TEST REPORT

Applicant:	Janam Technologies LLC
Address:	999 South Oyster Bay Rd Suite 409 Bethpage, NY 11714
Equipment Type:	Mobile Computer
Model Name:	XT4
Brand Name:	Janam
FCC ID:	UTWXT4WA
ISED Number:	6914A-XT4WA
Test Standard:	47 CFR Part 15 Subpart C RSS-Gen Issue 5 RSS-247 Issue 3 (refer to section 3.1)
Sample Arrival Date:	Nov. 15, 2024
Test Date:	Nov. 19, 2024 - Nov. 27, 2024
Date of Issue:	Apr. 23, 2025

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Julie Zhu

Checked by: Ye Hongji

Approved by: Sunny Zou

(Technical Director)

Revision History

Version	Issue Date	Revisions
Rev. 01	Apr. 23, 2025	Initial Issue

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1 GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	☑ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☐ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Janam Technologies LLC
Address	999 South Oyster Bay Rd Suite 409 Bethpage, NY 11714

2.2 Manufacturer Information

Manufacturer	Janam Technologies LLC
Address	999 South Oyster Bay Rd Suite 409 Bethpage, NY 11714

2.3 General Description for Equipment under Test (EUT)

EUT Name	Mobile Computer
Model Name Under Test	XT4
Series Model Name	N/A
Description of Model name differentiation	N/A
Serial Number	8A24410001
Hardware Version	QDC510
Software Version	XT4_CN_XX_WE__DS__R01_D_250109_01
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.4 Technical Information

Network and Wireless connectivity	2G Network GPRS/EDGE 850/1900 3G Network WCDMA/HSDPA/HSUPA Band 2/4/5 4G Network FDD LTE Band 2/4/5/7/12/13/14/17/25/26/66/71 TDD LTE Band 38/41/42/43/48 5G Network SA: NR n2/n5/n7/n12/n13/n14/n25/n26/n38/n41/n48/n66/n71/n77/n78 NSA(EN-DC): DC_2A_n5A, DC_2A_n41A, DC_2A_n66A, DC_2A_n71A, DC_2A_n78A, DC_5A_n2A, DC_5A_n7A, DC_5A_n48A, DC_5A_n66A, DC_5A_n78A, DC_7A_n5A, DC_7A_n66A, DC_7A_n77A, DC_7A_n78A, DC_12A_n2A, DC_12A_n25A, DC_12A_n66A, DC_13A_n2A, DC_13A_n48A, DC_13A_n66A, DC_26A_n41A, DC_26A_n78A, DC_48A_n5A, DC_48A_n55A, DC_66A_n2A, DC_66A_n5A, DC_66A_n7A, DC_66A_n25A, DC_66A_n41A, DC_66A_n48A, DC_66A_n71A, DC_66A_n78A Bluetooth (BR+EDR+BLE) WIFI 802.11a, 802.11b, 802.11g, 802.11n(HT20/40), 802.11ac(VHT20/40/80/160) and 802.11ax(HE20/40/80/160) GPS, GLONASS, Galileo, BDS, NFC

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology		DTS
Modulation Type		GFSK
Product Type		☐ Mobile ☒ Portable ☐ Fix Location
Transfer Rate		1 Mbps, 2 Mbps
Frequency Range		The frequency range used is 2400 MHz to 2483.5 MHz.
Number of Channel		40 (at intervals of 2 MHz) Note 1
Tested Channel		1 Mbps: 0 (2402 MHz), 19 (2440 MHz), 39 (2480 MHz) 2 Mbps: 1 (2404 MHz), 19 (2440 MHz), 38 (2478 MHz)
Antenna Type	Antenna 8	PIFA Antenna
	Antenna 9	
Antenna Gain	Antenna 8	0.95 dBi
	Antenna 9	2.83 dBi
Antenna Impedance		50Ω
Antenna System (MIMO Smart Antenna)		N/A
Note 1: 2 Mbps does not support Channel 0, Channel 12, and Channel 39.		

