TEST REPORT

No. I21N01062-BLE

for

Rootcloud technology CO.,LTD

T-AMS PRO

Model Name: LI1520-DC-T-GL PRO

with

Hardware Version: V1.0

Software Version: V1.0

FCC ID: 2AO7J-LI1520

IC: 27468-LI1520

Issued Date: 2021-07-08

Designation Number: CN1210

ISED Assigned Code: 23289

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of SAICT.

Test Laboratory:

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1. Summary of Test Report

1.1. Test Items

Description	T-AMS PRO
Model Name	LI1520-DC-T-GL PRO
Applicant's name	Rootcloud technology CO.,LTD
Manufacturer's Name	Rootcloud technology CO.,LTD

1.2. Test Standards

FCC Part15-2019; ANSI C63.10-2013; RSS-247 Issue 2; RSS-Gen Issue 5 A2

1.3. Test Result

Pass

Please refer to "5.2. Test Results"

1.4. Testing Location

Address: Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong, P. R. China

1.5. Project data

Testing Start Date:	2021-04-07
Testing End Date:	2021-07-03

1.6. Signature

Lin Zechuang

(Prepared this test report)

Tang Weisheng

(Reviewed this test report)

Zhang Bojun

(Approved this test report)

2. Client Information

2.1. Applicant Information

Company Name:	Rootcloud technology CO.,LTD
Address:	Room 303-309, No. 3, East Road, Pazhou Avenue,Haizhu District, Guangzhou 510335
Contact Person	Joyce Wu
E-Mail	Huiyan.wu@rootcloud.com
Telephone:	+86 18306678502
Fax:	/

2.2. Manufacturer Information

Company Name:	Rootcloud technology CO.,LTD
Address:	Room 303-309, No. 3, East Road, Pazhou Avenue,Haizhu District, Guangzhou 510335
Contact Person	Joyce Wu
E-Mail	Huiyan.wu@rootcloud.com
Telephone:	+86 18306678502
Fax:	/

3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1. About EUT

Description	T-AMS PRO
Model Name	LI1520-DC-T-GL PRO
Frequency Range	2400MHz~2483.5MHz
Type of Modulation	GFSK
Number of Channels	40
Antenna Type	Integrated
Antenna Gain	2.0dBi
Power Supply	12V DC by external power source
FCC ID	2AO7J-LI1520
IC	27468-LI1520
Condition of EUT as received	No abnormality in appearance

Note: Components list, please refer to documents of the manufacturer; it is also included in the original test record of Shenzhen Academy of Information and Communications Technology.

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Receive Date
UT06aa	/	V1.0	V1.0	2021-04-02
UT03aa	/	V1.0	V1.0	2021-04-08

*EUT ID: is used to identify the test sample in the lab internally.
UT06aa is used for conduction test, UT03aa is used for radiation test.

3.3. Internal Identification of AE used during the test

AE ID*	Description	SN
AE1	GPS/4G Antenna	/

AE1

Model	DAMGA2Y1G1X-SG-J5M
Manufacturer	GLEAD Electronics

*AE ID: is used to identify the test sample in the lab internally.

3.4. General Description

The Equipment under Test (EUT) is a model of T-AMS PRO with external antenna.
Manual and specifications of the EUT were provided to fulfil the test.
Samples undergoing test were selected by the client.

4. Reference Documents

4.1. Documents supplied by applicant

EUT feature information is supplied by the applicant or manufacturer, which is the basis of testing.

4.2. Reference Documents for testing

The following documents listed in this section are referred for testing.

Reference	Title	Version
FCC Part 15	FCC CFR 47, Part 15, Subpart C: 15.205 Restricted bands of operation; 15.209 Radiated emission limits, general requirements; 15.247 Operation within the bands 902–928MHz, 2400–2483.5 MHz, and 5725–5850 MHz	2019
ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013
RSS-247	Spectrum Management and Telecommunications Radio Standards Specification Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices	Issue 2 February, 2017
RSS-Gen	Spectrum Management and Telecommunications Radio Standards Specification General Requirements for Compliance of Radio Apparatus	Issue 5 February,2021 Amendment 2

5. Test Results

5.1. Testing Environment

Normal Temperature: 15~35°C

Relative Humidity: 20~75%

5.2. Test Results

No	Test cases	Sub-clause of Part 15C	Sub-clause of IC	Verdict
0	Antenna Requirement	15.203	/	**P**
1	Maximum Peak Output Power	15.247 (b)	RSS-247 section 5.4	**P**
2	Peak Power Spectral Density	15.247 (e)	RSS-247 section 5.2	**P**
3	6dB Bandwidth	15.247 (a)	RSS-247 section 5.2	**P**
4	Band Edges Compliance	15.247 (d)	RSS-247 section 5.5	**P**
5	Transmitter Spurious Emission - Conducted	15.247 (d)	RSS-247 section 5.5/ RSS-Gen section 6.13	**P**
6	Transmitter Spurious Emission - Radiated	15.247, 15.205, 15.209	RSS-247 section 5.5/ RSS-Gen section 6.13	**P**
7	99% Occupied Bandwidth	/	RSS-Gen section 6.7	**/**

See **ANNEX A** for details.

5.3. Statements

SAICT has evaluated the test cases requested by the applicant/manufacturer as listed in section 5.2 of this report, for the EUT specified in section 3, according to the standards or reference documents listed in section 4.2.

6. Test Equipments Utilized

Conducted test system

No.	Equipment	Model	Serial Number	Manufacturer	Calibration Due date	Calibration Period
1	Vector Signal Analyzer	FSV40	100903	Rohde & Schwarz	2021-12-30	1 year
2	Power Sensor	U2021XA	MY55430013	Agilent	2022-01-13	1 year
3	Data Acquisiton	U2531A	TW55443507	Agilent	/	/

Radiated test system

No.	Equipment	Model	Serial Number	Manufacturer	Calibration Due date	Calibration Period
1	Loop Antenna	HLA6120	35779	TESEQ	2022-04-25	3 years
2	BiLog Antenna	3142E	00224831	ETS-Lindgren	2022-05-24	3 years
3	Horn Antenna	3117	00066577	ETS-Lindgren	2022-04-02	3 years
4	Horn Antenna	QSH-SL-18-26-S-20	17013	Q-par	2023-01-06	3 years
5	Horn Antenna	QSH-SL-8-26-40-K-20	17014	Q-par	2023-01-06	3 years
6	Test Receiver	ESR7	101676	Rohde & Schwarz	2021-11-25	1 year
7	Spectrum Analyser	FSV40	101192	Rohde & Schwarz	2022-01-13	1 year
8	Chamber	FACT3-2.0	1285	ETS-Lindgren	2021-07-19	2 years

Test software

No.	Equipment	Manufacturer	Version
1	TechMgr Software	CAICT	2.1.1
2	EMC32	Rohde & Schwarz	10.50.40

EUT is engineering software provided by the customer to control the transmitting signal.
The EUT was programmed to be in continuously transmitting mode.

Anechoic chamber

Fully anechoic chamber by ETS-Lindgren

7. Laboratory Environment

Semi-anechoic chambe

Temperature	Min. = 15 ˚C, Max. = 35 ˚C
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz> 60 dB; 1MHz-18000MHz>90 dB
Electrical insulation	> 2MΩ
Ground system resistance	< 4 Ω
Normalised site attenuation (NSA)	<±4 dB, 3 m distance, from 30 to 1000 MHz

Shielded room

Temperature	Min. = 15 ˚C, Max. = 35 ˚C
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz> 60 dB; 1MHz-1000MHz>90 dB
Electrical insulation	> 2MΩ
Ground system resistance	< 4 Ω

Fully-anechoic chamber

Temperature	Min. = 15 ˚C, Max. = 35 ˚C
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz> 60 dB; 1MHz-18000MHz>90 dB
Electrical insulation	> 2MΩ
Ground system resistance	< 4 Ω
Voltage Standing Wave Ratio （VSWR）	≤ 6 dB, from 1 to 18 GHz， 3 m distance
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

8. Measurement Uncertainty

Test Name	Uncertainty (*k*=2)	
1. Maximum Peak Output Power	1.32dB	
2. Peak Power Spectral Density	2.32dB	
3. 6dB Bandwidth	66Hz	
4. Band Edges Compliance	1.92dB	
5. Transmitter Spurious Emission - Conducted	30MHz≤f<1GHz	1.41dB
	1GHz≤f<7GHz	1.92dB
	7GHz≤f<13GHz	2.31dB
	13GHz≤f≤26GHz	2.61dB
6. Transmitter Spurious Emission - Radiated	9kHz≤f<30MHz	1.74dB
	30MHz≤f<1GHz	4.84dB
	1GHz≤f<18GHz	4.68dB
	18GHz≤f≤40GHz	3.76dB
7. 99% Occupied Bandwidth	66Hz	

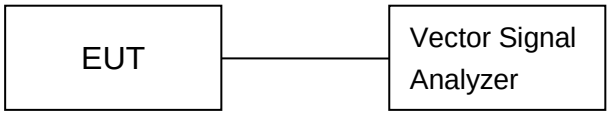
ANNEX A: Detailed Test Results

Test Configuration

The measurement is made according to ANSI C63.10.

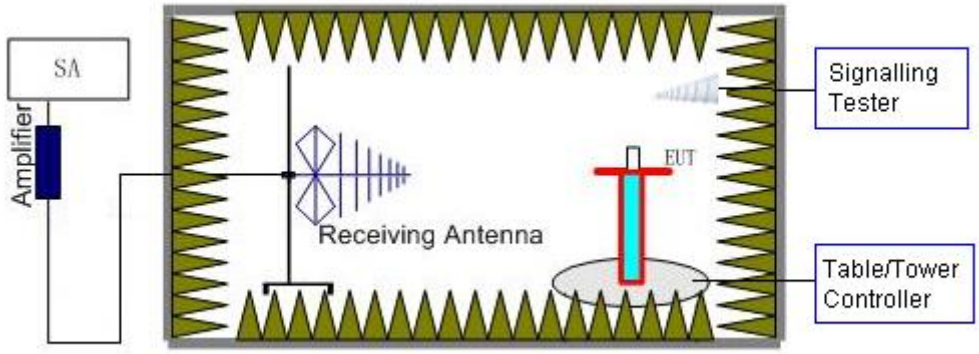
1) Conducted Measurements

1. Connect the EUT to the test system correctly.
2. Set the EUT to the required work mode.
3. Set the EUT to the required channel.
4. Set the spectrum analyzer to start measurement.
5. Record the values.



2) Radiated Measurements

Test setup: EUT was placed on a 1.5 meter high non-conductive table at a 3 meter test distance from the receive antenna. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT and adjusting the receiving antenna polarization.



A.0 Antenna requirement

Measurement Limit:

Standard	Requirement
FCC CRF Part 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 use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Conclusion: The Directional gains of antenna used for transmitting is 2.0dBi.
The RF transmitter uses an integrate antenna without connector.

A.1 Maximum Peak Output Power

Method of Measurement: See ANSI C63.10-clause 11.9.1.3

The maximum peak conducted output power may be measured using a broadband peak RF power meter.

