

FCC PART 15.247 TEST REPORT

For

ESPRESSIF SYSTEMS (SHANGHAI) CO., LTD.

Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai,
China (201203)

FCC ID: 2AC7Z-RIGEL

Report Type: CIIPC	Product Type: Wi-Fi& Bluetooth Internet of Things Module
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Report Number: RSHD190323001-00B	
Report Date: 2019-04-03	
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GENERAL INFORMATION

Applicant	ESPRESSIF SYSTEMS (SHANGHAI) CO., LTD.
Tested Model	RIGEL
Product Type	Wi-Fi& Bluetooth Internet of Things Module
Dimension	26.5 mm (L)* 63 mm (W)*3.4 mm(H)
Power Supply	DC 3.3V

**All measurement and test data in this report was gathered from production sample serial number: 20190323001.
(Assigned by the BACL. The EUT supplied by the applicant was received on 2019-01-09)*

Objective

This test report is prepared on behalf of ESPRESSIF SYSTEMS (SHANGHAI) CO., LTD. in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine Compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.209 and 15.247 rules.

This is a CIIPC report base on the original report RSHA180913005-00B with FCC ID: 2AC7Z-RIGEL, the differences between the original device and the current one are as follows:

1. Added three Fakra Antennas to test, one is W10436069, another is W10806955, the third is W10474143.

The above differences will affect “part of tests”, RADIATED EMISSIONS & RESTRICTED BANDS EMISSIONS were presented in this report, and other data were referred to the original report.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS submissions with FCC ID: 2AC7Z-RIGEL.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and 558074 D01 15.247 Meas Guidance v05r01.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISSED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Channel list for Bluetooth:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	40	2442
1	2403
...
...	...	78	2480
39	2441	/	/

EUT was tested with Channel 0, 39 and 78.

EUT Exercise Software

The EUT was tested under the engineering mode.

GFSK Power level: 5

$\pi/4$ -DQPSK Power level: 5

8DPSK Power level: 5

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

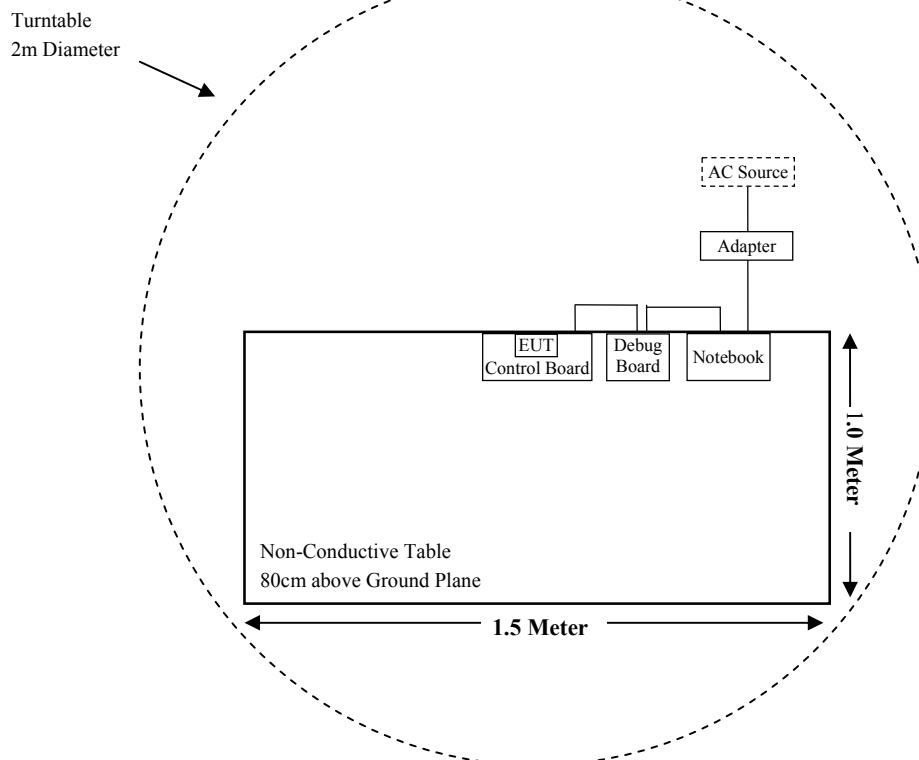
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
DELL	Adapter	LA65NS0-00	DF263
ESPRESSIF SYSTEMS	Control Board	/	/
ESPRESSIF SYSTEMS	Debug Board	ESP-WROOM-03	/

External I/O Cable

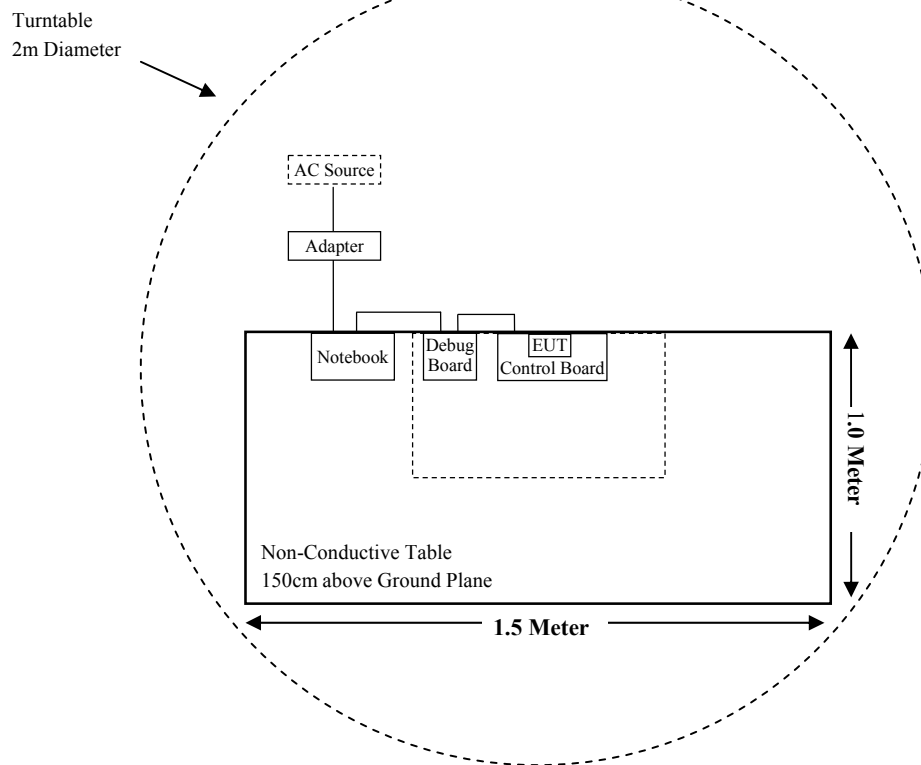
Cable Description	Length (m)	From Port	To
Power Cable	1.2	Notebook	Adapter
USB Cable	0.8	Notebook	Debug Board
Data Cable	0.3	Debug Board	Control Board

