

TEST REPORT

No. AR24-0101407-01

performed in accordance with

FCC Rules: Code of Federal Regulations (CFR) no. 47
Part 15 Subpart C Section 15.247

PRODUCT	Dual-mode IEEE 802.15.4 and Low Energy (LE) Bluetooth® radio module mounted in Communication and Location Terminal
MODEL TESTED	CLT20-Ex
FCC ID	2BG2S-CLT20EX1
IC ID	/
TRADEMARK	IMT - Intermodal Telematics BV

APPLICANT	Intermodal Telematics BV – Korte Huifakkerstraat 8 – 4815 PS Breda – NL
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Tested by	Robertino Torri <i>[Laboratory Technician]</i>	See signature below
	On behalf of Robertino Torri signed by Roberto Colombo	
Approved by	Roberto Colombo <i>[Laboratory manager]</i>	

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2024-03-27	First edition Digital signed - AR24-0101407-01_TR_FCC 15.247_IC RSS-247 - BLE _ IEEE 802.15.4 - IMT - CLT20-Ex
Rev. 1	2024-09-06	Modified FCC ID number on page 1 and 4
Rev. 2	2024-11-19	Removed INDUSTRY CANADA RSS-247:2023 as not required by the purpose of this test report. Pg.3 updated standard 47 CFR Part 15:2024 Pg.6 added note "A new battery was fitted during all tests" Added test set-up information in each test clause
Rev. 3	2024-12-11	Modified date of issue

The results of tests and checks reported in this Test Report refer exclusively to the samples tested and described in the Report itself.
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1. GENERAL DATA

SAMPLE		
Samples received on	2024-03-11	(Item(s) sampled and sent by applicant)
IMQ reference samples	BEM	116548
Samples tested No.	1	
Object under analysis recognition	Not carried out Except where stated, characteristics of products were taken from client description and were not verified by the laboratory	
Date of acceptance of test item	2024-03-11	
TEST LOCATION		
Testing dates	2024-03-11 ÷ 2024-03-14	
Testing laboratory	IMQ S.p.A. - Via Quintiliano, 43 – I-20138 Milano	
Testing site	Via Lombardia, 20B – IT-20021 Bollate	
ENVIRONMENTAL CONDITIONING		
Parameter	Measured	
Ambient Temperature	21.0 ÷ 22.5 °C	
Relative Humidity	42 ÷ 48 %	
Atmospheric Pressure	991 ÷ 997 mbar	
The laboratory is monitored by a continuous environmental conditions measurements system. Temperature, humidity and pressure data are recorded on a weekly basis and stored in local archive.		
REMARKS		
Throughout this report a point (comma) is used as the decimal separator. The ability or reliability of this product to perform its intended function in a particular application has not been investigated. Unless otherwise specified, warnings, installation instruction and/or user manual provided with the sample have been checked in Italian or English version only. The test results apply to the sample as received. All information relating to the details of the equipment under test at the § 3 of this document was provided by the applicant. IMQ declines any responsibility derived from missing or wrong information provided aside by the applicant.		

2. REFERENCE DOCUMENT

	DOCUMENT	DATE	TITLE
☒	47 CFR Part 15	2024	Radio Frequency Device
☒	ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
☒	ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3. EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL DATA (According to manufacturer declaration)

MODEL (basic)	Description
CLT20-Ex	Dual-mode IEEE 802.15.4 and Low Energy (LE) Bluetooth® radio module mounted on dedicated board employed for collecting data of wireless sensors
VARIANTS (derived)	Description
/	/

FCC ID	2BG2S-CLT20EX1
IC ID	/

Manufacturer	Intermodal Telematics BV – Korte Huifakkerstraat 8 – 4815 PS Breda – NL
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Type of equipment	DTS - Digital transmission equipment	
Operating frequency band	2400-2483.5MHz	
Max RF conducted power	IEEE 802.15.4: 17.86 dBm	BLE: 17.88 dBm
Modulation / Bit rate	IEEE 802.15.4: O-QPSK / 250 kbit/s	BLE: GFSK 1 or 2 Mbit/s
Number of channels	IEEE 802.15.4: 16	BLE: 40
Antenna gain	4.9 dBi	

Remarks	The EUT contains below radio as following table	
	Radio	FCC / IC ID
	2G/3G Pentaband modem	XPY1CGM5NNN / 8595A-1CGM5NNN
	4G/5G LTE-M (CAT M1) & NB-IOT	KPY2AGQN4NNN / 8595A-2AGQN4NNN
According to manufacturer declaration no simultaneous transmissions are allowed		

4. STATE OF THE EUT DURING TESTS

IEEE 802.15.4 Channel Number	Frequency
11	2405 MHz
12	2410 MHz
:	:
18	2440 MHz
19	2445 MHz
:	:
25	2475 MHz
26	2480 MHz

BLE Channel Number	Frequency
0	2402 MHz
1	2404 MHz
:	:
19	2440 MHz
20	2442 MHz
:	:
38	2478 MHz
39	2480 MHz

Mode	Description
See below test mode description	The EUT is mounted on dedicated board and internal battery supply. Engineering program for management of RF parameters was used during testing to control the transmitter for staying in continuous transmission at the max RF output power. The single TX channel was fixed which was for the purpose of the measurements and included the lower, middle, and higher frequency to perform the test. 3axis were chosen for radiated emission testing for each applicable mode. The choice of axis and transmission was made based on preliminary analysis measurements in order to maximize the emission characteristics of measurement performed. Only the worst result was recorded in the report, unless otherwise stated. A temporary antenna connector is provided by the manufacturer for conducted test. A new battery was fitted during all tests

EUT OPERATING CONDITION				
NO.	MODULATION	Transmission software setting		
		MODULATION	DATA RATE	POWER LEVEL
1	Lower channel O-QPSK (IEEE 802.15.4)	O-QPSK	250 kbit/s	Max
2	Middle channel O-QPSK (IEEE 802.15.4)	O-QPSK	250 kbit/s	Max
3	Higher channel O-QPSK (IEEE 802.15.4)	O-QPSK	250 kbit/s	Max
4	Lower channel GFSK (BLE)	GFSK	1 Mbit/s	Max
5	Middle channel GFSK (BLE)	GFSK	1 Mbit/s	Max
6	Higher channel GFSK (BLE)	GFSK	1 Mbit/s	Max
7	Lower channel GFSK (BLE)	GFSK	2 Mbit/s	Max
8	Middle channel GFSK (BLE)	GFSK	2 Mbit/s	Max
9	Higher channel GFSK (BLE)	GFSK	2 Mbit/s	Max

SUPPORT EQUIPMENT

Defined as equipment needed for correct operation or loading of the EUT, but not considered as tested

Equipment	Manufacturer	Model
/	/	/

ELECTROMAGNETICALLY RELEVANT COMPONENTS

Component	No.	Manufacturer	Model
BLE / IEEE 802.15.4 radio module	1	Silicon Labs	EFR32BG13

RFI SUPPRESSION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

EMI PROTECTION DEVICES

Component	No.	Manufacturer	Model
/	/	/	/

EUT TECHNICAL DOCUMENTATION

Document	Reference
/	/



Additional test requirements have been adopted according to the reference Section indicated in the § 6 of this test report.

FREQUENCY RANGE INVESTIGATED

Radiated emission tests: from 9 kHz to tenth harmonic of fundamental.

6. SUMMARY OF TEST RESULTS

POSSIBLE TEST CASE VERDICT	
Test object meets the requirement	PASS
Test object does not meet the requirement	FAIL
Test case does not apply to the test object	N.A.
Test not performed	N.P.

47CFR Part 15C	TITLE	RESULT
15.203	Antenna Requirements	PASS
15.207 (a)	Conducted Emission	N.A.
15.209 (a)(f)	Radiated Emission	PASS
15.247 (a)	Frequency Hopping Spread Spectrum Specifications	
15.247 (a)	20 dB Bandwidth	N.A.
15.247 (a)(1)	Carrier frequency (Hopping Channel) Separation	N.A.
15.247(a)(1)(iii)	Number of Hopping Channels Used	N.A.
15.247(a)(1)(iii)	Channel occupancy time	N.A.
15.247 (a)(2)	6dB Minimum Bandwidth	PASS
	99% emission bandwidth	PASS
15.247 (b)	Maximum Peak Output Power	
15.247 (b)(1)	Peak Output Power	N.A.
15.247 (b)(3)	Maximum conducted output power	PASS
15.247 (b)(4)	Antenna gain	N.A.
15.247 (c)	Operation with directional antenna gains greater than 6dBi	N.A.
15.247 (d)	100 kHz Bandwidth emissions outside frequency Band	PASS
15.247 (e)	Power Spectral Density	PASS
15.247 (f)	Hybrid systems	N.A.
15.247 (g)	FHSS Transmission characteristics	N.A.
15.247 (h)	Recognition of occupied channel & multiple transmission	N.A.
15.247 (i)	RF humane exposure § 47CFR 1.1307 (b)(1)	N.P.

7. TEST RESULTS

7.1 ANTENNA REQUIREMENTS

TEST 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 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 Sections 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 Section 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.	
Testing dates	2024-03-11

Antenna specifications	
N° of authorized antenna types	/
Antenna type	SMD - PCB surface mounted
Maximum total gain	4.9 dBi
External power amplifiers	Not present

TEST RESULT
The EUT meets the requirements of section 15.203.

7.2 RADIATED DISTURBANCES

TEST REQUIREMENT	
Test setup	ANSI C63.10 (clause 11)
Test facility	Semi-anechoic chamber
Test distance	3 meters
Frequency range	9 kHz to tenth harmonic of fundamental
IF bandwidth (below 30 MHz)	9 kHz
IF bandwidth (below 1,000 MHz)	120 kHz
IF bandwidth (above 1,000 MHz)	1 MHz
EMC class	B
EUT operating condition	1 to 6
Remark: In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = $40\log(300\text{meter} / 3\text{meter}) = +80\text{db}$ Extrapolation (dB) = $40\log(30\text{meter} / 3\text{meter}) = +40\text{db}$	
Testing dates	2024-03-11 ÷ 2024-03-13

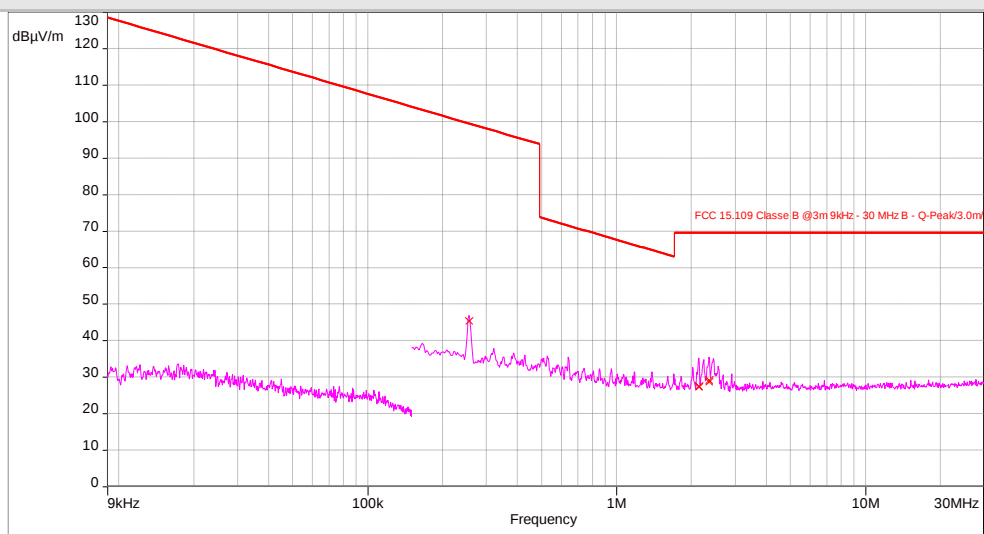
LIMITS		
Band of operations	Peak (dB μ V/m)	Average Limit (dB μ V/m)
Restricted bands	74	54
Other bands	According to emissions limits or Fundamental –20dB (which is greater)	According to emissions limits or Fundamental –20dB (which is greater)

TEST PROCEDURE
1) The EUT was placed on turntable which is 0.8 m above the ground plane for frequencies below 1 GHz and 1.5 m above the ground plane for frequencies above 1GHz. 2) The turntable shall rotate from 0° to 360° degrees to determine the position of maximum emission level. 3) The EUT is positioned 3 m away from the receiving antenna, which varied from 1 to 4 m to find the highest emission. 4) The measurements were made with the detector set to PEAK and AVERAGE amplitude within a bandwidth of 100 kHz below 1000 MHz and 1 MHz above 1000 MHz. 5) The receiving antenna was positioned in both horizontal and vertical polarization. 6) The measurements with Quasi-Peak detector, below 1000 MHz are performed only for frequencies for which the Peak values are $\geq$ (Q.P. limit - 6 dB).

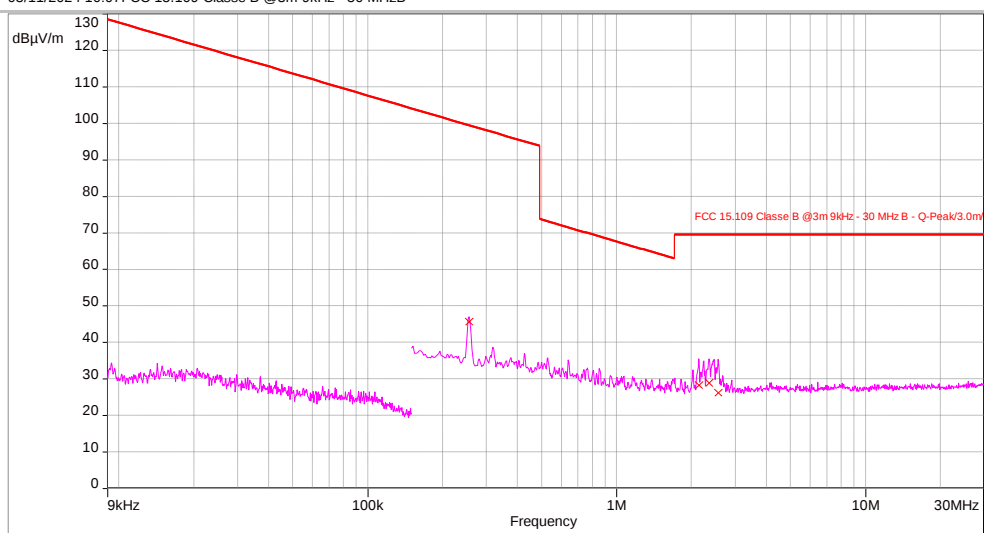
TEST RESULT
The EUT has been tested in 3 orthogonal axes at the frequencies lowest, middle and highest for each modulation. The results reported are worst case. The measurement of spurious emission of EUT in receiver mode is deemed to be fulfilled as no limits are exceeded in transmitter mode (condition considered more burdensome). The EUT meets the requirements of sections 15.205, 15.209, 15.247.

9 kHz÷30 MHz – IEEE 802.15.4 Measurement result

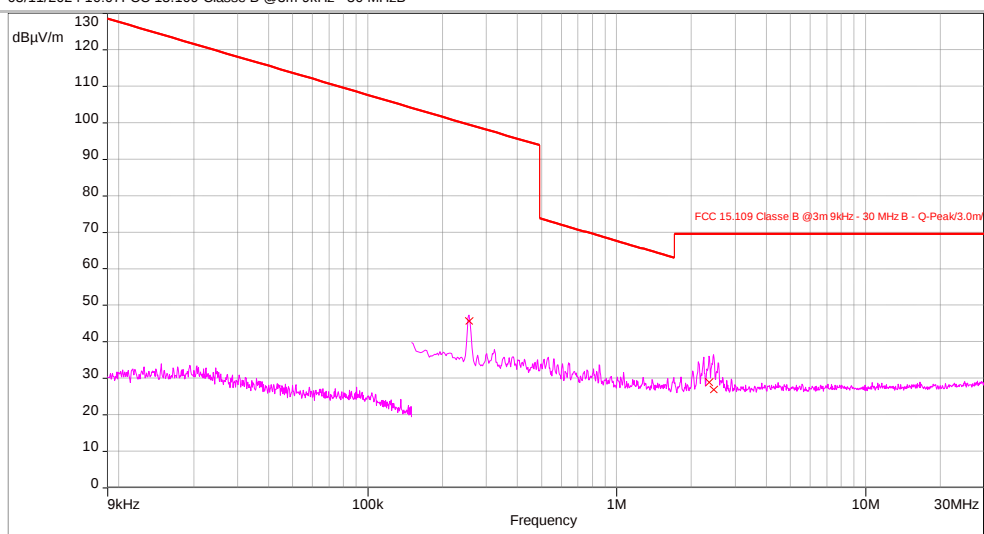
LOWER CHANNEL



MIDDLE CHANNEL

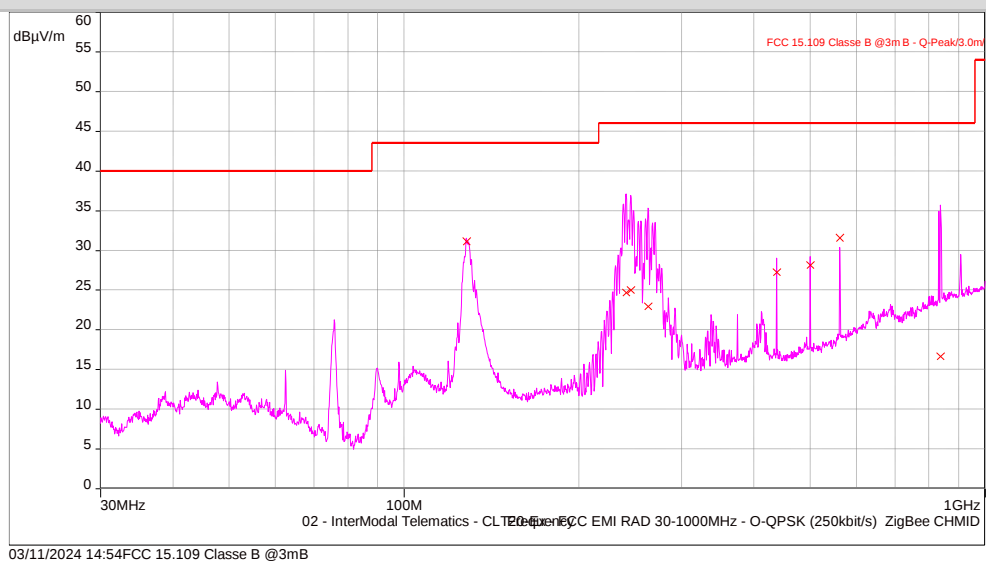


HIGHER CHANNEL

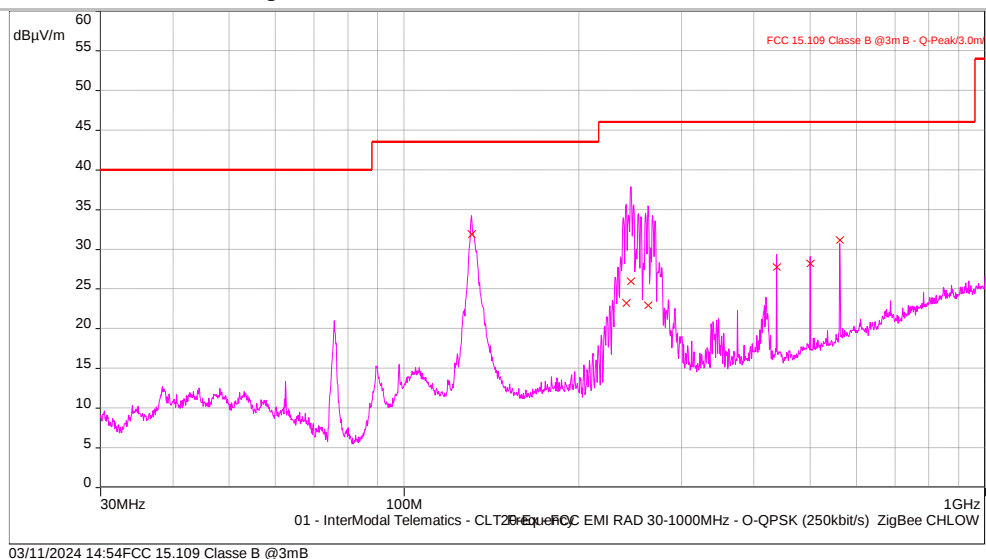


30÷1,000 MHz – IEEE 802.15.4 Measurement result

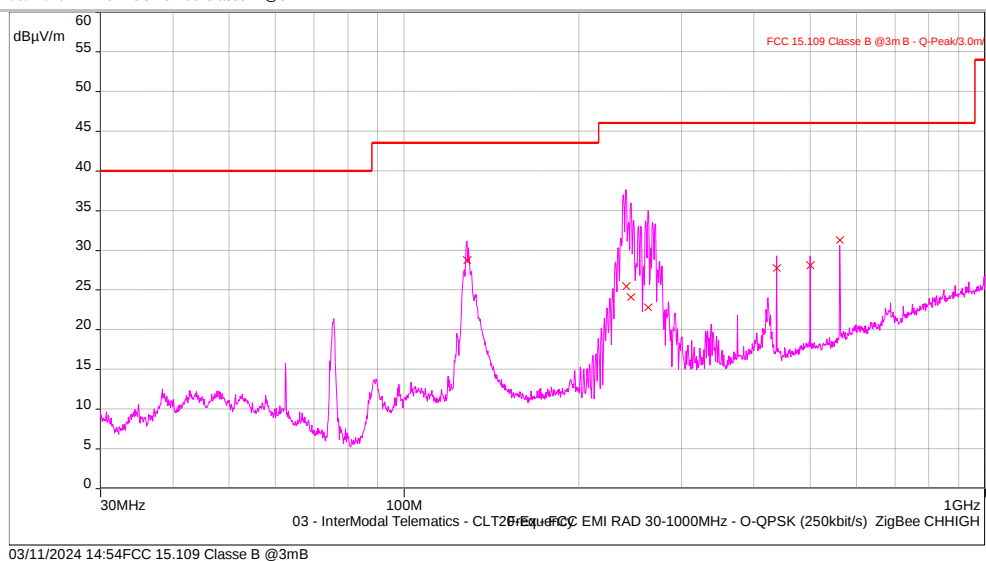
LOWER CHANNEL



MIDDLE CHANNEL

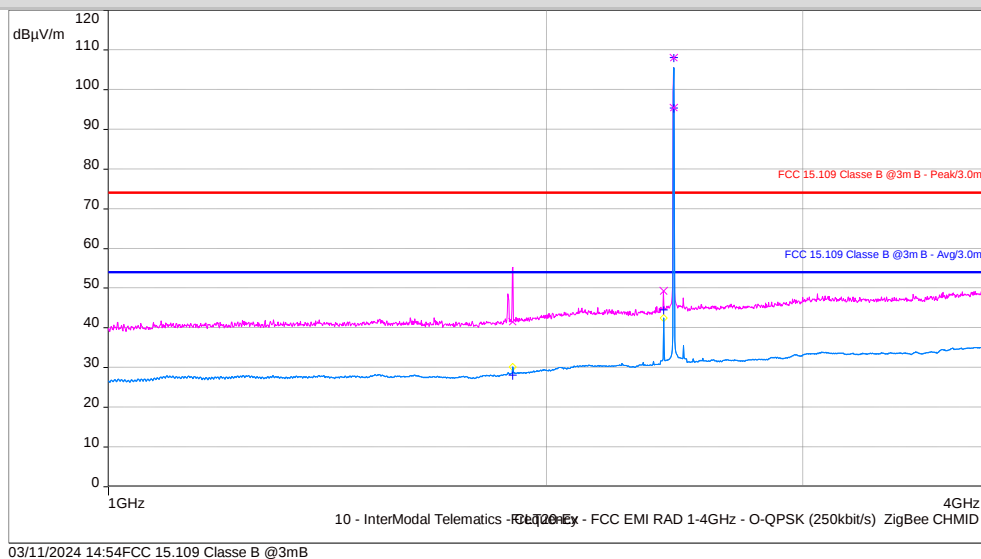


HIGHER CHANNEL



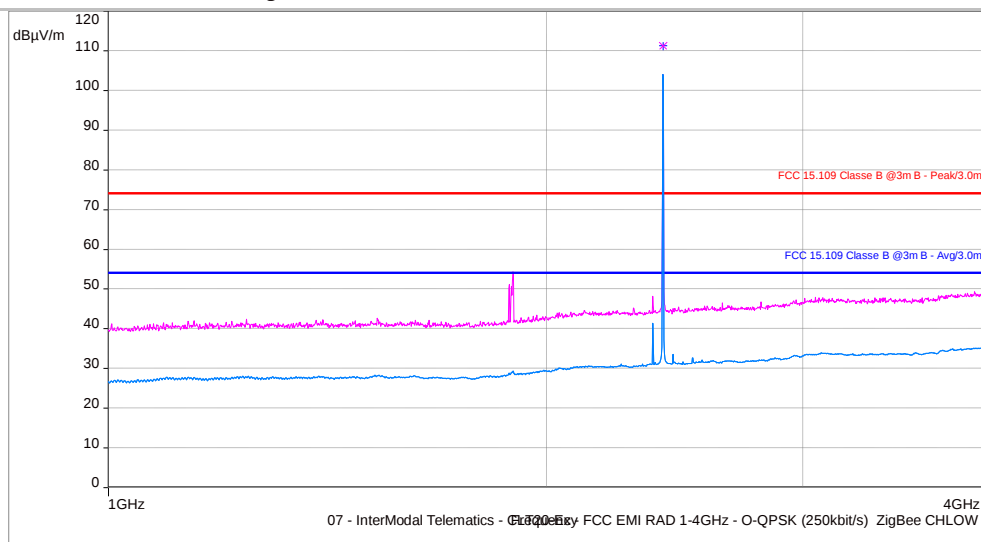
1÷4 GHz – IEEE 802.15.4 Measurement result

