QP
12		10.2258	28.24	10.59	38.83	50.00	-11.17	AVG



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1900	34.84	9.95	44.79	64.04	-19.25	QP
2		0.1900	21.33	9.95	31.28	54.04	-22.76	AVG
3		0.3579	31.66	9.97	41.63	58.78	-17.15	QP
4		0.3579	28.82	9.97	38.79	48.78	-9.99	AVG
5		0.5100	33.41	9.99	43.40	56.00	-12.60	QP
6		0.5100	25.83	9.99	35.82	46.00	-10.18	AVG
7		1.6619	39.90	10.06	49.96	56.00	-6.04	QP
8	*	1.6619	31.43	10.06	41.49	46.00	-4.51	AVG
9		4.4739	27.71	10.33	38.04	56.00	-17.96	QP
10		4.4739	21.12	10.33	31.45	46.00	-14.55	AVG
11		9.8459	34.29	10.58	44.87	60.00	-15.13	QP
12		9.8459	30.06	10.58	40.64	50.00	-9.36	AVG

#### Remark:

- Factor = Cable loss + LISN factor, Margin = Limit – Level
- All modes were tested at AC 120V and 240V, only the worst result of AC 120V 60Hz was reported.
- All the test modes completed for test. Only the worst result of GFSK Low Channel was reported.

## 7. RADIATED SPURIOUS EMISSION

### 7.1 Block Diagram Of Test Setup

Figure 1. Below 30MHz

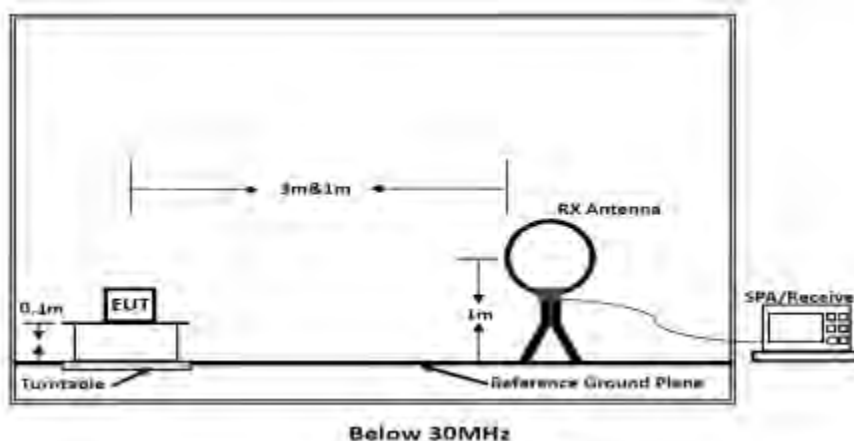


Figure 2. 30MHz to 1GHz

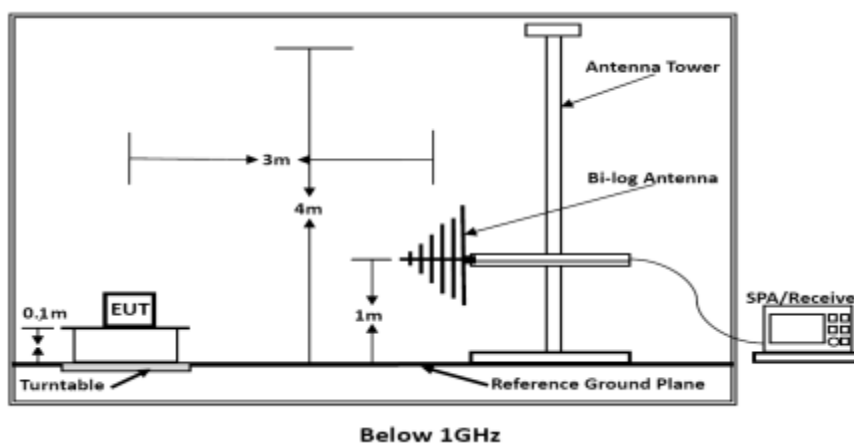
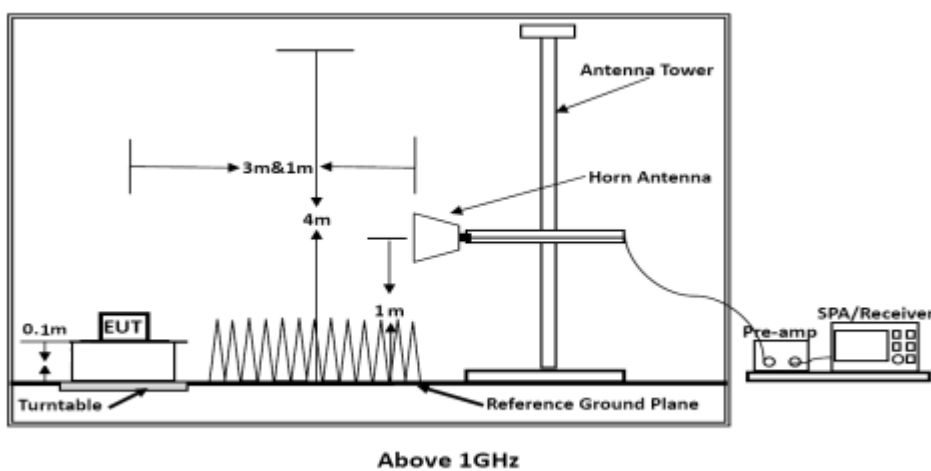


Figure 3. Above 1GHz



## 7.2 Limit

### Spurious Emissions:

Frequency	Field strength (microvolt/meter)	Limit (dB $\mu$ V/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

Note: a.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.

b. The lower limit shall apply at the transition frequencies.

c. Emission level(dBuV/m)=20log Emission level(uV/m)

### 7.3 Test procedure

#### Below 1GHz test procedure as below:

- a.The EUT was placed on the top of a rotating table 0.1 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.
- 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.
- 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.
- 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 (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e.The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f.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.

#### Above 1GHz test procedure as below:

- g.Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter( Above 18GHz the distance is 1 meter and table is 1.5 meter).
- h.Test the EUT in the lowest channel ,the middle channel ,the Highest channel
- j.Repeat above procedures until all frequencies measured was complete.

Receiver set:

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

## 7.4 Test Result

ANT1+ANT2+ANT3+ANT4 MIMO:

Low channel below 1GHz Test Results:

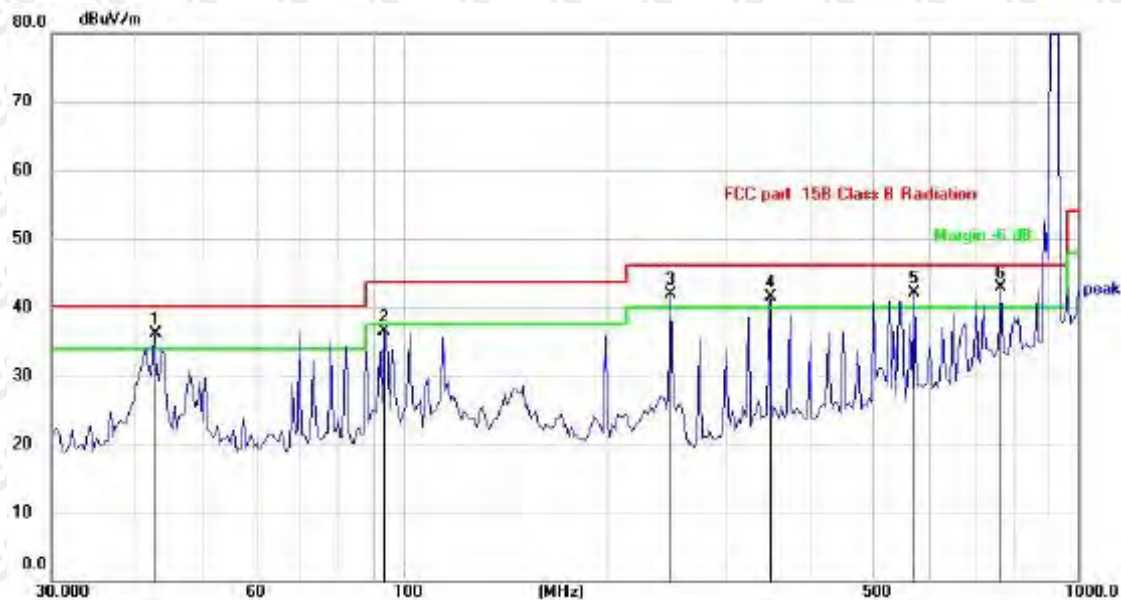
Antenna polarity: H



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	
		MHz	Level	Factor	ment			Detector
			dBuV	dB	dBuV/m	dB/m	dB	
1		42.6000	33.11	-5.26	27.85	40.00	-12.15	QP
2		106.0126	39.80	-7.78	32.02	43.50	-11.48	QP
3		275.6397	42.52	-5.79	36.73	46.00	-9.27	QP
4	!	401.8383	43.03	-2.11	40.92	46.00	-5.08	QP
5	!	575.6340	40.32	2.00	42.32	46.00	-3.68	QP
6	*	722.9923	37.61	4.98	42.59	46.00	-3.41	QP

Remark: Transd = Cableloss + Antenna factor - Pre-amplifier; Margin = Limit - Level.

Antenna polarity: V



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1	!	42.6000	41.39	-5.26	36.13	40.00	-3.87	QP
2		93.7682	46.15	-9.59	36.56	43.50	-6.94	QP
3	!	250.3009	48.75	-6.89	41.86	46.00	-4.14	QP
4	!	349.2500	44.94	-3.46	41.48	46.00	-4.52	QP
5	!	575.6340	40.05	2.00	42.05	46.00	-3.95	QP
6	*	768.7481	37.10	5.84	42.94	46.00	-3.06	QP

Remark: Transd = Cableloss + Antenna factor - Pre-amplifier; Margin = Limit - Level

Above 1 GHz Test Results:

ANT1+ANT2+ANT3+ANT4 MIMO:

CH Low

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1805.5	108.33	-5.84	52.69	74	-21.31	peak
1805.5	95.55	-5.84	43.65	54	-10.35	AVG
2708.25	56.31	-3.64	52.67	74	-21.33	peak
2708.25	47.03	-3.64	43.39	54	-10.61	AVG
3611	58.27	-0.95	57.32	74	-16.68	peak
3611	48.18	-0.95	47.23	54	-6.77	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1805.5	108.51	-5.84	52.69	74	-21.31	peak
1805.5	95.57	-5.84	43.65	54	-10.35	AVG
2708.25	56.42	-3.64	52.78	74	-21.22	peak
2708.25	47.03	-3.64	43.39	54	-10.61	AVG
3611	58.29	-0.95	57.34	74	-16.66	peak
3611	48.20	-0.95	47.25	54	-6.75	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