Block Diagram of Test Setup

For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (I), §1.1310 & §2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant (See Note 1)
§15.205, §15.209 & §15.247(d)	Radiated Emissions & Restricted Bands Emissions	Compliant
§15.247(a)(1)	20 dB Emission Bandwidth	Compliant (See Note 1)
§15.247(a)(1)	Channel Separation Test	Compliant (See Note 1)
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant (See Note 1)
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant (See Note 1)
§15.247(b)(1)	Peak Output Power Measurement	Compliant (See Note 1)
§15.247(d)	Band edges	Compliant (See Note 1)

Note 1: For these items, all the test data please refer to the original report RSHA180913005-00B with FCC ID: 2AC7Z-RIGEL.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test (Chamber 1#)					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2018-11-30	2019-11-29
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrunent	Pre-amplifier	310N	171205	2018-08-14	2019-08-13
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2018-08-15	2019-08-14
Radiated Emission Test (Chamber 2#)					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2018-08-27	2019-08-26
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2017-07-15	2020-07-14
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-12-12	2019-12-11
A.H.Systems, inc	Amplifier	2641-1	466	2018-09-11	2019-09-10
A.H.Systems, inc	Amplifier	2641-1	491	2019-02-20	2020-02-19
EM Electronics Corporation	Amplifier	EM18G40G	060726	2018-03-22	2019-03-21
MICRO-TRONICS	Band Reject Filter	BRM50702	G024	2018-08-05	2019-08-04
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2018-08-15	2019-08-14

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1310, 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/		f/1500	30
1500-100,000	/		1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data (worst case):

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi	2412-2462	4.20	2.63	22.00	158.49	20	0.0829	1.00
	2422-2452	4.20	2.63	21.00	125.89	20	0.0659	1.00
BLE	2402-2480	4.20	2.63	0.00	1.00	20	0.0005	1.00
Bluetooth	2402-2480	4.20	2.63	3.00	2.00	20	0.0010	1.00

Conclusion: The EUT meets exemption requirement- RF exposure evaluation greater than 20cm distance specified in § 2.1091. If the device built into a host as a portable usage, the additional RF exposure evaluation may be required as specified by § 2.1093.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, 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 shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine Compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
 - b. Antenna must use a unique type of connector to attach to the EUT.
- Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

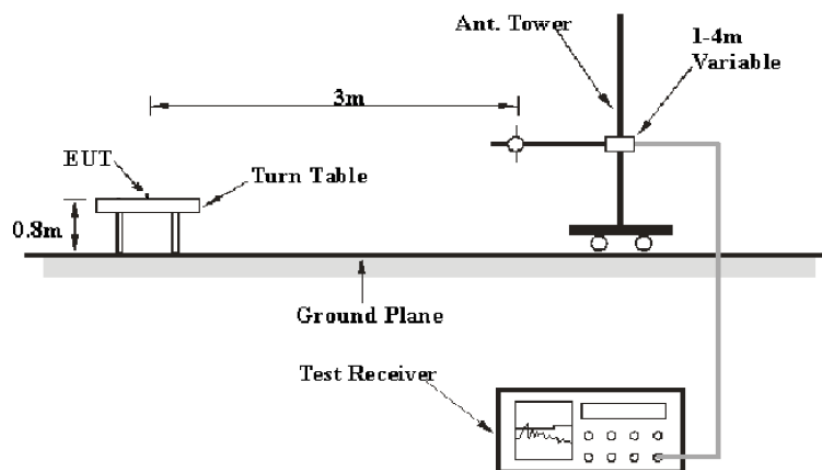
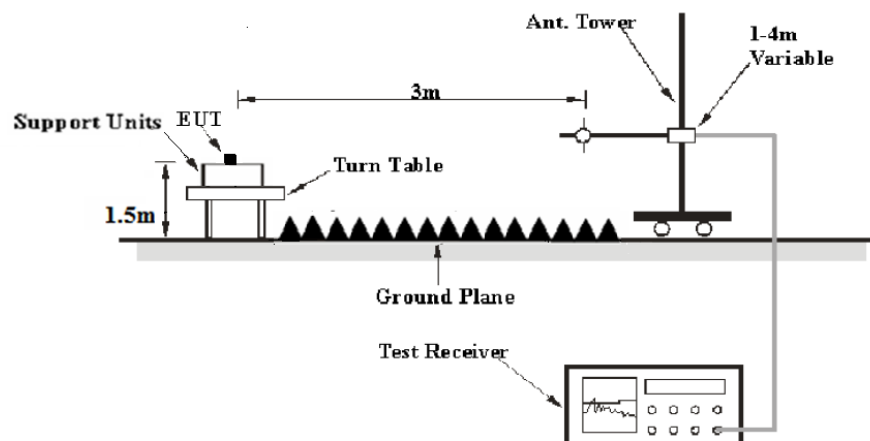
Antenna Connector Construction

Antenna	Antenna Type	Max. Antenna Gain	Description	Result
W10436069	Fakra	4.20 dBi	use a unique type of connector to attach to the EUT	Compliant
W10806955	Fakra	1.24 dBi	use a unique type of connector to attach to the EUT	Compliant
W10474143	Fakra	1.30 dBi	use a unique type of connector to attach to the EUT	Compliant

Result: Compliant.

FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS**Applicable Standard**

FCC §15.205; §15.209; §15.247(d)

EUT Setup**Below 1 GHz:****Above 1GHz:**

The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver Setup was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Duty cycle	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	/	QP
Above 1GHz	1MHz	3 MHz	/	/	PK
	1MHz	3 MHz	/	/	Ave.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude (dB}\mu\text{V /m)} = \text{Meter Reading (dB}\mu\text{V)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Amplifier Gain (dB)}$$

The “**Margin**” column of the following data tables indicates the degree of Compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V/m)} - \text{Corrected Amplitude (dB}\mu\text{V /m)}$$

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data**Environmental Conditions**

Temperature:	24.1 °C~24.5 °C
Relative Humidity:	50 %~51 %
ATM Pressure:	101.2kPa~101.4kPa

The testing was performed by Hope Zhang from 2019-01-18 to 2019-04-02.

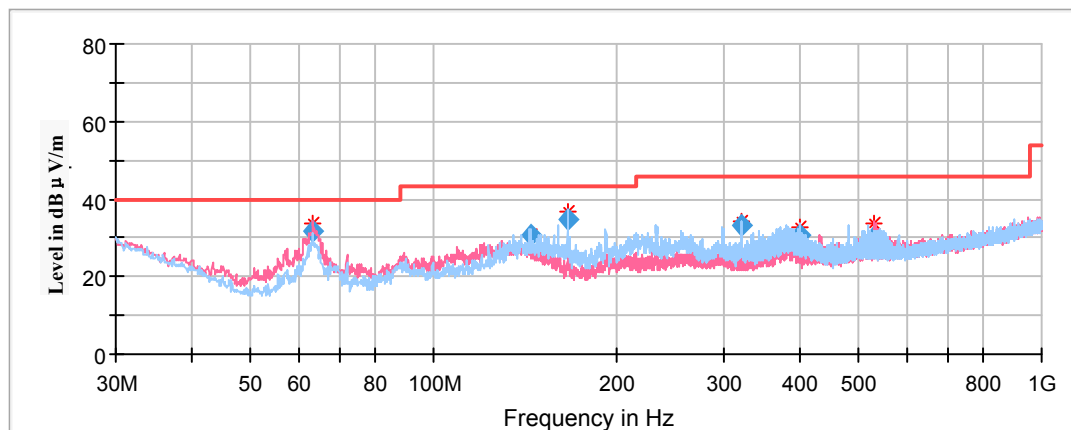
EUT operation mode: Transmitting

Spurious Emission Test:

For Antenna W10436069:

30MHz-1GHz:

Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation, the worst case low channel of 8DPSK Mode in X-axis of orientation was recorded



Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	Quasi-peak (dBμV/m)	Height (cm)	Polar (H/V)				
63.407050	31.79	101.0	V	77.0	-17.7	40.00	8.21
144.059350	30.75	198.0	H	83.0	-12.1	43.50	12.75
165.983350	34.89	198.0	H	88.0	-13.0	43.50	8.61
320.001800	33.30	101.0	H	11.0	-10.1	46.00	12.70
399.967650	30.86	101.0	H	243.0	-8.2	46.00	15.14
531.090450	30.18	101.0	V	0.0	-5.8	46.00	15.82

1GHz-18GHz:

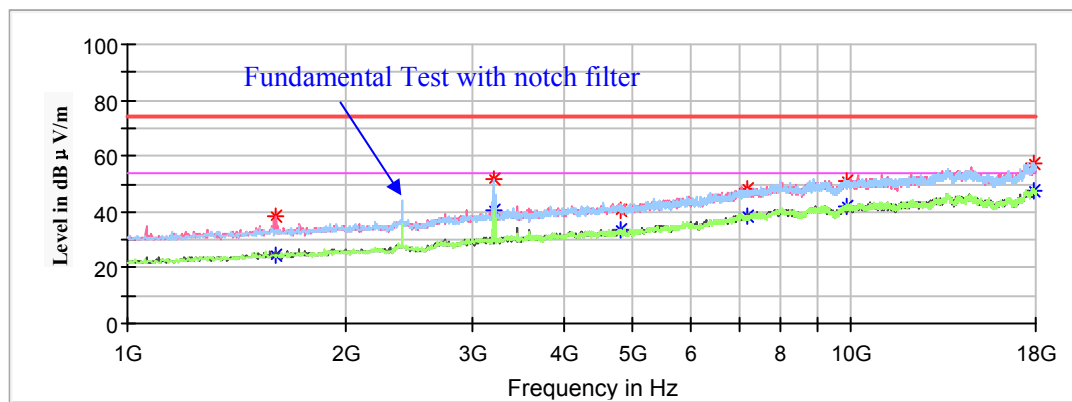
Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation, the worst case 8DPSK Mode in X-axis of orientation was recorded

Note:

1. This test was performed with the 2.4-2.5 GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V /m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V /m)

Low Channel: 2402MHz

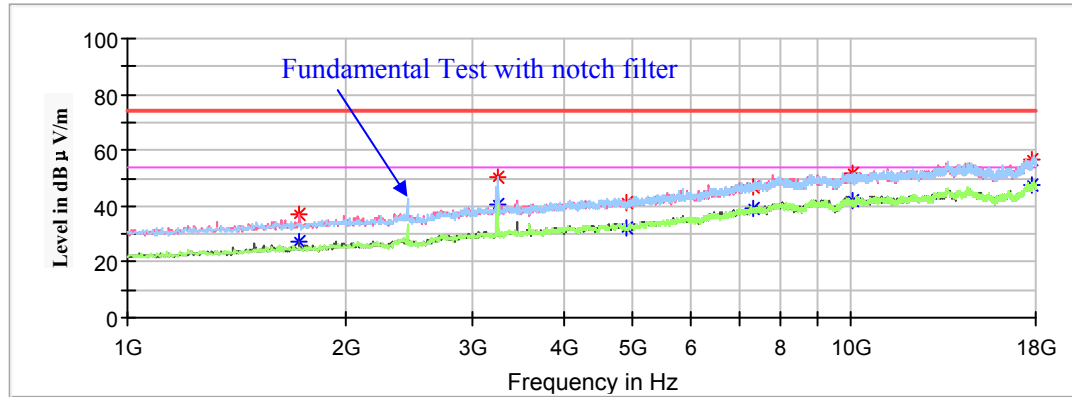
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V /m)	Average (dB μ V /m)	Height (cm)	Polar (H/V)				
1605.200000	38.34	---	250.0	V	190.0	-7.2	74.00	35.66
1605.200000	---	24.68	250.0	V	190.0	-7.2	54.00	29.32
3199.800000	51.41	---	250.0	H	325.0	-1.3	74.00	22.59
3199.800000	---	40.44	250.0	H	325.0	-1.3	54.00	13.56
4804.000000	40.67	---	150.0	V	105.0	1.8	74.00	33.33
4804.000000	---	33.55	150.0	V	105.0	1.8	54.00	20.45
7206.000000	48.41	---	200.0	V	265.0	8.9	74.00	25.59
7206.000000	---	38.27	200.0	V	265.0	8.9	54.00	15.73
9857.000000	50.85	---	150.0	H	239.0	12.3	74.00	23.15
9857.000000	---	42.15	150.0	H	239.0	12.3	54.00	11.85
17891.200000	57.60	---	150.0	H	79.0	17.6	74.00	16.40
17891.200000	---	47.48	150.0	H	79.0	17.6	54.00	6.52

Middle Channel: 2441MHz

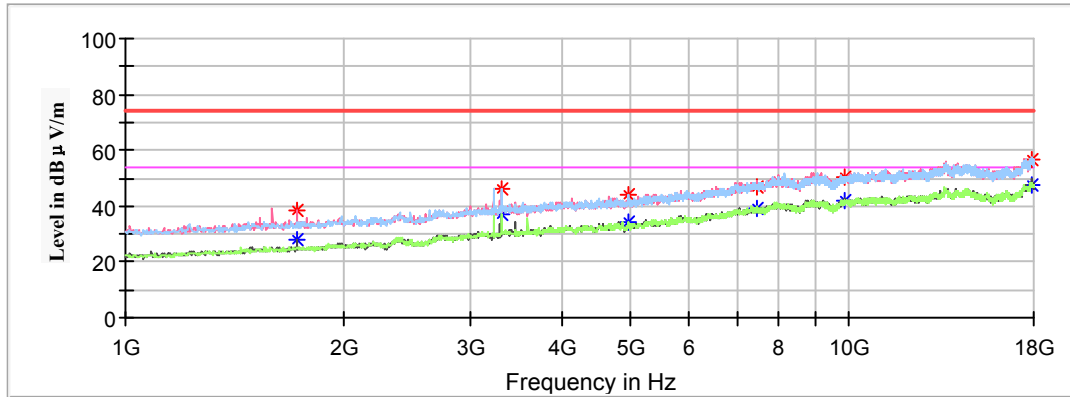
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1727.600000	37.00	---	250.0	V	99.0	-6.8	74.00	37.00
1727.600000	---	27.25	250.0	V	99.0	-6.8	54.00	26.75
3254.200000	50.58	---	150.0	H	229.0	-1.2	74.00	23.42
3254.200000	---	40.80	150.0	H	229.0	-1.2	54.00	13.20
4882.000000	41.13	---	200.0	H	293.0	1.9	74.00	32.87
4882.000000	---	32.31	200.0	H	293.0	1.9	54.00	21.69
7323.000000	47.06	---	150.0	H	180.0	9.2	74.00	26.94
7323.000000	---	39.14	150.0	H	180.0	9.2	54.00	14.86
10027.000000	51.43	---	150.0	V	355.0	12.6	74.00	22.57
10027.000000	---	42.05	150.0	V	355.0	12.6	54.00	11.95
17813.000000	56.53	---	200.0	V	30.0	17.5	74.00	17.47
17813.000000	---	47.61	200.0	V	30.0	17.5	54.00	6.39