LOWER CHANNEL



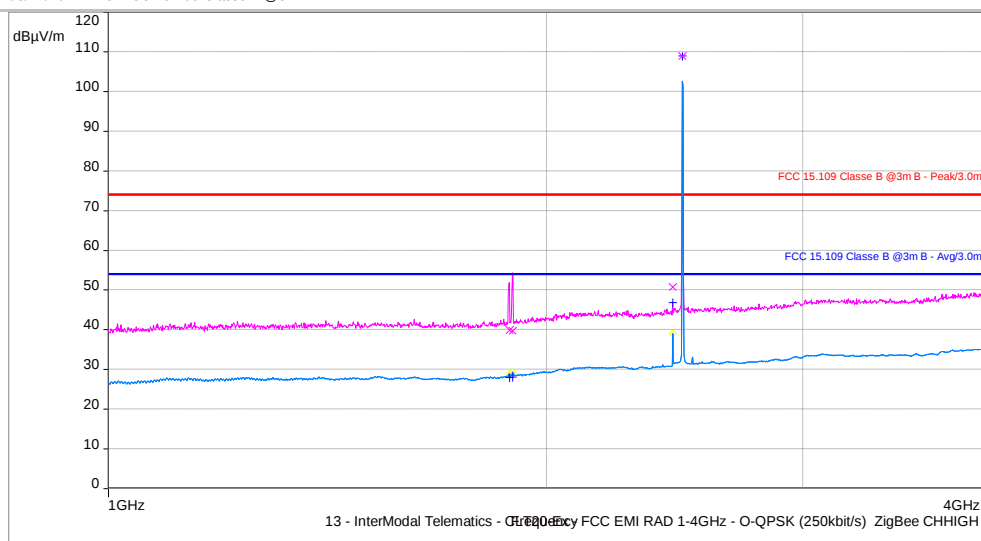
03/11/2024 14:54 FCC 15.109 Classe B @3mB

MIDDLE CHANNEL



03/11/2024 14:54 FCC 15.109 Classe B @3mB

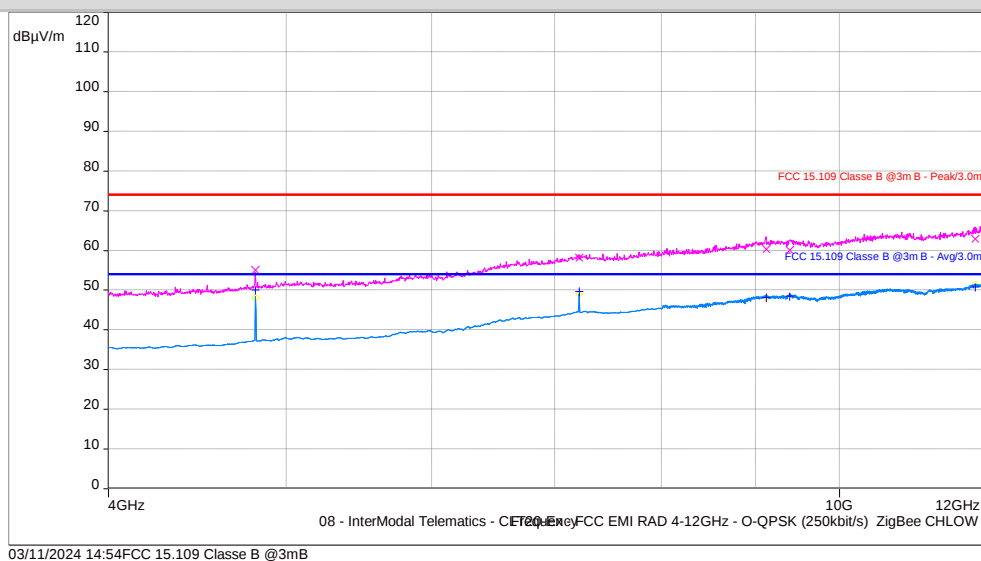
HIGHER CHANNEL



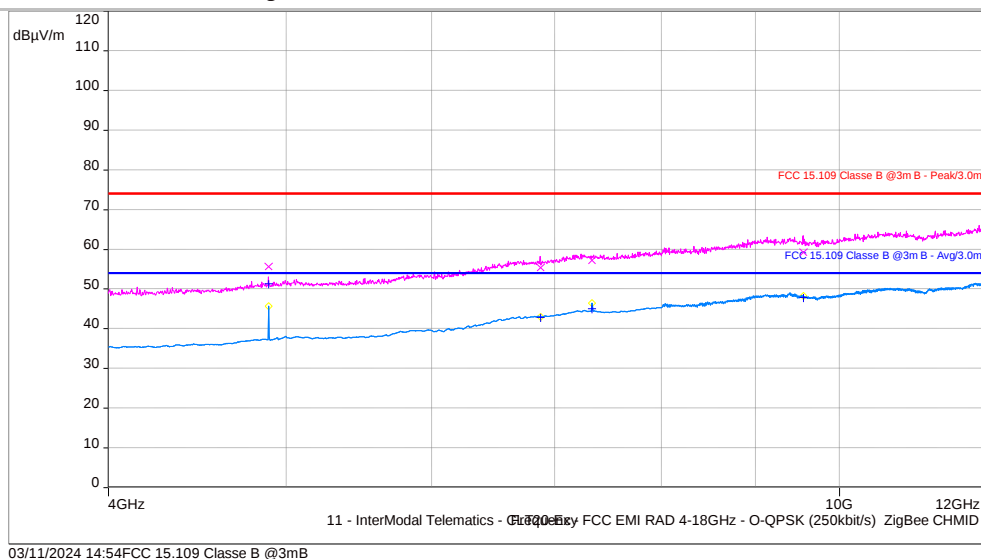
03/11/2024 14:54 FCC 15.109 Classe B @3mB