All channel was listed on the following table:

BLE 1M:

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
0	**2402**	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	**19**	**2440**	29	2460	**39**	**2480**

BLE 2M:

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
\	\	10	2422	20	2442	30	2462
1	**2404**	11	2424	21	2444	31	2464
2	2406	\	\	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	**38**	**2478**
9	2420	**19**	**2440**	29	2460	\	\

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Intentional radiators of radio frequency equipment
2	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
3	RSS-247 Issue 3	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exemp Local Area Network (LE-LAN) Devices
4	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
5	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules

3.2 Test Verdict

No.	Description	FCC Part No.	ISED Part No.	Channel	Test Result	Verdict
1	Antenna Requirement	15.203	RSS-247, 5.4 (f)	N/A	--	Pass[Note1]
2	Output Power	15.247(b)	RSS-247, 5.4 (d)	Low/Middle/ High	ANNEX A.1	Pass
3	Occupied Bandwidth	15.247(a)	RSS-GEN, 6.7; RSS-247, 5.2 (a)	Low/Middle/ High	ANNEX A.2	Pass
4	Conducted Spurious Emission	15.247(d)	RSS-247, 5.5	Low/Middle/ High	ANNEX A.3	Pass
5	Band Edge(Authorized-band band-edge)	15.247(d)	RSS-247, 5.5;	Low/High	ANNEX A.4	Pass
6	Conducted Emission	15.207	RSS-GEN, 8.8	Low/Middle/ High	ANNEX A.5	Pass
7	Radiated Spurious Emission	15.209 15.247(d)	RSS-247, 5.5	Low/Middle/ High	ANNEX A.6	Pass
8	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	RSS-247, 5.5	Low/High	ANNEX A.7	Pass
9	Power spectral density (PSD)	15.247(e)	RSS-247, 5.2 (b)	Low/Middle/ High	ANNEX A.8	Pass
10	Receiver Spurious Emissions	--	RSS-Gen, 7.4	--	N/A	N/A[Note2]

Note [1]: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

Note [2]: Only radio communication receivers operating in stand-alone mode within the band 30-960 MHz, as well as scanner receivers, are subject to Industry Canada requirements, so this test is not applicable.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	46% to 63%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+22.7℃ to +26.3℃
Working Voltage of the EUT	NV (Normal Voltage)	3.84 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	KEYSIGHT	N9020A	MY50330200	2024.05.08	2025.05.07
Spectrum Analyzer	KEYSIGHT	N9020A	MY46471071	2024.07.04	2025.07.03
Spectrum Analyzer	KEYSIGHT	N9020A	MY50531259	2024.08.01	2025.07.31
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	02460	2024.05.16	2027.05.15
Test Antenna-Horn	A-INFO	LB-180400KF	J211060273	2024.06.15	2027.06.14
Anechoic Chamber	RAINFORD	9m*6m*6m	140	2024.07.28	2027.07.27
Amplifier	COM-MV	LSCX_LNA1-12G-01	7210214	2024.08.01	2025.07.31
Amplifier	COM-MV	XKu_LNA7-18G-01	7210209	2024.08.01	2025.07.31
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2024.08.01	2025.07.31
Test Antenna-Loop	SCHWARZBECK	FMZB 1519	1519-037	2024.01.23	2025.01.22
Amplifier	COM-MV	ZT30-1000M	B2018054558	2023.12.05	2024.12.04
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60*7.35m	130	2024.07.13	2027.07.12
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2024.08.01	2025.07.31
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	9163-624	2024.07.06	2027.07.05
Amplifier	COM-MV	ZT30-1000M	B2017119082	2023.12.05	2024.12.04
Anechoic Chamber	RAINFORD	9m*6m*6m	101	2023.03.04	2026.03.03
EMI Receiver	KEYSIGHT	N9010B	MY57110309	2024.08.01	2025.07.31
LISN	SCHWARZBECK	NSLK 8127	8127-687	2024.05.09	2025.05.08
Shielded Enclosure	YiHeng Electronic Co., Ltd	3.5m*3.1m*2.8m	112	2022.02.19	2025.02.18

4.3 Test Software List

Description	Manufacturer	Software Version	Serial No.	Applicable test Setup
BL410R	BALUN	V2.1.1.488	N/A	The section 4.5.1
BL410E	BALUN	V22.930	N/A	The section 4.5.2&4.5.3&4.5.4&4.5.5