Measurement Limit:

Standard	Limit (dBm)	E.I.R.P Limit (dBm)
FCC 47 CRF Part 15.247(b) & RSS-247 section 5.4	< 30	< 36

Measurement Results:

Mode	Frequency (MHz)	Peak Conducted Output Power（dBm）	E.I.R.P（dBm）	Conclusion
LE 1M	2402(CH0)	0.62	2.62	**P**
	2440(CH19)	0.45	2.45	**P**
	2480(CH39)	0.17	2.17	**P**

Conclusion: Pass

A.2 Peak Power Spectral Density

Method of Measurement: See ANSI C63.10-clause 11.10.2

Measurement Limit:

Standard	Limit
FCC 47 CRF Part 15.247(e) & RSS-247 section 5.2	< 8 dBm/3 kHz

Measurement Results:

Mode	Frequency (MHz)	Peak Power Spectral Density （dBm）		Conclusion
LE 1M	2402(CH0)	Fig.1	-14.91	**P**
	2440(CH19)	Fig.2	-15.01	**P**
	2480(CH39)	Fig.3	-15.32	**P**

See below for test graphs.
Conclusion: PASS

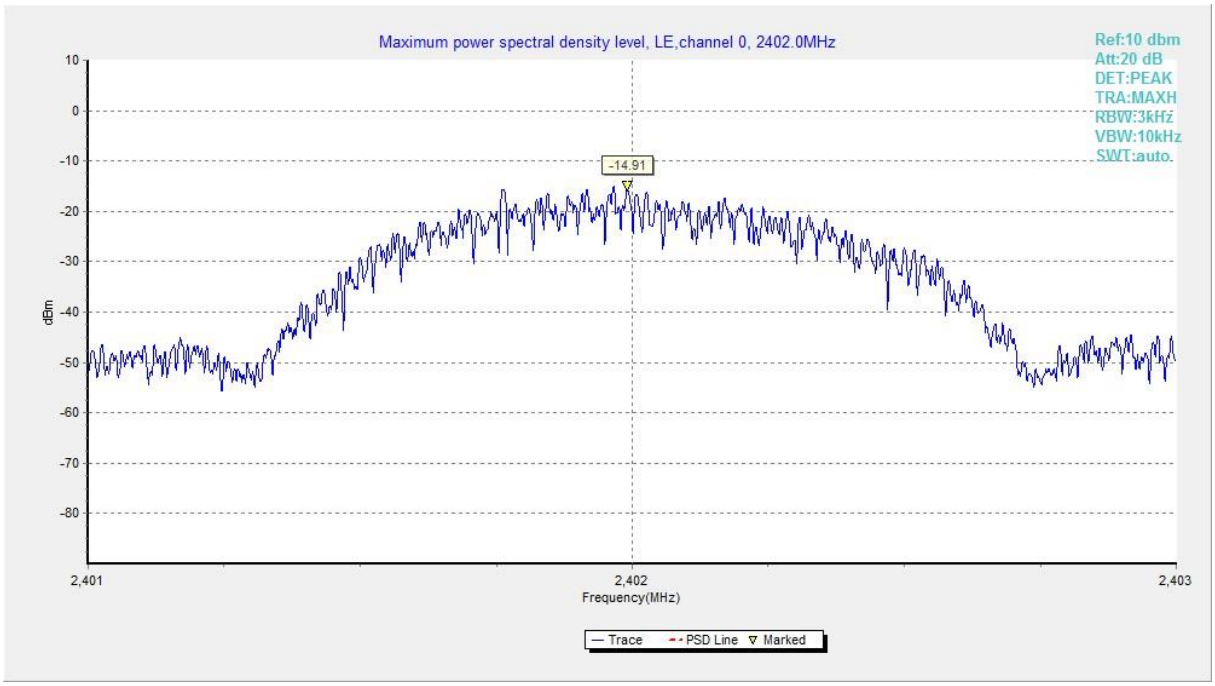


Fig.1 Power Spectral Density (CH0), LE 1M

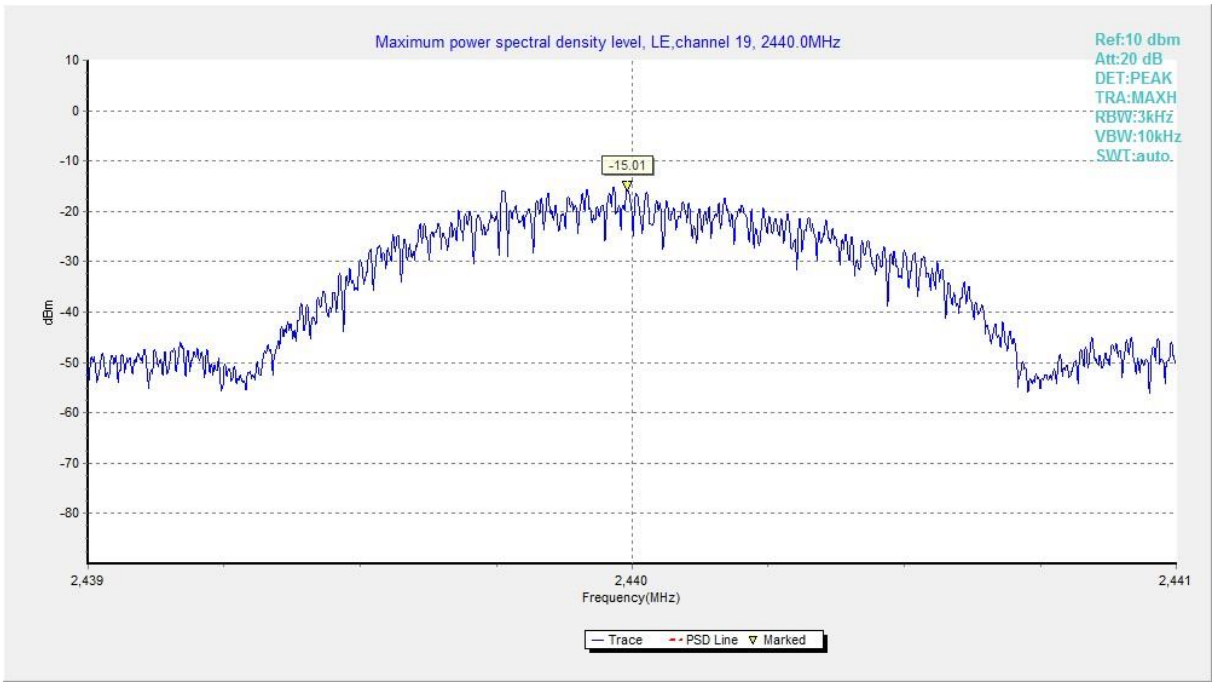


Fig.2 Power Spectral Density (CH19), LE 1M

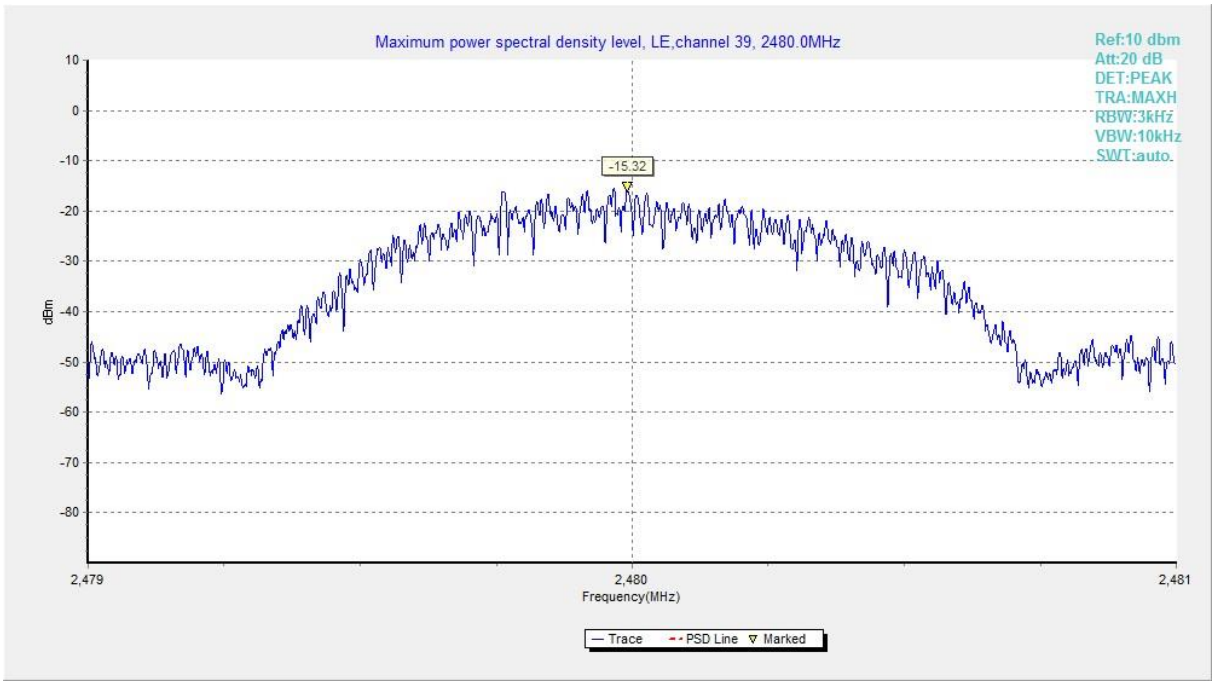


Fig.3 Power Spectral Density (CH39), LE 1M

A.3 6dB Bandwidth

Measurement Limit:

Standard	Limit (kHz)
FCC 47 CFR Part 15.247 (a) & RSS-247 section 5.2	≥ 500

Measurement Result:

Mode	Frequency (MHz)	Test Results (kHz)		Conclusion
LE 1M	2402(CH0)	Fig.4	710.50	**P**
	2440(CH19)	Fig.5	698.50	**P**
	2480(CH39)	Fig.6	702.50	**P**

See below for test graphs.

Conclusion: PASS

Fig.4 6dB Bandwidth (CH0), LE 1M

Fig.5 6dB Bandwidth (CH19), LE 1M

Fig.6 6dB Bandwidth (CH39), LE 1M

A.4 Band Edges Compliance

Measurement Limit:

Standard	Limit (dB)
FCC 47 CFR Part 15.247 (d) & RSS-247 section 5.5	> 20

Measurement Result:

Mode	Frequency (MHz)	Test Results (dB)		Conclusion
LE 1M	2402(CH0)	Fig.7	44.65	**P**
	2480(CH39)	Fig.8	45.80	**P**