4÷12 GHz – IEEE 802.15.4 Measurement result

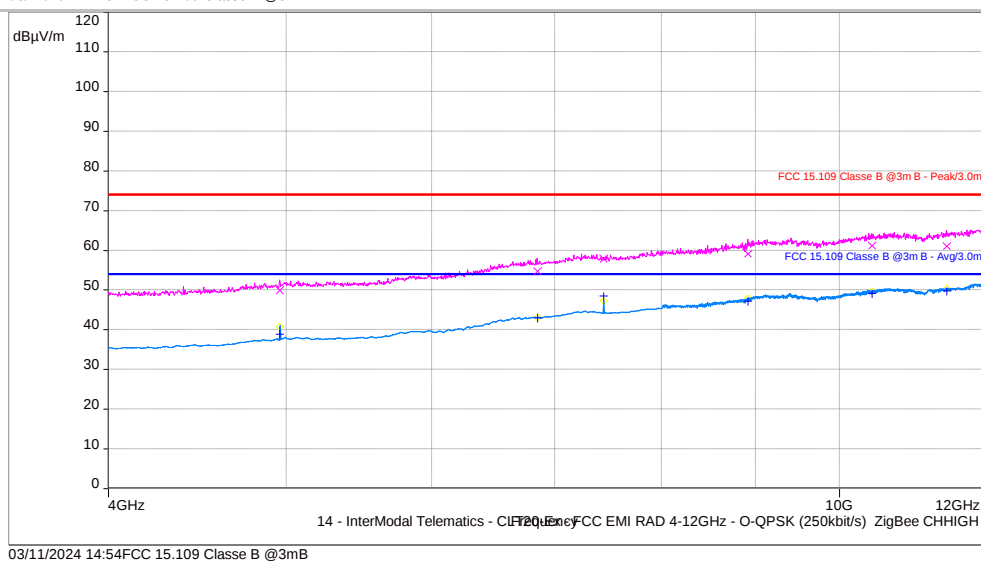
LOWER CHANNEL



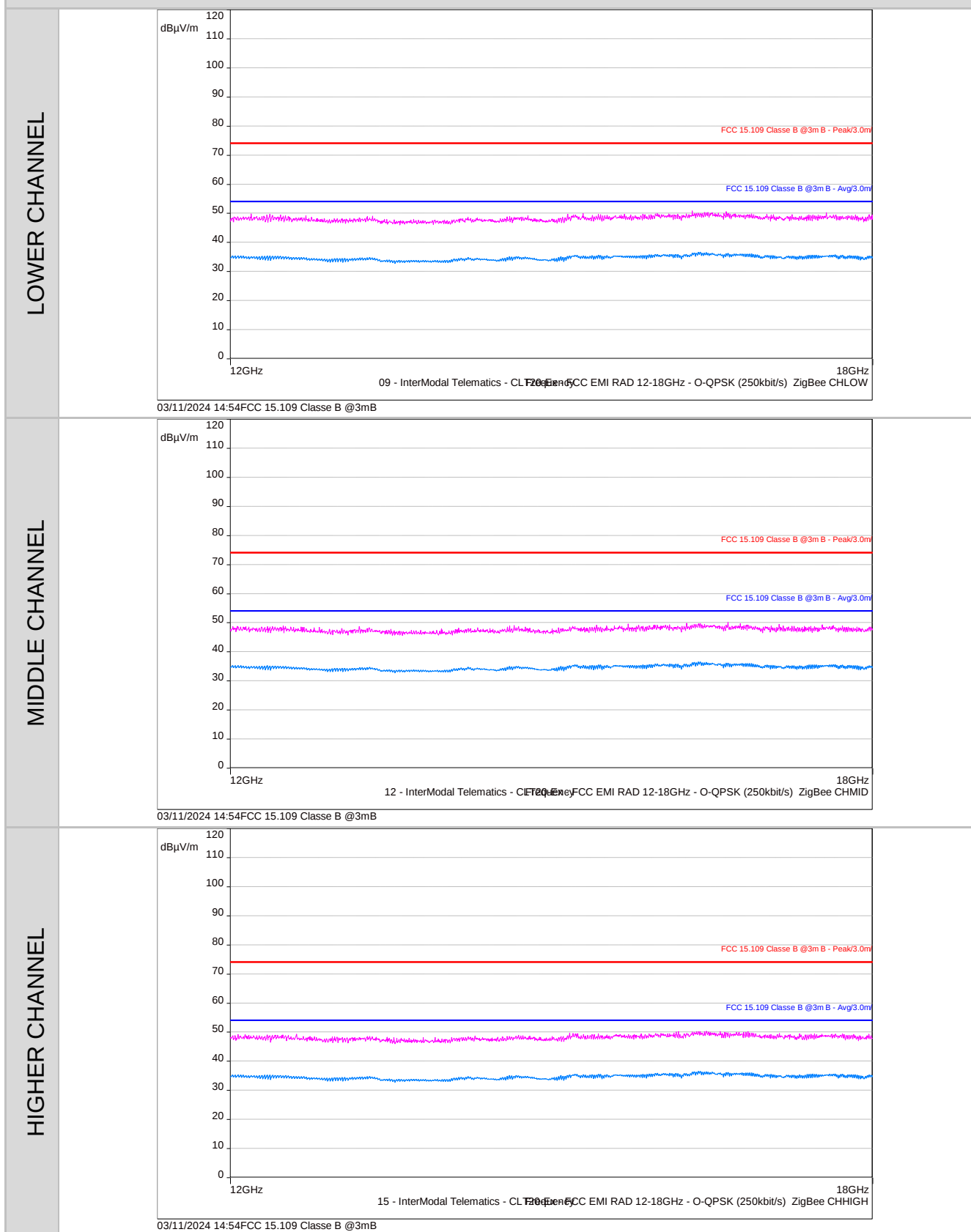
MIDDLE CHANNEL



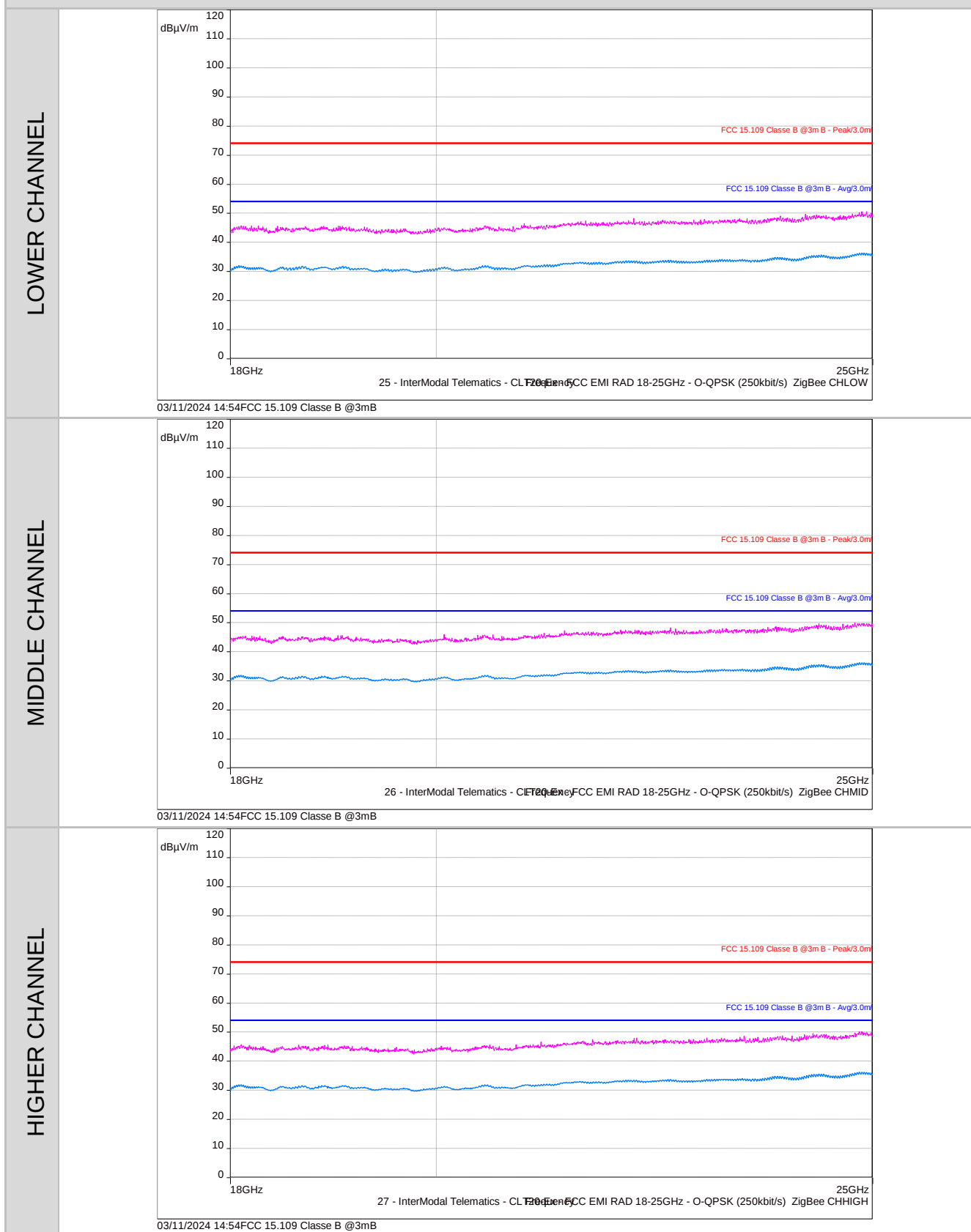
HIGHER CHANNEL



12÷18 GHz – IEEE 802.15.4 Measurement result

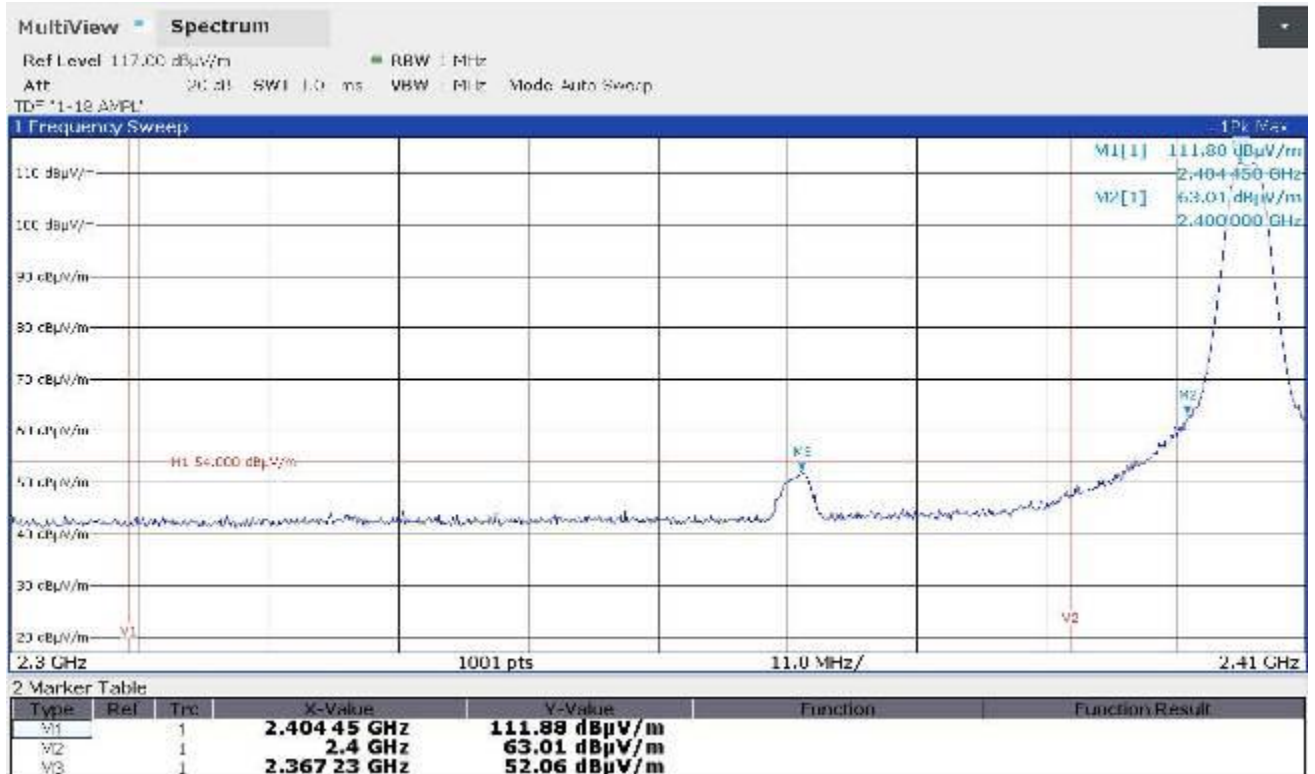


18÷25 GHz – IEEE 802.15.4 Measurement result

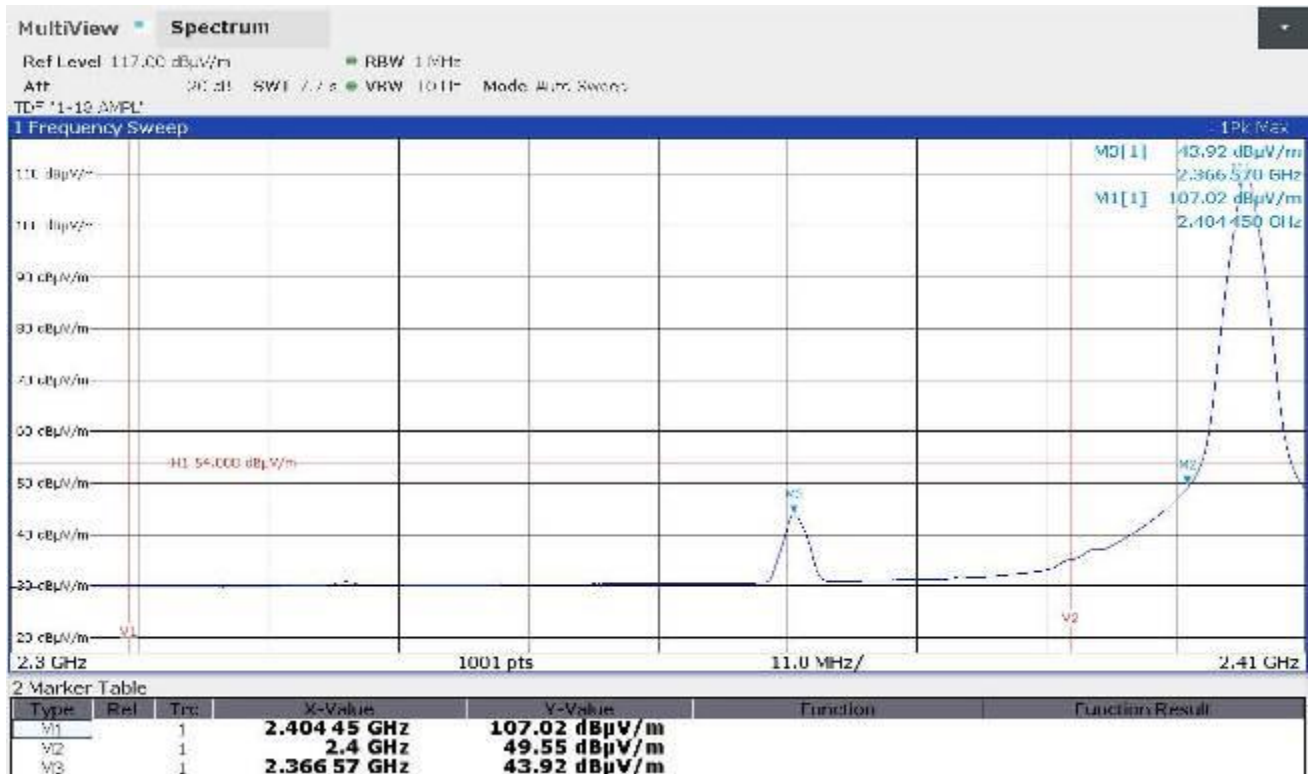


IEEE 802.15.4 LOWER CHANNEL – BAND-EDGE

PEAK

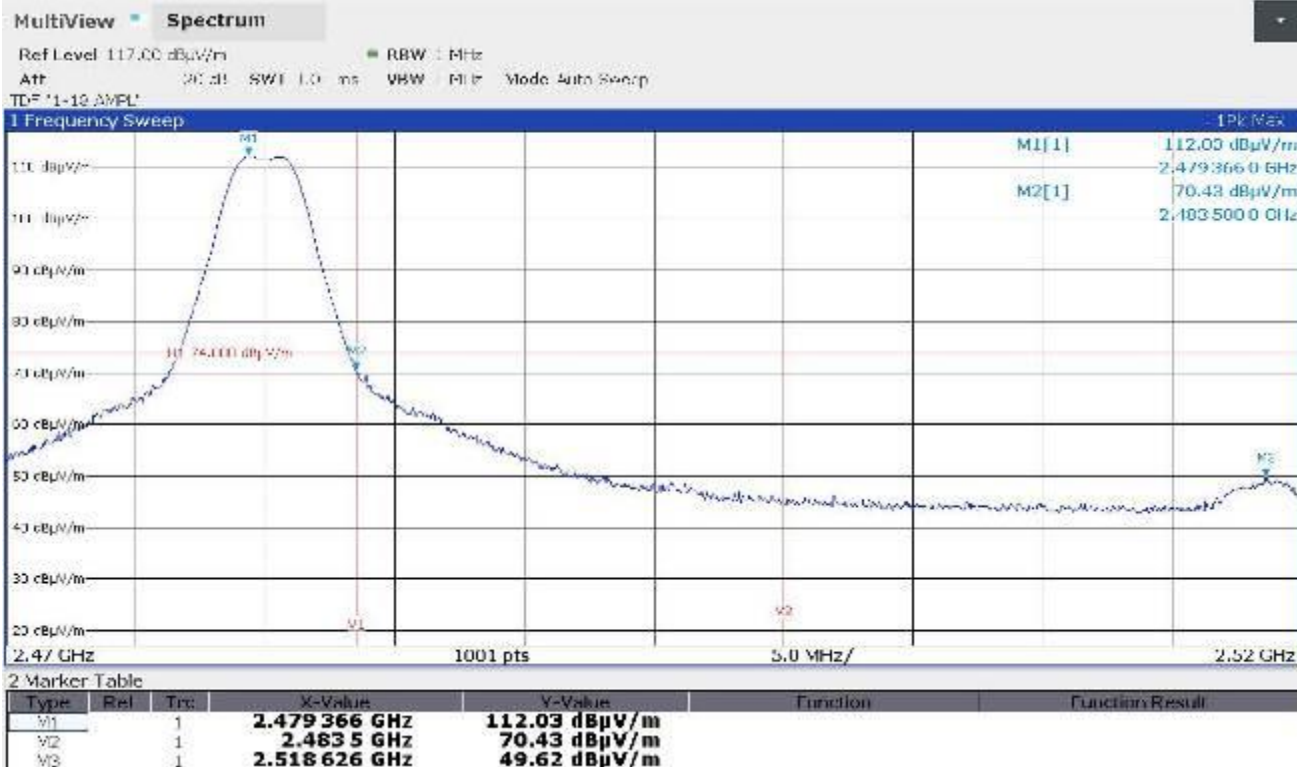


AVERAGE

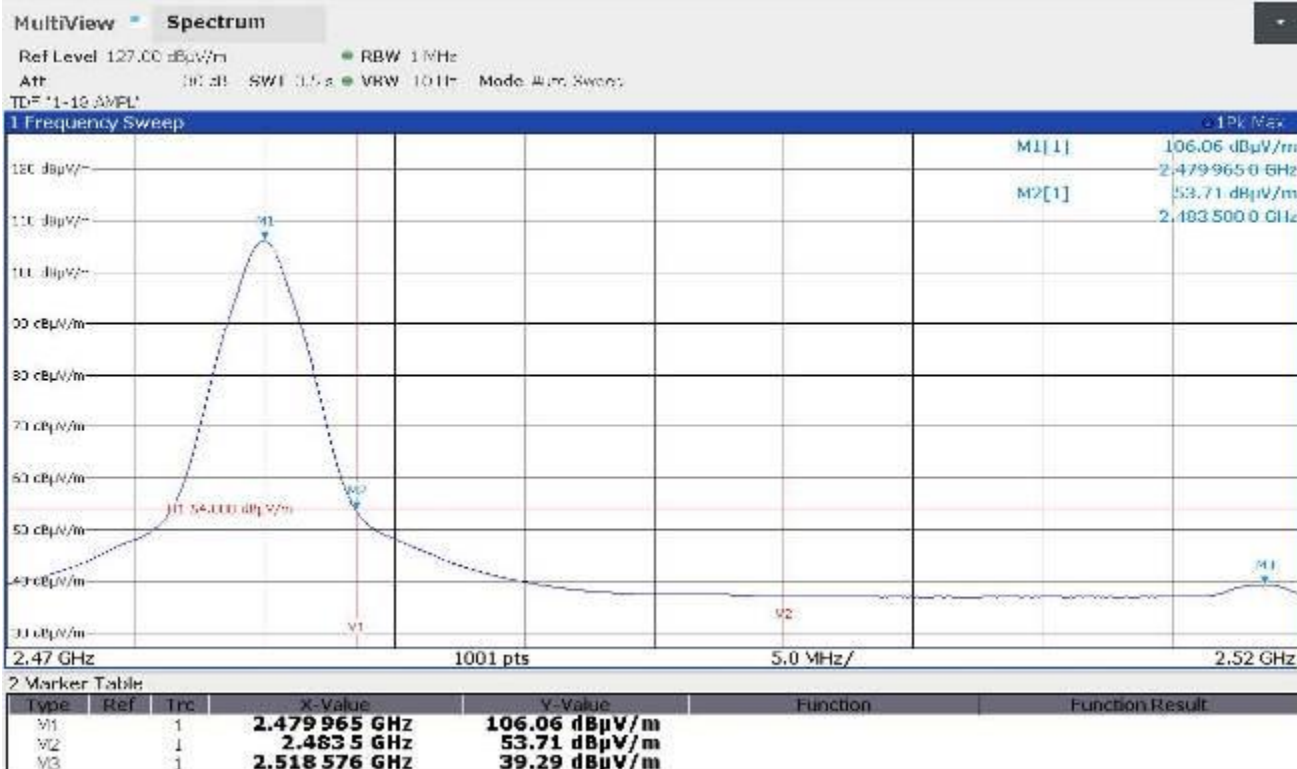


IEEE 802.15.4 HIGHER CHANNEL – BAND-EDGE

PEAK

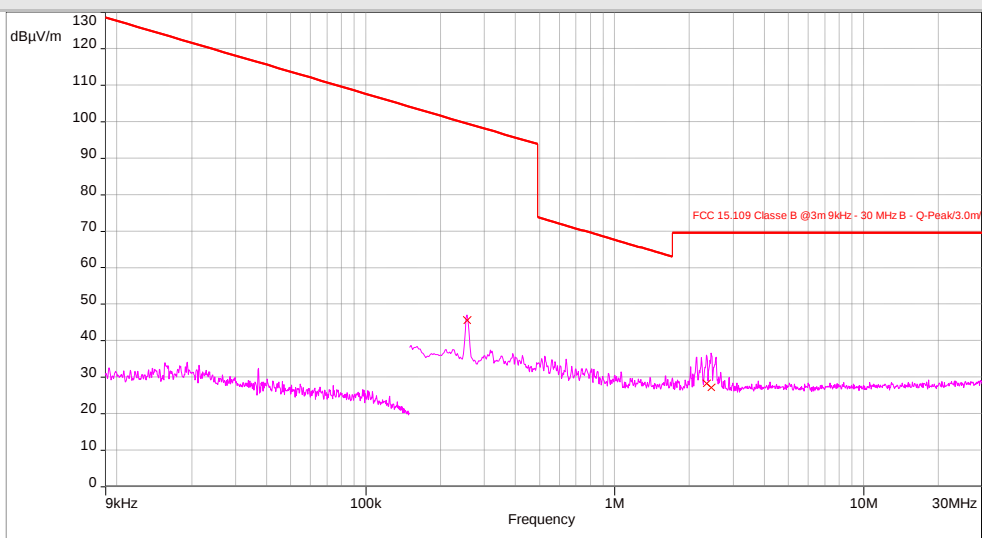


AVERAGE



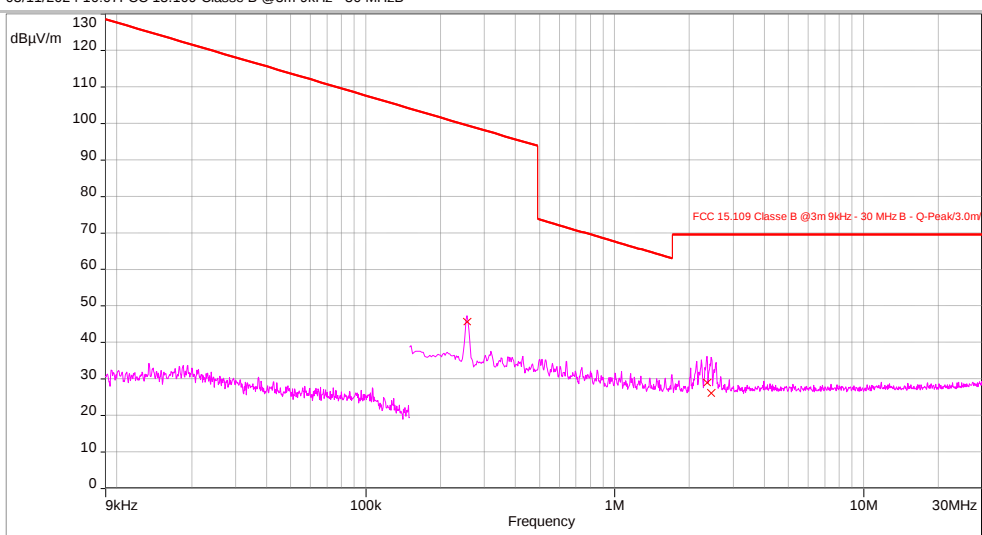
9 kHz÷30 MHz – BLE Measurement result

LOWER CHANNEL



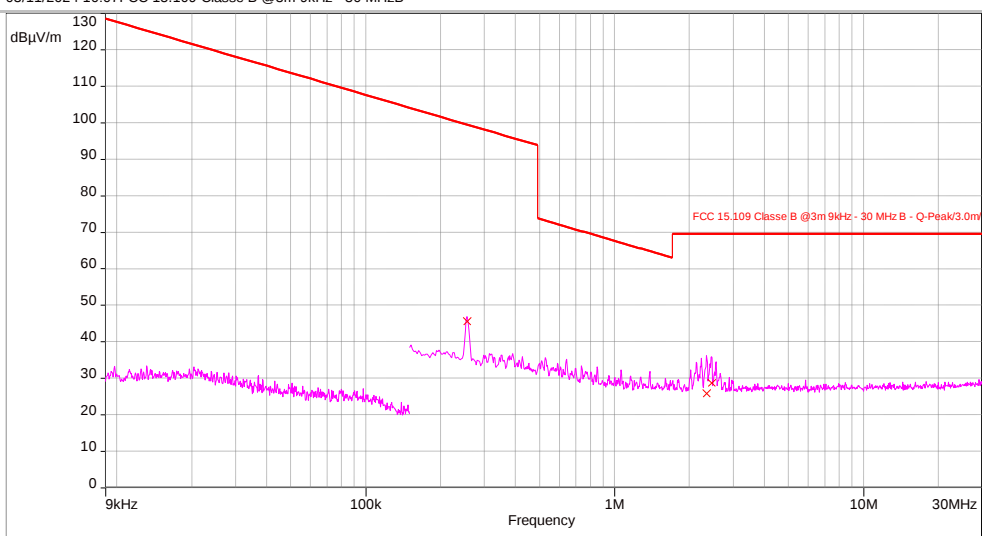
03/11/2024 10:07 FCC 15.109 Classe B @3m 9kHz - 30 MHz B

MIDDLE CHANNEL



03/11/2024 10:07 FCC 15.109 Classe B @3m 9kHz - 30 MHz B

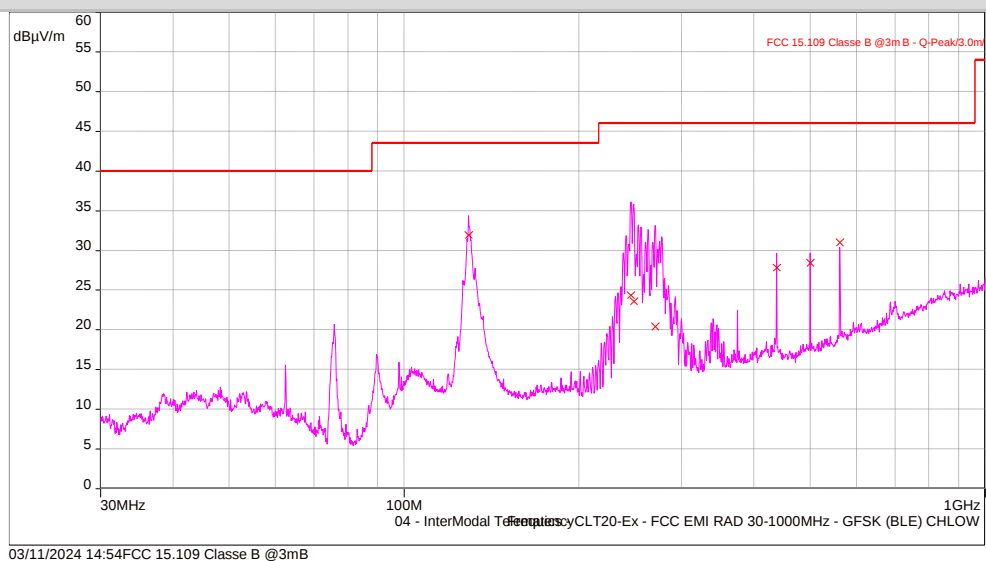
HIGHER CHANNEL



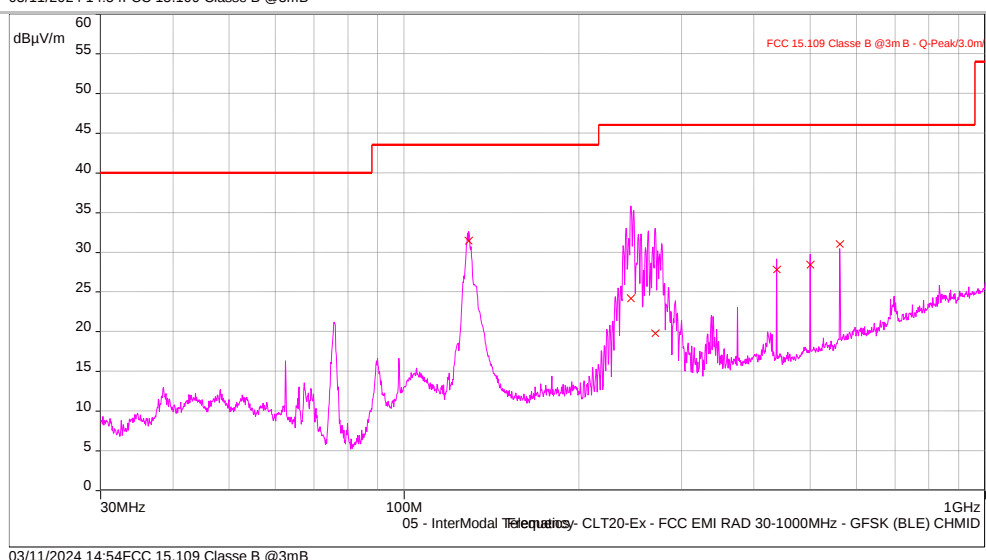
03/11/2024 10:07 FCC 15.109 Classe B @3m 9kHz - 30 MHz B

30÷1,000 MHz – BLE Measurement result

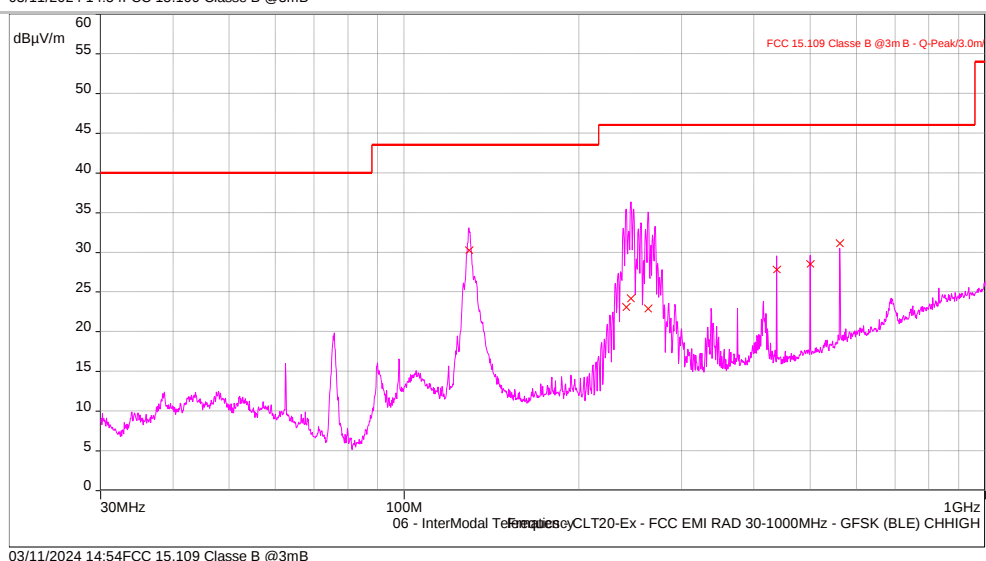
LOWER CHANNEL



MIDDLE CHANNEL

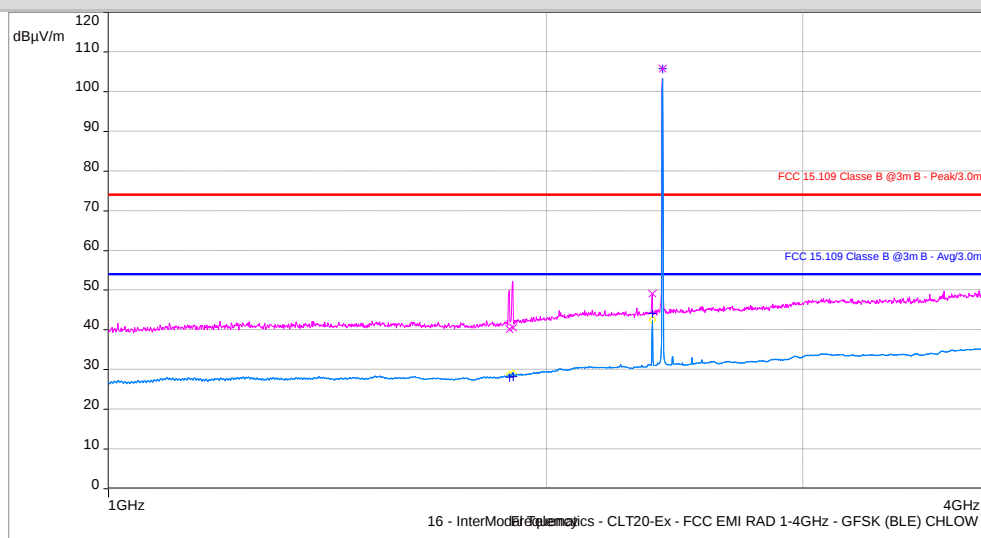


HIGHER CHANNEL



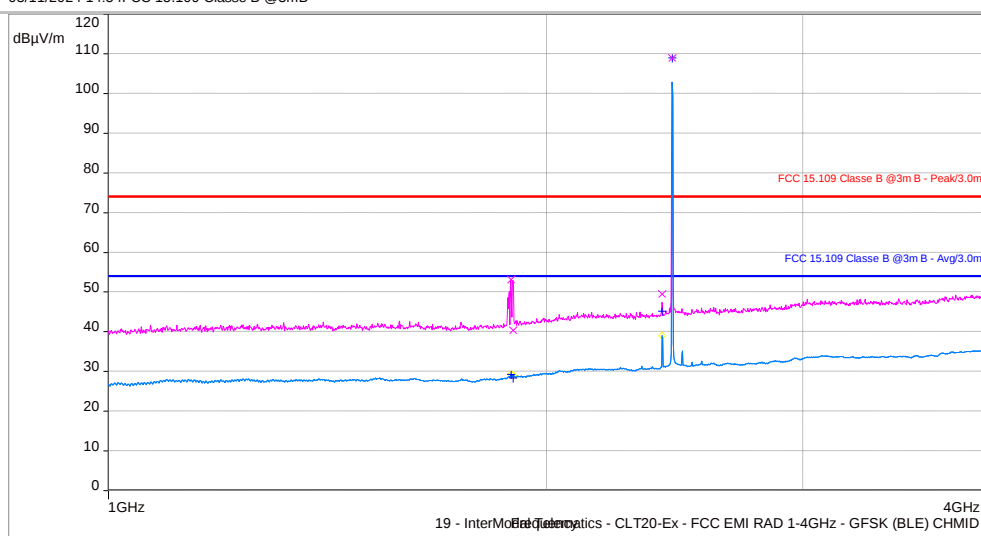
1÷4 GHz – BLE Measurement result

LOWER CHANNEL



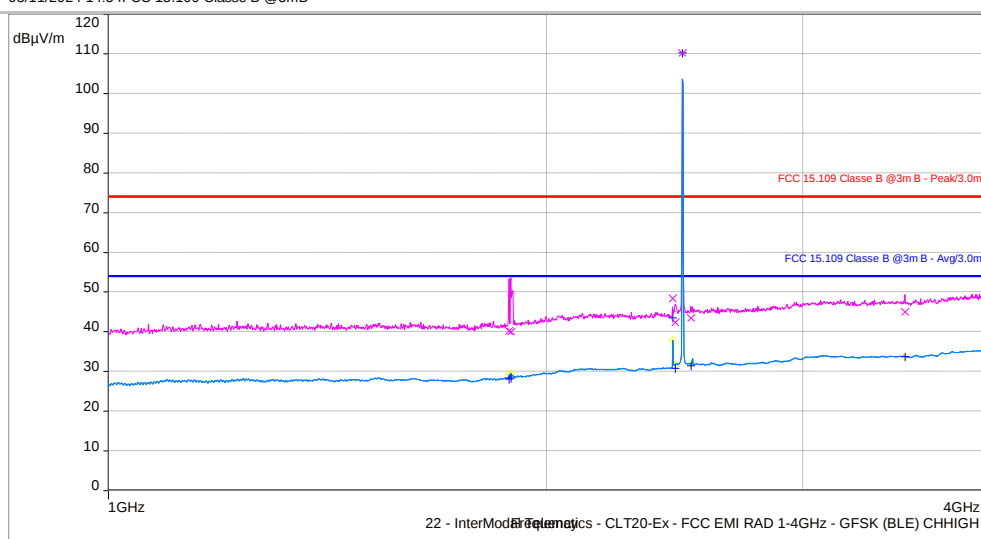
03/11/2024 14:54 FCC 15.109 Classe B @3mB

MIDDLE CHANNEL



03/11/2024 14:54 FCC 15.109 Classe B @3mB

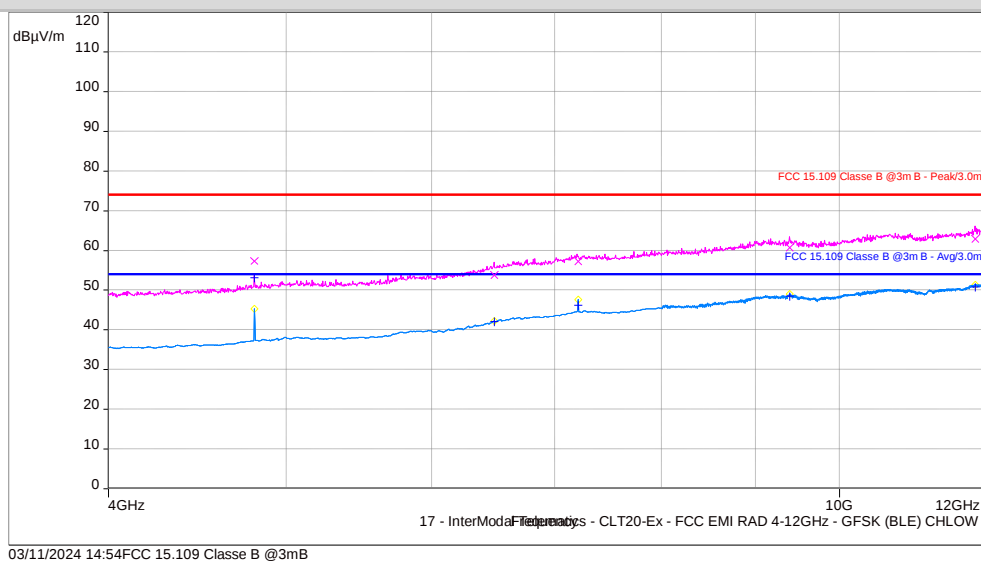
HIGHER CHANNEL



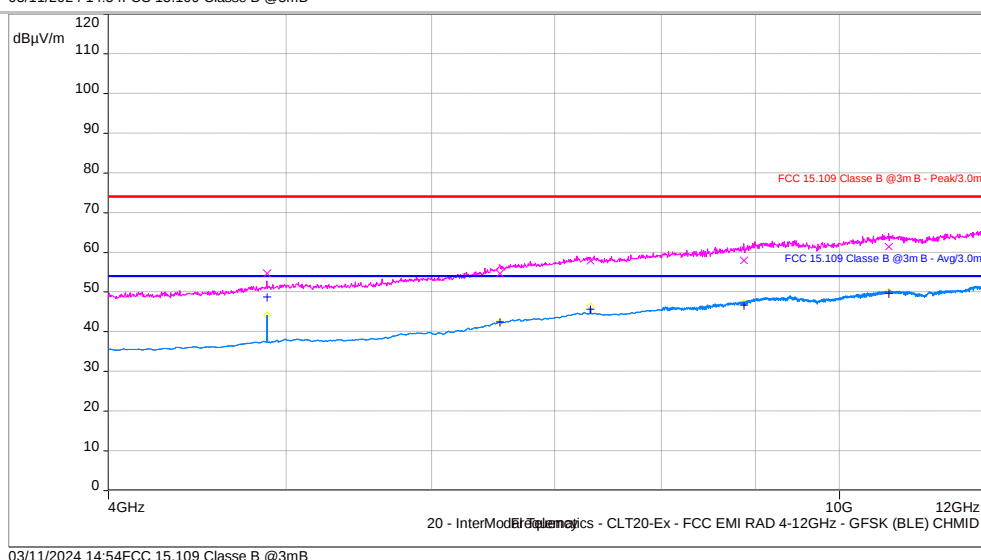
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4÷12 GHz – BLE Measurement result