High Channel: 2480MHz

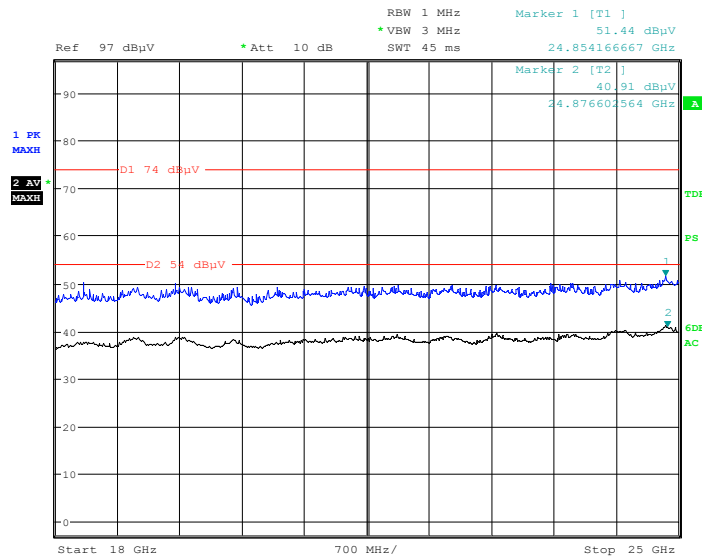
Full Spectrum



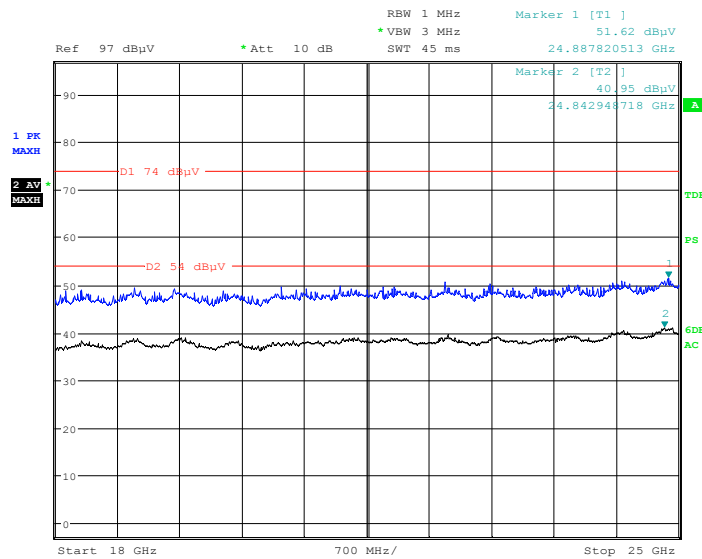
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V /m)	Average (dB μ V /m)	Height (cm)	Polar (H/V)				
1727.600000	38.47	---	250.0	V	122.0	-6.8	74.00	35.53
1727.600000	---	28.01	250.0	V	122.0	-6.8	54.00	25.99
3305.200000	46.22	---	200.0	H	345.0	-1.1	74.00	27.78
3305.200000	---	37.00	200.0	H	345.0	-1.1	54.00	17.00
4960.000000	---	34.23	150.0	H	158.0	2.0	54.00	19.77
4960.000000	43.85	---	150.0	H	158.0	2.0	74.00	30.15
7440.000000	46.60	---	150.0	H	111.0	9.6	74.00	27.40
7440.000000	---	39.22	150.0	H	111.0	9.6	54.00	14.78
9853.600000	50.64	---	200.0	H	239.0	12.3	74.00	23.36
9853.600000	---	42.12	200.0	H	239.0	12.3	54.00	11.88
17864.000000	56.81	---	150.0	H	158.0	17.6	74.00	17.19
17864.000000	---	47.64	150.0	H	158.0	17.6	54.00	6.36

18GHz-25GHz:

Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case low channel of 8DPSK Mode in X-axis of orientation was recorded

Horizontal

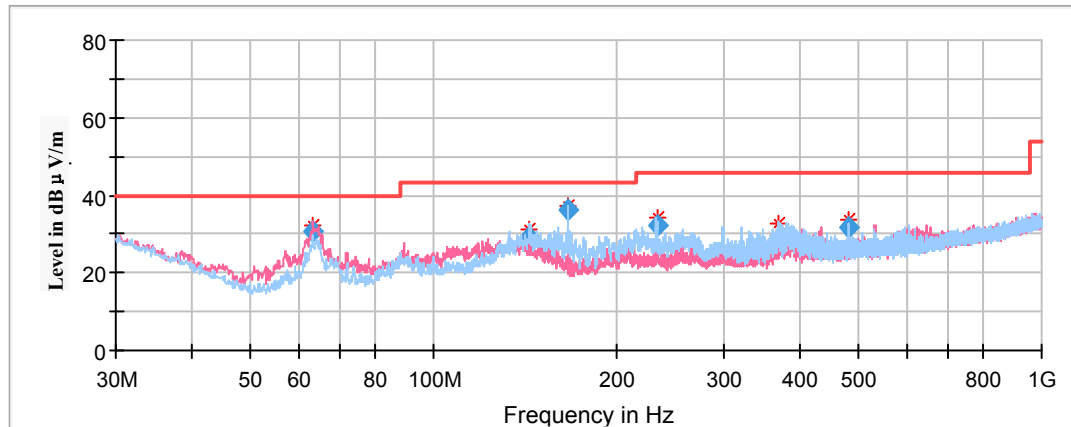
Date: 18.JAN.2019 12:58:57

Vertical

Date: 18.JAN.2019 13:17:25

Spurious Emission Test:**For Antenna W10806955:****30MHz-1GHz:**

Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case low channel of 8DPSK Mode in X-axis of orientation was recorded



Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	Quasi-peak (dBμV/m)	Height (cm)	Polar (H/V)				
63.387550	30.81	101.0	V	35.0	-17.7	40.00	9.19
143.847200	29.27	199.0	H	77.0	-12.1	43.50	14.23
166.013250	36.15	199.0	H	87.0	-13.0	43.50	7.35
233.113550	32.03	101.0	H	104.0	-12.2	46.00	13.97
368.739250	28.54	101.0	H	200.0	-8.8	46.00	17.46
479.970800	31.62	199.0	H	111.0	-6.7	46.00	14.38

1GHz-18GHz:

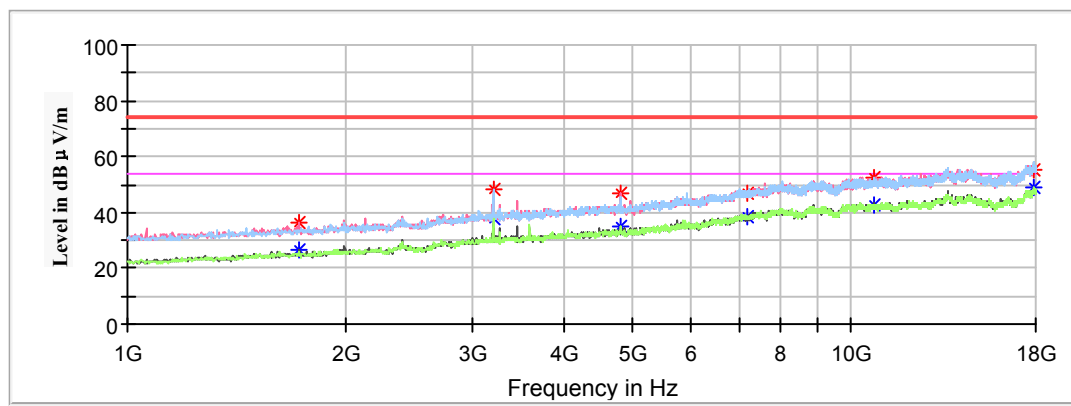
Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case 8DPSK Mode in X-axis of orientation was recorded

Note:

1. This test was performed with the 2.4-2.5 GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V /m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dBV/m) – Corrected Amplitude (dB μ V /m)

Low Channel: 2402MHz

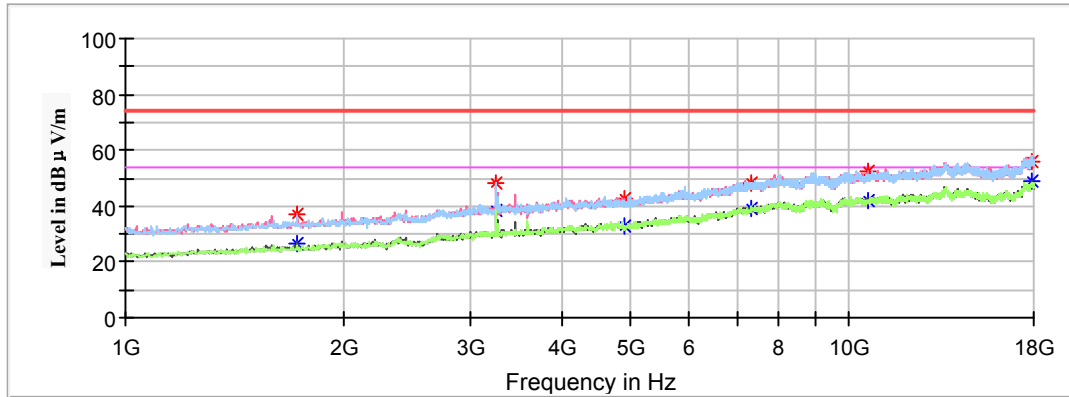
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V /m)	Average (dB μ V /m)	Height (cm)	Polar (H/V)				
1724.200000	---	26.86	250.0	V	121.0	-6.8	54.00	27.14
1724.200000	36.47	---	250.0	V	121.0	-6.8	74.00	37.53
3199.800000	---	38.02	250.0	H	46.0	-1.3	54.00	15.98
3199.800000	48.57	---	250.0	H	46.0	-1.3	74.00	25.43
4804.000000	---	34.69	150.0	V	58.0	1.8	54.00	19.31
4804.000000	46.92	---	150.0	V	58.0	1.8	74.00	27.08
7206.000000	---	38.43	150.0	V	335.0	8.9	54.00	15.57
7206.000000	46.88	---	150.0	V	335.0	8.9	74.00	27.12
10730.800000	---	42.87	150.0	H	239.0	13.1	54.00	11.13
10730.800000	52.43	---	150.0	H	239.0	13.1	74.00	21.57
17911.600000	55.22	---	150.0	H	325.0	17.6	74.00	18.78
17911.600000	---	48.85	150.0	H	325.0	17.6	54.00	5.15

Middle Channel: 2441MHz

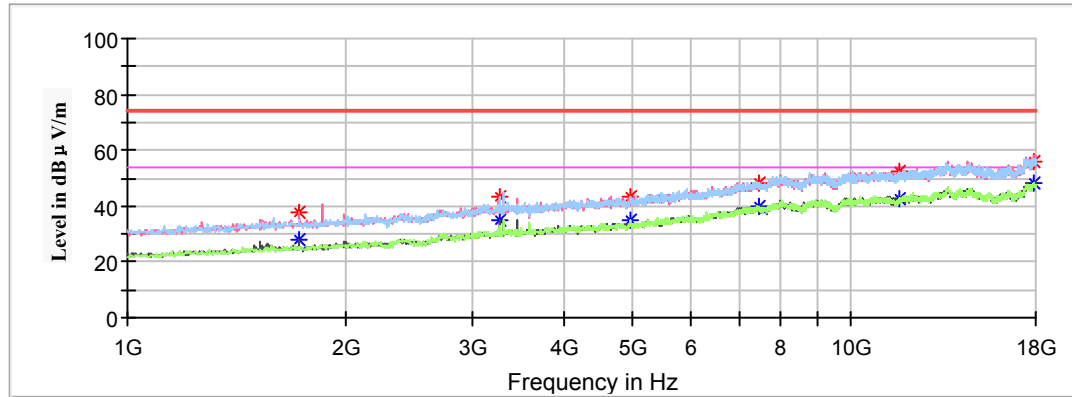
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1724.200000	---	26.82	250.0	V	95.0	-6.8	54.00	27.18
1724.200000	37.27	---	250.0	V	95.0	-6.8	74.00	36.73
3254.200000	---	38.76	200.0	H	266.0	-1.2	54.00	15.24
3254.200000	48.29	---	200.0	H	266.0	-1.2	74.00	25.71
4882.000000	---	33.17	250.0	V	116.0	1.9	54.00	20.83
4882.000000	42.74	---	250.0	V	116.0	1.9	74.00	31.26
7323.000000	---	38.95	200.0	V	116.0	9.2	54.00	15.05
7323.000000	48.48	---	200.0	V	116.0	9.2	74.00	25.52
10652.600000	---	41.89	250.0	V	5.0	13.0	54.00	12.11
10652.600000	52.49	---	250.0	V	5.0	13.0	74.00	21.51
17891.200000	56.18	---	250.0	V	106.0	17.6	74.00	17.82
17891.200000	---	48.69	250.0	V	106.0	17.6	54.00	5.31