See below for test graphs.
Conclusion: PASS

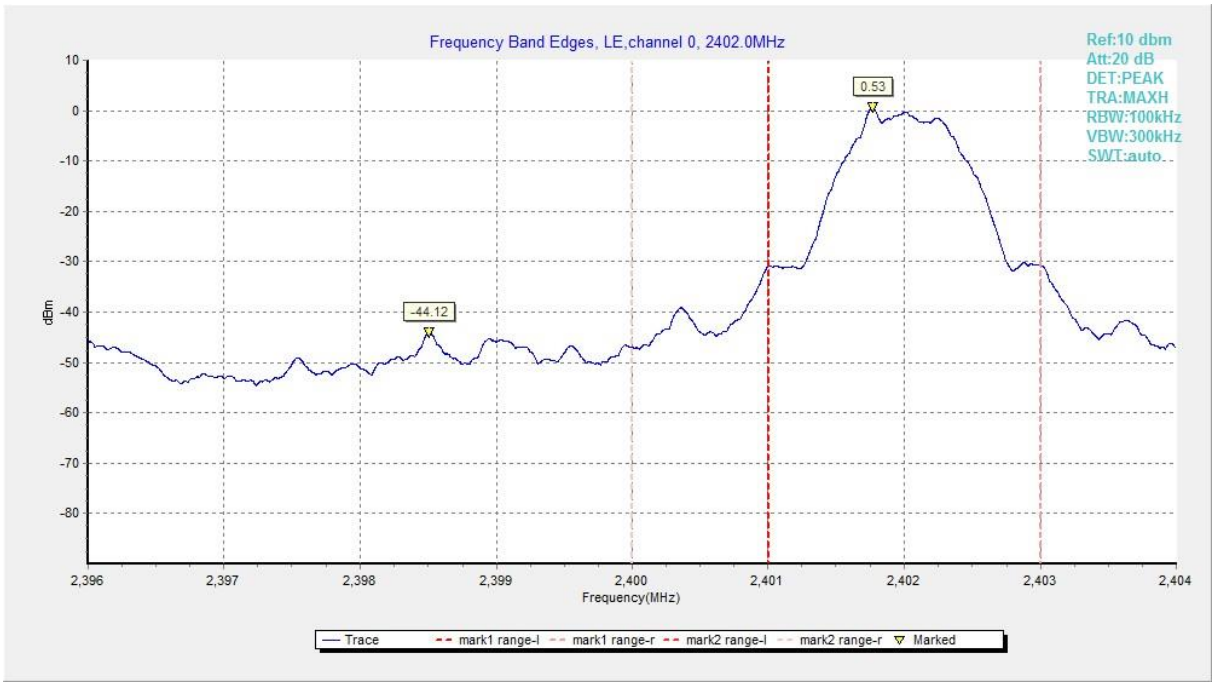


Fig.7 Band Edges (CH0), LE 1M

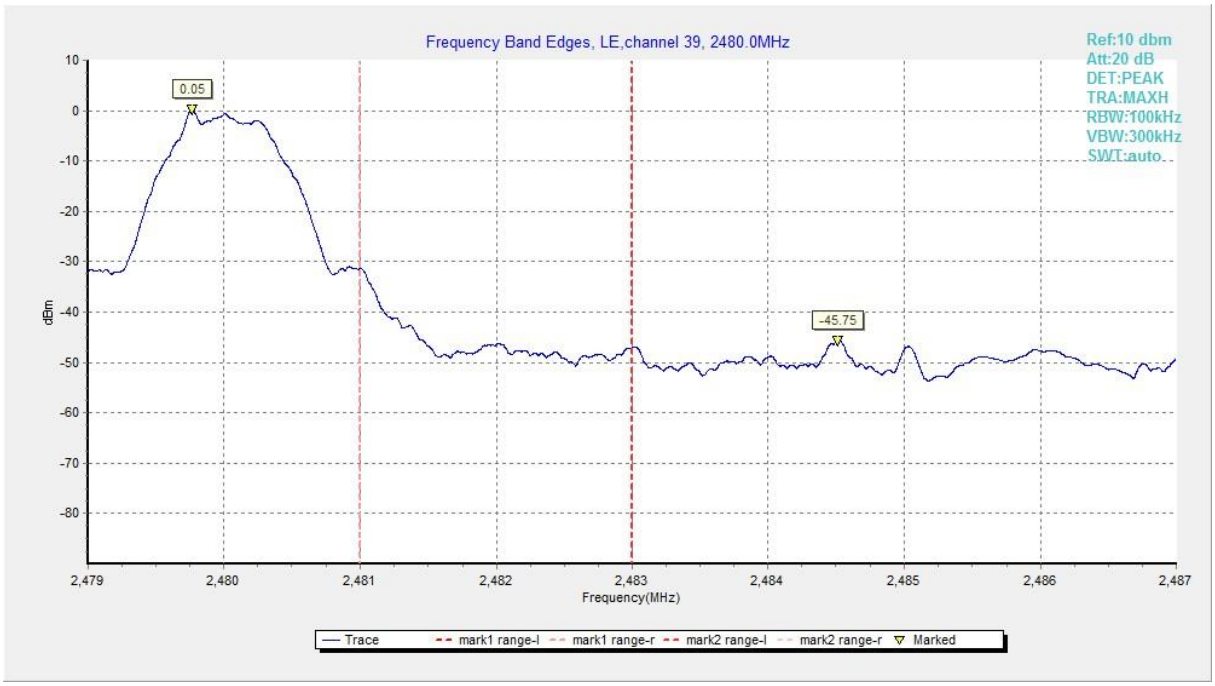


Fig.8 Band Edges (CH39), LE 1M

A.5 Transmitter Spurious Emission - Conducted

Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247 (d) & RSS-247 5.5/RSS-Gen section 6.13	20dB below peak output power in 100 kHz bandwidth

Measurement Results:

MODE	Channel	Frequency Range	Test Results	Conclusion
LE 1M	0	2.402 GHz	Fig.9	**P**
		1GHz -3GHz	Fig.10	**P**
		3GHz-10GHz	Fig.11	**P**
	19	2.440 GHz	Fig.12	**P**
		1GHz -3GHz	Fig.13	**P**
		3GHz-10GHz	Fig.14	**P**
	39	2.480 GHz	Fig.15	**P**
		1GHz -3GHz	Fig.16	**P**
		3GHz-10GHz	Fig.17	**P**
	All channels	30MHz-1GHz	Fig.18	**P**
		10GHz-26GHz	Fig.19	**P**

See below for test graphs.