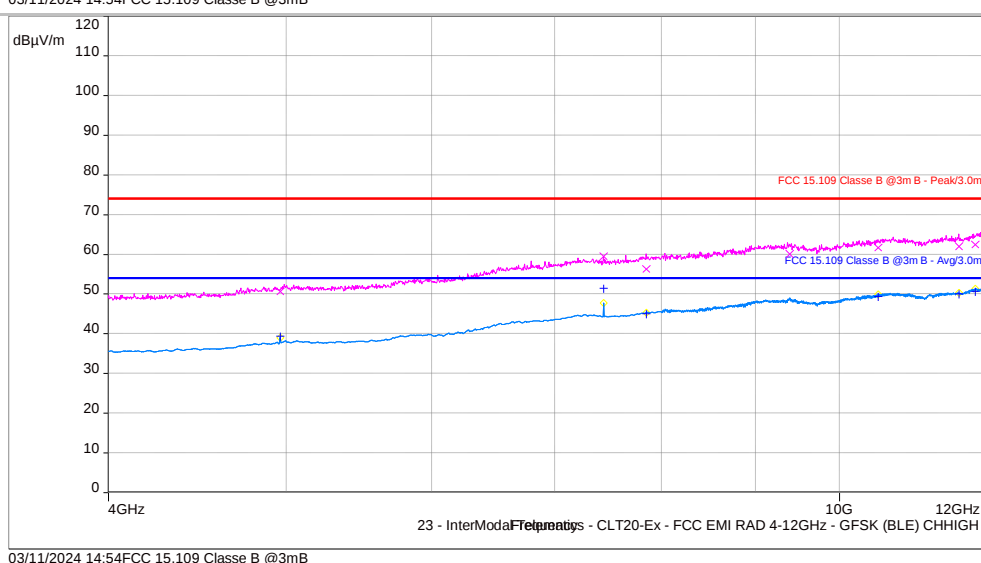
LOWER CHANNEL



MIDDLE CHANNEL

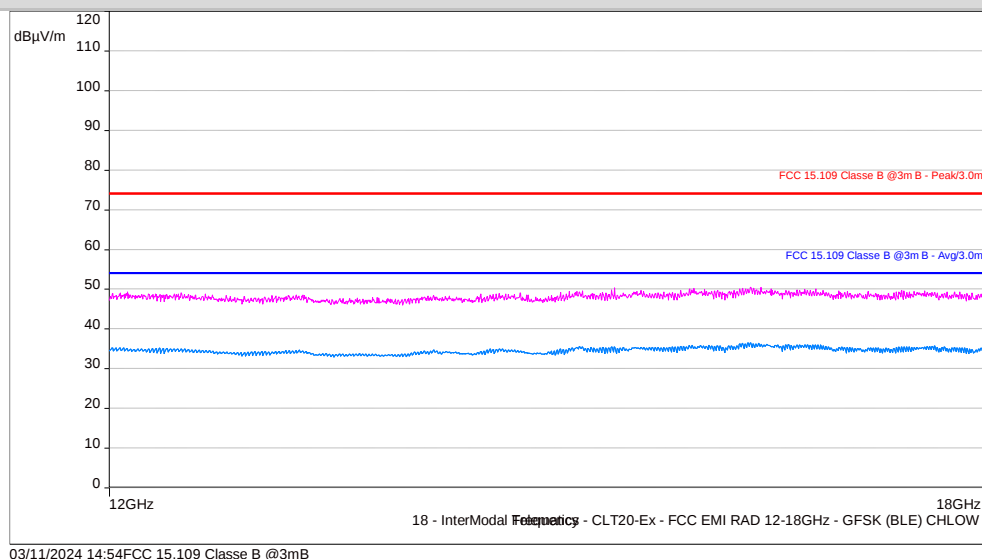


HIGHER CHANNEL

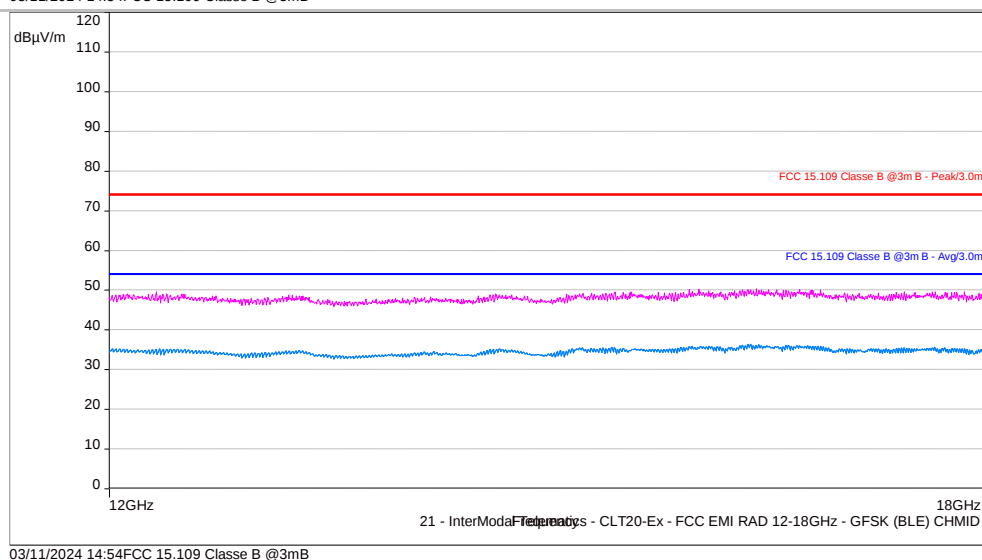


12÷18 GHz – BLE Measurement result

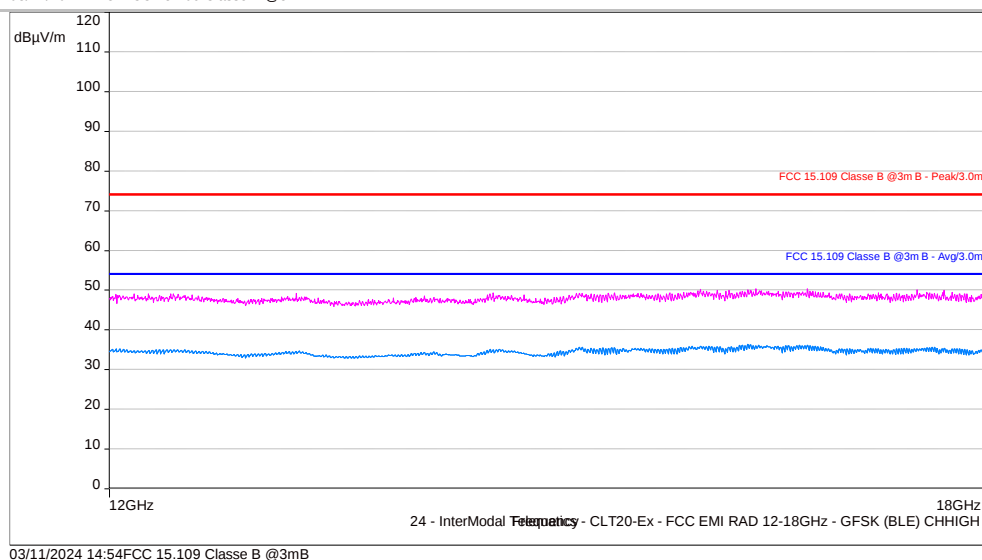
LOWER CHANNEL



MIDDLE CHANNEL

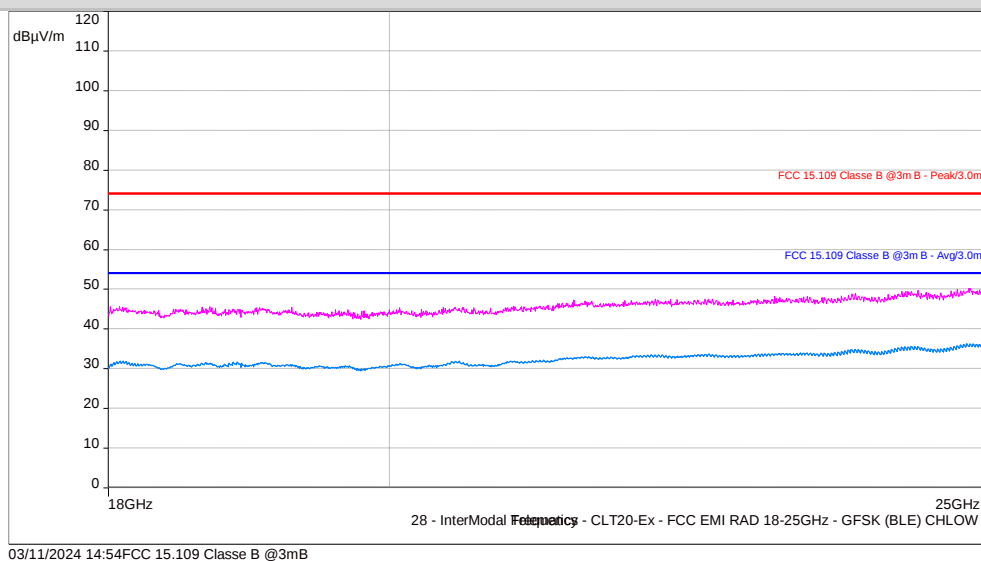


HIGHER CHANNEL

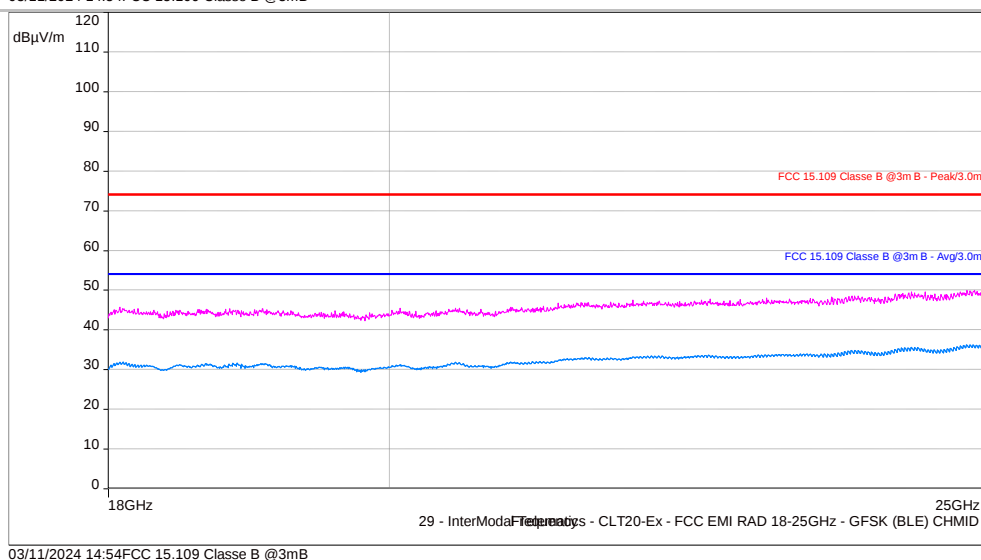


18÷25 GHz –BLE Measurement result

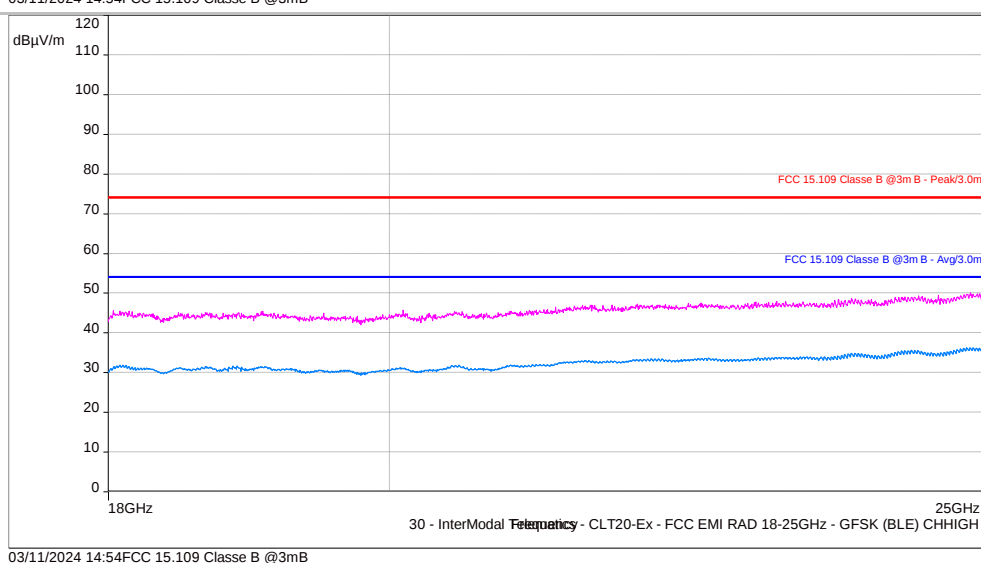
LOWER CHANNEL



MIDDLE CHANNEL

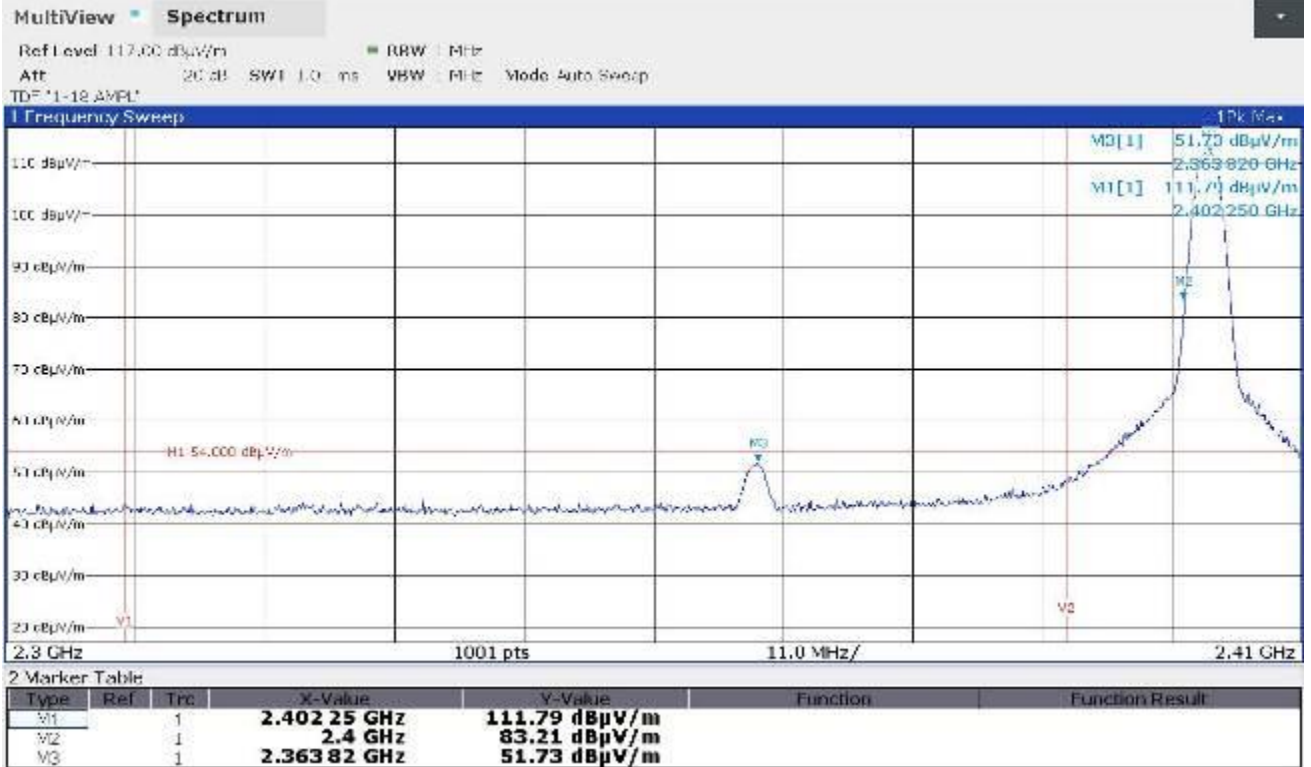


HIGHER CHANNEL

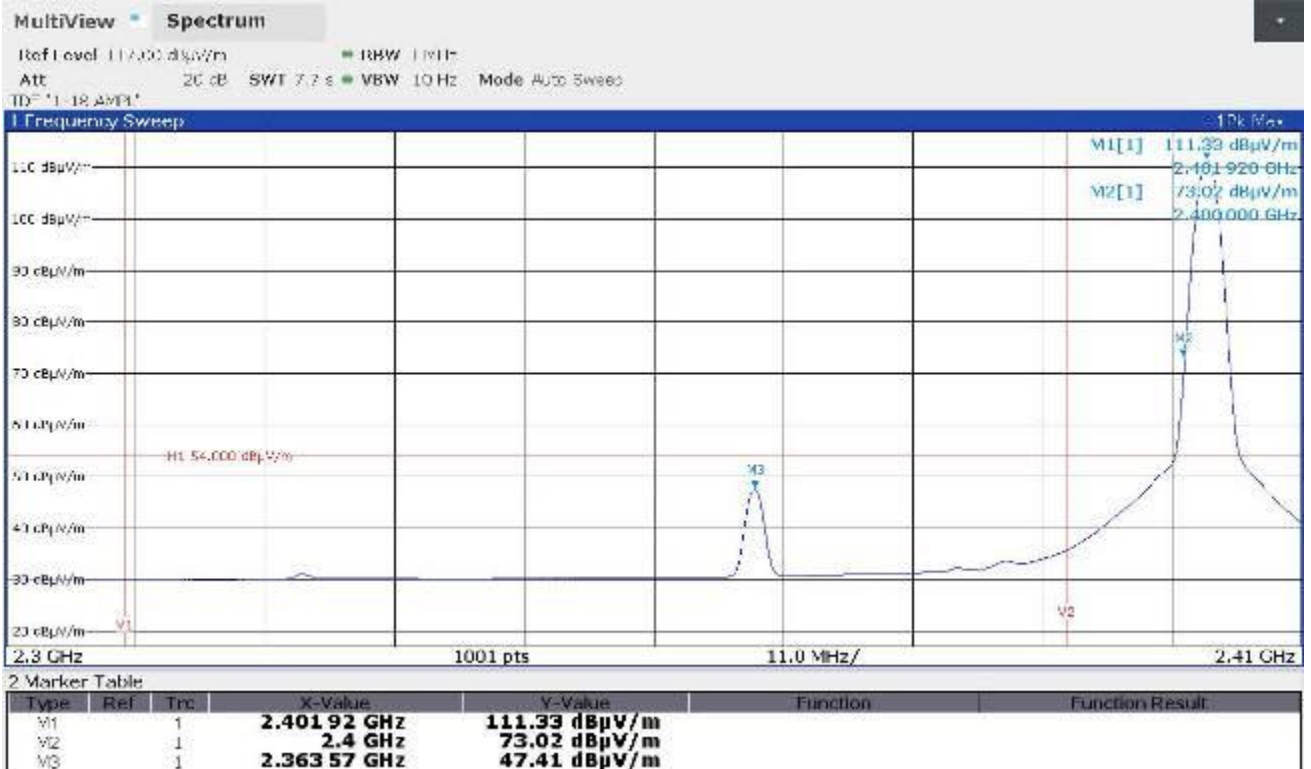


BLE LOWER CHANNEL – BAND-EDGE

PEAK

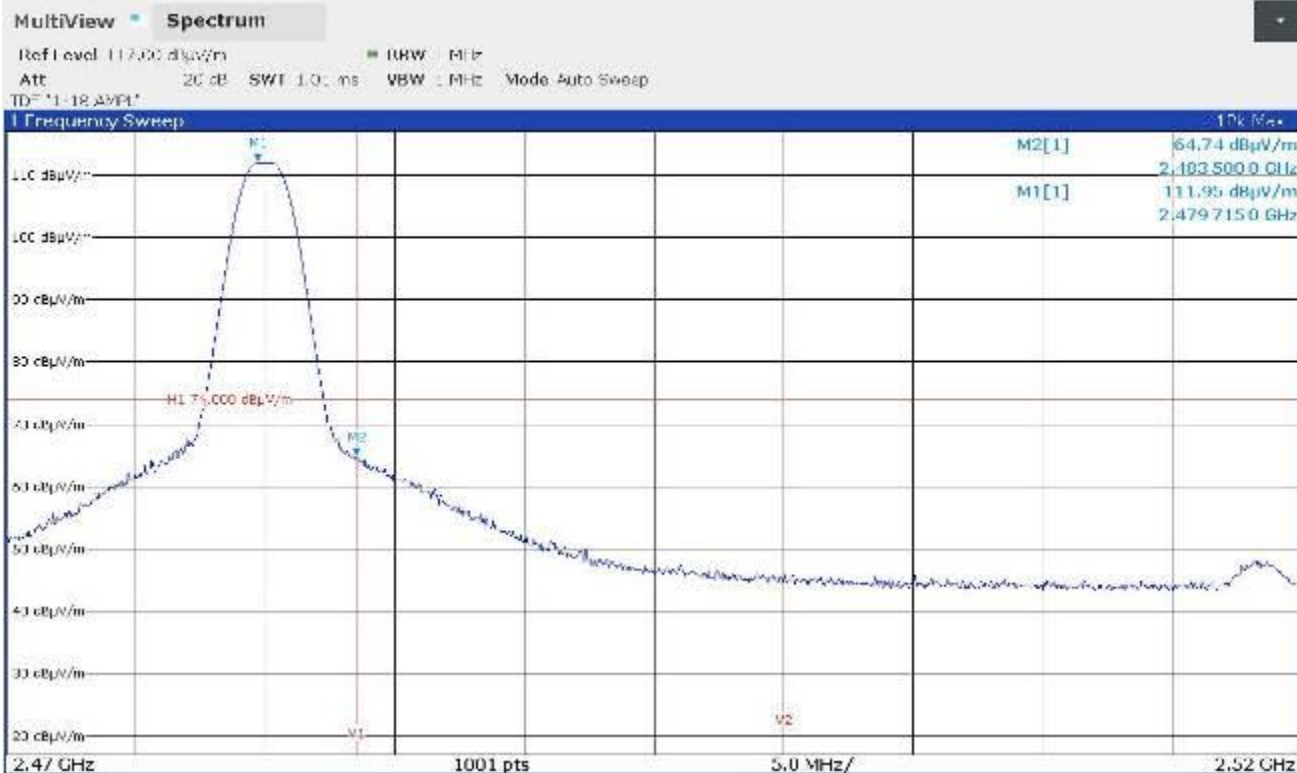


AVERAGE



BLE HIGHER CHANNEL - BAND-EDGE

PEAK



AVERAGE



7.4 6dB & 99% BANDWIDTH

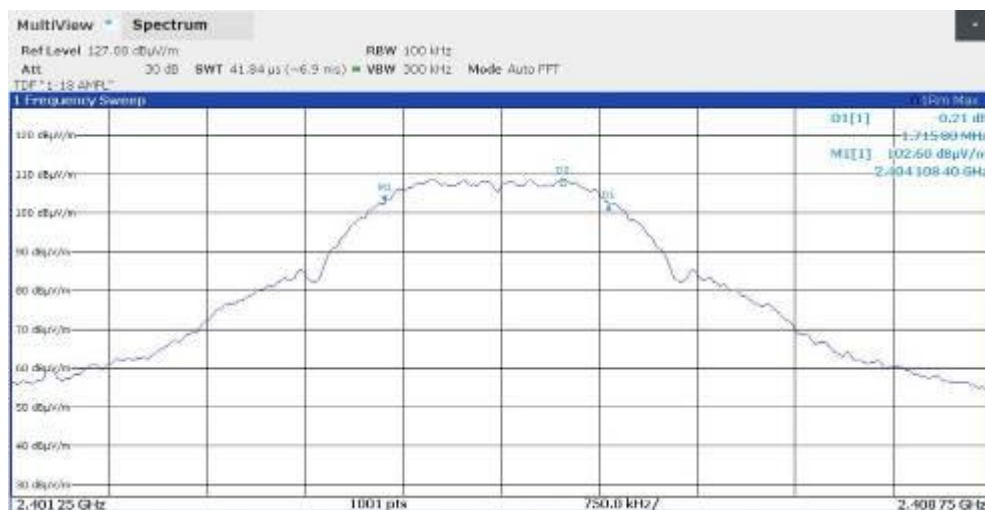
TEST REQUIREMENT	
Spectrum analyzer settings	
Test setup	ANSI C63.10 (clause 11.8)
Span	Wide enough for the measurement to be made
Resolution bandwidth (RBW)	100 kHz
Video bandwidth (VBW)	300 kHz
Sweep time (SWT)	AUTO
Detector function	Peak
Trace	Max hold
EUT operating condition	1 to 9
Remark	None
Testing dates	2024-03-13

TEST RESULT
The EUT meets the requirements of sections 15.247 (a)(2).