High Channel: 2480MHz

Full Spectrum

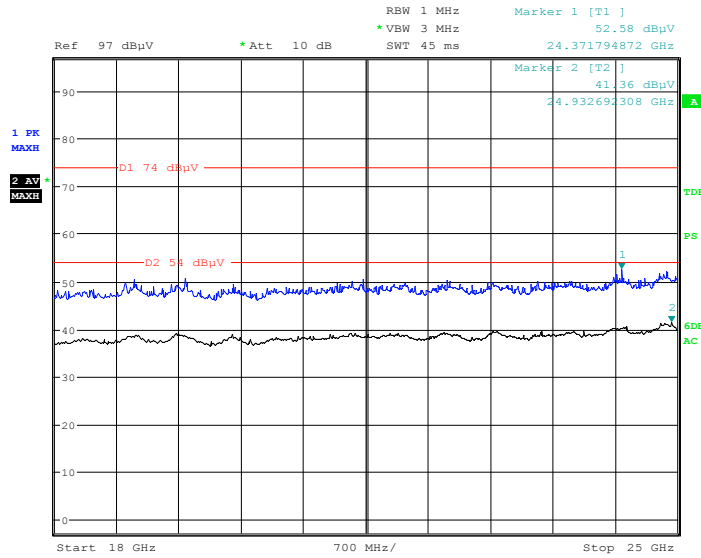


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1724.200000	---	27.73	250.0	V	83.0	-6.8	54.00	26.27
1724.200000	38.00	---	250.0	V	83.0	-6.8	74.00	36.00
3267.800000	43.09	---	200.0	V	186.0	-1.2	74.00	30.91
3267.800000	---	34.83	200.0	V	186.0	-1.2	54.00	19.17
4960.000000	43.04	---	150.0	H	46.0	2.0	74.00	30.96
4960.000000	---	34.69	150.0	H	46.0	2.0	54.00	19.31
7440.000000	---	39.73	150.0	H	142.0	9.6	54.00	14.27
7440.000000	48.27	---	150.0	H	142.0	9.6	74.00	25.73
11642.000000	---	42.48	250.0	V	51.0	13.0	54.00	11.52
11642.000000	52.76	---	250.0	V	51.0	13.0	74.00	21.24
17925.200000	56.06	---	200.0	V	69.0	17.6	74.00	17.94
17925.200000	---	48.27	200.0	V	69.0	17.6	54.00	5.73

18GHz-25GHz:

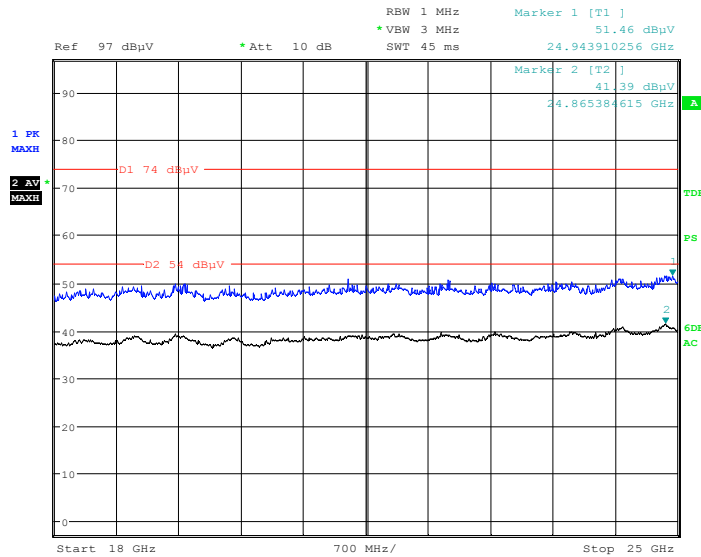
Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case low channel of 8DPSK Mode in X-axis of orientation was recorded

Horizontal



Date: 23.JAN.2019 15:35:23

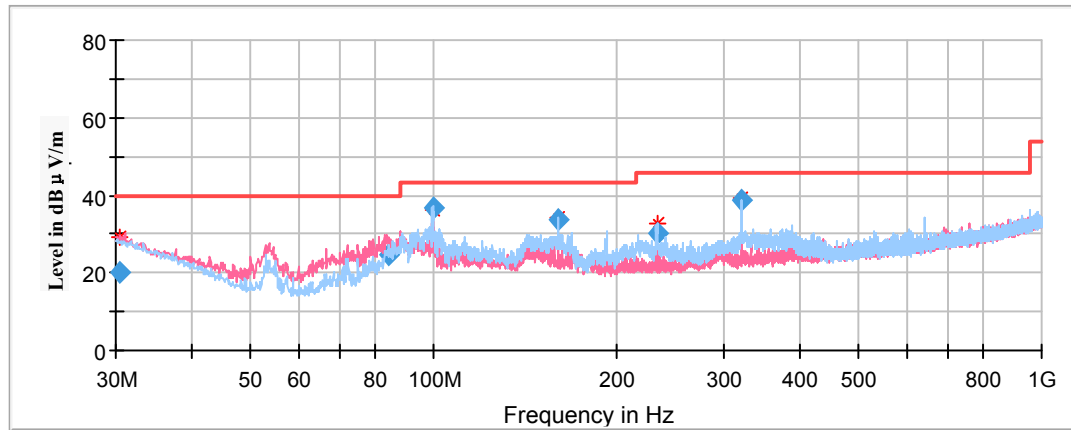
Vertical



Date: 23.JAN.2019 15:51:58

Spurious Emission Test:**For Antenna W10474143:****30MHz-1GHz:**

Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation, the worst case low channel of 8DPSK Mode in X-axis of orientation was recorded



Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	Quasi-peak (dBμV/m)	Height (cm)	Polar (H/V)				
30.487750	20.15	199.0	V	245.0	-4.3	40.00	19.85
84.096200	24.79	101.0	V	80.0	-17.7	40.00	15.21
99.587900	36.64	199.0	H	201.0	-15.0	43.50	6.86
159.987500	33.96	199.0	H	193.0	-12.7	43.50	9.54
233.233000	30.27	199.0	H	216.0	-12.2	46.00	15.73
320.005400	38.84	101.0	H	342.0	-10.1	46.00	7.16

1GHz-18GHz:

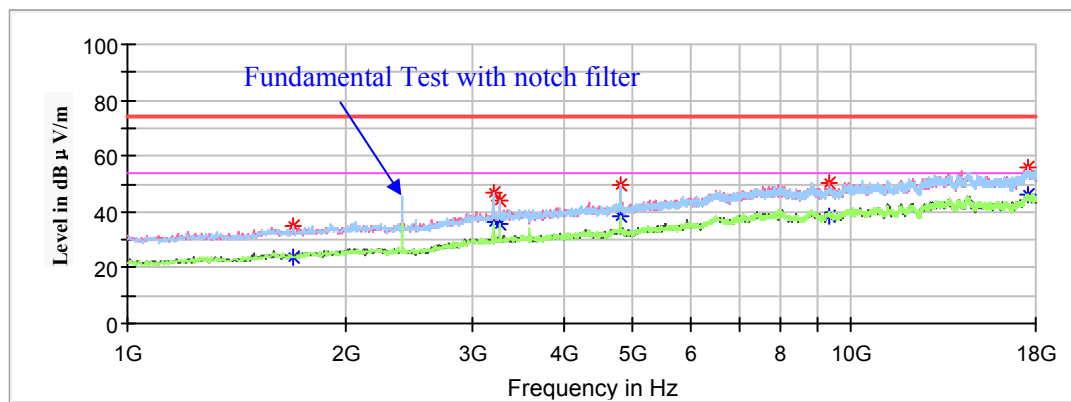
Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation, the worst case 8DPSK Mode in X-axis of orientation was recorded