CH Middle

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
1829.5	108.30	-5.71	52.67	74	-21.33	peak
1829.5	95.14	-5.71	45.61	54	-8.39	AVG
2744.25	56.12	-3.51	52.61	74	-21.39	peak
2744.25	46.90	-3.51	43.39	54	-10.61	AVG
3659	58.05	-0.82	57.23	74	-16.77	peak
3659	47.84	-0.82	47.02	54	-6.98	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
1829.5	108.29	-5.71	52.67	74	-21.33	peak
1829.5	95.06	-5.71	45.61	54	-8.39	AVG
2744.25	55.94	-3.51	52.43	74	-21.57	peak
2744.25	46.78	-3.51	43.27	54	-10.73	AVG
3659	58.03	-0.82	57.21	74	-16.79	peak
3659	47.92	-0.82	47.10	54	-6.90	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

CH High  
Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1851.5	56.30	-5.65	52.36	74	-21.64	peak
1851.5	47.23	-5.65	46.89	54	-7.11	AVG
2777.25	56.19	-3.43	52.76	74	-21.24	peak
2777.25	47.35	-3.43	43.92	54	-10.08	AVG
3703	57.35	-0.75	56.60	74	-17.40	peak
3703	47.65	-0.75	46.90	54	-7.10	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

## Vertical:

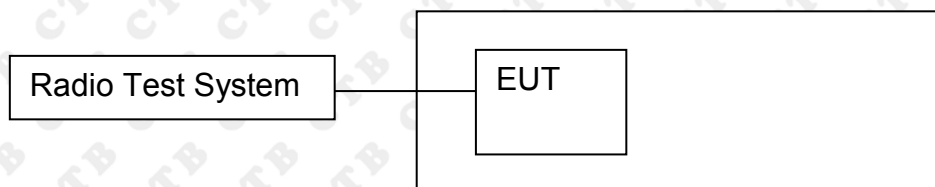
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
1851.5	56.49	-5.65	52.36	74	-21.64	peak
1851.5	47.37	-5.65	46.89	54	-7.11	AVG
2777.25	56.10	-3.43	52.67	74	-21.33	peak
2777.25	47.41	-3.43	43.98	54	-10.02	AVG
3703	57.40	-0.75	56.65	74	-17.35	peak
3703	47.67	-0.75	46.92	54	-7.08	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

## Remark:

- (1) Measuring frequencies from 1 GHz to the 25 GHz .
- (2) All modes of operation were investigated and the worst-case emissions are reported.
- (3) Radiated emission test from 9kHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9kHz to 30MHz and not recorded in this report.

## 8. BAND EDGE AND RF CONDUCTED SPURIOUS EMISSIONS

### 8.1 Block Diagram Of Test Setup



### 8.2 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 8.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:

Below 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

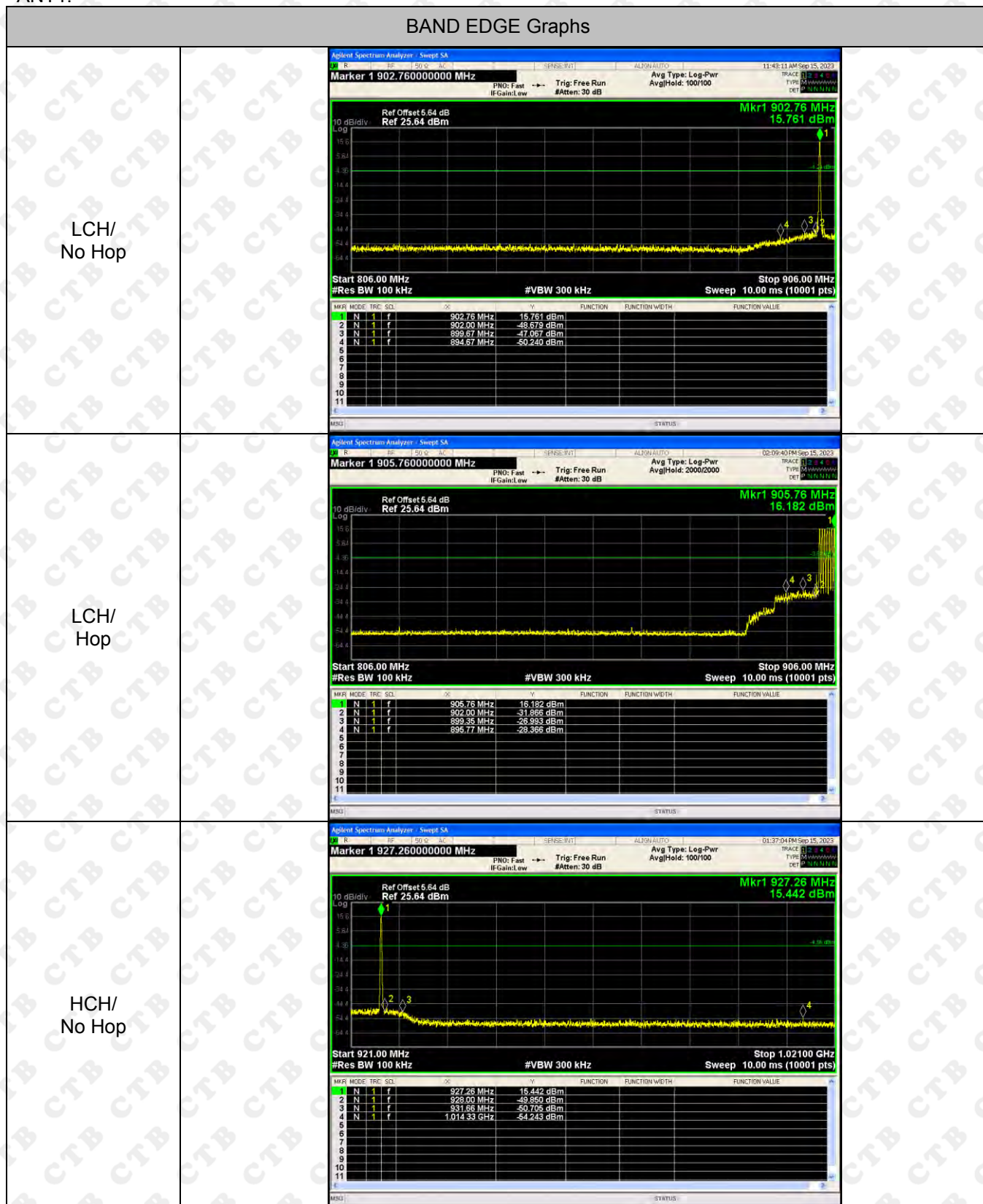
Above 30MHz:

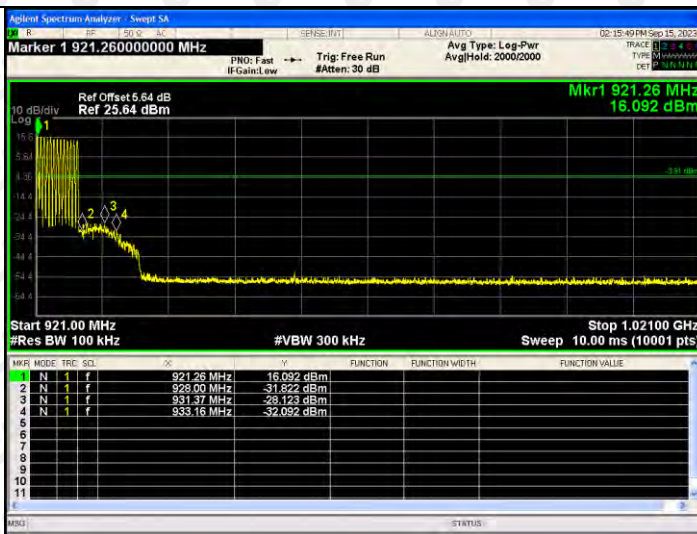
RBW = 100KHz, VBW = 300KHz, Sweep = auto

Detector function = peak, Trace = max hold

## 8.4 Test Result

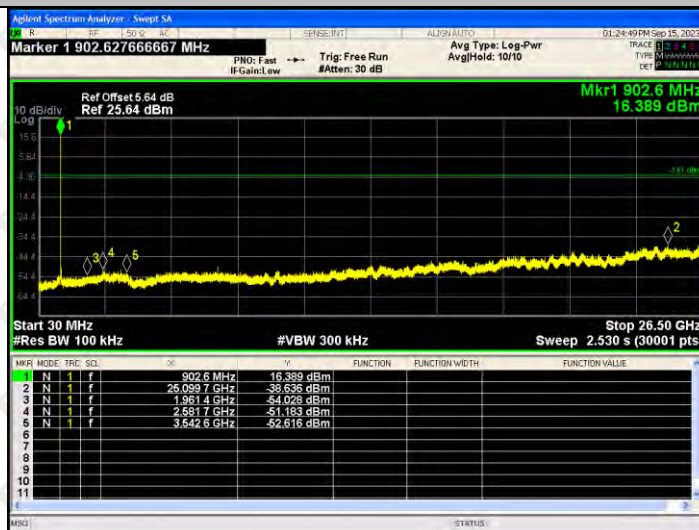
ANT1:



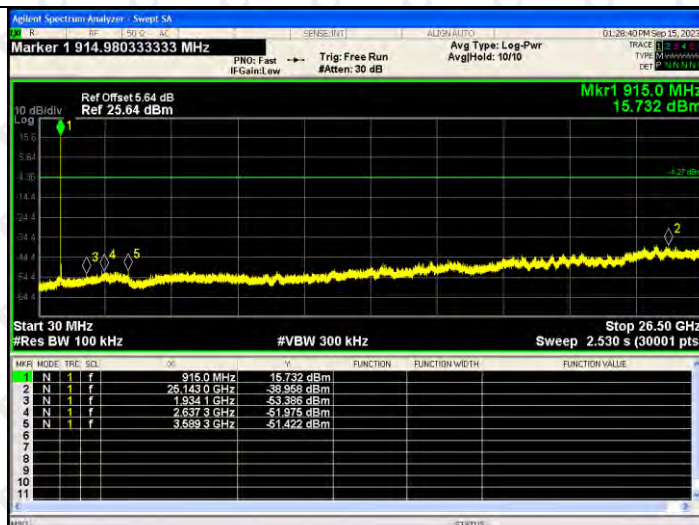
HCH/  
Hop


## RF Conducted Spurious Emissions Graphs

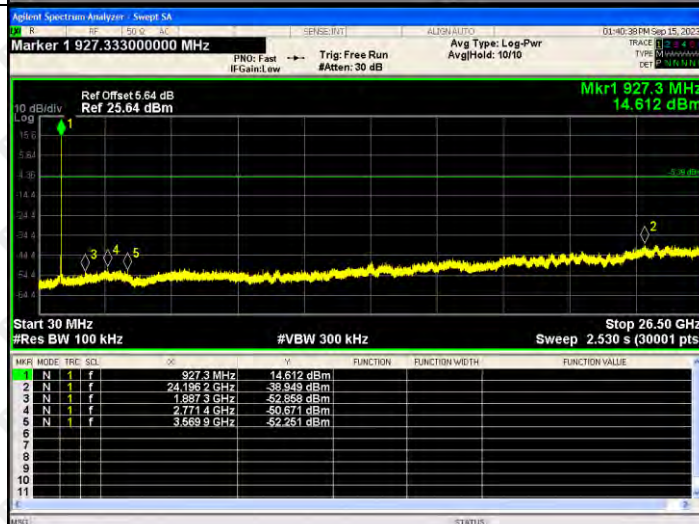
LCH



MCH

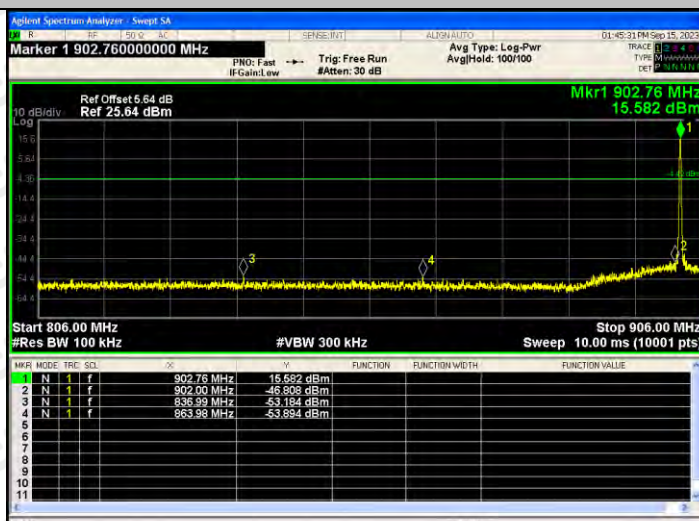
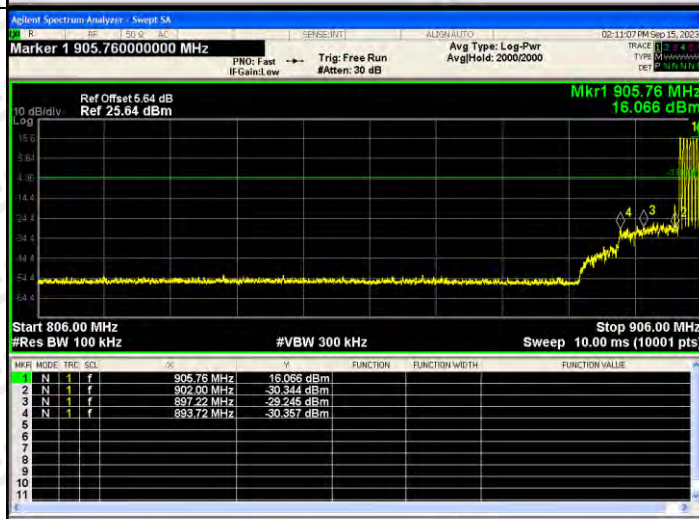
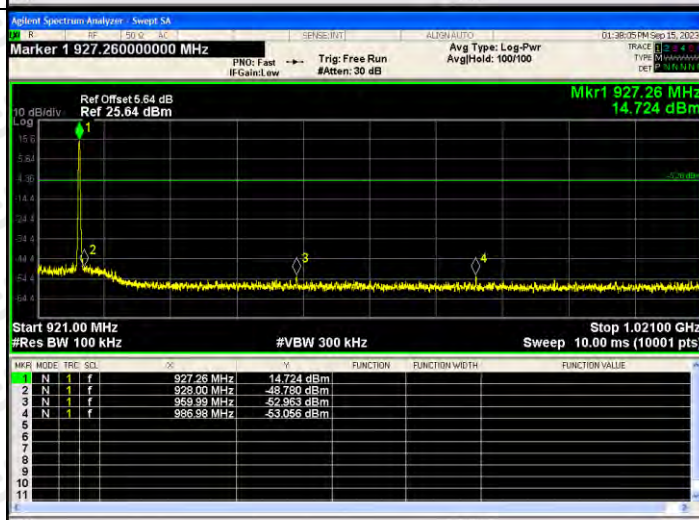


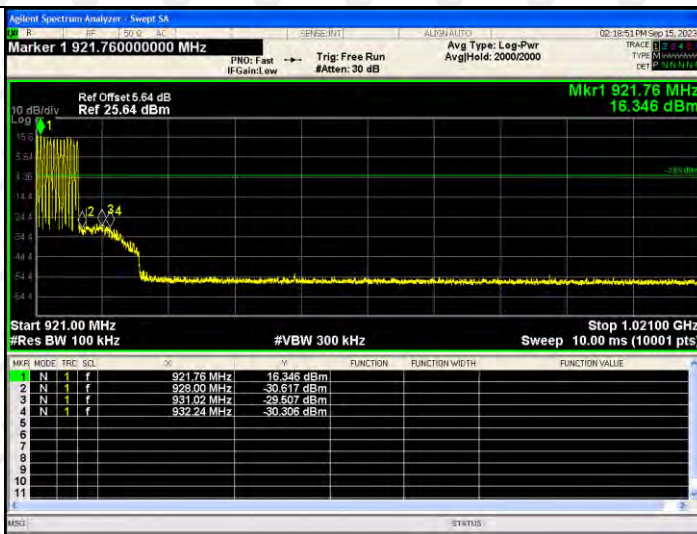
HCH



ANT2:

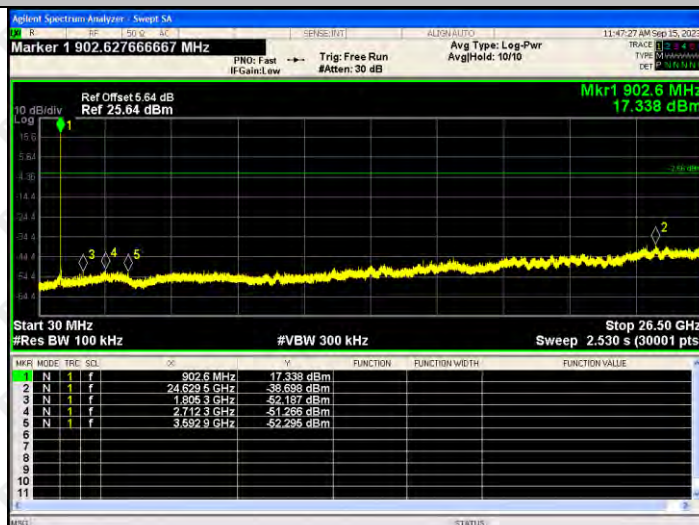
## BAND EDGE Graphs

LCH/  
No Hop

LCH/  
Hop

HCH/  
No Hop


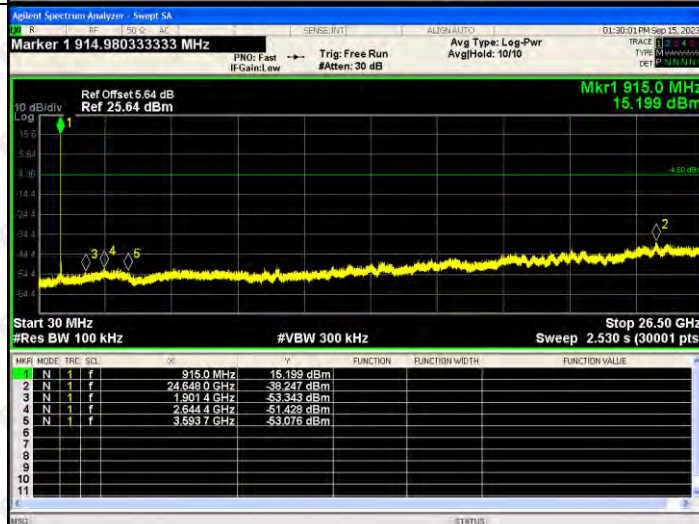
HCH/  
Hop


# RF Conducted Spurious Emissions Graphs

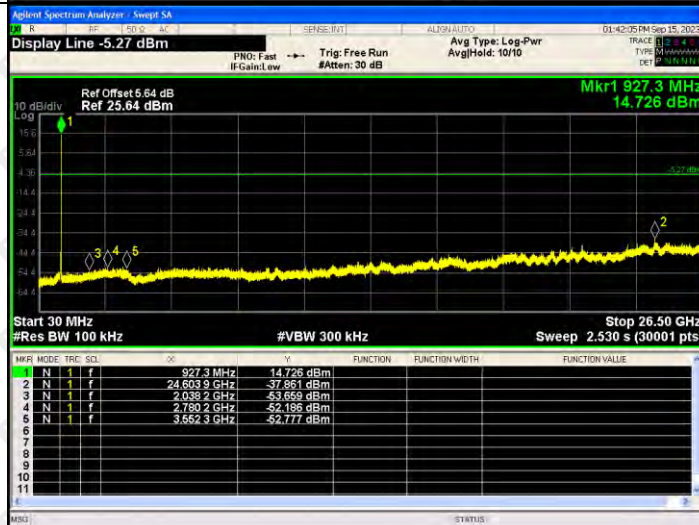
LCH



MCH

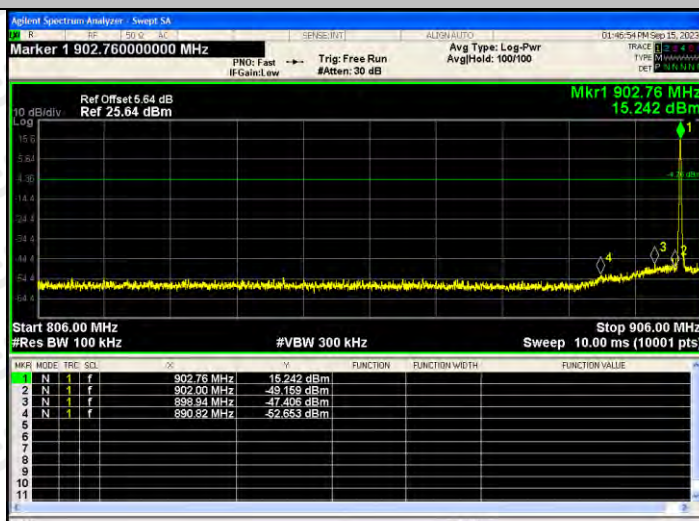
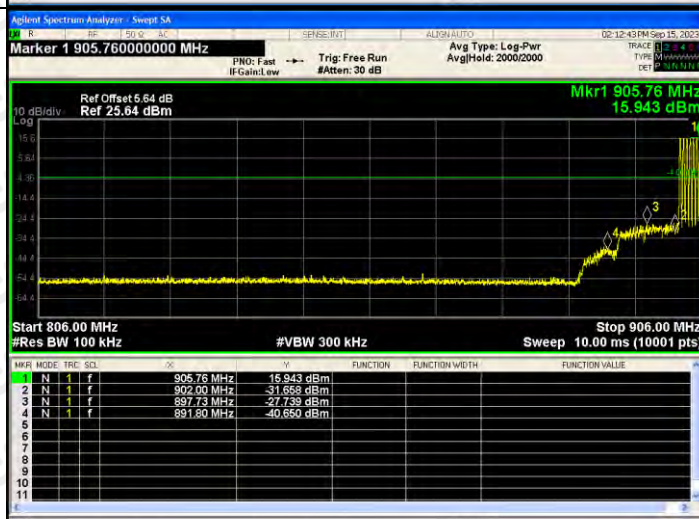
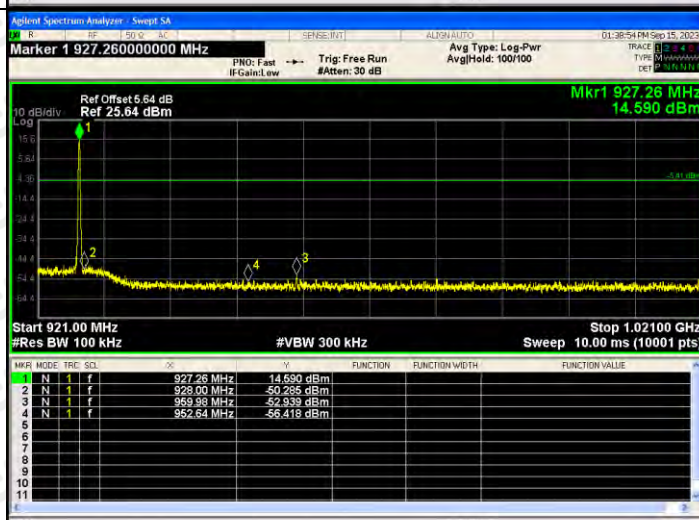