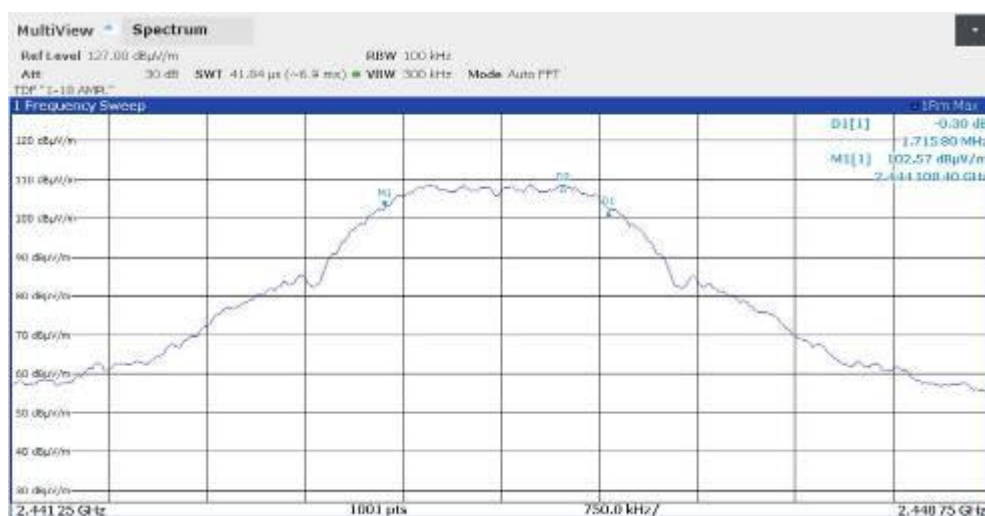
TEST PROCEDURE
The Channel bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6 dB. For 99% BW was used the measurement facility function of spectrum analyzer.

Modulation	Channel	Frequency	-6dB Bandwidth (MHz)
O-QPSK (IEEE 802.15.4)	Lower	2405	1.7158
	Middle	2445	1.7158
	Higher	2480	1.7158

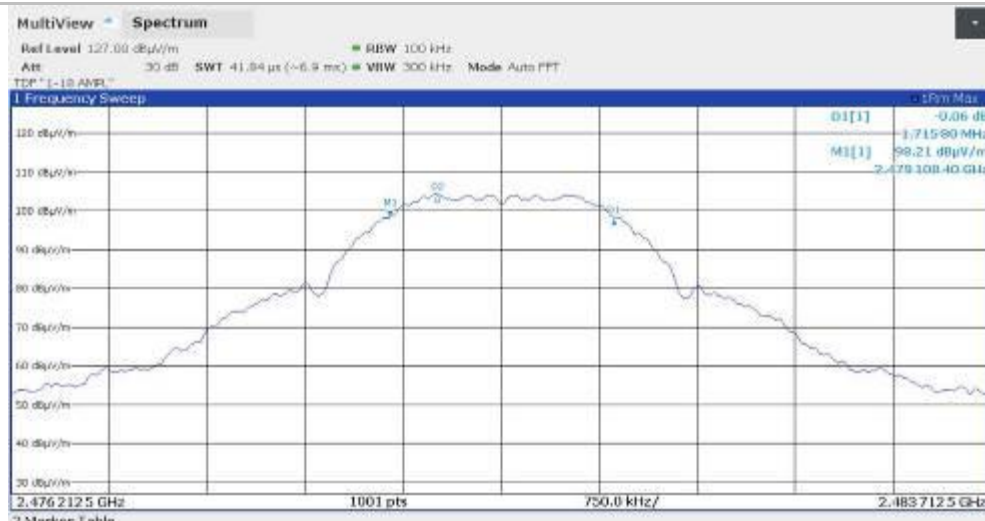
LOWER CHANNEL



MIDDLE CHANNEL

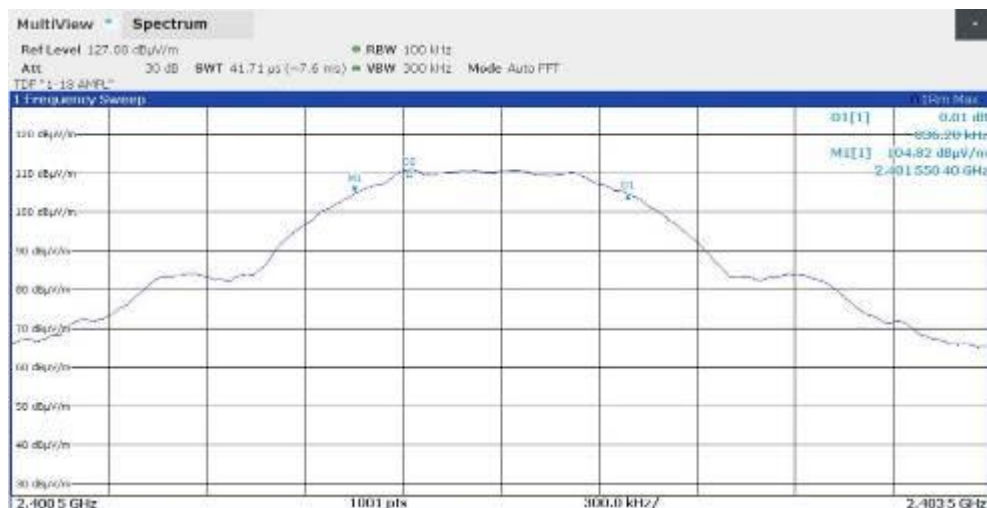


HIGHER CHANNEL

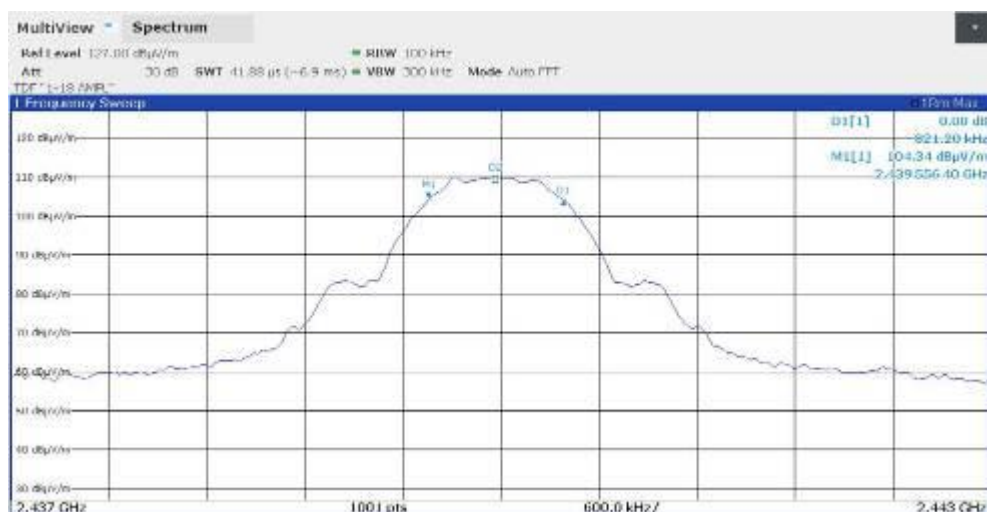


Modulation	Channel	Frequency	-6dB Bandwidth (MHz)
GFSK (BLE 1Mbit/s)	Lower	2402	0.8362
	Middle	2440	0.8212
	Higher	2480	0.8067

LOWER CHANNEL



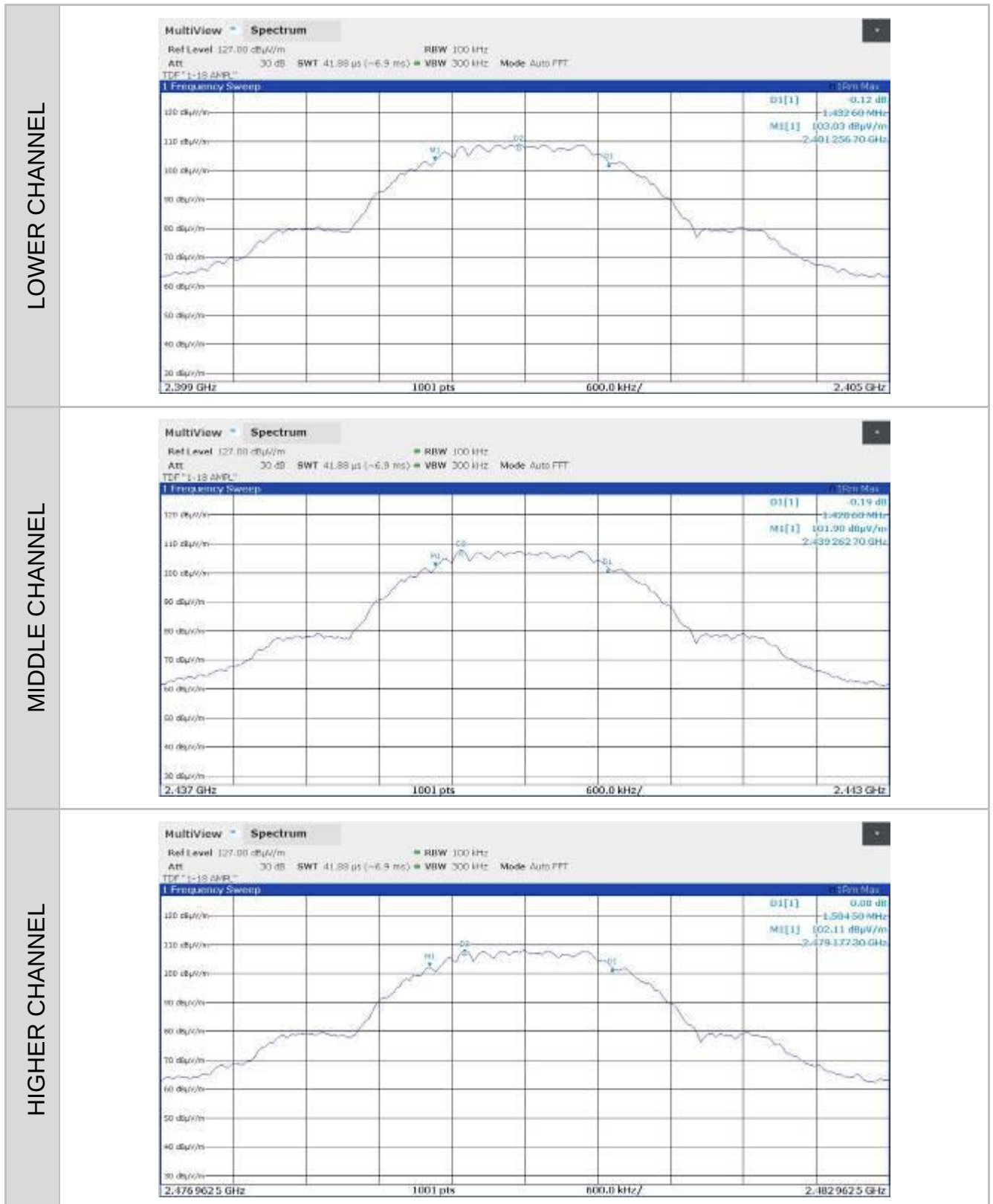
MIDDLE CHANNEL



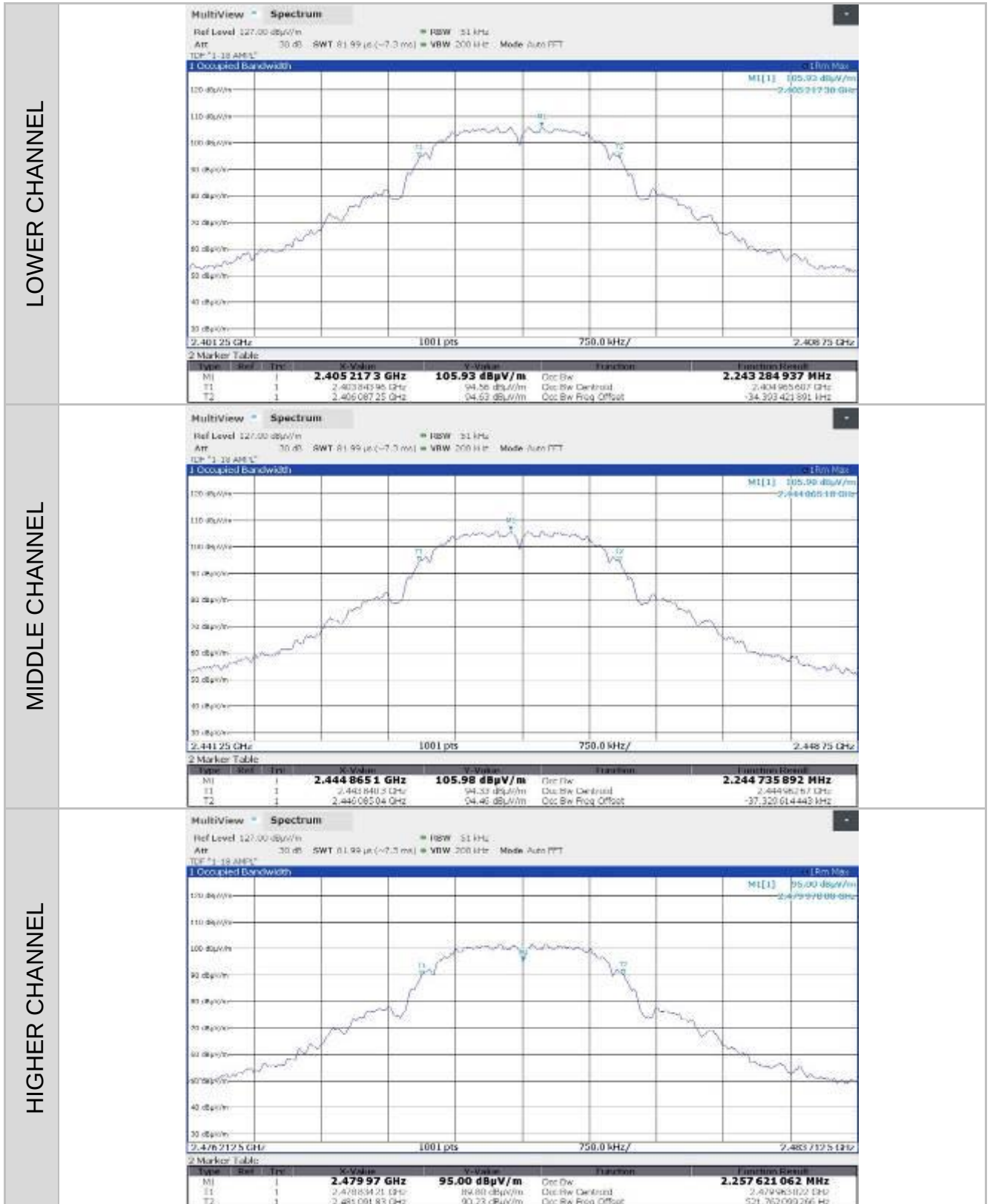
HIGHER CHANNEL



Modulation	Channel	Frequency	-6dB Bandwidth (MHz)
GFSK (BLE 2Mbit/s)	Lower	2402	1.4326
	Middle	2440	1.4206
	Higher	2480	1.5045



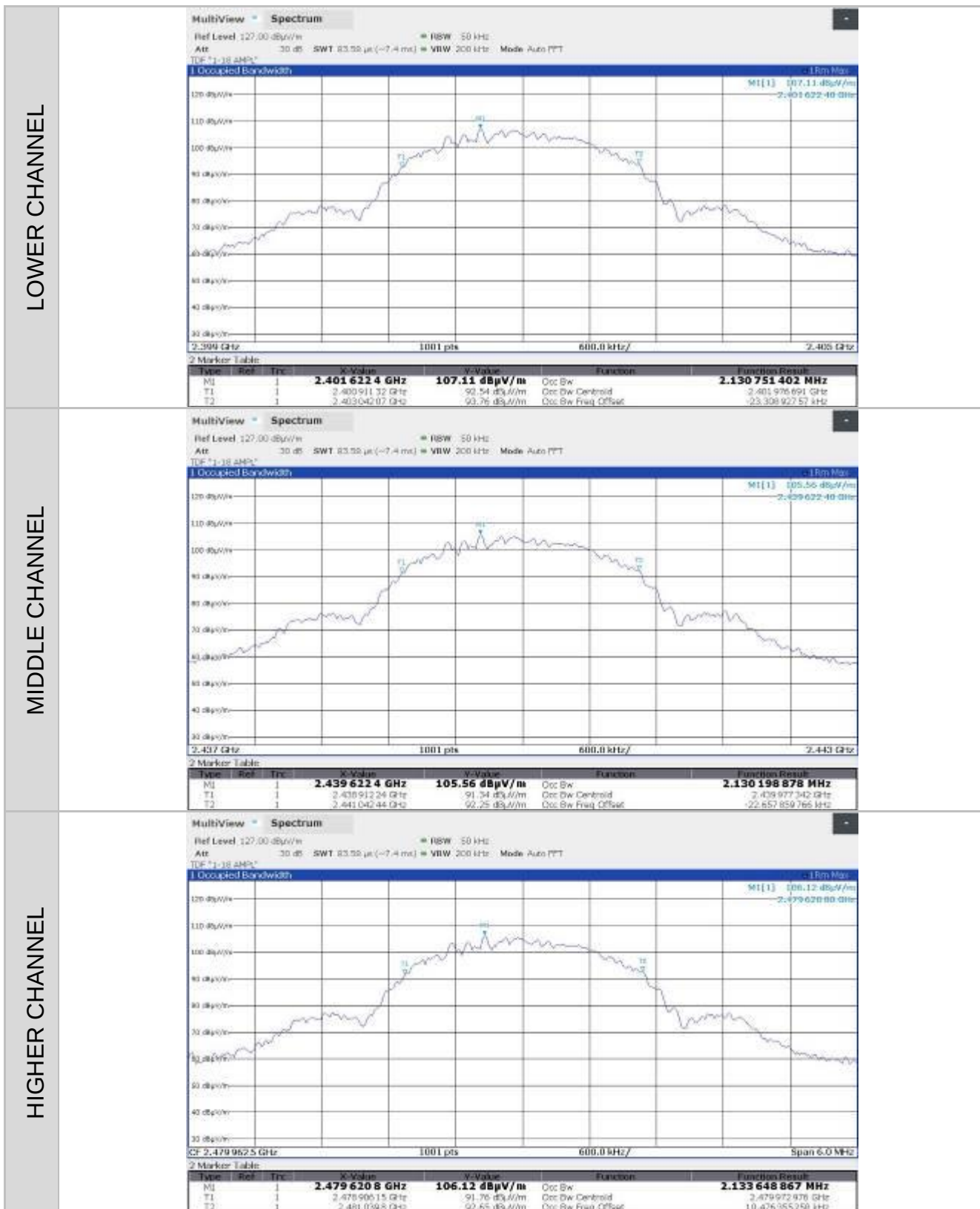
Modulation	Channel	Frequency	99% Bandwidth (MHz)
O-QPSK (IEEE 802.15.4)	Lower	2405	2.243284937
	Middle	2445	2.444735892
	Higher	2480	2.257621062



Modulation	Channel	Frequency	99% Bandwidth (MHz)
GFSK (BLE 1Mbit/s)	Lower	2402	1.085809349
	Middle	2440	1.085523297
	Higher	2480	1.088136393



Modulation	Channel	Frequency	99% Bandwidth (MHz)
GFSK (BLE 2Mbit/s)	Lower	2402	2.130751402
	Middle	2440	2.130198878
	Higher	2480	2.133648867



7.5 MAXIMUM PEAK CONDUCTED OUTPUT POWER

TEST REQUIREMENT	
Spectrum analyzer settings	
Test setup	ANSI C63.10 (clause 11.9)
Resolution bandwidth (RBW)	>20dB BW of the emission being measured
Video bandwidth (VBW)	$\geq$ RBW
Sweep time (SWT)	AUTO
Detector function	Peak
Trace	Max hold
EUT operating condition	1 to 6 in CW mode
Remark	None
Testing dates	2024-03-14

TEST RESULT
The EUT meets the requirements of sections 15.247 (b) (3).

LIMITS
0,125 Watt (21dBm)

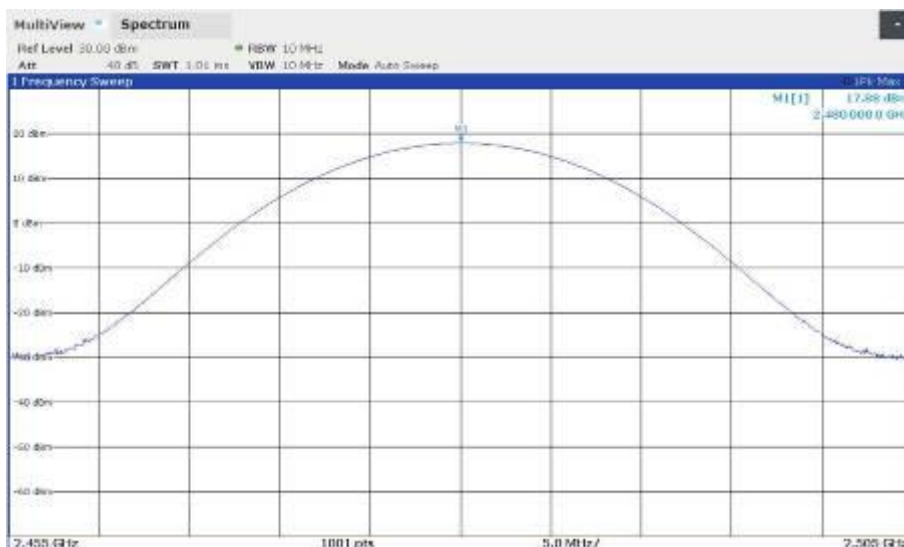
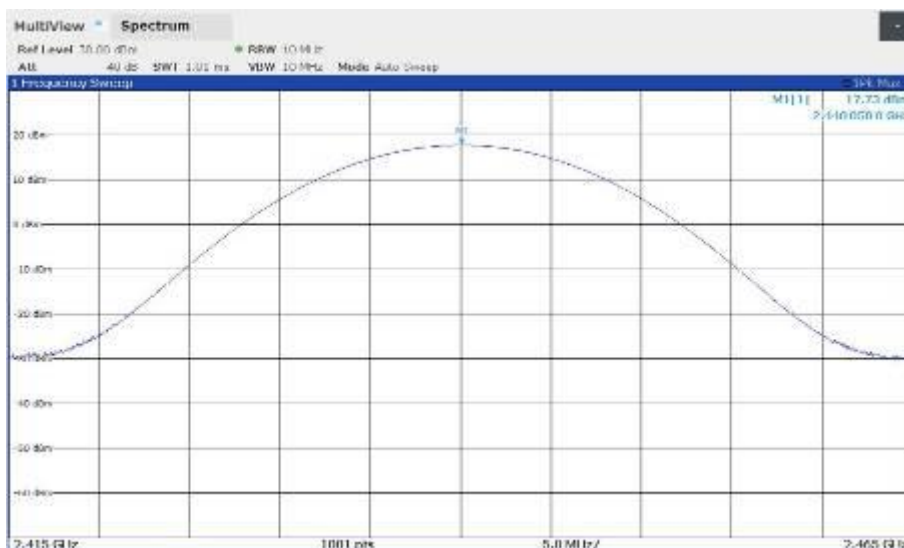
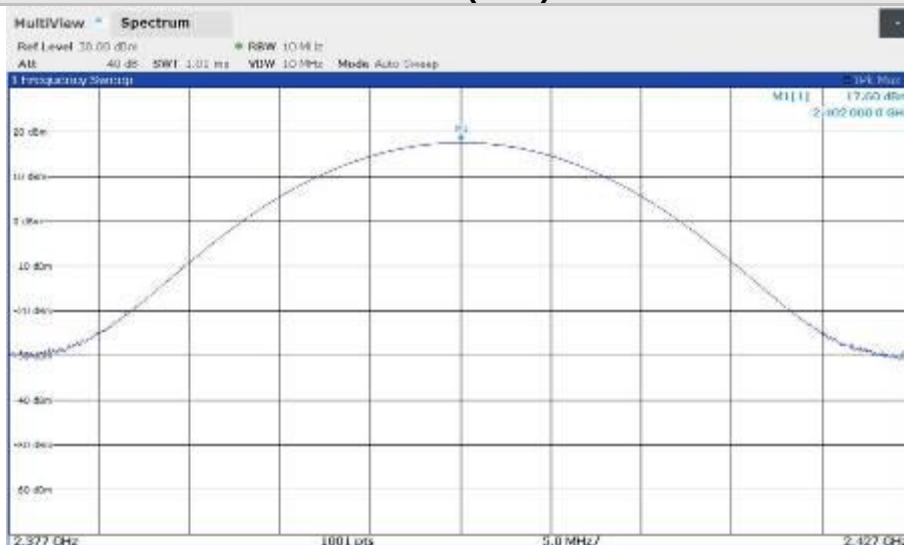
Conducted measurements test procedure
The EUT RF output port is connected directly to RF input port of spectrum analyzer by short RF pigtail adapter. Set the EUT to work at lower, middle and higher channel. With a SPAN of about five times the measured -20dB BW and centered on a channel, wait until the trace has stabilized and set the marker to the peak of emission.