Conclusion: Pass

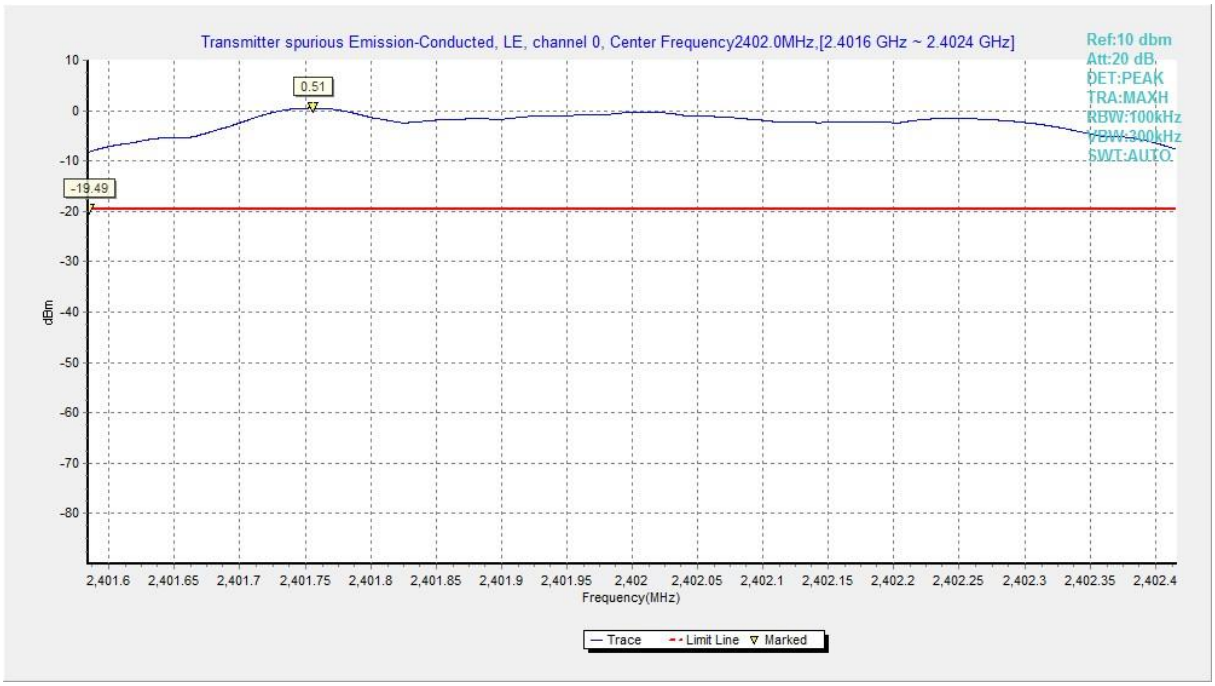


Fig.9 Conducted Spurious Emission (CH0, Center Frequency), LE 1M

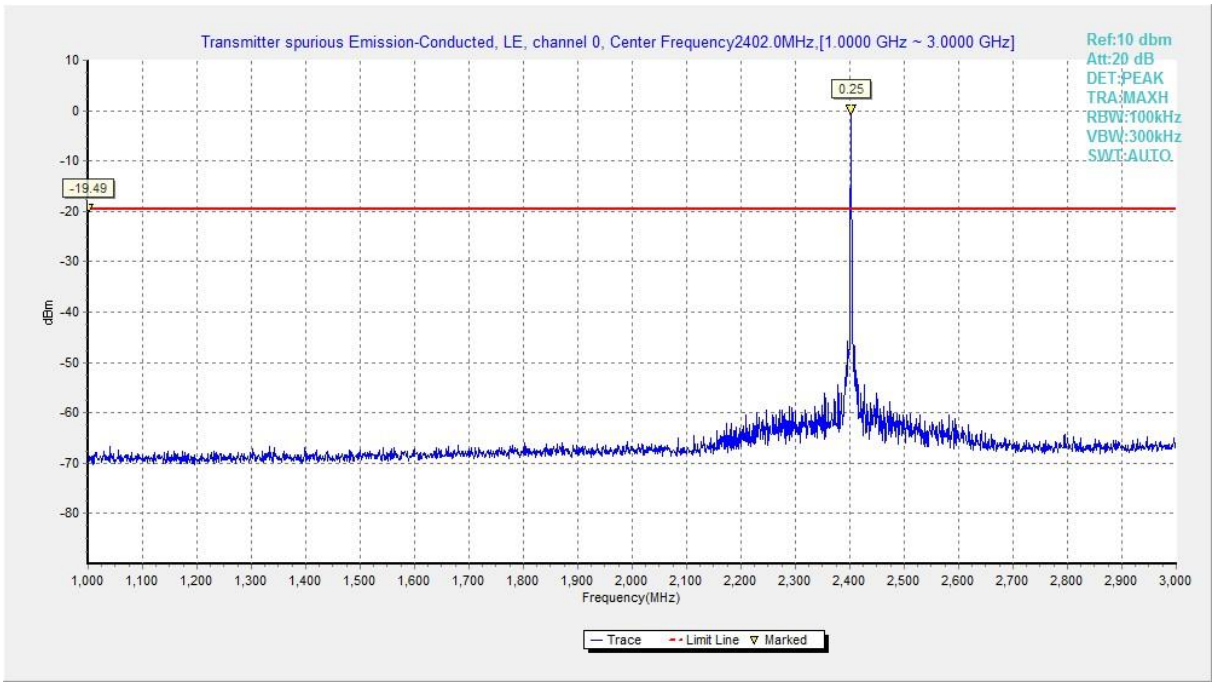


Fig.10 Conducted Spurious Emission (CH0, 1 GHz-3 GHz), LE 1M

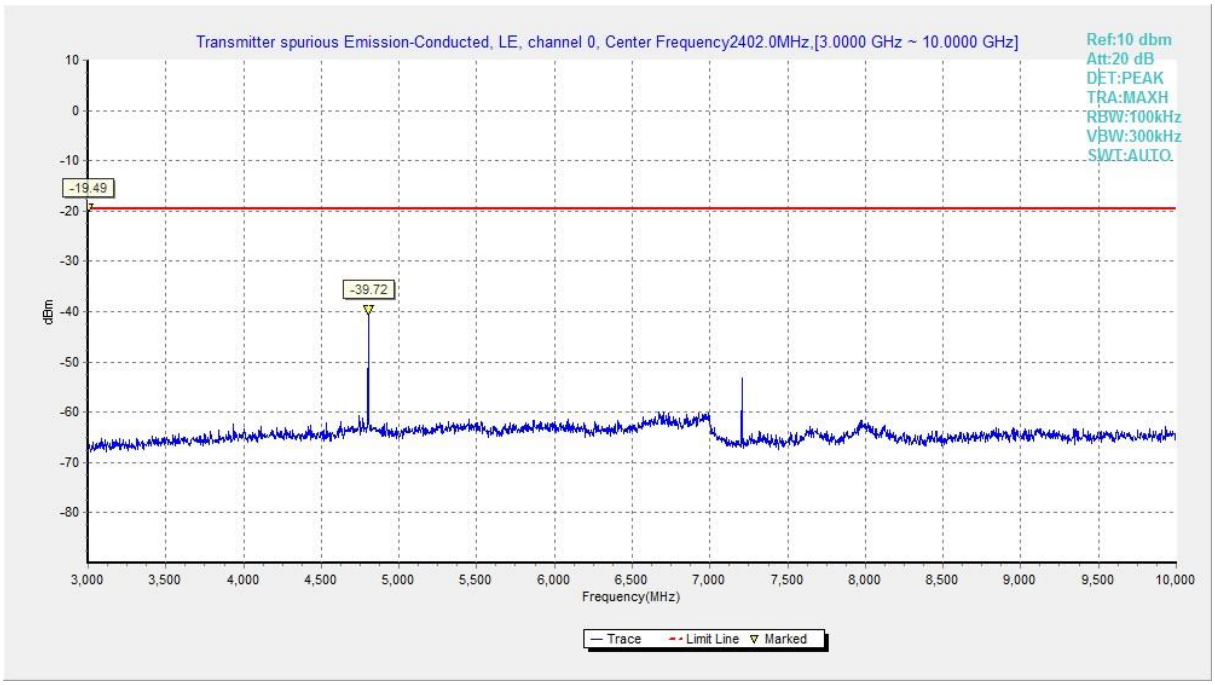


Fig.11 Conducted Spurious Emission (CH0, 3 GHz-10 GHz), LE 1M

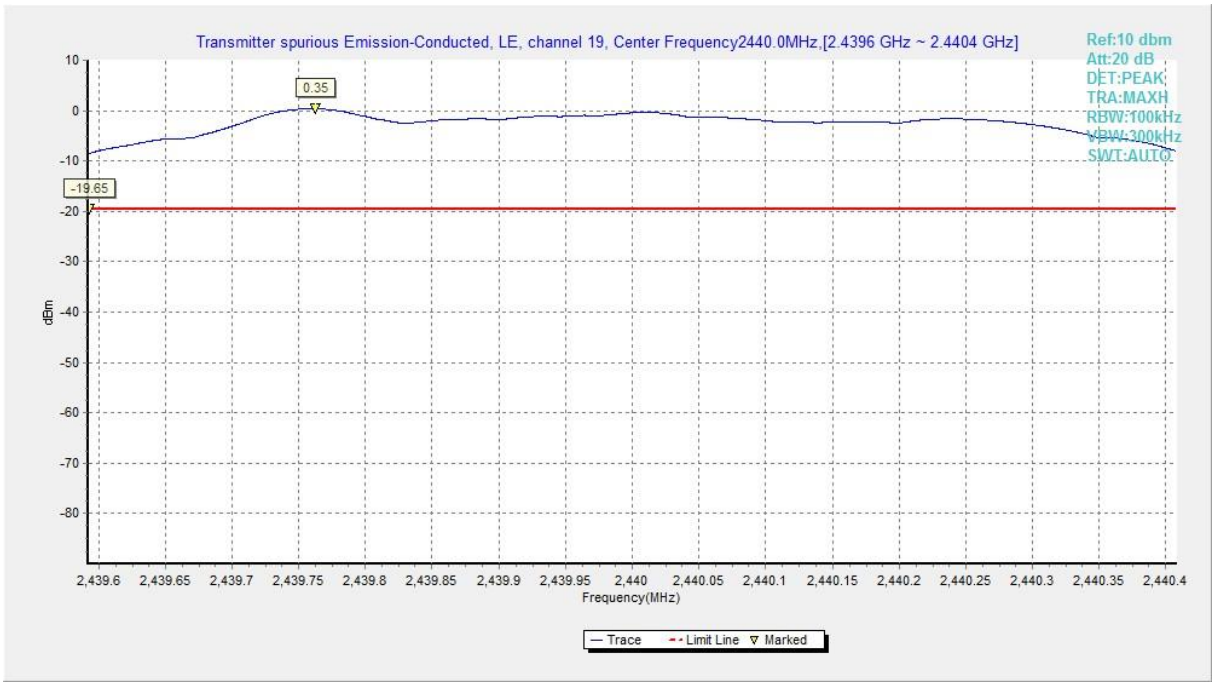


Fig.12 Conducted Spurious Emission (CH19, Center Frequency), LE 1M

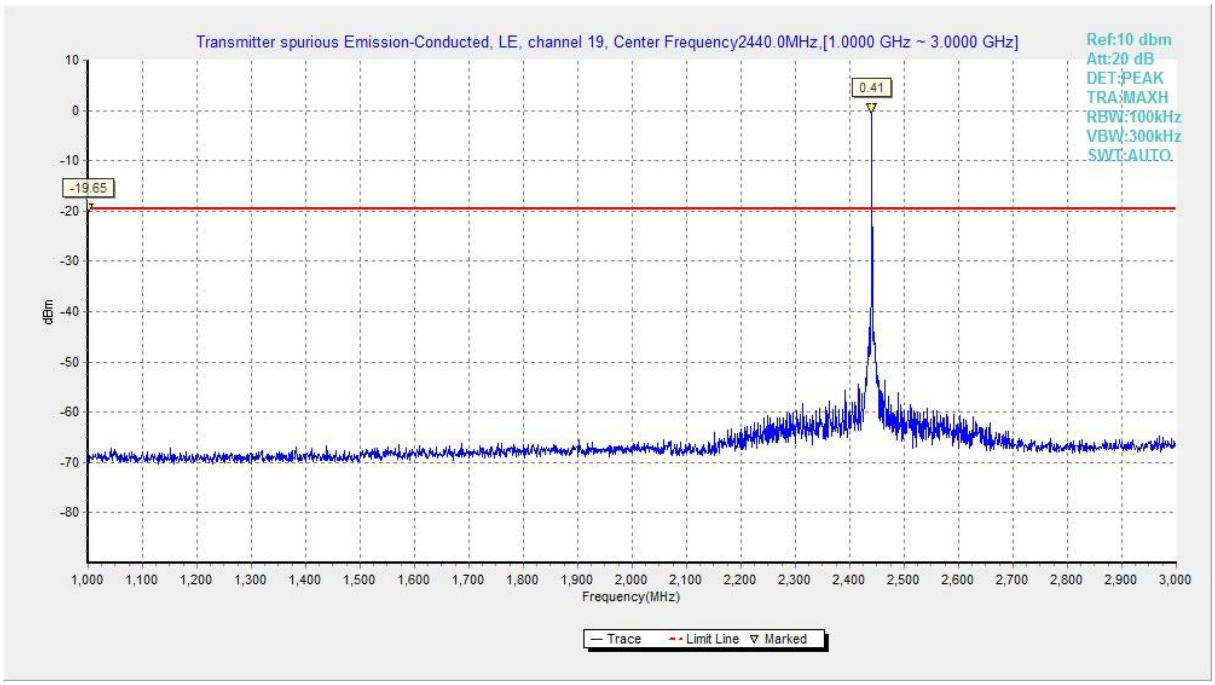


Fig.13 Conducted Spurious Emission (CH19, 1 GHz-3 GHz), LE 1M

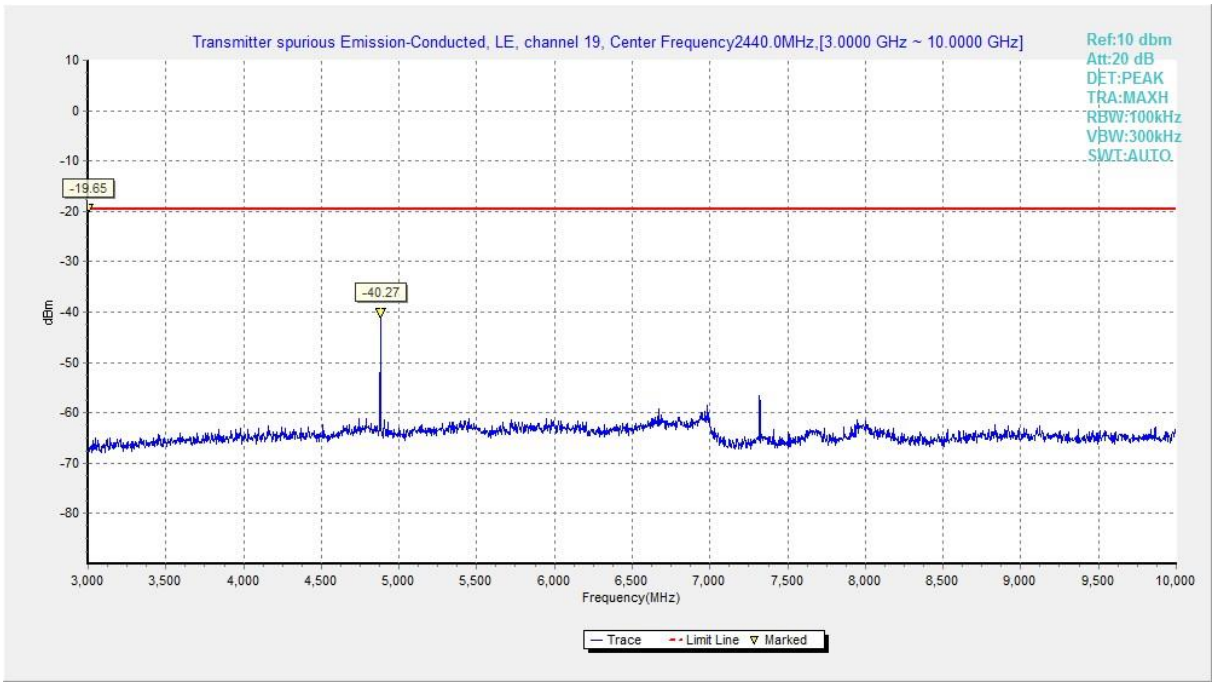


Fig.14 Conducted Spurious Emission (CH19, 3 GHz-10 GHz), LE 1M

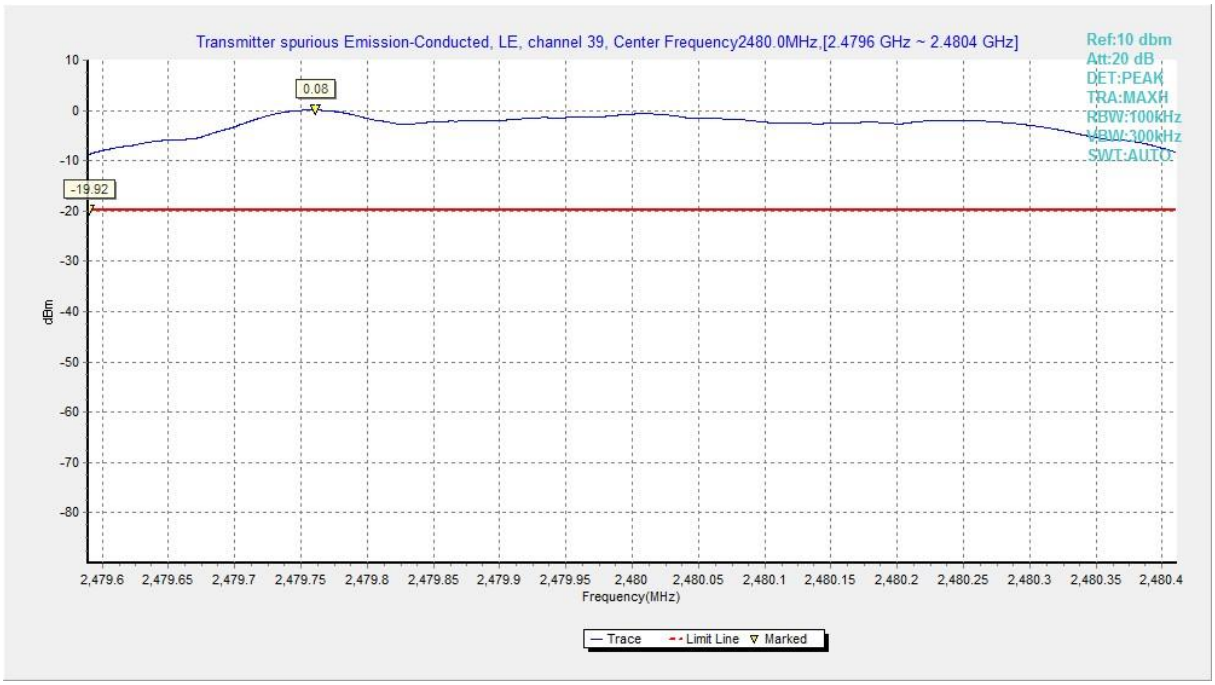


Fig.15 Conducted Spurious Emission (CH39, Center Frequency), LE 1M

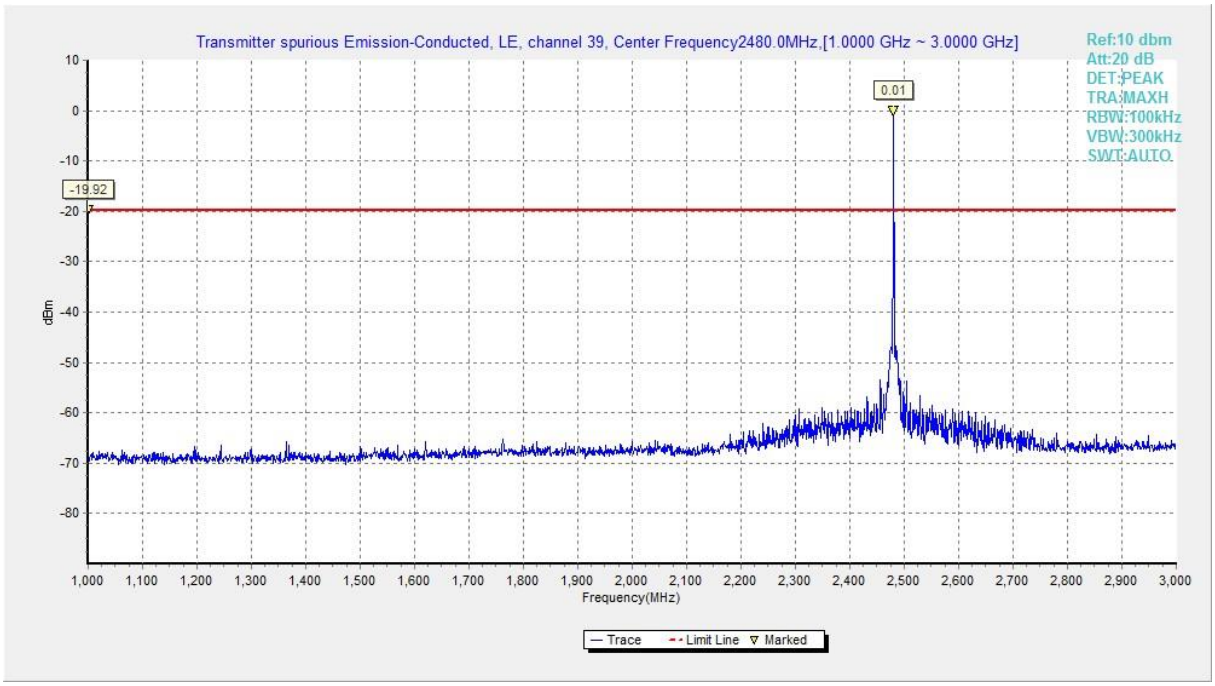


Fig.16 Conducted Spurious Emission (CH39, 1 GHz-3 GHz), LE 1M

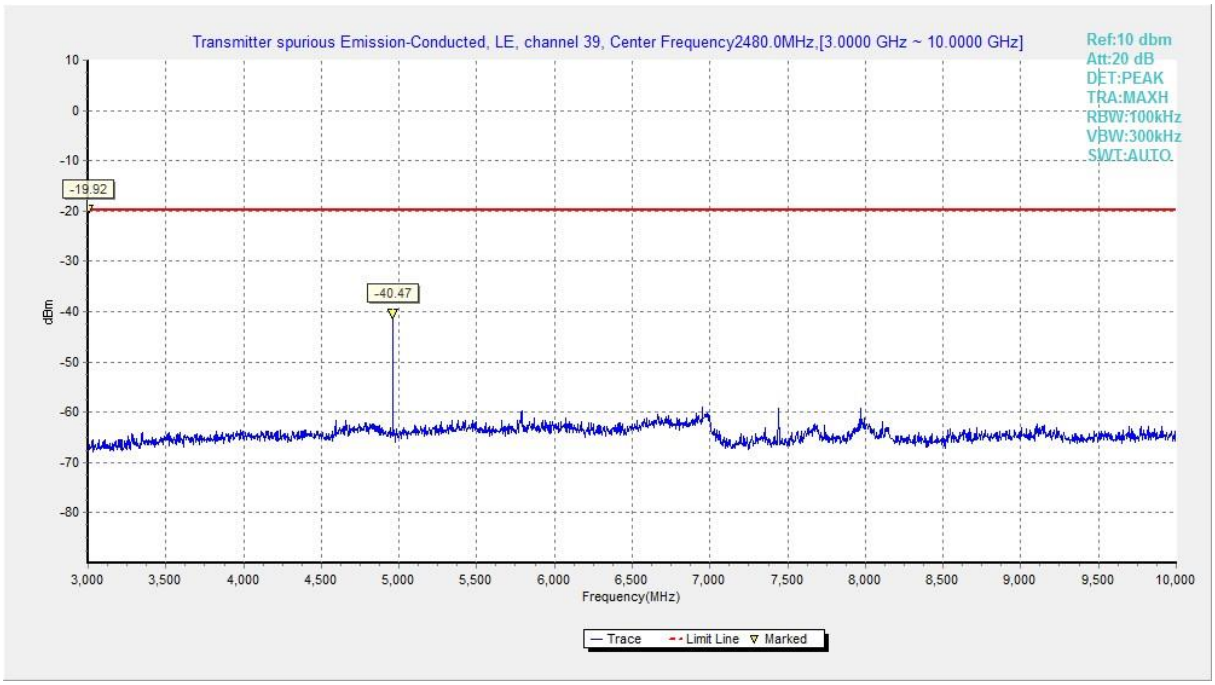


Fig.17 Conducted Spurious Emission (CH39, 3 GHz-10 GHz), LE 1M

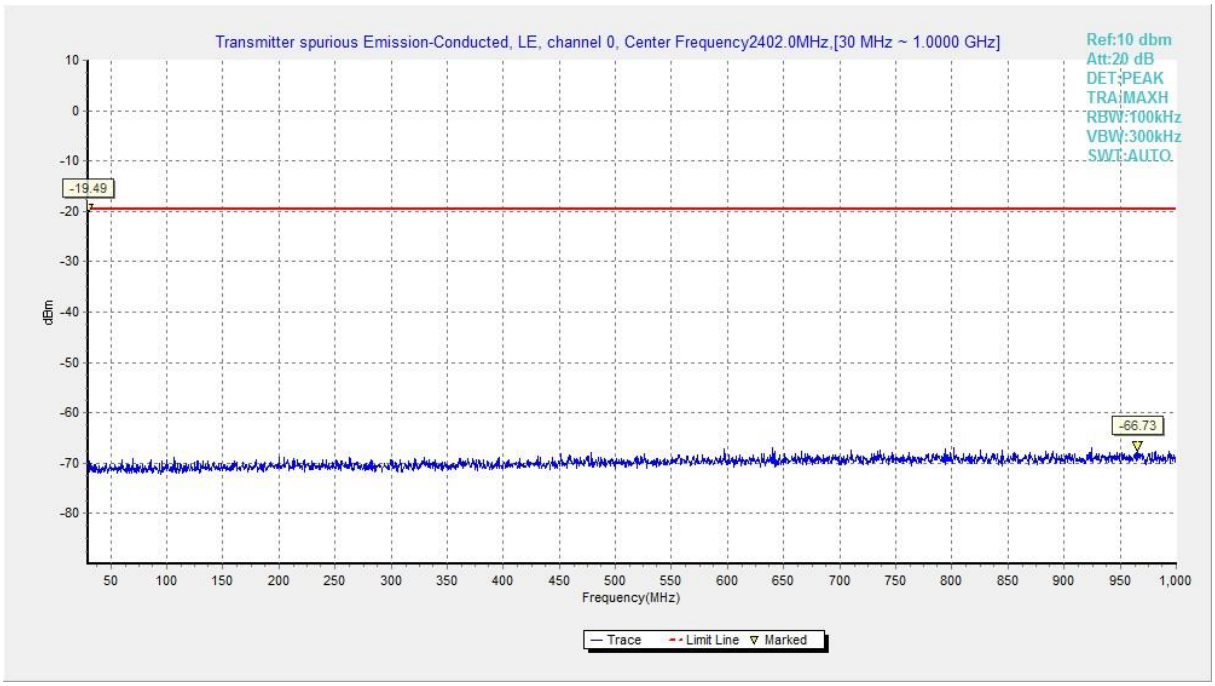