Note:

1. This test was performed with the 2.4-2.5 GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V /m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V /m)

Low Channel: 2402MHz

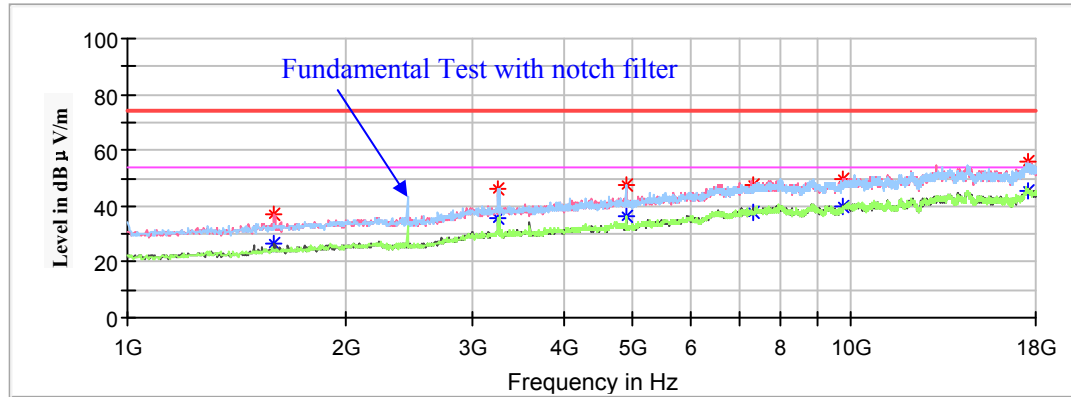
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
	MaxPeak (dB μ V /m)	Average (dB μ V /m)	Height (cm)	Polar (H/V)				
1697.000000	---	23.61	150.0	H	118.0	-9.3	54.00	30.39
1697.000000	35.01	---	150.0	H	118.0	-9.3	74.00	38.99
3199.800000	---	36.39	200.0	H	319.0	-4.0	54.00	17.61
3199.800000	46.81	---	200.0	H	319.0	-4.0	74.00	27.19
3267.800000	---	35.35	200.0	H	200.0	-3.9	54.00	18.65
3267.800000	44.11	---	200.0	H	200.0	-3.9	74.00	29.89
4804.000000	---	38.71	150.0	V	212.0	-0.6	54.00	15.29
4804.000000	49.42	---	150.0	V	212.0	-0.6	74.00	24.58
7206.000000	---	38.59	150.0	V	160.0	7.7	54.00	15.41
7206.000000	50.45	---	150.0	V	160.0	7.7	74.00	23.55
17558.000000	---	46.00	200.0	H	6.0	14.2	54.00	8.00
17558.000000	55.82	---	200.0	H	6.0	14.2	74.00	18.18

Middle Channel: 2441MHz

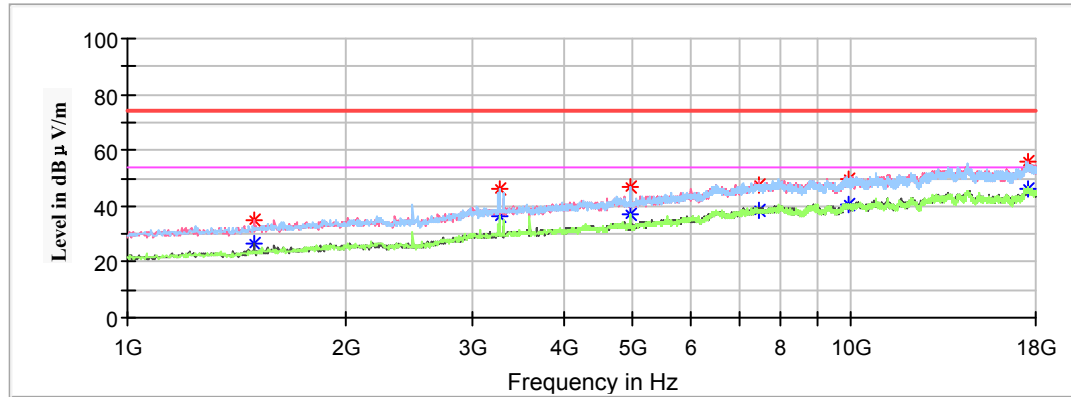
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1595.000000	---	26.26	150.0	V	271.0	-9.6	54.00	27.74
1595.000000	37.23	---	150.0	V	271.0	-9.6	74.00	36.77
3254.200000	---	35.36	200.0	H	137.0	-4.0	54.00	18.64
3254.200000	46.00	---	200.0	H	137.0	-4.0	74.00	28.00
4882.000000	---	36.59	200.0	H	149.0	-0.4	54.00	17.41
4882.000000	47.60	---	200.0	H	149.0	-0.4	74.00	26.40
7323.000000	---	37.80	150.0	H	323.0	5.8	54.00	16.20
7323.000000	47.42	---	150.0	H	323.0	5.8	74.00	26.58
9758.400000	---	40.05	150.0	V	25.0	7.9	54.00	13.95
9758.400000	49.45	---	150.0	V	25.0	7.9	74.00	24.55
17575.000000	---	45.35	200.0	V	230.0	14.2	54.00	8.65
17575.000000	55.81	---	200.0	V	230.0	14.2	74.00	18.19