MEASURED CONDUCTED OUTPUT POWER				
Test Mode	Test Channel	Peak Power (dBm)	Limits (dBm)	Result
O-QPSK (IEEE 802.15.4)	Lower	17.73	≤ 30	Pass
	Middle	17.77	≤ 30	Pass
	Higher	17.86	≤ 30	Pass
GFSK (BLE)	Lower	17.60	≤ 30	Pass
	Middle	17.72	≤ 30	Pass
	Higher	17.88	≤ 30	Pass

O-QPSK (IEEE 802.15.4)



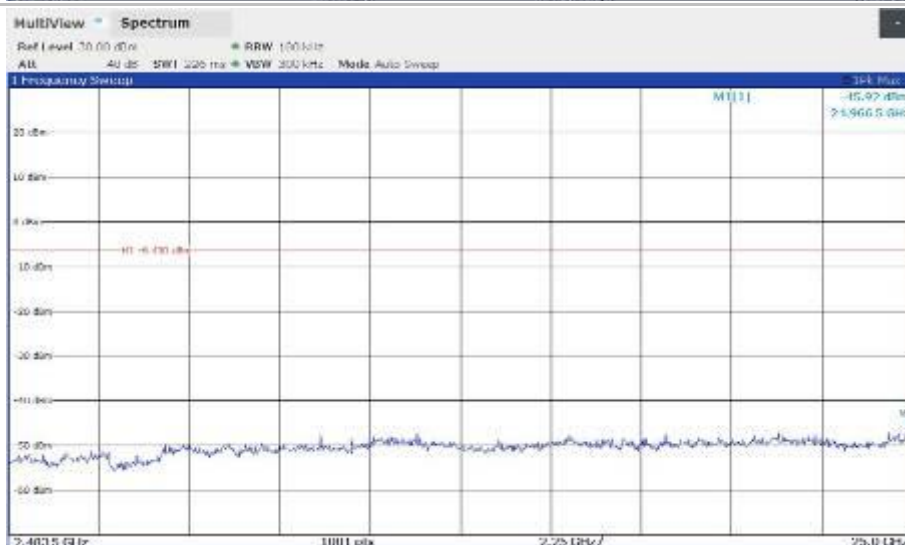
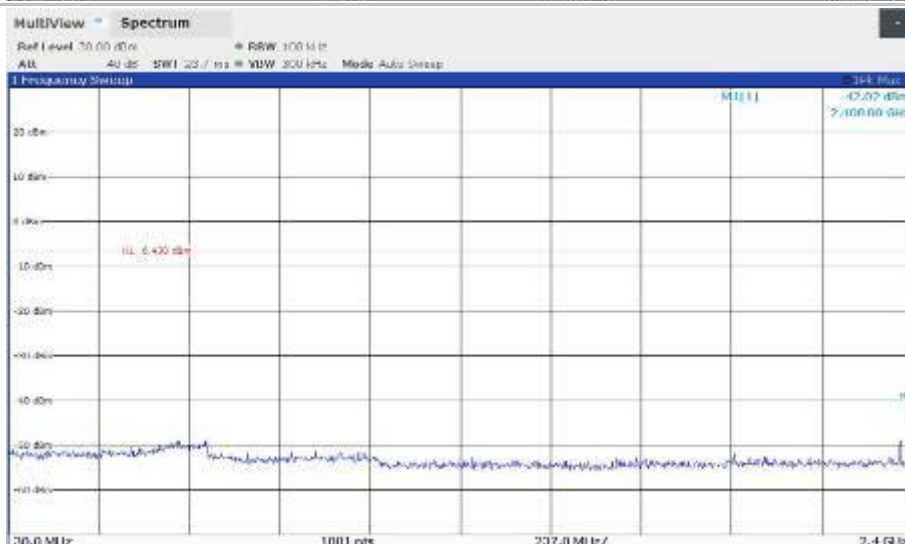
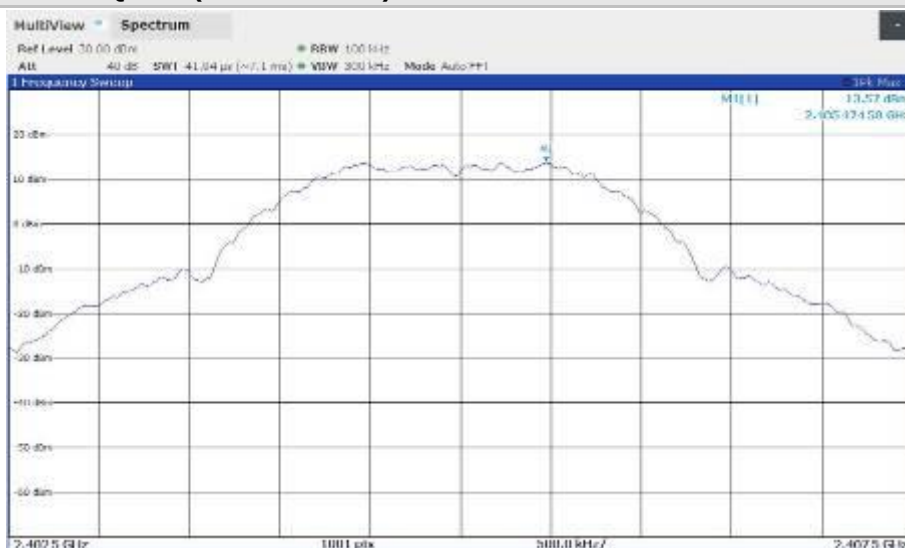
GFSK (BLE)



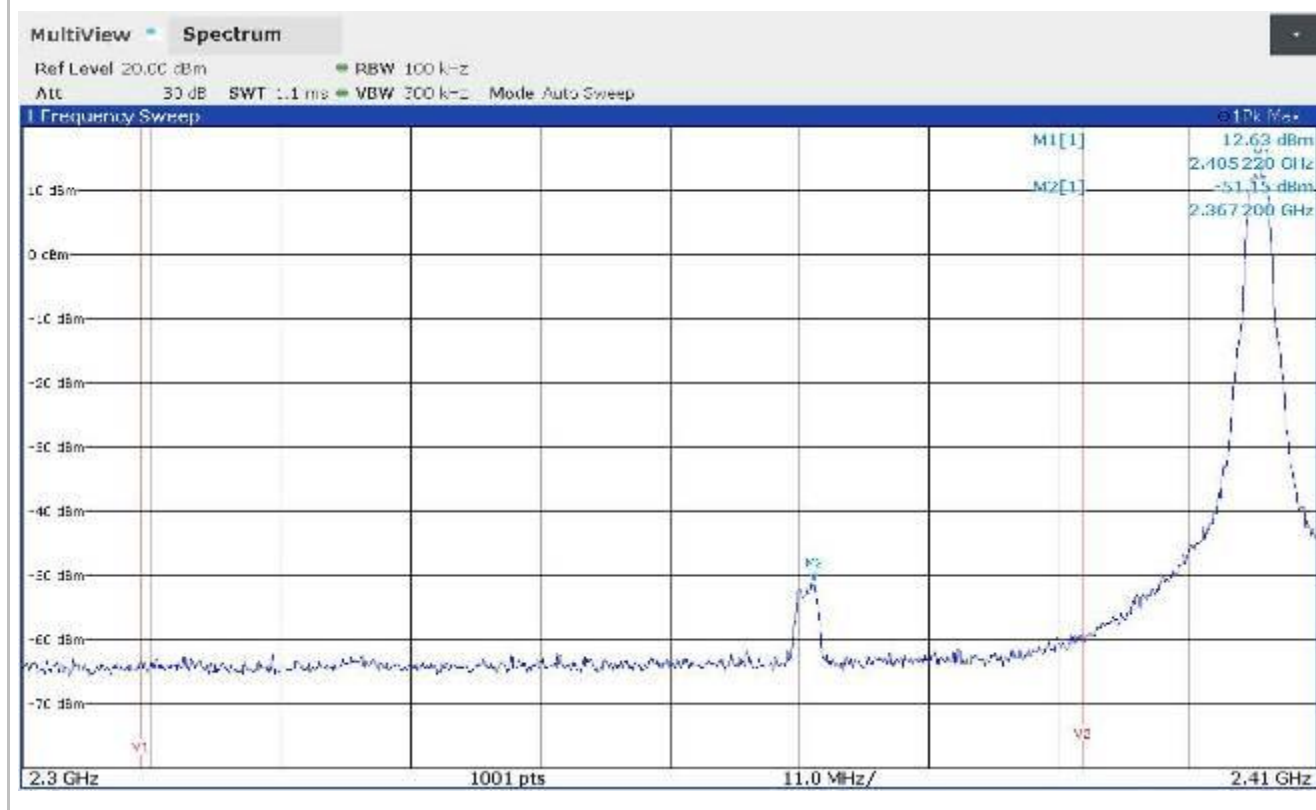
7.6 100kHz EMISSIONS OUTSIDE THE FREQUENCY BAND

TEST REQUIREMENT	
Spectrum analyzer settings	
Test setup	ANSI C63.10 (clause 11.11)
Resolution bandwidth (RBW)	100 kHz
Video bandwidth (VBW)	300 kHz
Sweep time (SWT)	Auto
Detector function	Peak
Trace	Max hold
EUT operating condition	1 to 6
Testing dates	2024-03-14
TEST PROCEDURE	
The EUT RF output port is connected directly to RF input port of spectrum analyzer by short RF pigtail adapter. Set the EUT to work at lower, middle and higher channel. With a SPAN adjusted as necessary to best identify the center of each individual channel, wait until the trace has stabilized and set the markers to the peak of affected frequencies emission.	
LIMITS	
-20dBc below peak output power	
TEST RESULT	
All out of band spurious emissions are more -20dBc of the in-band power of the fundamental. The EUT meets the requirements of sections 15.247 (d).	

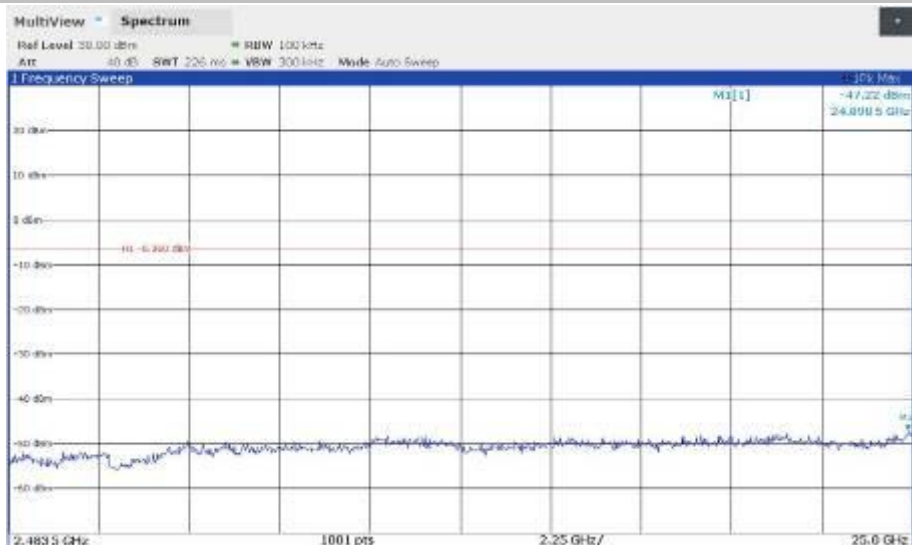
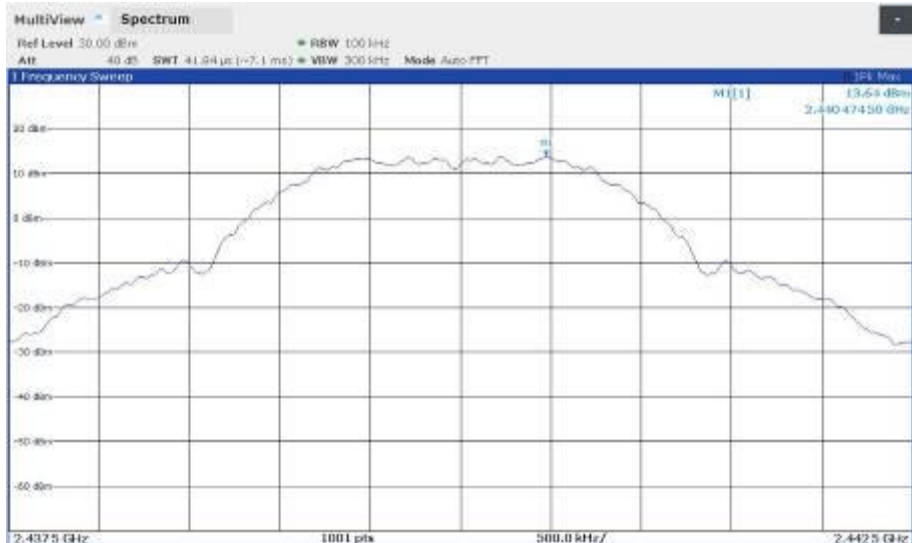
O-QPSK (IEEE 802.15.4) MODULATION LOWER CHANNEL



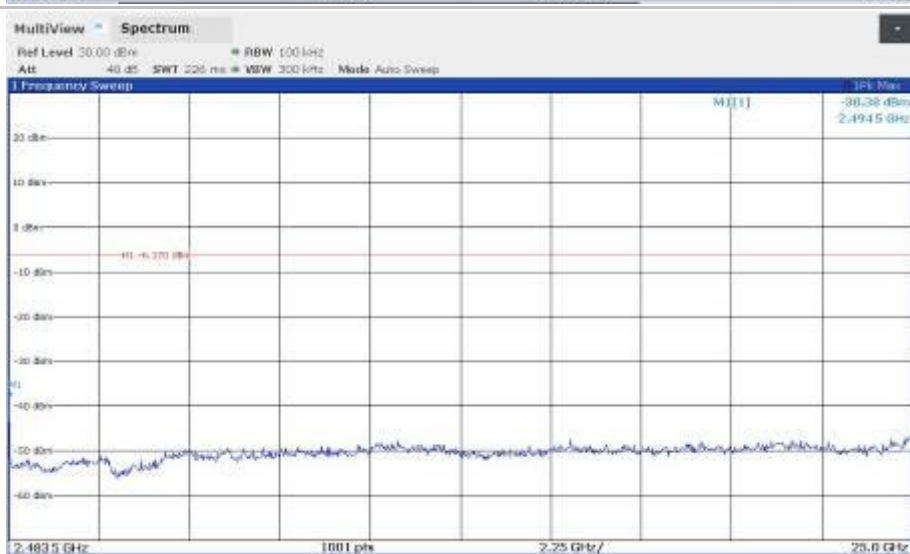
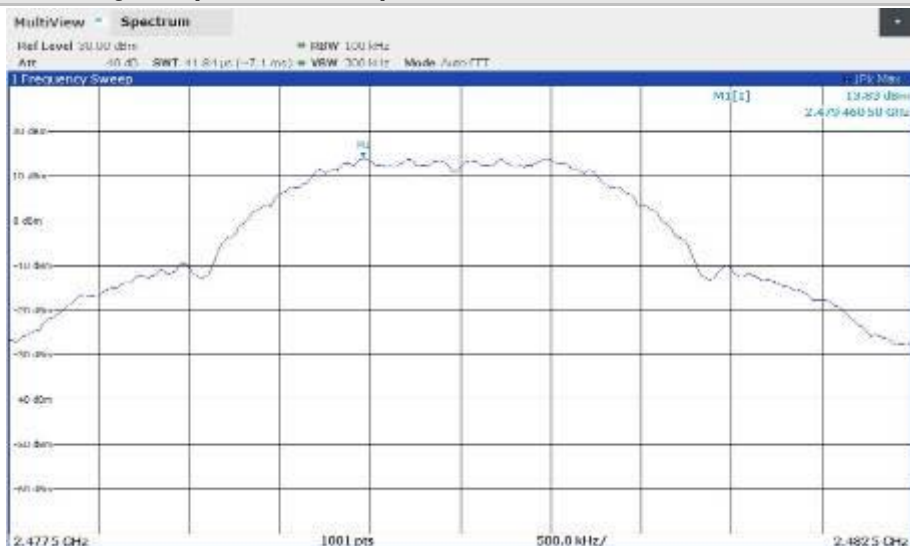
O-QPSK (IEEE 802.15.4) MODULATION LOWER CHANNEL – PEAK BAND-EDGE



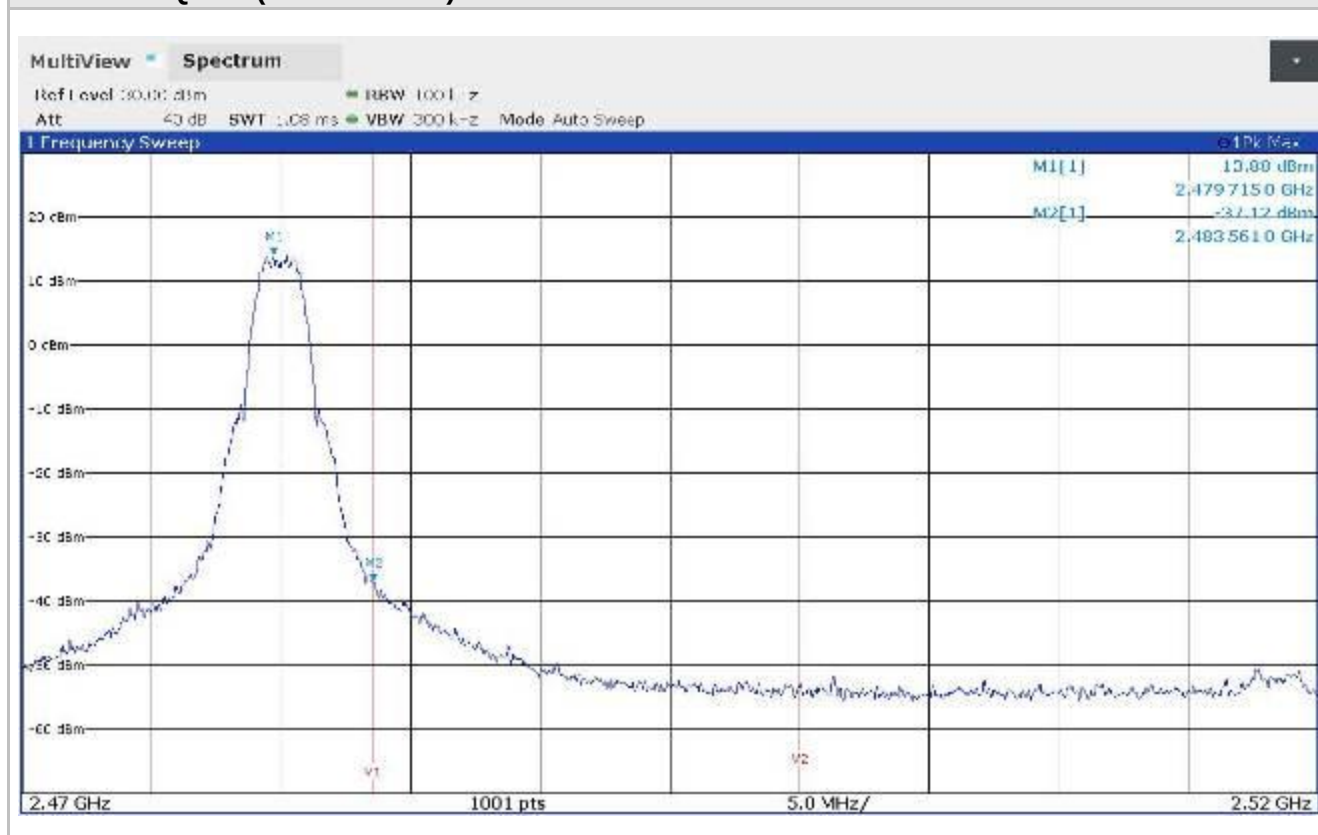
O-QPSK (IEEE 802.15.4) MODULATION MIDDLE CHANNEL



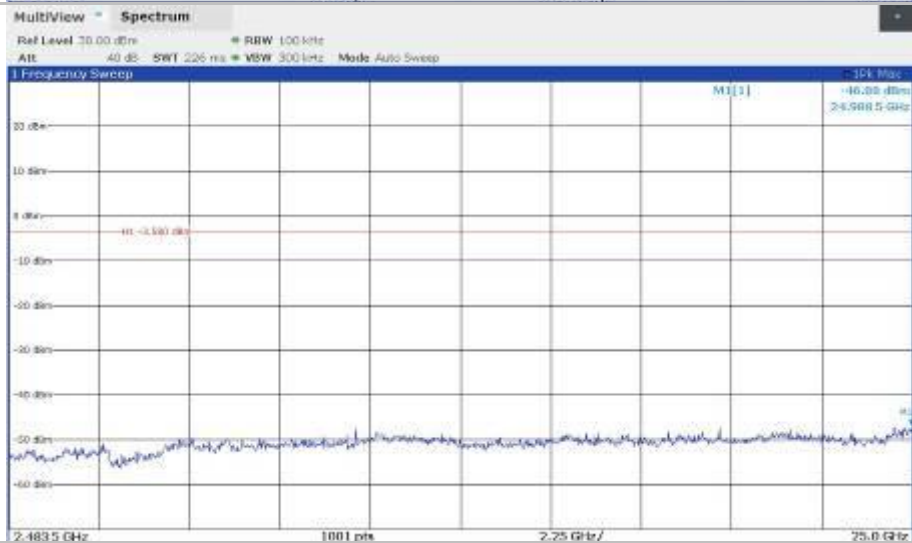
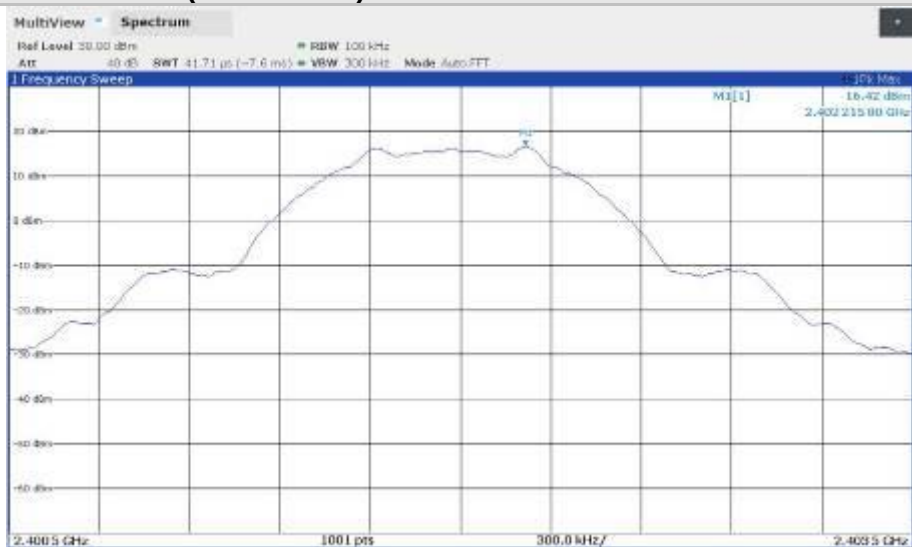
O-QPSK (IEEE 802.15.4) MODULATION HIGHER CHANNEL