Fig.18 Conducted Spurious Emission (All channels, 30 MHz-1 GHz), LE 1M

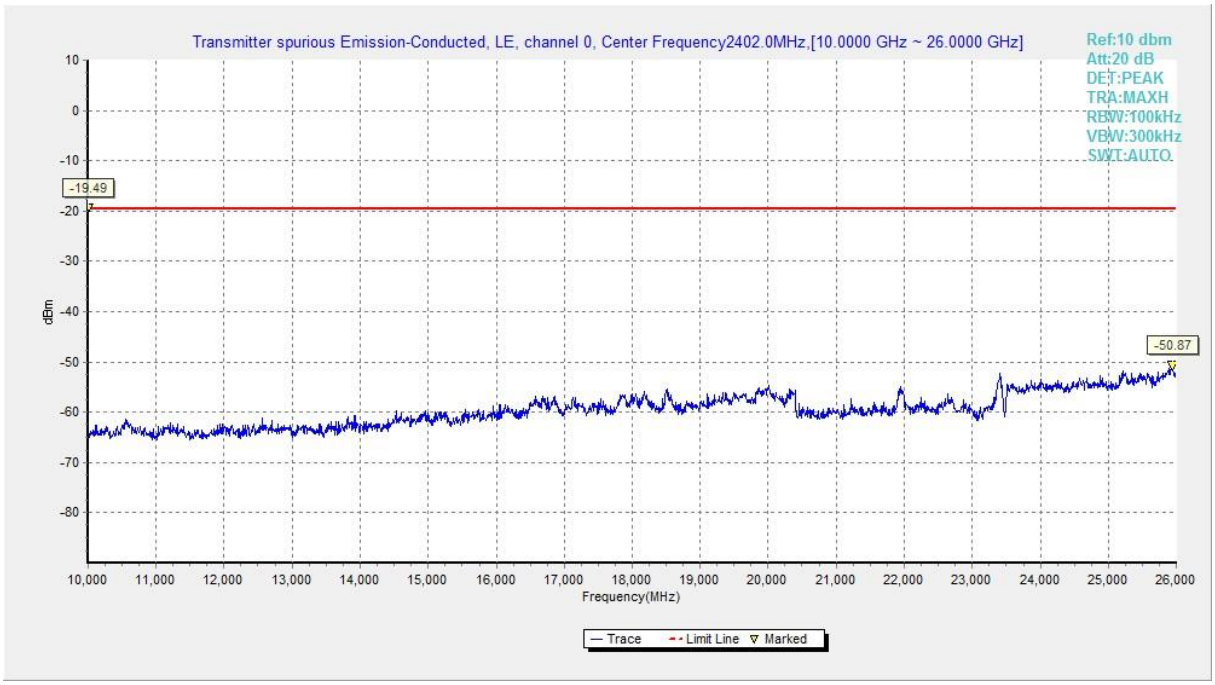


Fig.19 Conducted Spurious Emission (All channels, 10 GHz-26 GHz), LE 1M

A.6 Transmitter Spurious Emission - Radiated

Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247, 15.205, 15.209 & RSS-247 section 5.5/RSS-Gen section 6.13	20dB below peak output power

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)).

Limit in restricted band:

Frequency of emission (MHz)	Field strength(μV/m)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Condition:

The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

Frequency of emission (MHz)	RBW/VBW	Sweep Time(s)
30-1000	120kHz/300kHz	5
1000-4000	1MHz/3MHz	15
4000-18000	1MHz/3MHz	40
18000-26500	1MHz/3MHz	20

Note: According to the performance evaluation, the radiated emission margin of EUT is over 20dB in the band from 9kHz to 30MHz.Therefore, the measurement starts from 30MHz to tenth harmonic. The measurement results include the horizontal polarization and vertical polarization measurements.