High Channel: 2480MHz

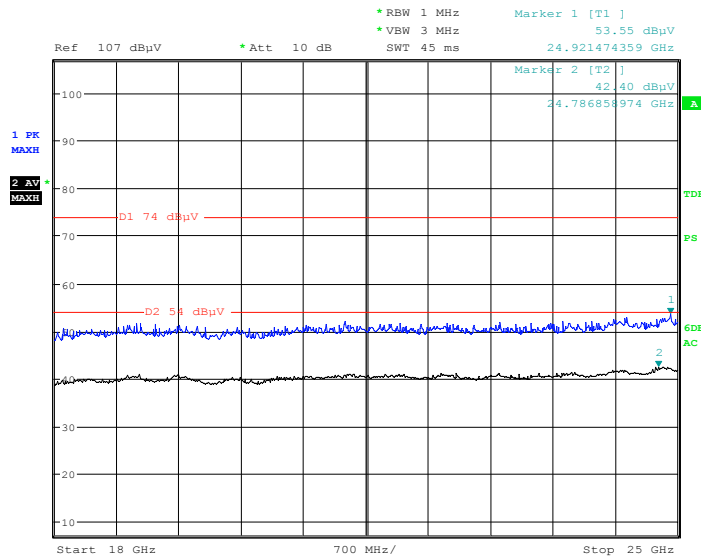
Full Spectrum



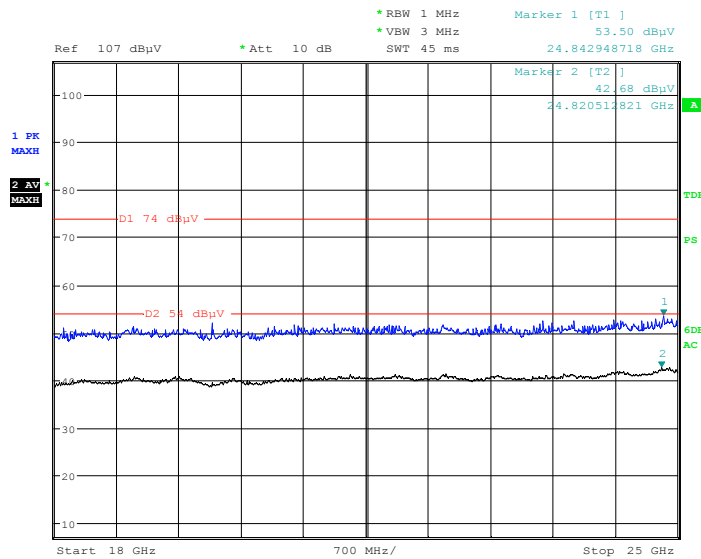
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1496.400000	---	26.35	200.0	V	241.0	-9.9	54.00	27.65
1496.400000	34.85	---	200.0	V	241.0	-9.9	74.00	39.15
3267.800000	46.13	---	200.0	H	176.0	-3.9	74.00	27.87
3267.800000	---	36.67	200.0	H	176.0	-3.9	54.00	17.33
4960.000000	---	36.91	150.0	H	130.0	-0.3	54.00	17.09
4960.000000	47.18	---	150.0	H	130.0	-0.3	74.00	26.82
7440.000000	---	38.48	150.0	H	247.0	6.1	54.00	15.52
7440.000000	47.39	---	150.0	H	247.0	6.1	74.00	26.61
9904.600000	---	40.77	150.0	V	347.0	8.1	54.00	13.23
9904.600000	49.71	---	150.0	V	347.0	8.1	74.00	24.29
17578.400000	---	46.40	150.0	V	217.0	14.2	54.00	7.60
17578.400000	55.66	---	150.0	V	217.0	14.2	74.00	18.34

18GHz-25GHz:

Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case low channel of 8DPSK Mode in X-axis of orientation was recorded

Horizontal

Date: 2,APR.2019 21:16:08

Vertical

Date: 2,APR.2019 21:31:44

Fundamental Test & Restricted Bands Emissions:

Pre-Scan with GFSK, $\pi/4$ -DQPSK, 8DPSK modes of operation in the X,Y and Z axes of orientation,, the worst case 8DPSK Mode in X-axis of orientation was recorded

For Antenna W10436069:

Note:

- Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
 Corrected Amplitude (dB μ V /m) = Corrected Factor (dB/m) + Reading (dB μ V)
 Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V /m)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Low Channel: 2402MHz								
2402.000000	98.91	---	200.0	H	26.0	6.0	/	/
2402.000000	---	96.89	200.0	H	26.0	6.0	/	/
2402.000000	94.66	---	150.0	V	325.0	6.0	/	/
2402.000000	---	92.52	150.0	V	325.0	6.0	/	/
2390.000000	---	40.35	200.0	H	298.0	6.0	54.00	13.65
2390.000000	49.42	---	200.0	H	298.0	6.0	74.00	24.58
Middle Channel: 2441MHz								
2441.000000	98.83	---	200.0	H	75.0	6.2	/	/
2441.000000	---	96.75	200.0	H	75.0	6.2	/	/
2441.000000	94.49	---	250.0	V	205.0	6.2	/	/
2441.000000	---	92.40	250.0	V	205.0	6.2	/	/
High Channel: 2480MHz								
2480.000000	96.12	---	200.0	H	103.0	6.3	/	/
2480.000000	---	94.87	200.0	H	103.0	6.3	/	/
2480.000000	91.87	---	150.0	V	183.0	6.3	/	/
2480.000000	---	90.66	150.0	V	183.0	6.3	/	/
2483.500000	52.60	---	100.0	H	311.0	6.3	74.00	21.40
2483.500000	---	40.79	100.0	H	311.0	6.3	54.00	13.21

For Antenna W10806955:

Note:

1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)

Corrected Amplitude (dB μ V /m) = Corrected Factor (dB/m) + Reading (dB μ V)Margin (dB) = Limit (dB μ V/m) – Corrected Amplitude (dB μ V /m)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Low Channel: 2402MHz								
2402.000000	92.45	---	200.0	H	68.0	6.0	/	/
2402.000000	---	91.38	200.0	H	68.0	6.0	/	/
2402.000000	88.05	---	150.0	V	15.0	6.0	/	/
2402.000000	---	86.94	150.0	V	15.0	6.0	/	/
2390.000000	---	40.53	250.0	H	123.0	6.0	54.00	13.47
2390.000000	50.11	---	250.0	H	123.0	6.0	74.00	23.89
Middle Channel: 2441MHz								
2441.000000	97.86	---	200.0	H	97.0	6.2	/	/
2441.000000	---	96.57	200.0	H	97.0	6.2	/	/
2441.000000	93.45	---	250.0	V	37.0	6.2	/	/
2441.000000	---	92.22	250.0	V	37.0	6.2	/	/
High Channel: 2480MHz								
2480.000000	98.13	---	200.0	H	103.0	6.3	/	/
2480.000000	---	97.26	200.0	H	103.0	6.3	/	/
2480.000000	93.87	---	250.0	V	2.0	6.3	/	/
2480.000000	---	92.79	250.0	V	2.0	6.3	/	/
2483.500000	51.32	---	100.0	H	83.0	6.3	74.00	22.68
2483.500000	---	40.81	100.0	H	83.0	6.3	54.00	13.19

For Antenna W10474143:

Note:

1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)

Corrected Amplitude (dBμV /m) = Corrected Factor (dB/m) + Reading (dBμV)

Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV /m)

Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
Low Channel: 2402MHz								
2402.000000	92.97	---	200.0	H	58.0	2.8	/	/
2402.000000	---	92.32	200.0	H	58.0	2.8	/	/
2402.000000	90.53	---	200.0	V	248.0	2.8	/	/
2402.000000	---	89.95	200.0	V	248.0	2.8	/	/
2390.000000	---	37.67	150.0	H	335.0	2.8	54.00	16.33
2390.000000	47.72	---	150.0	H	335.0	2.8	74.00	26.28
Middle Channel: 2441MHz								
2441.000000	94.55	---	150.0	H	304.0	2.8	/	/
2441.000000	---	94.07	150.0	H	304.0	2.8	/	/
2441.000000	92.53	---	150.0	V	55.0	2.8	/	/
2441.000000	---	91.87	150.0	V	55.0	2.8	/	/
High Channel: 2480MHz								
2480.000000	94.02	---	150.0	H	234.0	3.0	/	/
2480.000000	---	93.57	150.0	H	234.0	3.0	/	/
2480.000000	91.56	---	150.0	V	329.0	3.0	/	/
2480.000000	---	91.53	150.0	V	329.0	3.0	/	/
2483.500000	54.52	---	200.0	H	34.0	3.0	74.00	19.48
2483.500000	---	41.19	200.0	H	34.0	3.0	54.00	12.81

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