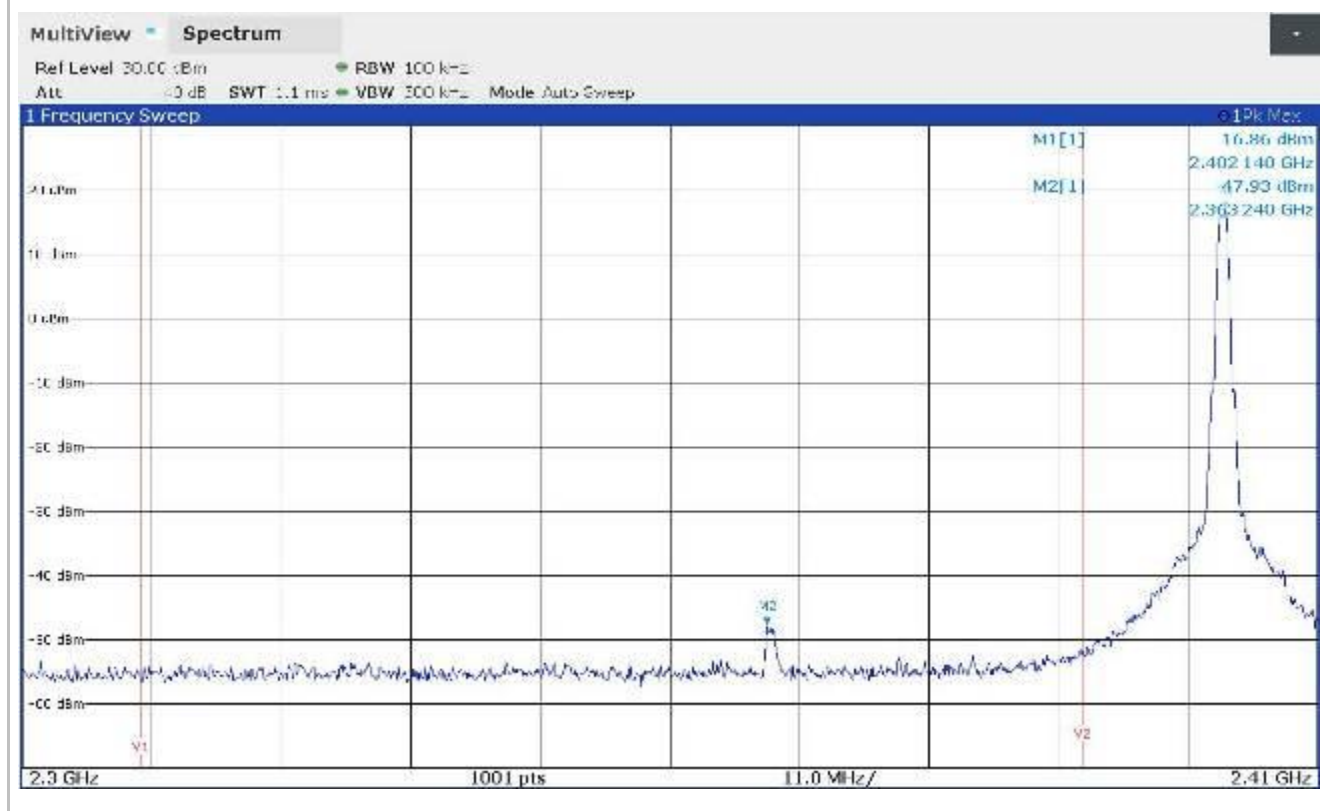
O-QPSK (IEEE 802.15.4) MODULATION HIGHER CHANNEL – PEAK BAND-EDGE



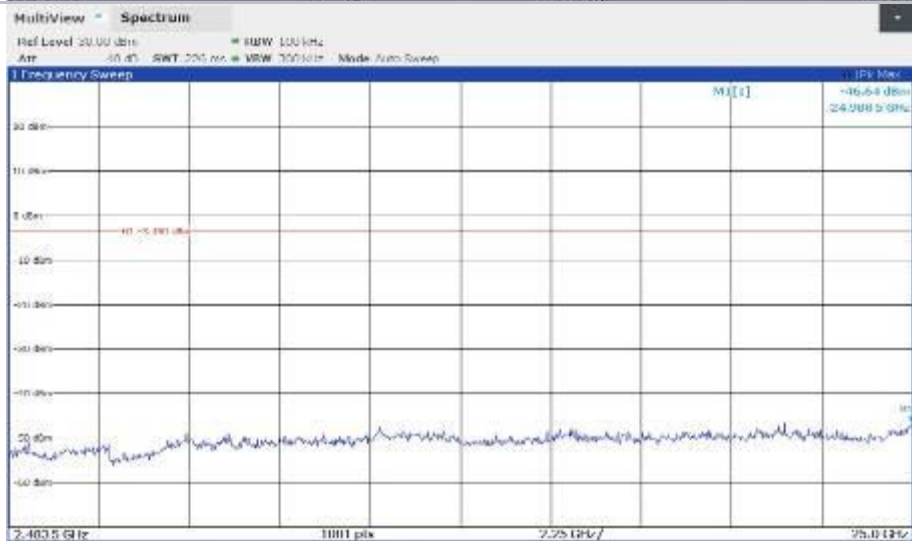
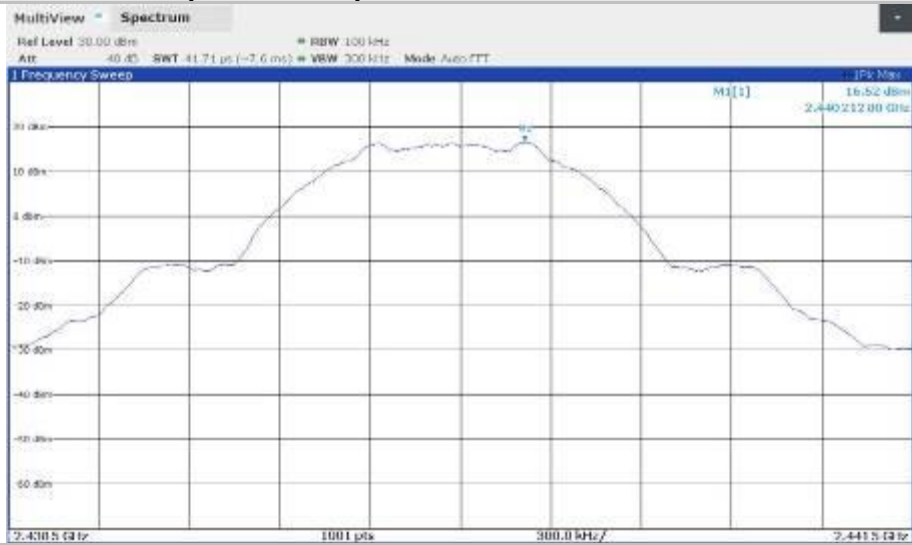
GFSK (BLE 1Mbit/s) MODULATION LOWER CHANNEL



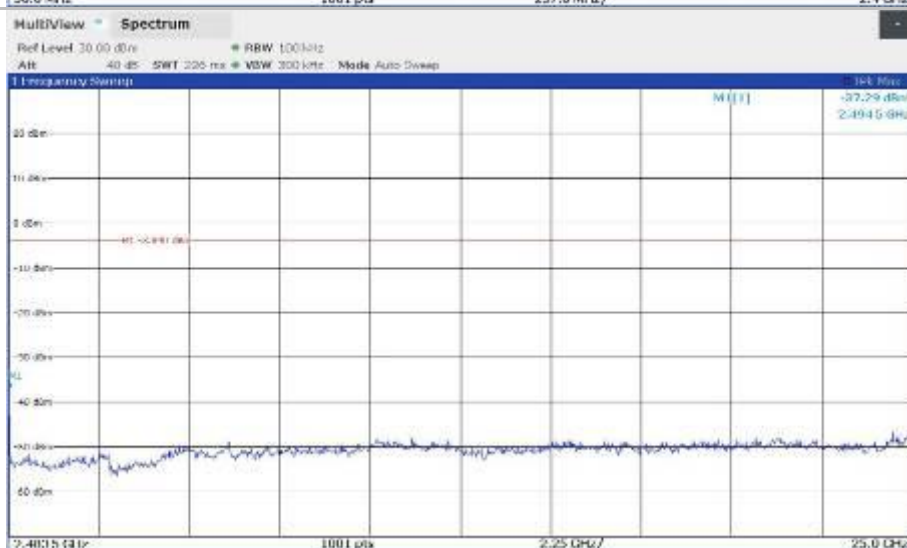
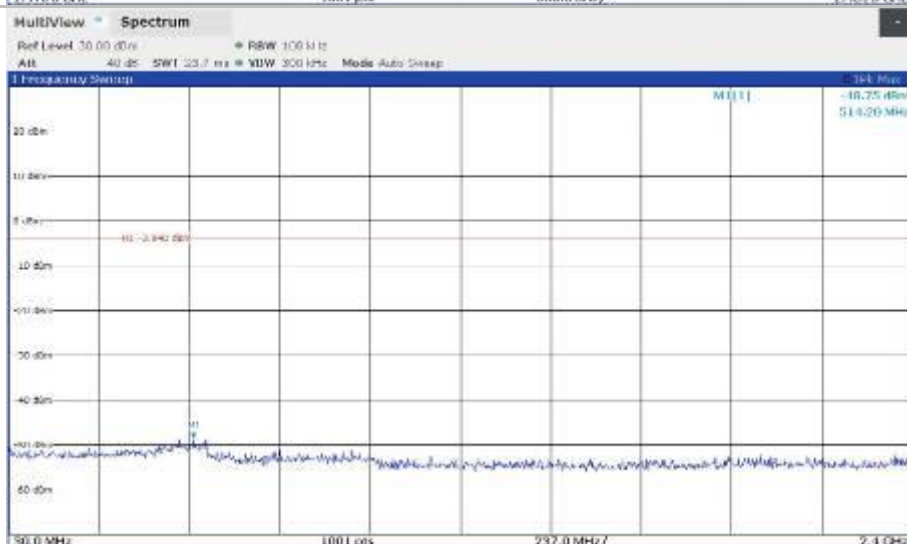
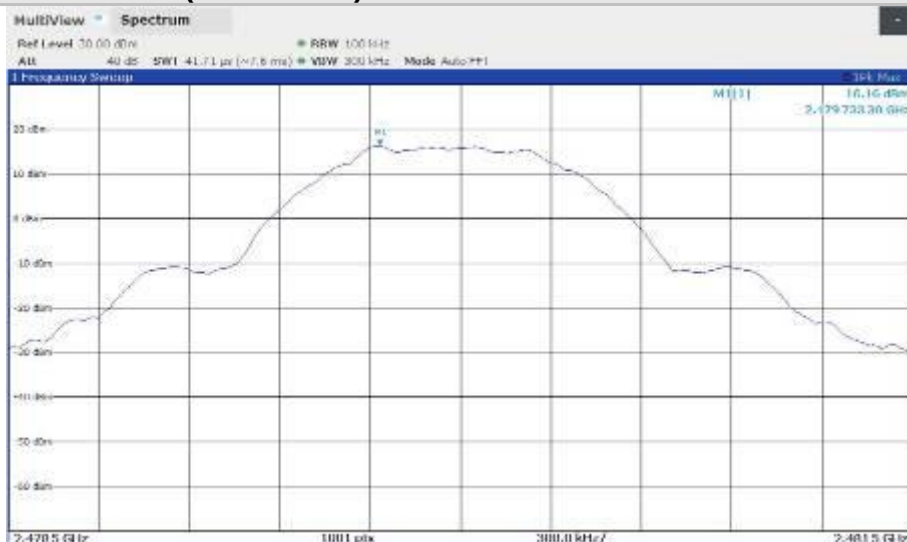
GFSK (BLE 1Mbit/s) MODULATION LOWER CHANNEL – PEAK BAND-EDGE



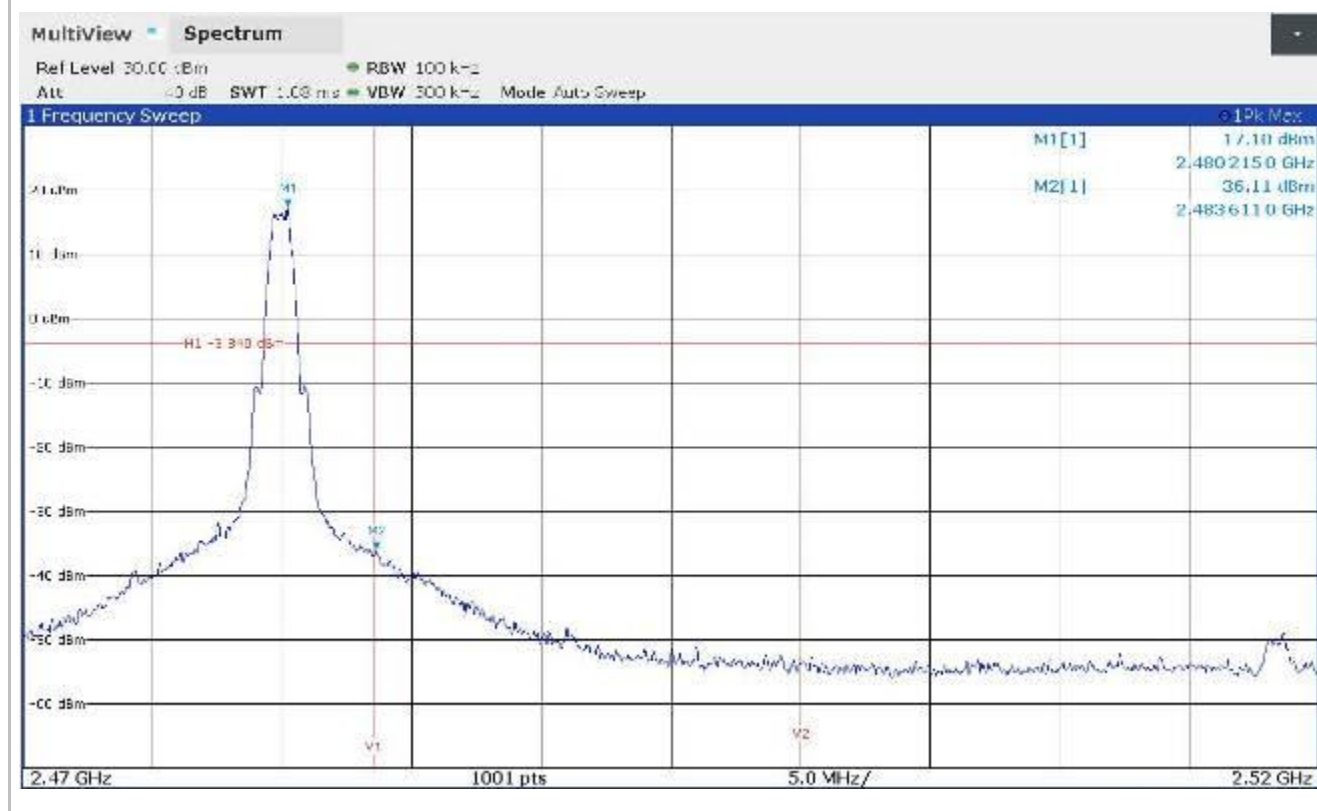
GFSK (BLE 1Mbit/s) MODULATION MIDDLE CHANNEL



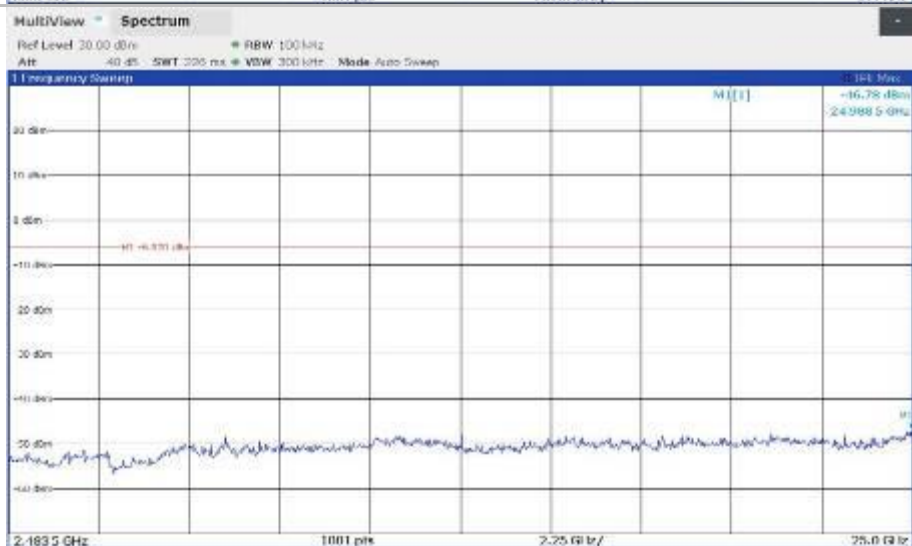
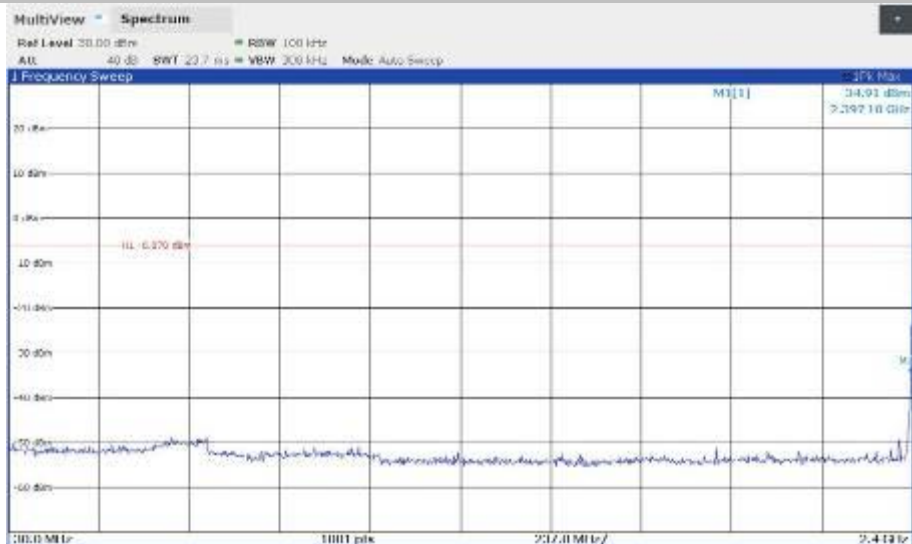
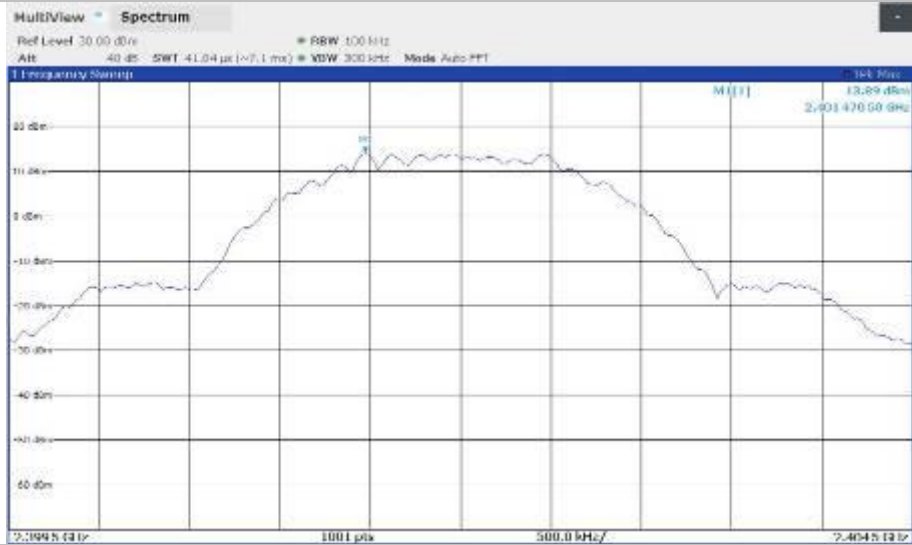
GFSK (BLE 1Mbit/s) MODULATION HIGHER CHANNEL



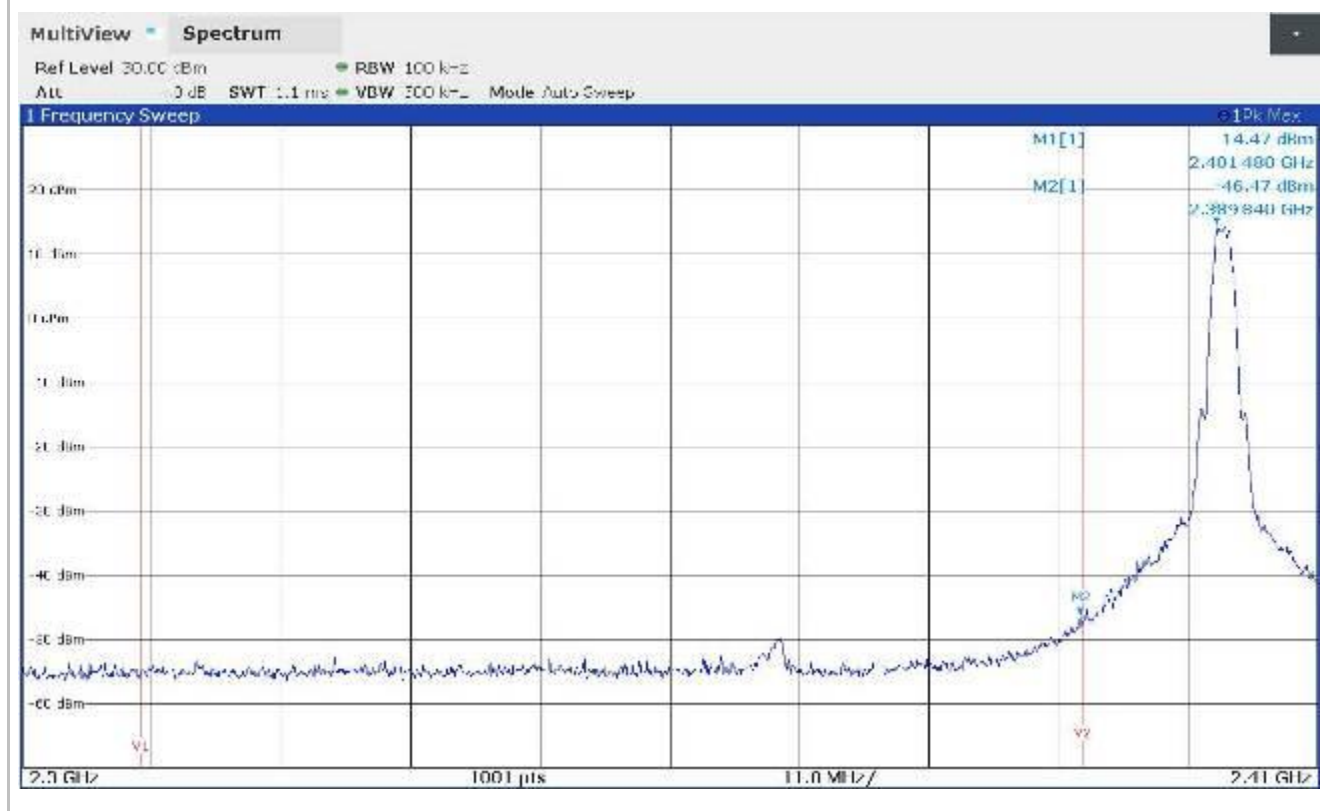
GFSK (BLE 1Mbit/s) MODULATION HIGHER CHANNEL – PEAK BAND-EDGE



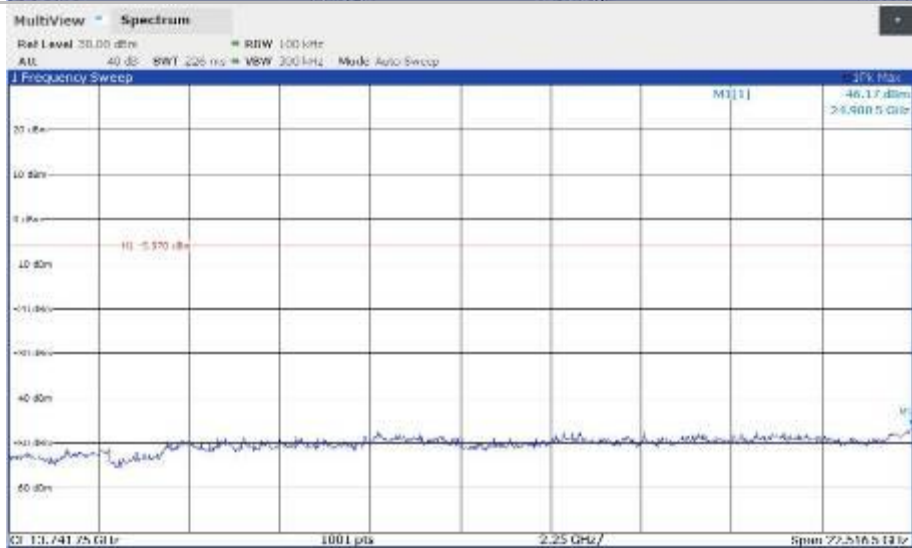
GFSK (BLE 2Mbit/s) MODULATION LOWER CHANNEL