Measurement Results:

Mode	Channel	Frequency Range	Test Results	Conclusion
LE 1M	0	1 GHz ~3 GHz	Fig.20	**P**
		3 GHz ~18 GHz	Fig.21	**P**
	19	1 GHz ~3 GHz	Fig.22	**P**
		3 GHz ~18 GHz	Fig.23	**P**
	39	1 GHz ~3 GHz	Fig.24	**P**
		3 GHz ~18 GHz	Fig.25	**P**
	Restricted Band(CH0)	2.38 GHz ~ 2.45 GHz	Fig.26	**P**
	Restricted Band(CH39)	2.45 GHz ~ 2.5 GHz	Fig.27	**P**
	All channels	9 kHz ~30 MHz	Fig.28	**P**
		30 MHz ~1 GHz	Fig.29	**P**
		18 GHz ~ 26.5 GHz	Fig.30	**P**

Worst Case Result

For LE 1M:

CH0 (1-18GHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
7206.500000	46.46	74.00	27.54	V	2.6
10680.500000	45.91	74.00	28.09	H	5.7
13066.500000	47.94	74.00	26.06	V	9.4
14451.500000	48.58	74.00	25.42	V	11.6
15432.000000	49.21	74.00	24.79	V	12.5
16912.500000	51.93	74.00	22.07	H	16.0

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
4803.500000	34.79	54.00	19.21	V	-0.3
7206.500000	38.66	54.00	15.34	V	2.6
13193.000000	36.29	54.00	17.71	H	9.7
15475.500000	37.19	54.00	16.81	H	12.7
16925.000000	40.10	54.00	13.90	V	16.0
17910.000000	40.90	54.00	13.10	H	17.4

CH19 (1-18GHz)

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
7355.500000	44.70	74.00	29.30	V	2.4
9891.000000	45.63	74.00	28.37	H	5.3
12136.000000	47.91	74.00	26.09	V	8.3
15317.000000	49.28	74.00	24.72	V	12.1
16898.500000	51.44	74.00	22.56	V	15.9
17969.000000	51.92	74.00	22.08	H	16.8

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)
7355.500000	44.70	74.00	29.30	V	2.4
9891.000000	45.63	74.00	28.37	H	5.3
12136.000000	47.91	74.00	26.09	V	8.3
15317.000000	49.28	74.00	24.72	V	12.1
16898.500000	51.44	74.00	22.56	V	15.9
17969.000000	51.92	74.00	22.08	H	16.8

CH39 (1-18GHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)
3866.500000	46.61	74.00	27.39	H	-2.1
10671.500000	46.93	74.00	27.07	V	6.1
12972.500000	48.16	74.00	25.84	V	9.3
14505.000000	49.45	74.00	24.55	H	11.7
16707.500000	51.27	74.00	22.73	V	15.4
17943.500000	52.15	74.00	21.85	H	17.3

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)
3866.500000	43.11	54.00	10.89	H	-2.1
4959.500000	37.60	54.00	16.40	V	-0.1
13238.500000	36.20	54.00	17.80	H	9.6
14488.000000	37.49	54.00	16.51	H	11.7
16777.000000	39.81	54.00	14.19	H	15.8
17909.500000	40.85	54.00	13.15	H	17.4

Note:

A "reference path loss" is established and the A_{Rpl} is the attenuation of “reference path loss”, and Antenna Factor, the gain of the preamplifier, the cable loss. P_{Mea} is the field strength recorded from the instrument.

The measurement results are obtained as described below:

Result= P_{Mea} +Cable Loss +Antenna Factor-Gain of the preamplifier.

See below for test graphs.