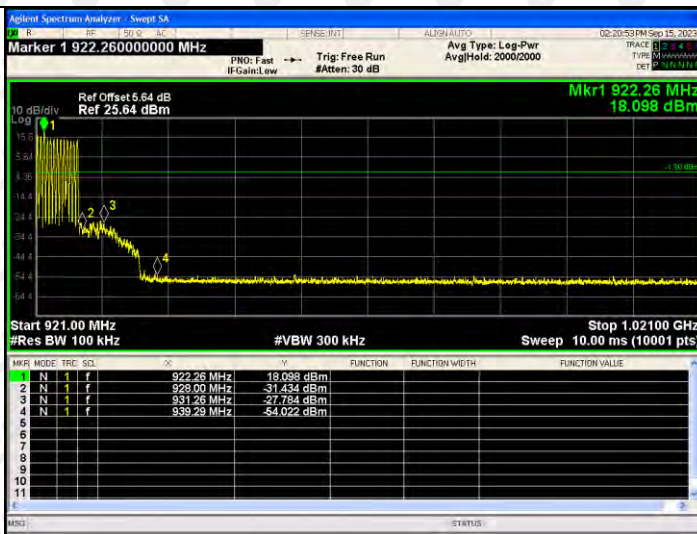
HCH



ANT3:

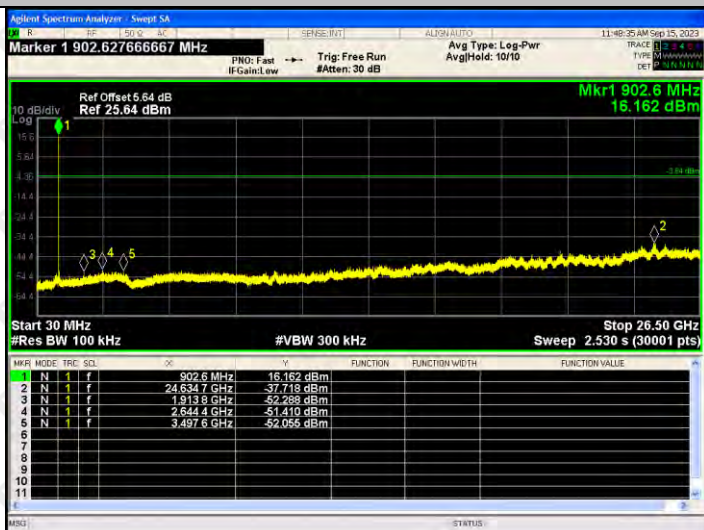
## BAND EDGE Graphs

LCH/  
No Hop

LCH/  
Hop

HCH/  
No Hop


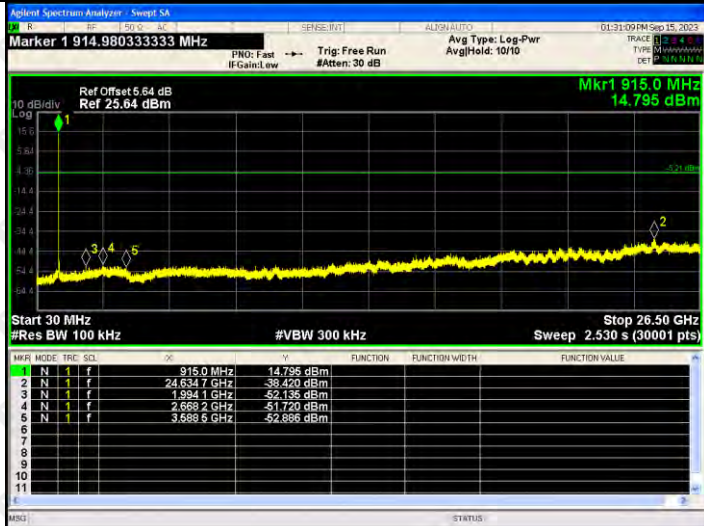
HCH/  
Hop


## RF Conducted Spurious Emissions Graphs

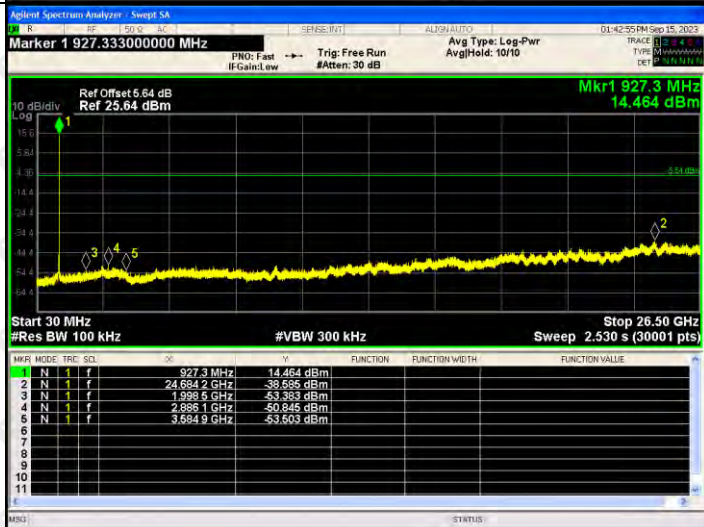
LCH



MCH

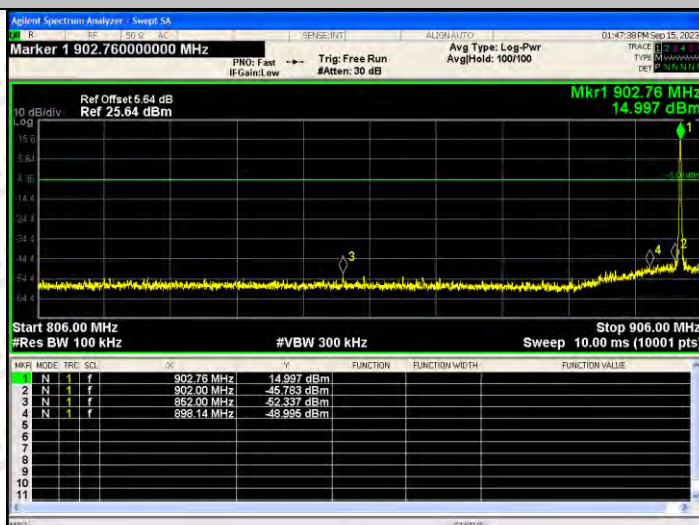
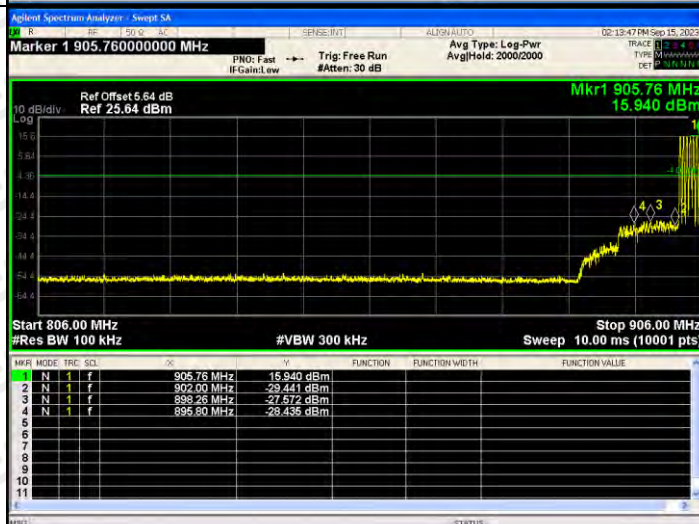
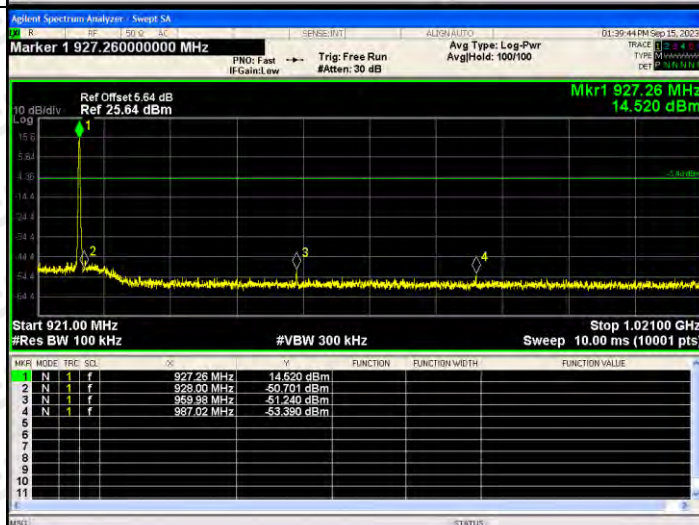


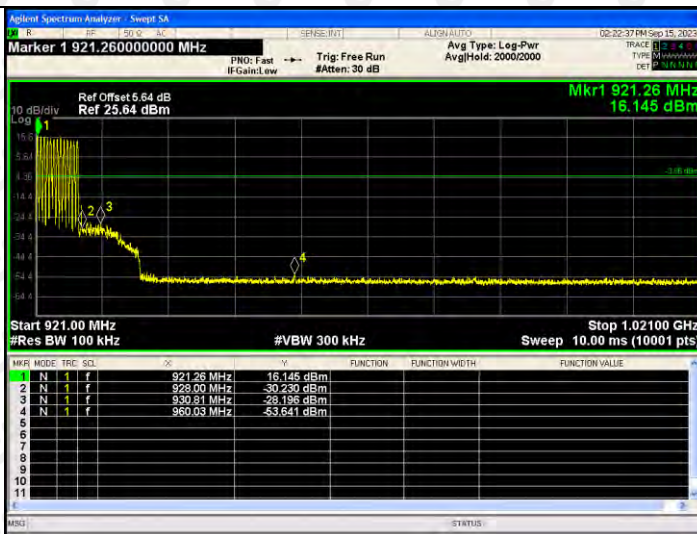
HCH



ANT4:

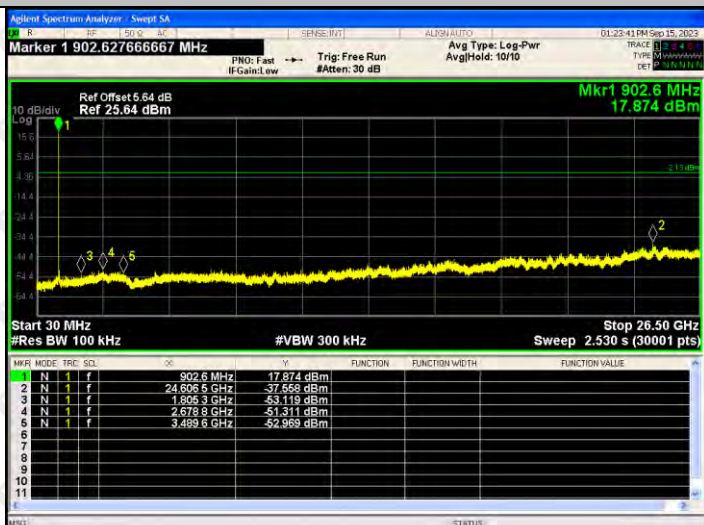
## BAND EDGE Graphs

LCH/  
No Hop

LCH/  
Hop

HCH/  
No Hop


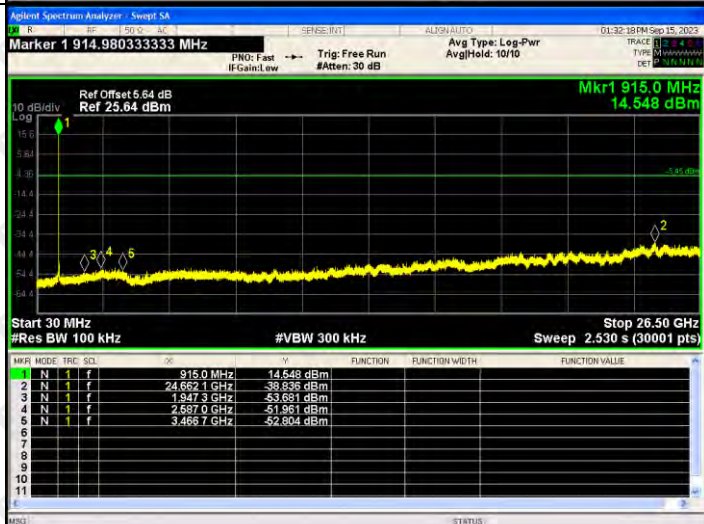
HCH/  
Hop


## RF Conducted Spurious Emissions Graphs

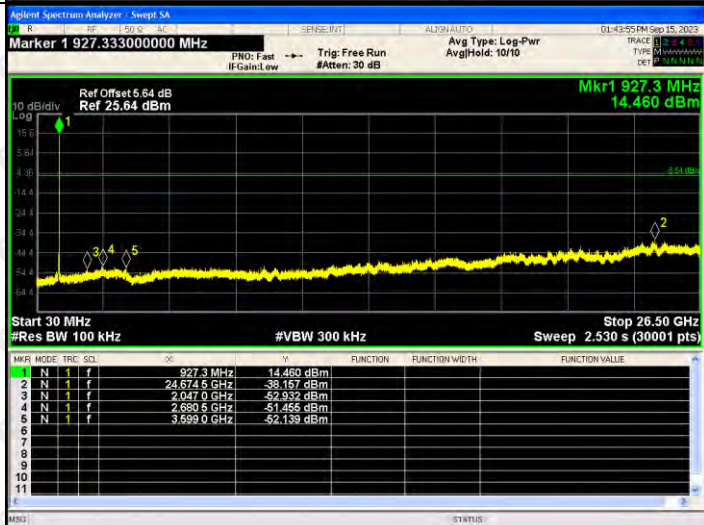
LCH



MCH

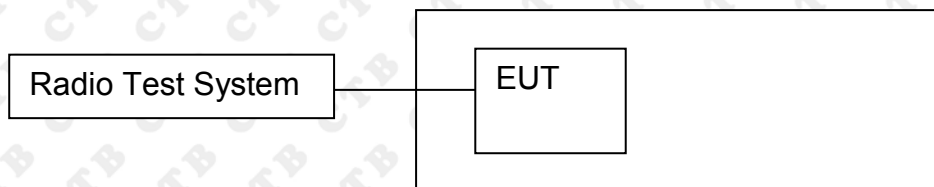


HCH



## 9. COUDUCTED PEAK OUTPUT POWER

### 9.1 Block Diagram Of Test Setup



### 9.2 Limit

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) 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.

Peak output Power: <1W=30dBm

### 9.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

#### 9.4 Test Result

ANT1+ANT2+ANT3+ANT4:

Antenna Gain: 9dBi

Channel.	Maximum Peak Power [dBm] Ant1	Maximum Peak Power [dBm] Ant2	Maximum Peak Power [dBm] Ant3	Maximum Peak Power [dBm] Ant4	Total Power Peak Output Power(dBm)	Limit[dBm]
LCH	17.395	17.688	17.538	17.511	23.555	27
MCH	17.037	17.115	17.425	17.584	23.317	27
HCH	16.61	16.635	16.044	16.522	22.480	27

Test Graph:  
ANT1:

Graphs

LCH



MCH



HCH



ANT2:

### Graphs

LCH



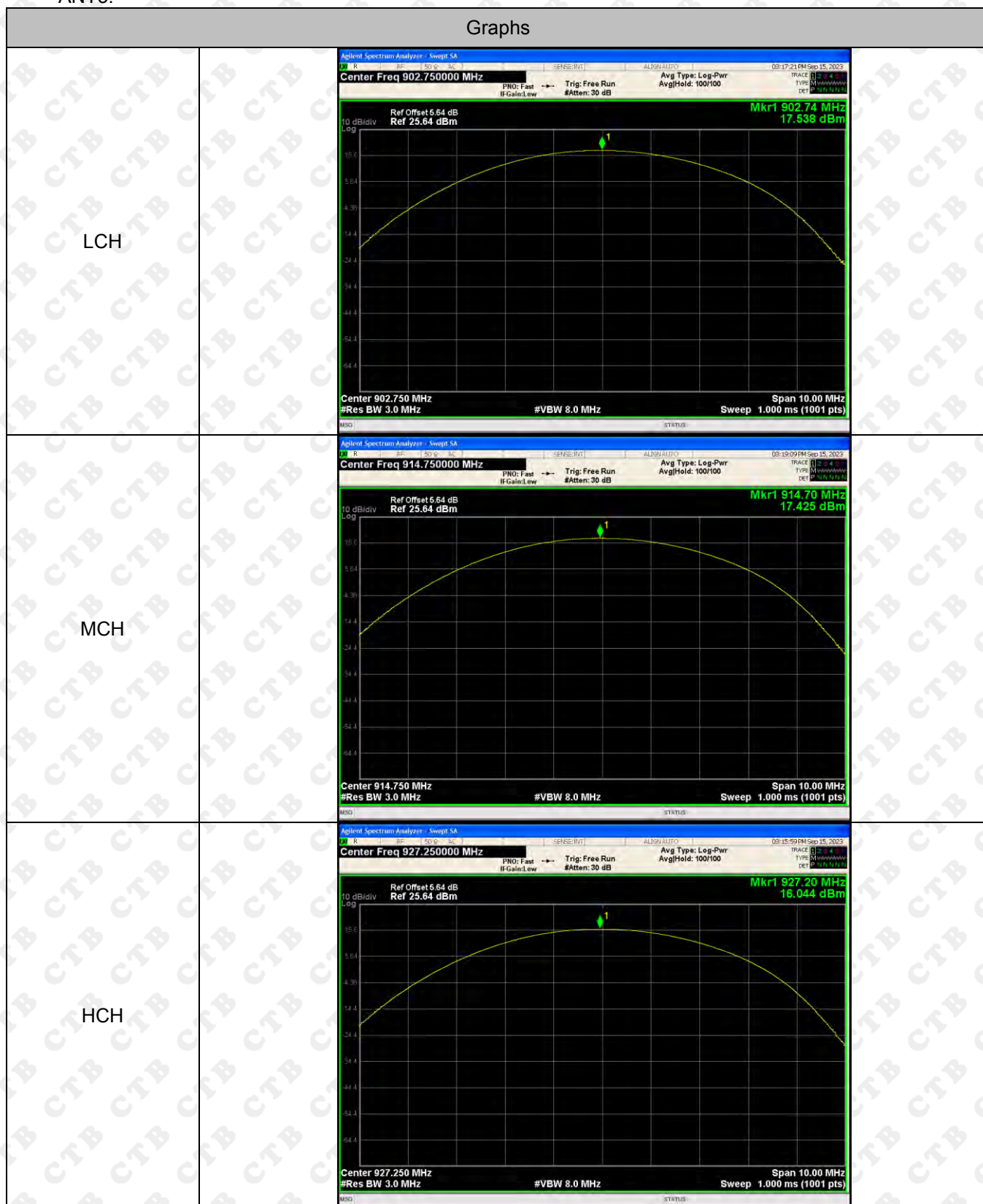
MCH



HCH



ANT3:



ANT4:

### Graphs

LCH



MCH

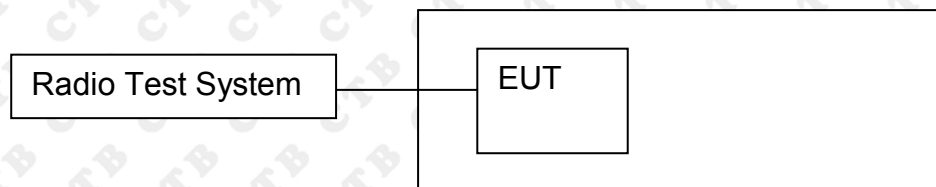


HCH



## 10. 20DB OCCUPIED BANDWIDTH

### 10.1 Block Diagram Of Test Setup



### 10.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies

### 10.3 Test procedure

1. Rem1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### 10.4 Test Result

ANT1:

Frequency	20dB Bandwidth (kHz)	Result
Low channel	103.43	<b>PASS</b>
Mid channel	103.48	<b>PASS</b>
High channel	104.57	<b>PASS</b>

ANT2:

Frequency	20dB Bandwidth (kHz)	Result
Low channel	103.49	<b>PASS</b>
Mid channel	103.52	<b>PASS</b>
High channel	104.37	<b>PASS</b>

ANT3:

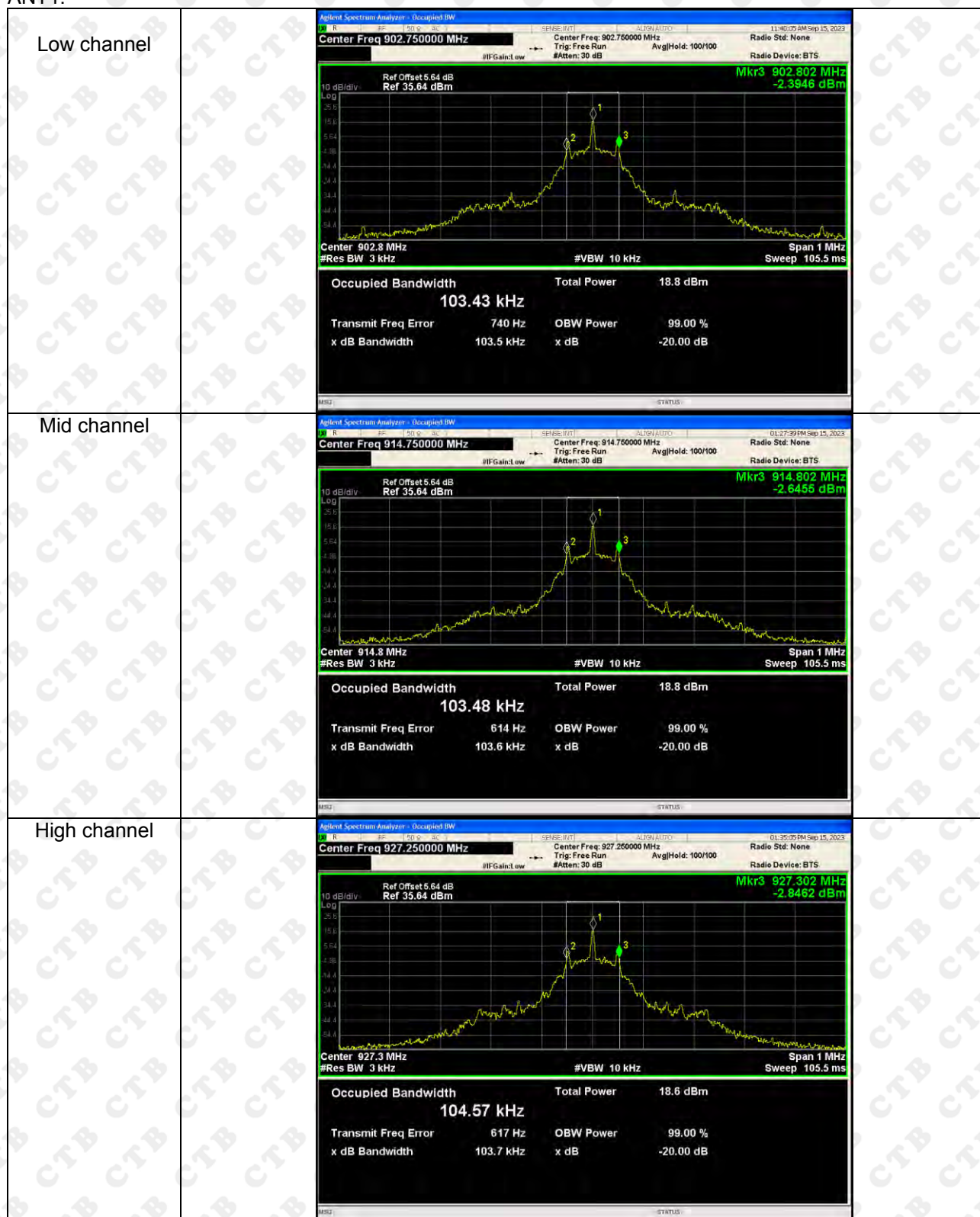
Frequency	20dB Bandwidth (kHz)	Result
Low channel	103.68	<b>PASS</b>
Mid channel	103.68	<b>PASS</b>
High channel	104.59	<b>PASS</b>

ANT4:



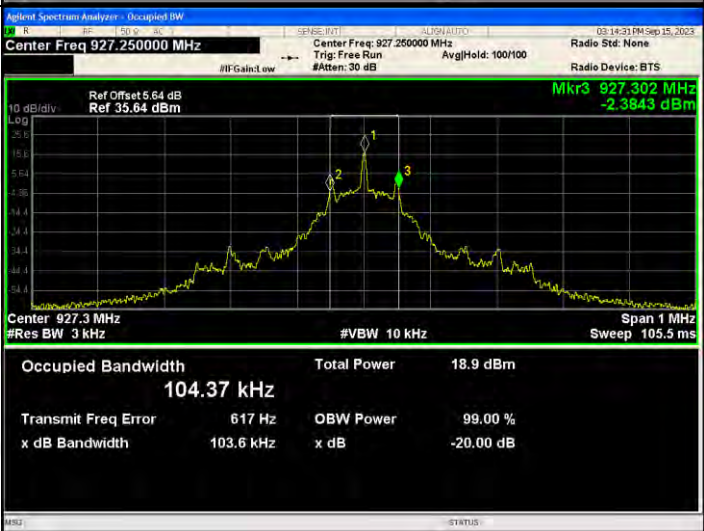
Frequency	20dB Bandwidth (kHz)	Result
Low channel	103.63	<b>PASS</b>
Mid channel	103.60	<b>PASS</b>
High channel	104.55	<b>PASS</b>

Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

Test Graph:  
ANT1:






ANT2:

<p>Low channel</p>		
<p>Mid channel</p>		
<p>High channel</p>		

## ANT3:

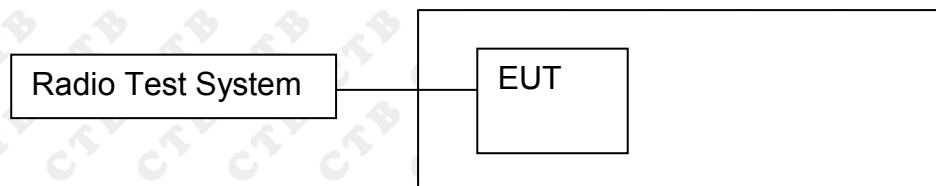
<p>Low channel</p>		
<p>Mid channel</p>		
<p>High channel</p>		

## ANT4:

<p>Low channel</p>	
<p>Mid channel</p>	
<p>High channel</p>	

## 11. CARRIER FREQUENCIES SEPARATION

### 11.1 Block Diagram Of Test Setup



### 11.2 Limit

At least 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

### 11.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 10kHz. VBW = 30kHz , Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

### 11.4 Test Result

#### ANT1:

Channel.	Carrier Frequency Separation [MHz]	Verdict
LCH	0.501	PASS
MCH	0.500	PASS
HCH	0.500	PASS

#### ANT2:

Channel.	Carrier Frequency Separation [MHz]	Verdict
LCH	0.500	PASS
MCH	0.500	PASS
HCH	0.500	PASS

#### ANT3:

Channel.	Carrier Frequency Separation [MHz]	Verdict
LCH	0.500	PASS
MCH	0.500	PASS
HCH	0.500	PASS

#### ANT4:

Channel.	Carrier Frequency Separation [MHz]	Verdict
LCH	0.500	PASS
MCH	0.500	PASS
HCH	0.500	PASS

## Test Graph

ANT1:

### Graphs

LCH



MCH



HCH



ANT2:

## Graphs

LCH



MCH



HCH



ANT3:

## Graphs

LCH



MCH



HCH



## Graphs

[illegible]

Agilent Spectrum Analyzer - Sweep SA

02:31:47 PM Sep 15, 2023

Marker 1  $\Delta$  500.00000 kHz

PRO: Wide IF Gain: Low Trig: Free Run #Atten: 30 dB Avg Type: Log-Pwr Avg/Hold: >100/100

Ref Offset: 5.64 dB Ref: 23.64 dBm

$\Delta$ Mkr1 500 kHz -0.043 dB

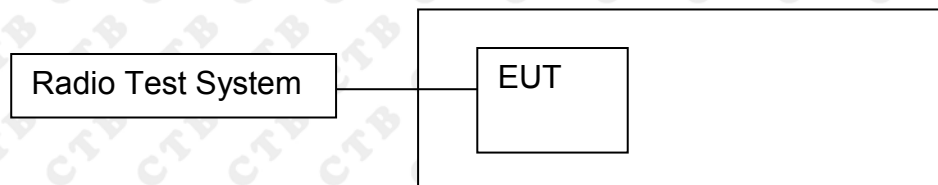
Start 914.5000 MHz #Res BW 10 kHz #VBW 30 kHz Stop 915.5000 MHz Sweep 9.600 ms (1001 pts)

MNR	MODE	TRIG	SCN	F	F	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	$\Delta$ 2	1	f	(A)	500 kHz (A)	-0.043 dB		
2	F	1	f		914.751 MHz	16.358 dBm		
3								
4								
5								
6								
7								
8								
9								
10								
11								

[illegible]

## 12. HOPPING CHANNEL NUMBER

### 12.1 Block Diagram Of Test Setup



### 12.2 Limit

Frequency hopping systems in the 920-928 MHz band shall use at least 50 channels.

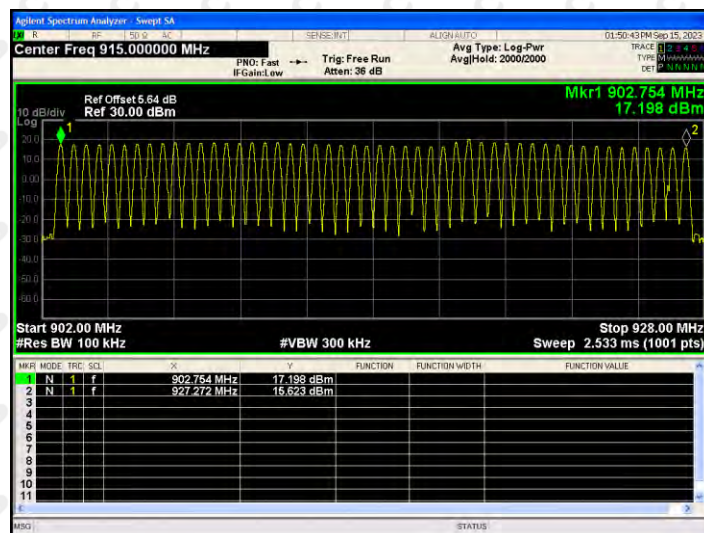
### 12.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

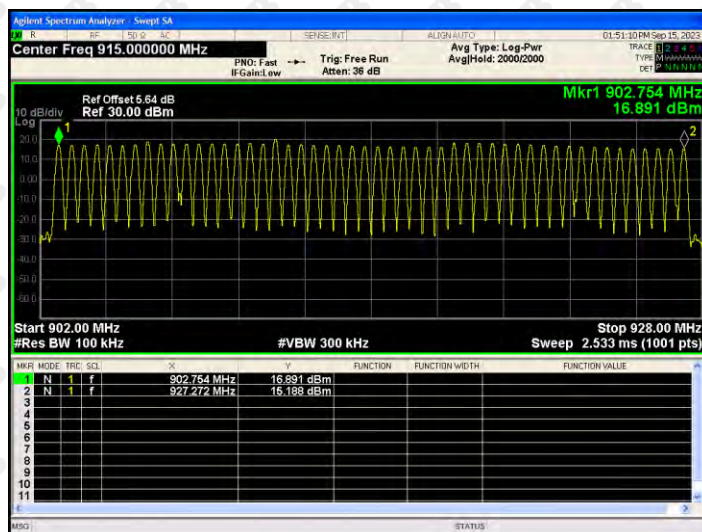
### 12.4 Test Result

Mode	Channel.	Number of Hopping Channel	Verdict
ASK	Hop	50	PASS

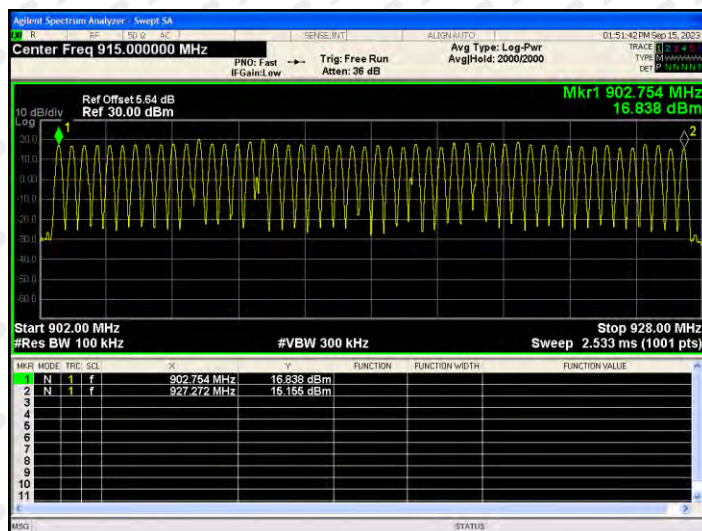
ANT1:



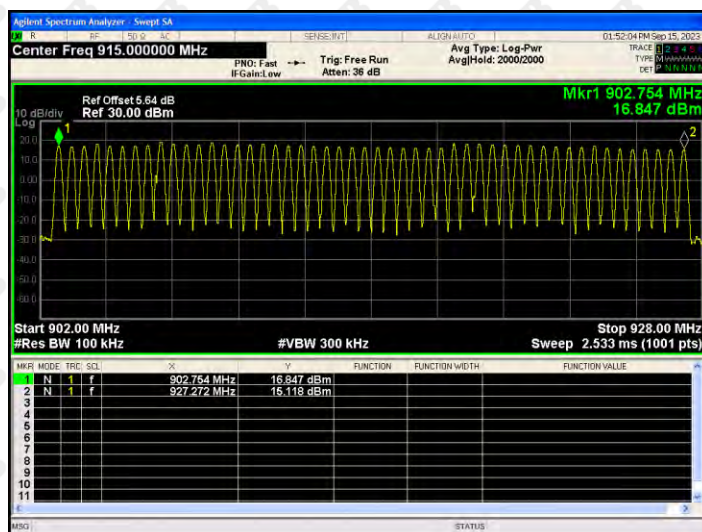
ANT2:



ANT3:

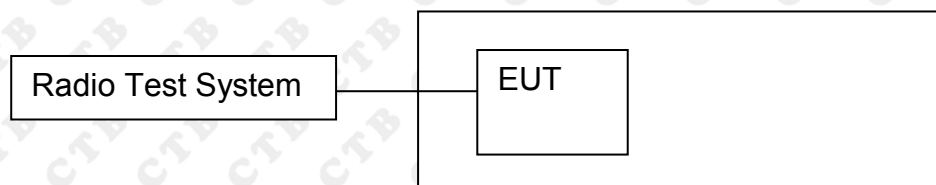


ANT4:



### 13. DWELL TIME

#### 13.1 Block Diagram Of Test Setup



#### 13.2 Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

#### 13.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

### 13.4 Test Result

#### ANT1:

Channel	No. of transmission in 20s(a)	Pulse Time (ms)(b)	Total Dwell Time in 20s (ms) (c)	Limit (ms)	Verdict
LCH	11	28.00	308	400	PASS
MCH	11	31.60	347.6	400	PASS
HCH	11	34.40	378.4	400	PASS

#### ANT2:

Channel	No. of transmission in 20s(a)	Pulse Time (ms)(b)	Total Dwell Time in 20s (ms) (c)	Limit (ms)	Verdict
LCH	11	31.60	347.6	400	PASS
MCH	10	30.00	300	400	PASS
HCH	10	34.40	344	400	PASS

#### ANT3:

Channel	No. of transmission in 20s(a)	Pulse Time (ms)(b)	Total Dwell Time in 20s (ms) (c)	Limit (ms)	Verdict
LCH	11	33.60	369.6	400	PASS
MCH	11	29.20	321.2	400	PASS
HCH	10	32.80	328	400	PASS

#### ANT4:

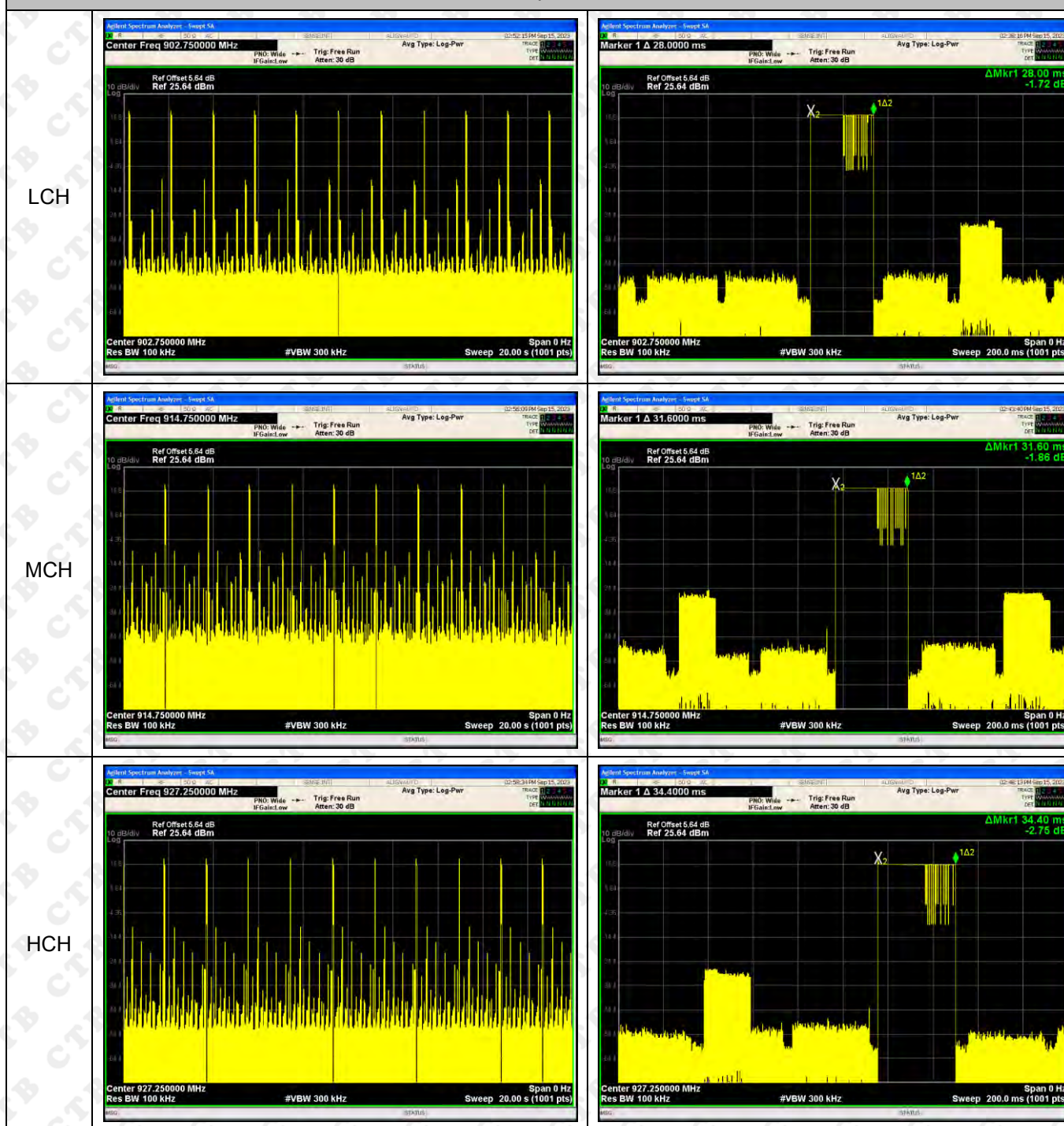
Channel	No. of transmission in 20s(a)	Pulse Time (ms)(b)	Total Dwell Time in 20s (ms) (c)	Limit (ms)	Verdict
LCH	10	34.00	340	400	PASS
MCH	11	31.80	349.8	400	PASS
HCH	11	31.80	349.8	400	PASS

Remark: Total dwell time in 20s, c=(a)\*(b)

## Test Graph

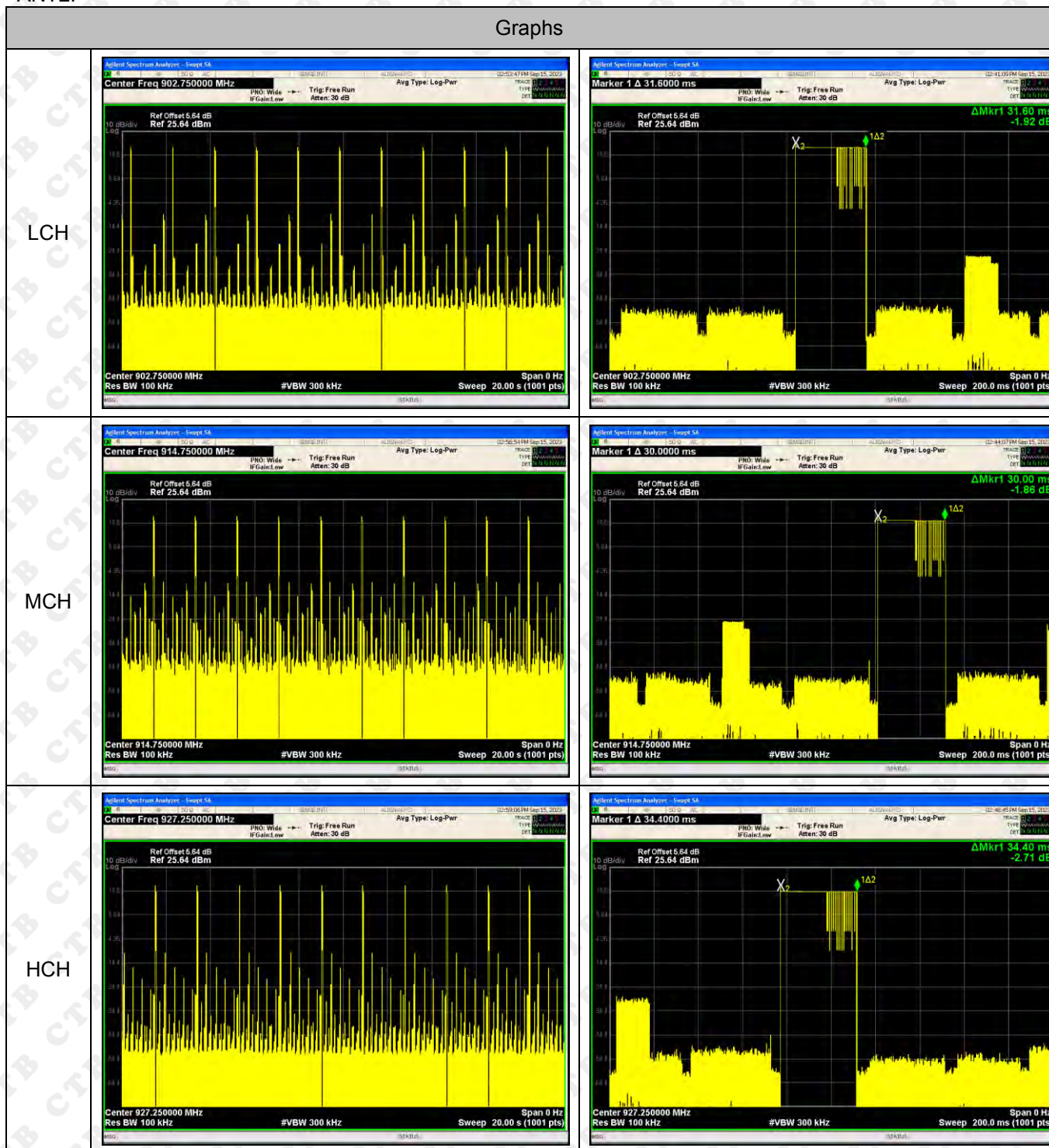
ANT1:

### Graphs



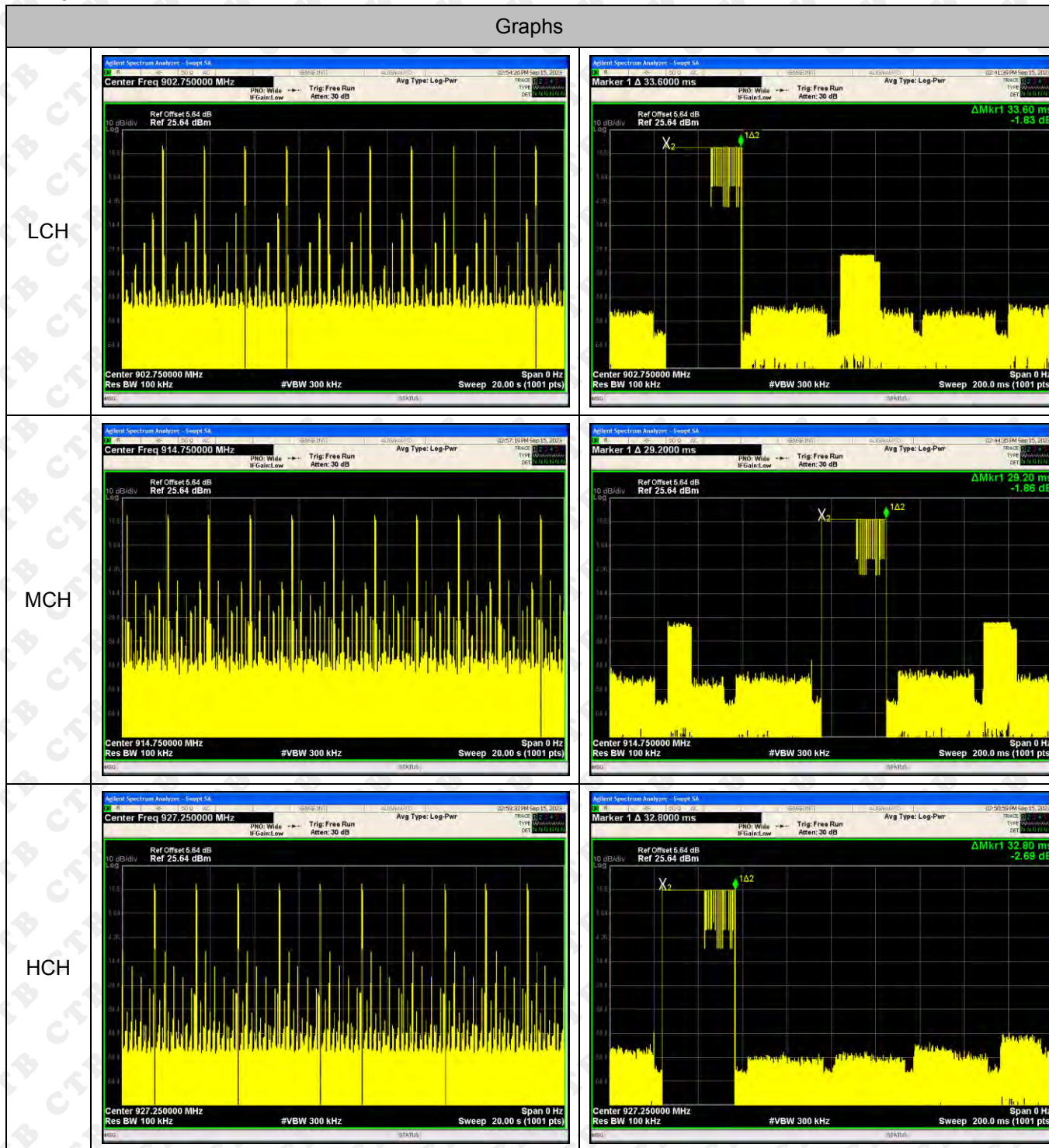
ANT2:

## Graphs



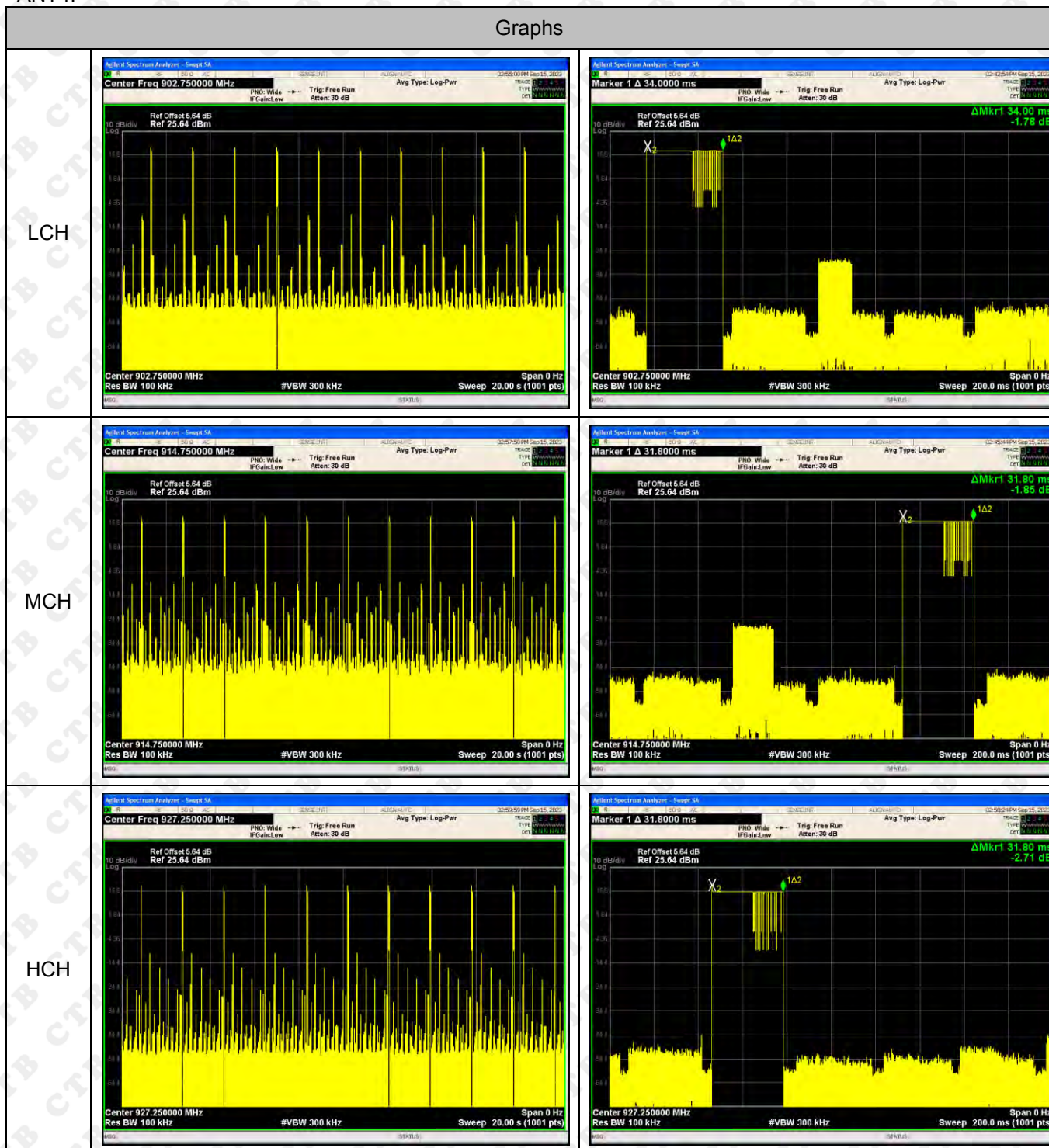
ANT3:

## Graphs



ANT4:

## Graphs



## 14. ANTENNA REQUIREMENT

### 15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

### 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.

### EUT Antenna:

The antenna is Internal antenna and no consideration of replacement. The best case gain of the antenna is 9dBi.

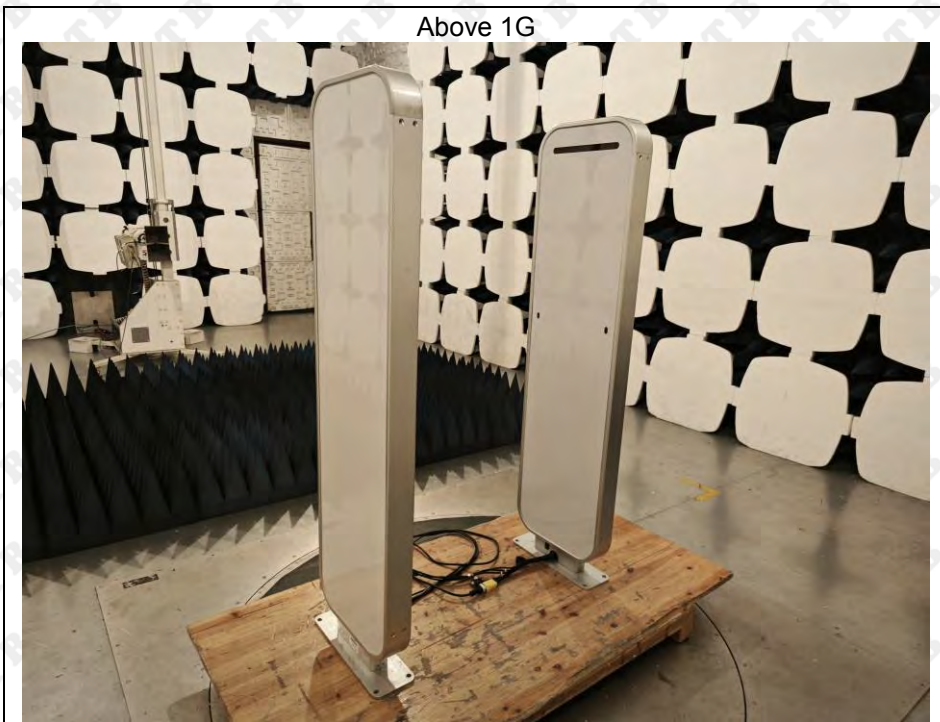
## 15. EUT TEST SETUP PHOTOGRAPHS

### Radiated Emission

Below 1G



Above 1G



## Conducted emission



\*\*\*\*\* END OF REPORT \*\*\*\*\*