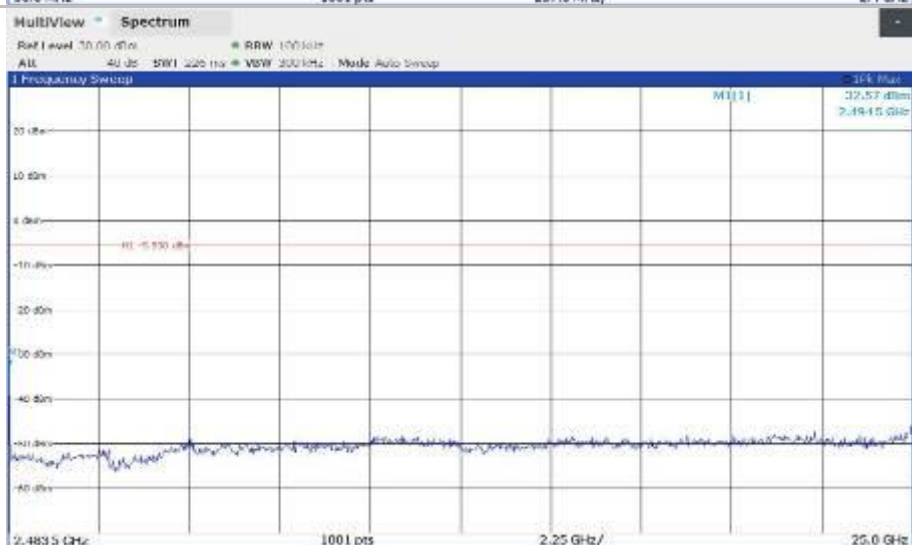
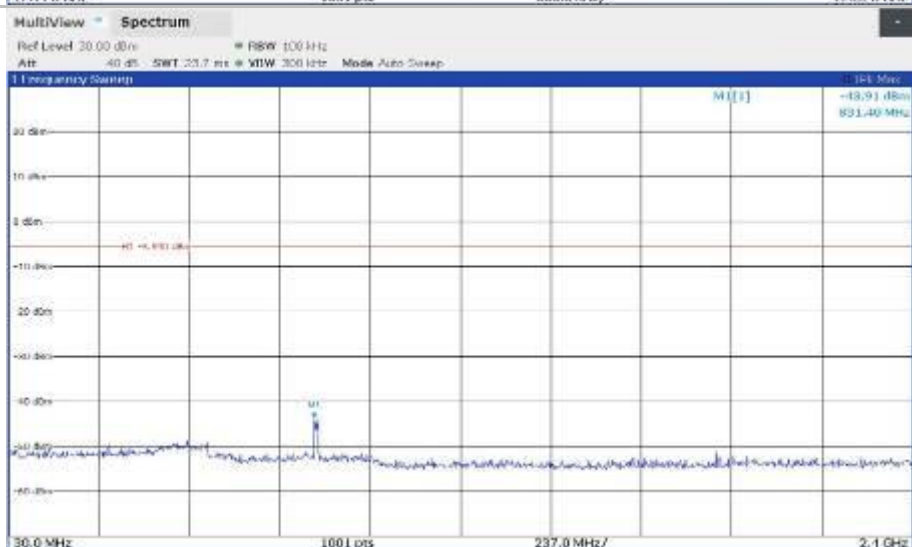
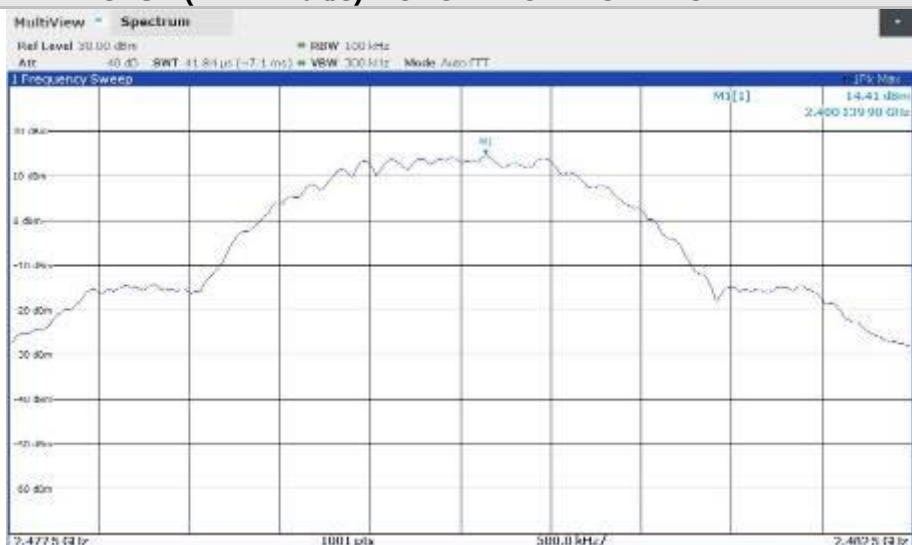
GFSK (BLE 2Mbit/s) MODULATION LOWER CHANNEL – PEAK BAND-EDGE



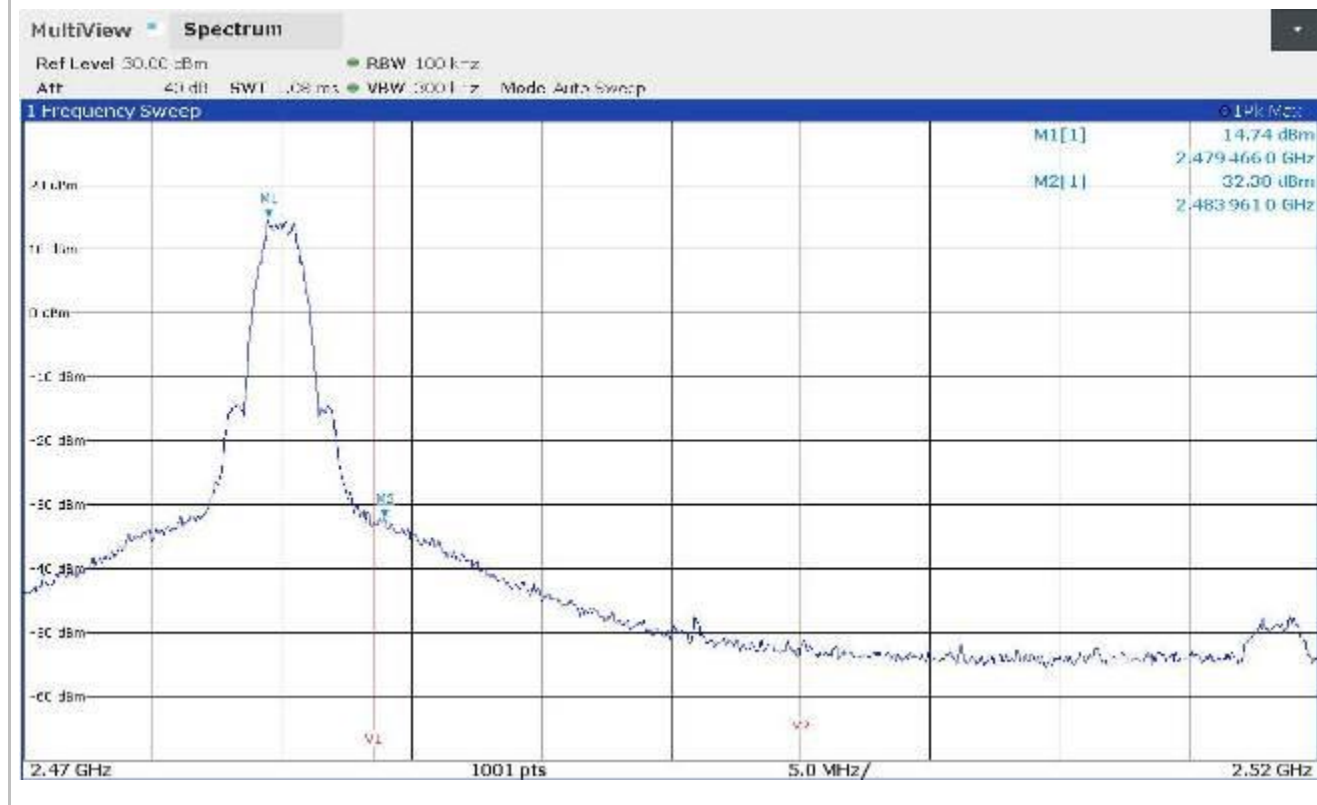
GFSK (BLE 2Mbit/s) MODULATION MIDDLE CHANNEL



GFSK (BLE 2Mbit/s) MODULATION HIGHER CHANNEL



GFSK (BLE 2Mbit/s) MODULATION HIGHER CHANNEL – PEAK BAND-EDGE



7.7 TRANSMITTER POWER SPECTRAL DENSITY

TEST REQUIREMENT	
Spectrum analyzer settings	
Test setup	ANSI C63.10 (clause 11.10)
Resolution bandwidth (RBW)	3 kHz
Video bandwidth (VBW)	10 kHz
Sweep time (SWT)	AUTO
Detector function	Peak
Trace	Max hold
EUT operating condition	1 to 3
Testing dates	2024-03-14

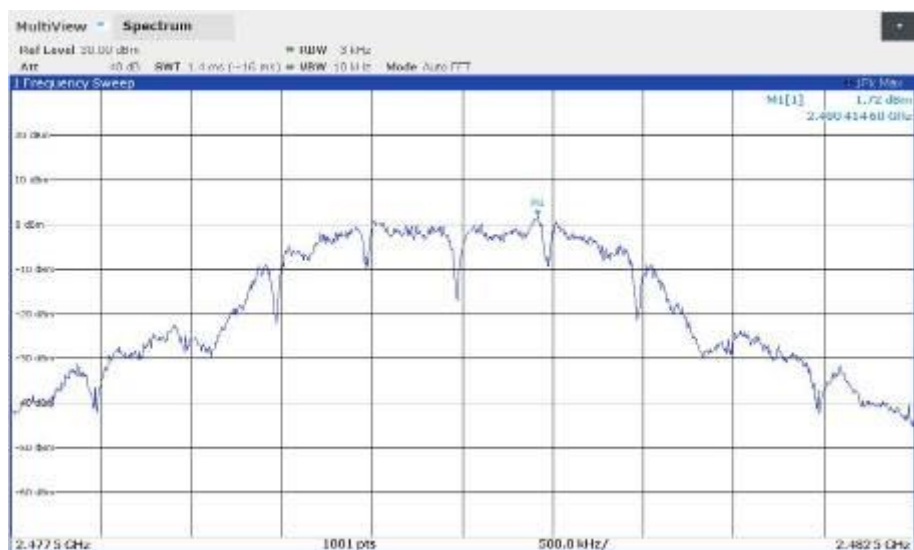
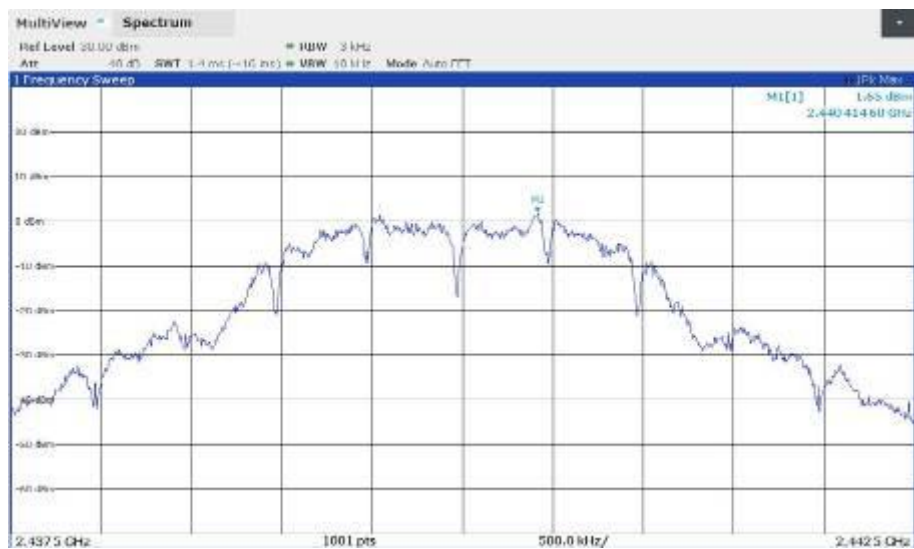
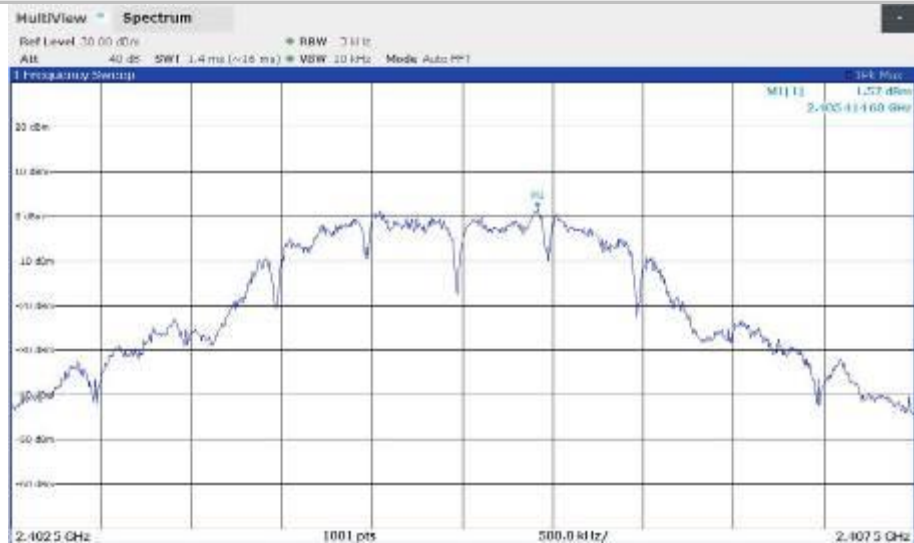
TEST RESULT
The EUT meets the requirements of sections 15.247 (e).

LIMITS
8 dBm in 3 kHz bandwidth.

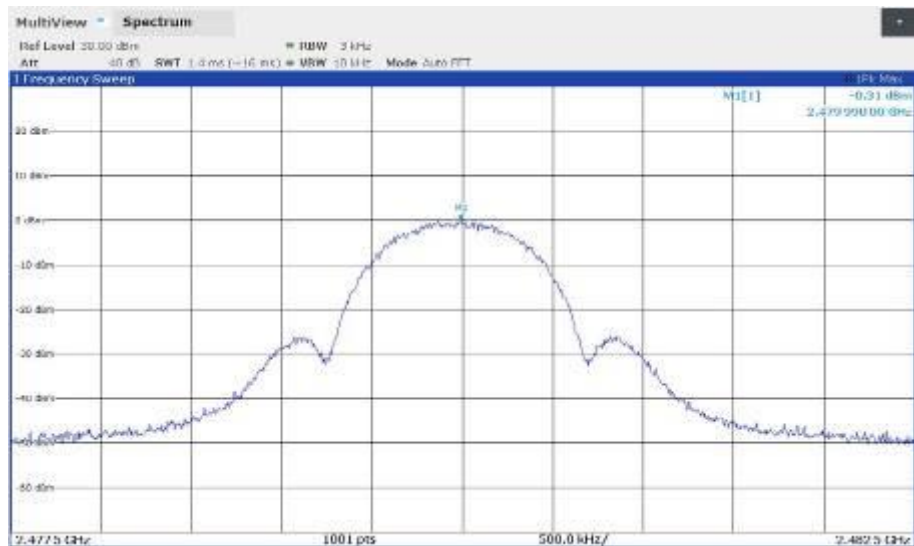
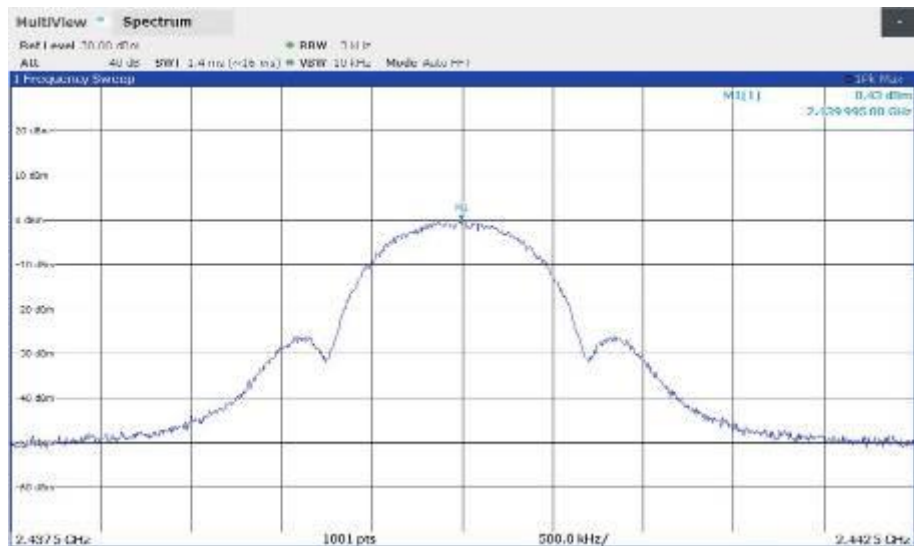
TEST PROCEDURE
The EUT RF output port is connected directly to RF input port of spectrum analyzer. Set the EUT to work at lower, middle and higher channel. With a SPAN of about the measured -20dB BW and centered on a channel, wait until the trace has stabilized and set the marker to the peak of emission.

MEASURED CONDUCTED OUTPUT POWER SPECTRAL DENSITY				
Test Mode	Test Channel	Peak Power (dBm/3kHz)	Limits (dBm)	Result
O-QPSK (IEEE 802.15.4)	Lower	1.57	≤8	Pass
	Middle	1.65	≤8	Pass
	Higher	1.72	≤8	Pass
GFSK (BLE 1Mbit/s)	Lower	-0.67	≤8	Pass
	Middle	-0.43	≤8	Pass
	Higher	-0.31	≤8	Pass
GFSK (BLE 2Mbit/s)	Lower	-2.81	≤8	Pass
	Middle	-2.74	≤8	Pass
	Higher	-2.45	≤8	Pass

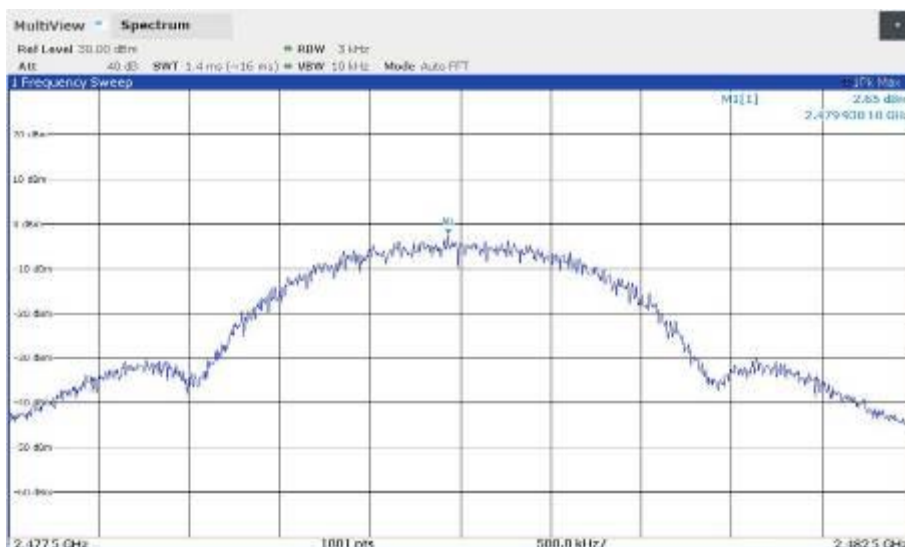
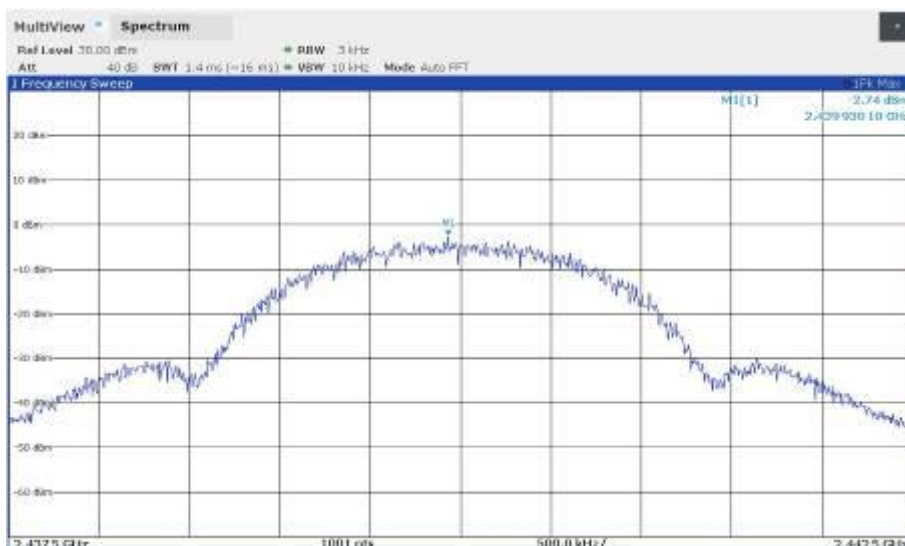
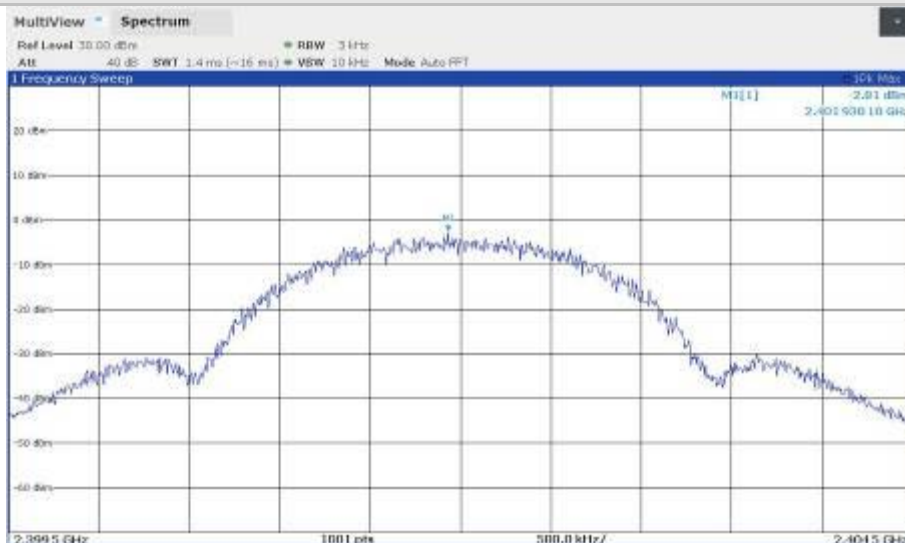
O-QPSK (IEEE 802.15.4) MODULATION



GFSK (BLE 1Mbit/s) MODULATION



GFSK (BLE 2Mbit/s) MODULATION



8. MEASUREMENTS AND TESTS UNCERTAINTY

Unless otherwise stated the uncertainties for the tests and measurements are evaluated in according to IMQ Operational Instruction IO-LAB-001, IO-LAB-004 and IO-LAB-009. and requirement of NIST Technical Note 1297 and NIS 81: 1994 "The Treatment of Uncertainty in EMC Measurements"

The expanded uncertainty was calculated for all measurements and tests listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainty in EMC Measurements ", with UKAS document LAB 34 and is documented in the quality system accordance to ISO/IEC 17025.

Internal Procedure PG-037 ensures that the requirements for traceability of calibrations, of all test equipment requiring calibration, and calibration intervals are met.

Methods Standard	Parameter	Expanded Uncertainty	Unit	Confidence level
Continuous disturbance	Terminal disturbance voltages (9 – 150 kHz)	2.4	dB	95%
	Terminal disturbance voltages (150 k – 30 MHz)	2.7	dB	95%
Radiated disturbance	Radiation disturbance (30-200 MHz – Horizontal Polariz.)	4.0	dB	95%
	Radiation disturbance (30-200 MHz – Vertical Polariz.)	4.0	dB	95%
	Radiation disturbance (200 -1000 MHz – Horizontal Polariz.)	3.5	dB	95%
	Radiation disturbance (200-1000 MHz – Vertical Polariz.)	3.4	dB	95%
	Radiation disturbance (1-6 GHz – H/V Polarization)	4.3	dB	95%
	Radiation disturbance (6-18 GHz – H/V Polarization)	4.8	dB	95%
	Radiation disturbance (18-26 GHz – H/V Polarization)	5.0	dB	95%
	Radiation disturbance (26-40 GHz – H/V Polarization)	5.2	dB	95%

9. TEST EQUIPMENT

Instrument	Manufacturer	Model	IMQ Ref.	Calibration	
				Last date	Due date
Shielded semi-anechoic chamber	ETS-LINDGREN	--	P04112	/	/
Shielded anechoic chamber	SIDT	--	P02386	/	/
Spectrum Analyser	Rohde & Schwarz	ESW26	S09498	2023-12-18	2024-12-18
Spectrum Analyser	Rohde & Schwarz	FSW50	S07990	2023-06-20	2024-06-20
Broadband preamplifier	SCHWARZBECK	BBV 9744	S09213	2023-12-06	2024-12-06
Broadband preamplifier	HEWLETT & PACKARD	HP8449B	S03542	2023-02-07	2024-02-07(*)
Broadband preamplifier	SCHWARZBECK	BBV 9721	S09215	2023-12-18	2024-12-18
LOOP ANTENNA	ROHDE & SCHWARZ	HFH2-Z2E	S08326	2023-05-26	2024-05-26
LOG ANTENNA	SCHWARZBECK	VULB 9162	S09211	2023-05-21	2024-05-21
HORN ANTENNA	SCHWARZBECK	BBHA9120D	S03463	2023-08-07	2026-08-07
HORN ANTENNA	SCHWARZBECK	BBHA9170	S03724	2023-08-08	2026-08-08
SOFTWARE	Nexio	BAT-EMC V3.21.0.14	/	/	/

Note

(*) Some calibration intervals may be extended, based on sufficient calibration data and experience of use (see IEC60529:2015 clause 8.3)

END OF TEST REPORT