Conclusion: Pass

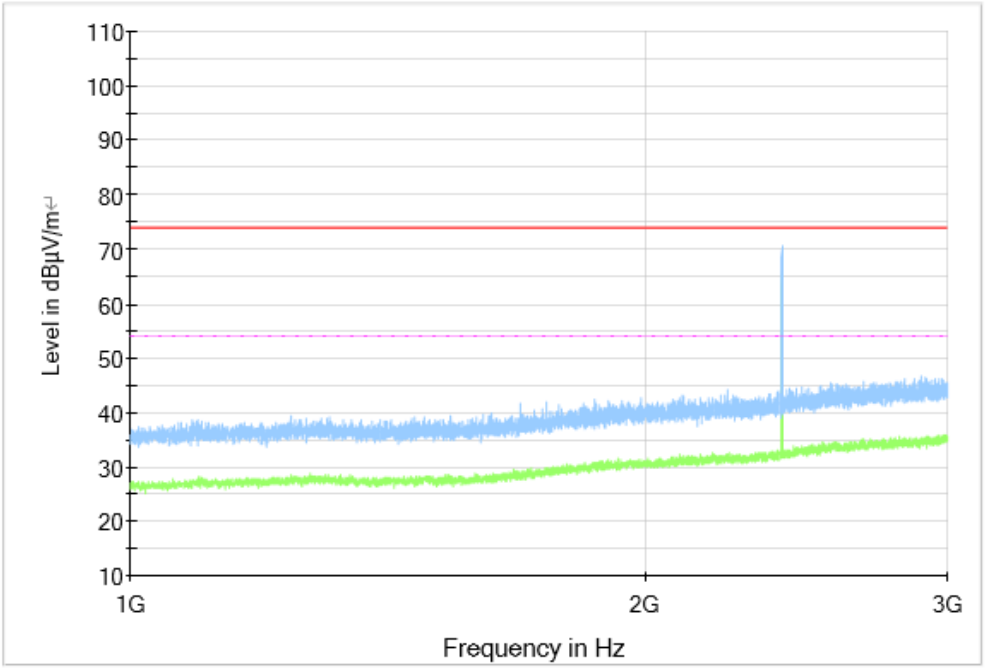


Fig.20 Radiated Spurious Emission (CH0, 1 GHz ~3 GHz), LE 1M

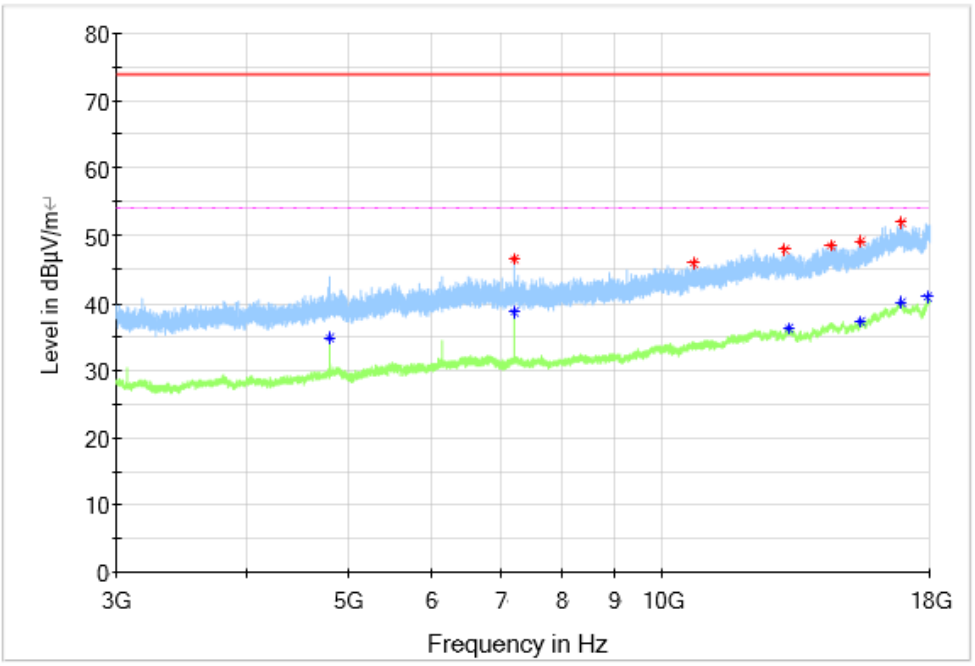


Fig.21 Radiated Spurious Emission (CH0, 3 GHz ~18 GHz), LE 1M

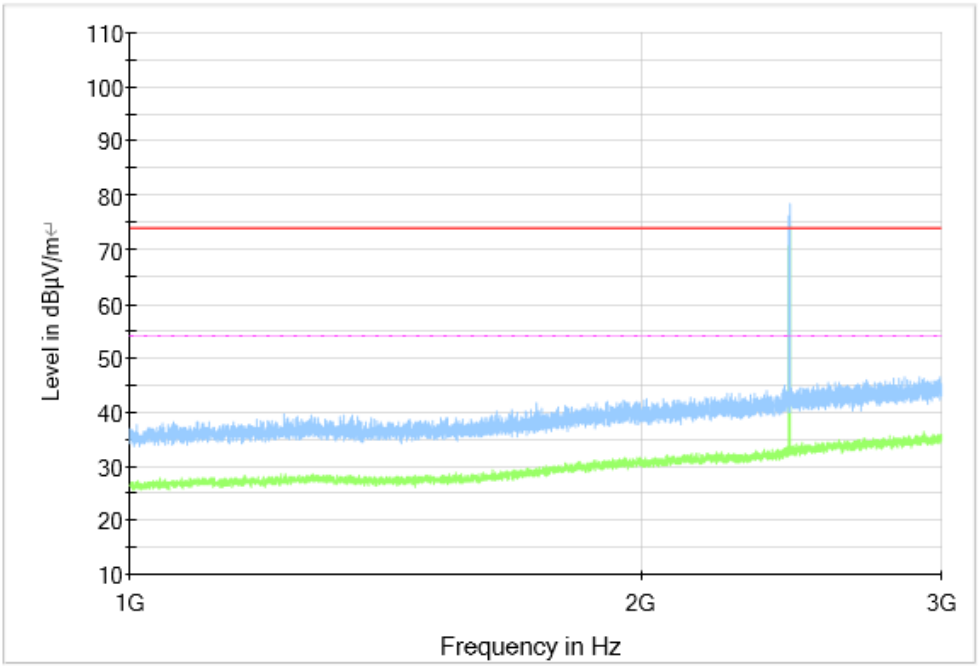


Fig.22 Radiated Spurious Emission (CH19, 1 GHz ~3 GHz), LE 1M

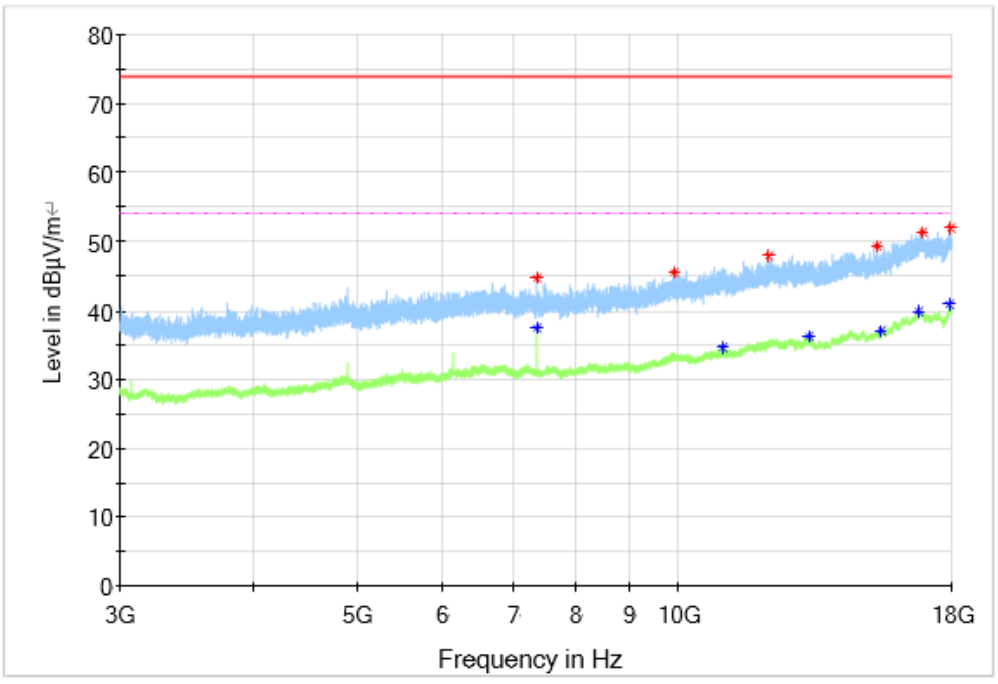


Fig.23 Radiated Spurious Emission (CH19, 3 GHz ~18 GHz), LE 1M

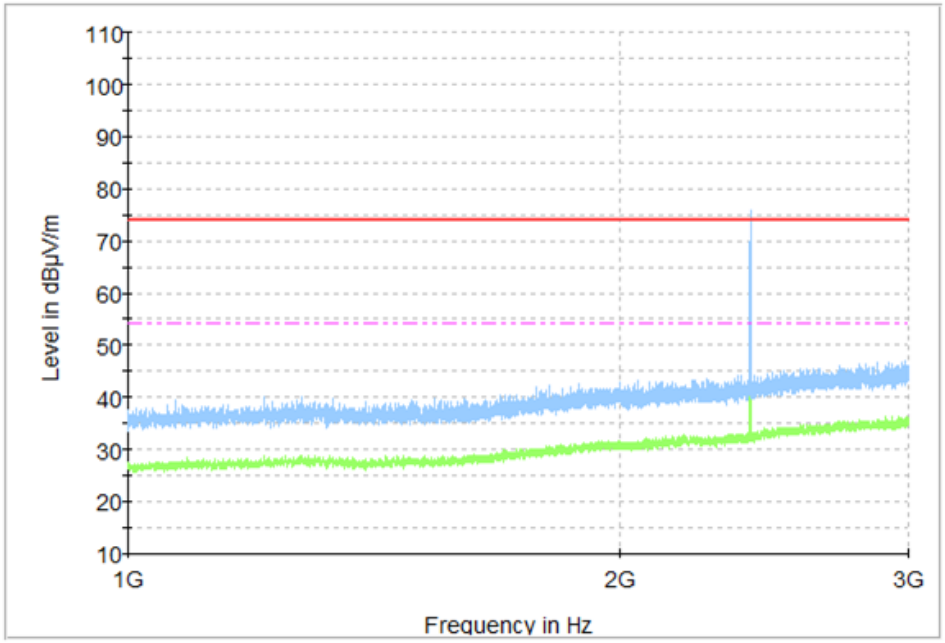


Fig.24 Radiated Spurious Emission (CH39, 1 GHz ~3 GHz), LE 1M

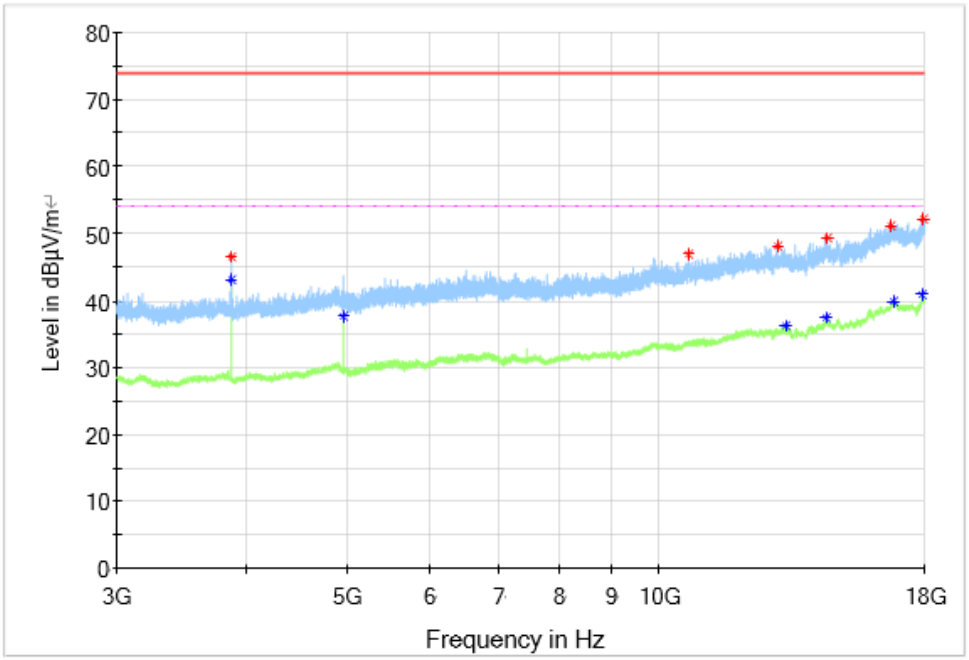


Fig.25 Radiated Spurious Emission (CH39, 3 GHz ~18 GHz), LE 1M

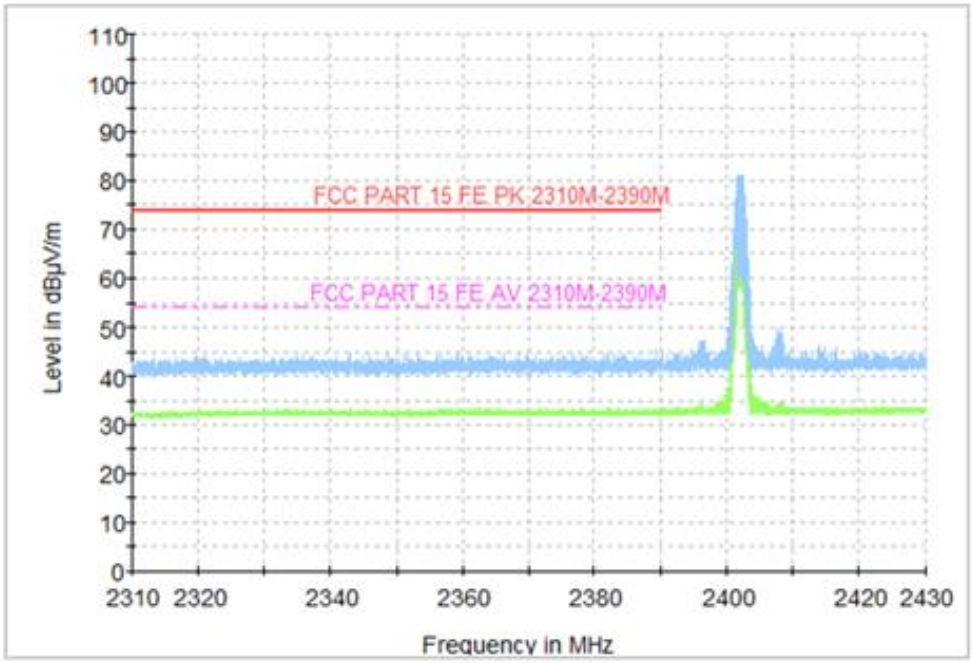


Fig.26 Radiated Band Edges (CH0, 2380GHz~2450GHz), LE 1M

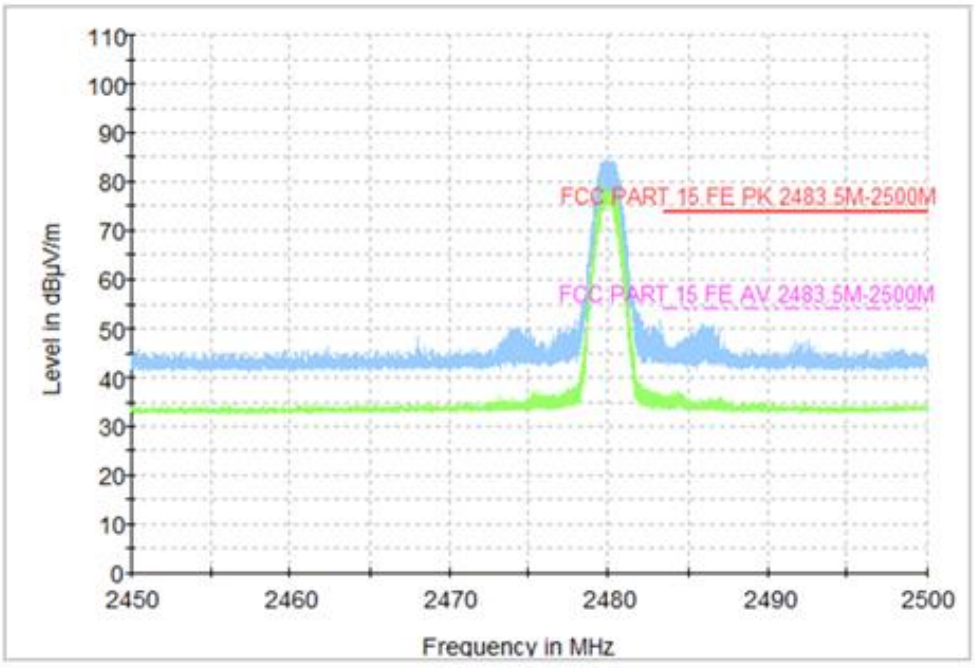


Fig.27 Radiated Band Edges (CH39, 2450GHz~2500GHz), LE 1M

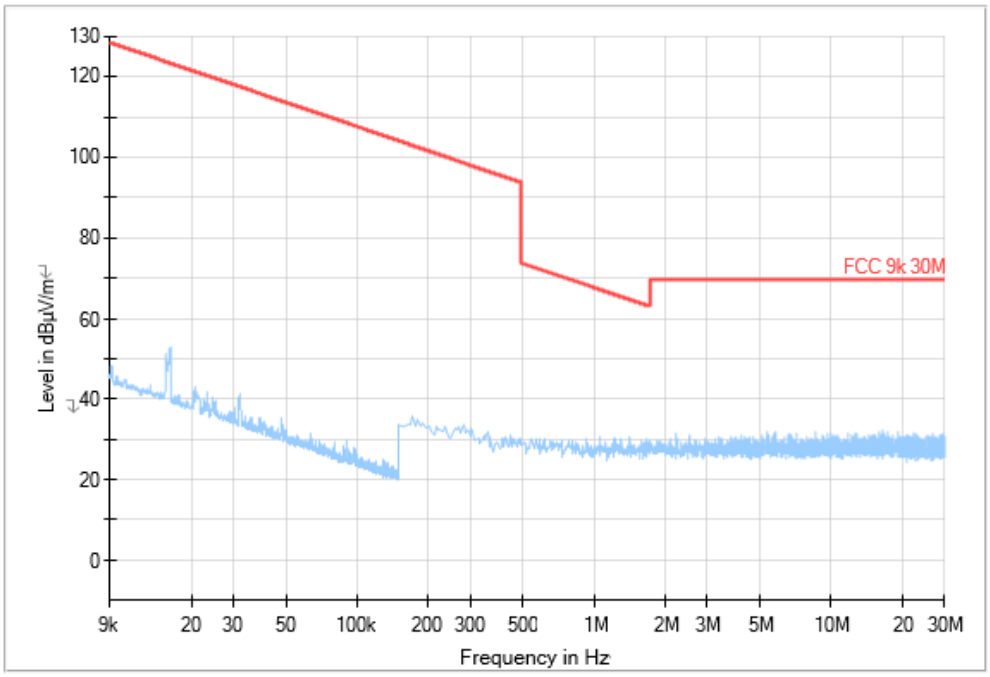


Fig.28 Radiated Spurious Emission (All Channels, 9 kHz-30 MHz), LE 1M

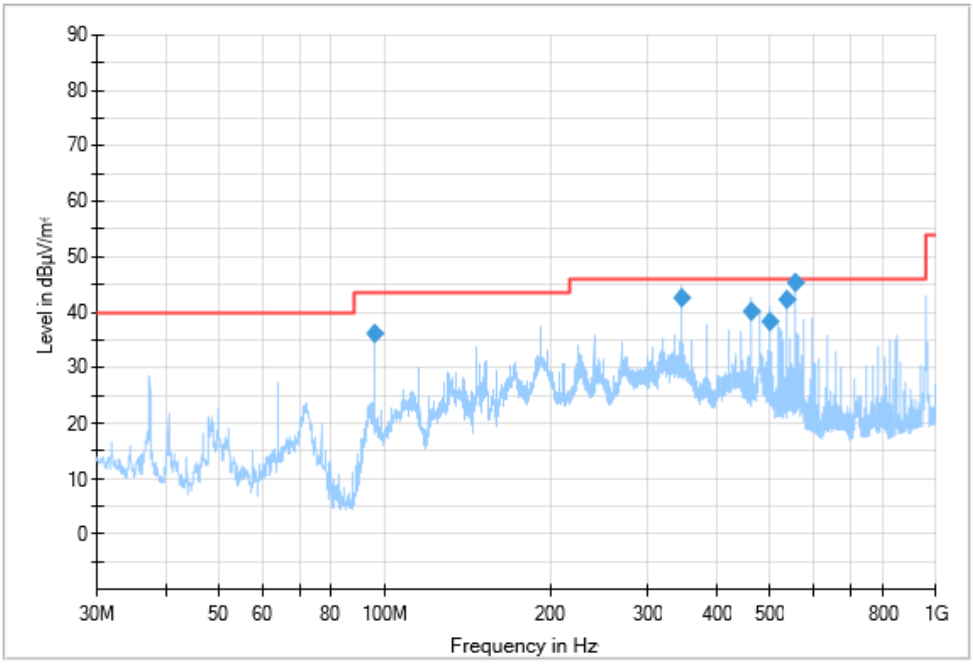


Fig.29 Radiated Spurious Emission (All Channels, 30 MHz-1 GHz), LE 1M

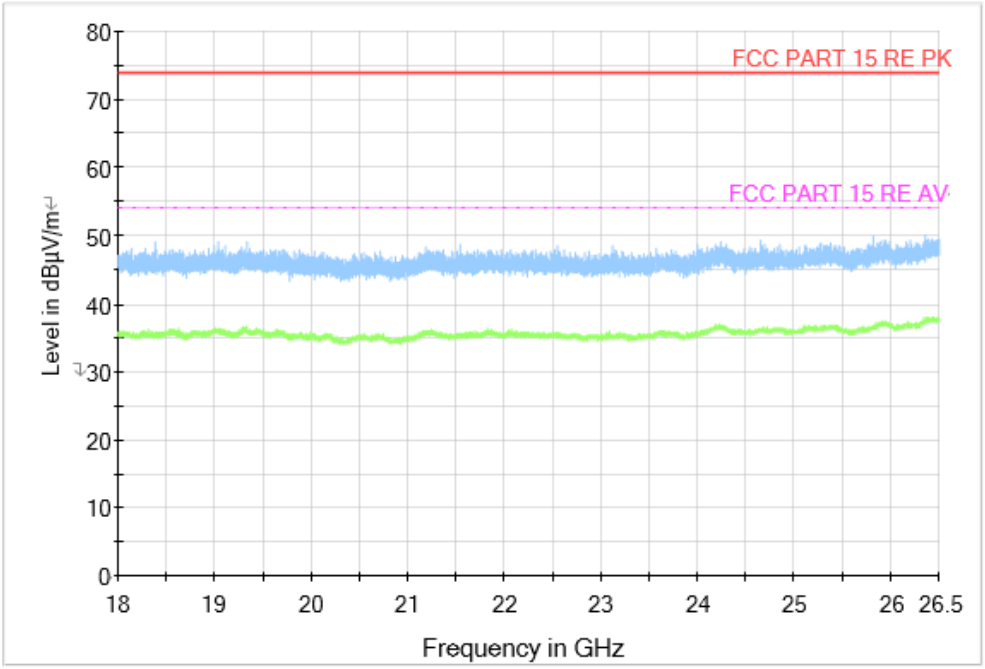


Fig.30 Radiated Spurious Emission (All Channels, 18 GHz-26.5 GHz), LE 1M

A.7 99% Occupied Bandwidth

Measurement Limit:

Standard	Limit (kHz)
RSS-Gen section 6.7	/

Measurement Result:

Mode	Frequency (MHz)	Test Results (kHz)		Conclusion
LE 1M	2402(CH0)	Fig.31	1050.00	**/**
	2440(CH19)	Fig.32	1051.00	**/**
	2480(CH39)	Fig.33	1044.00	**/**

See below for test graphs.

Conclusion: PASS

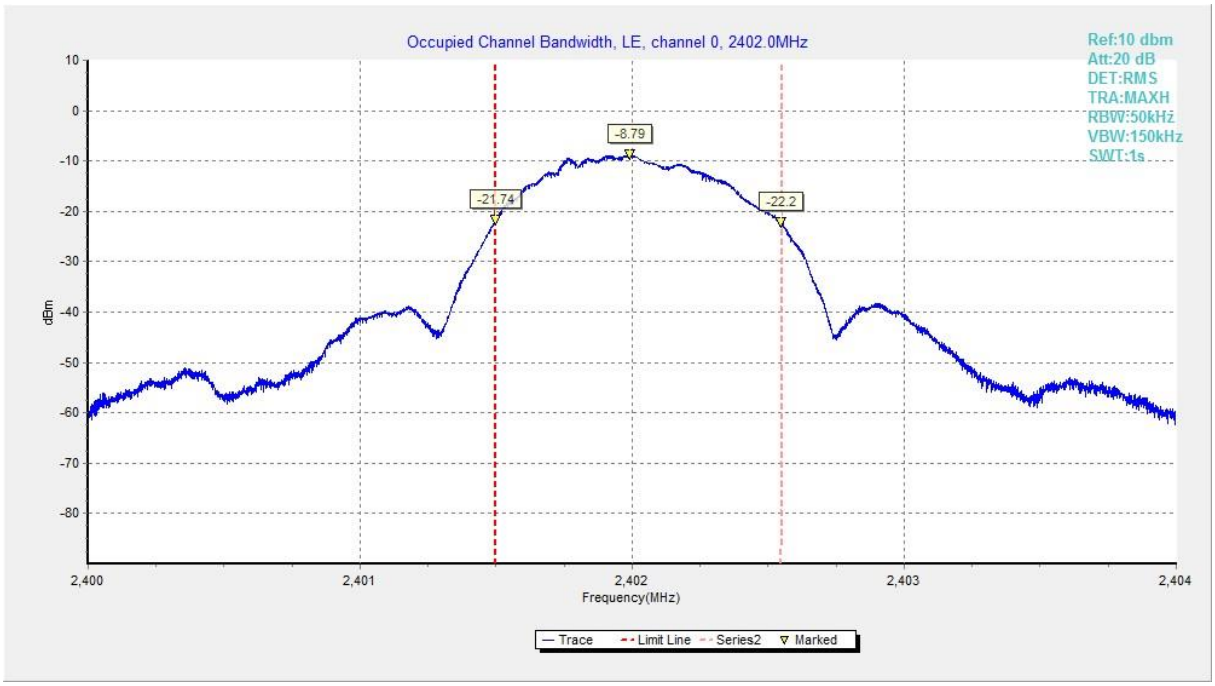


Fig.31 99% Occupied Bandwidth: GFSK, Channel 0, LE 1M

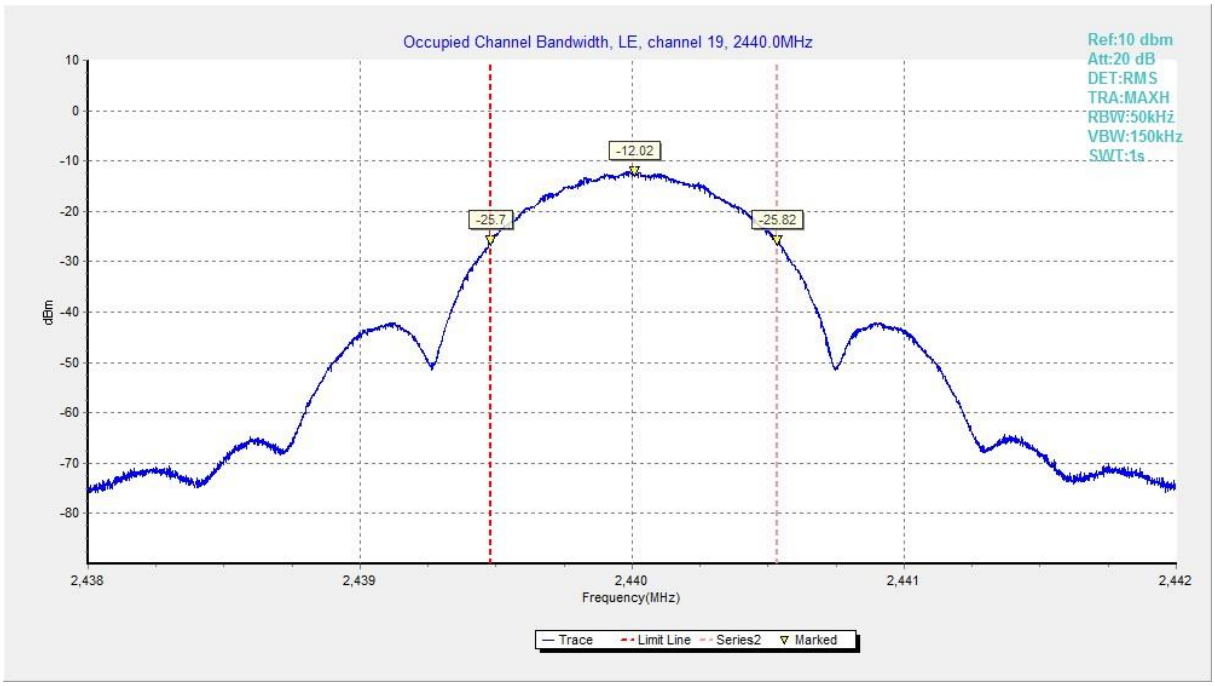


Fig.32 99% Occupied Bandwidth: GFSK, Channel 19, LE 1M

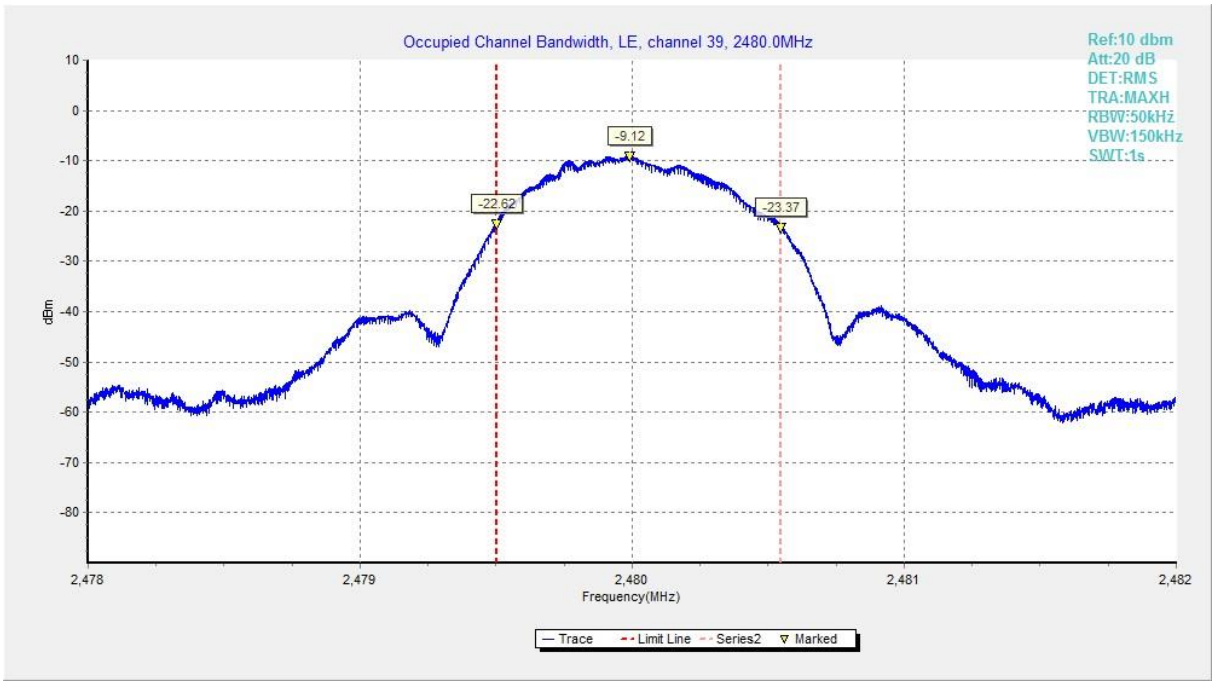


Fig.33 99% Occupied Bandwidth: GFSK, Channel 39, LE 1M

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