4.4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

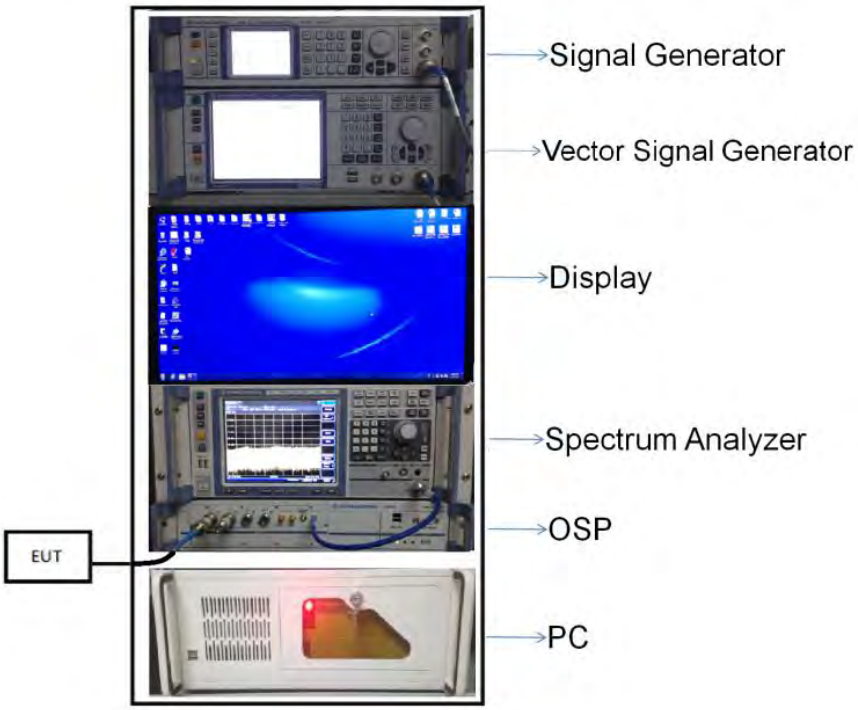
Parameters	Uncertainty
Occupied Channel Bandwidth	2.8%
RF output power, conducted	1.28 dB
Power Spectral Density, conducted	1.30 dB
Unwanted Emissions, conducted	1.84 dB
All emissions, radiated	5.36 dB
Temperature	0.8℃
Humidity	4%

4.5 Description of Test Setup

4.5.1 For Antenna Port Test

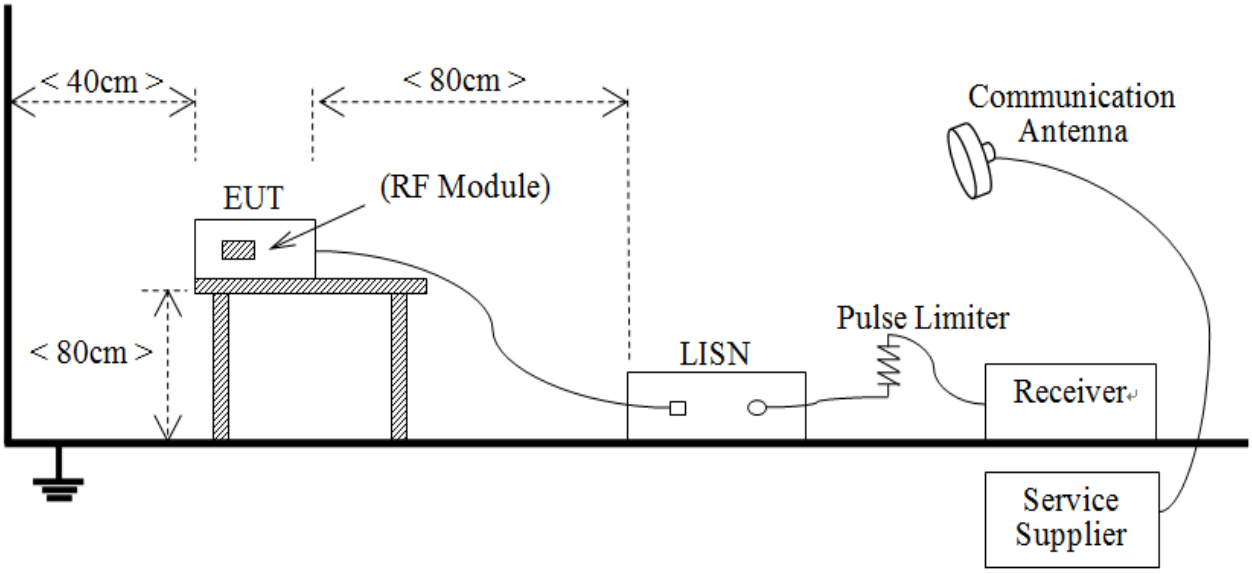
Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT: Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



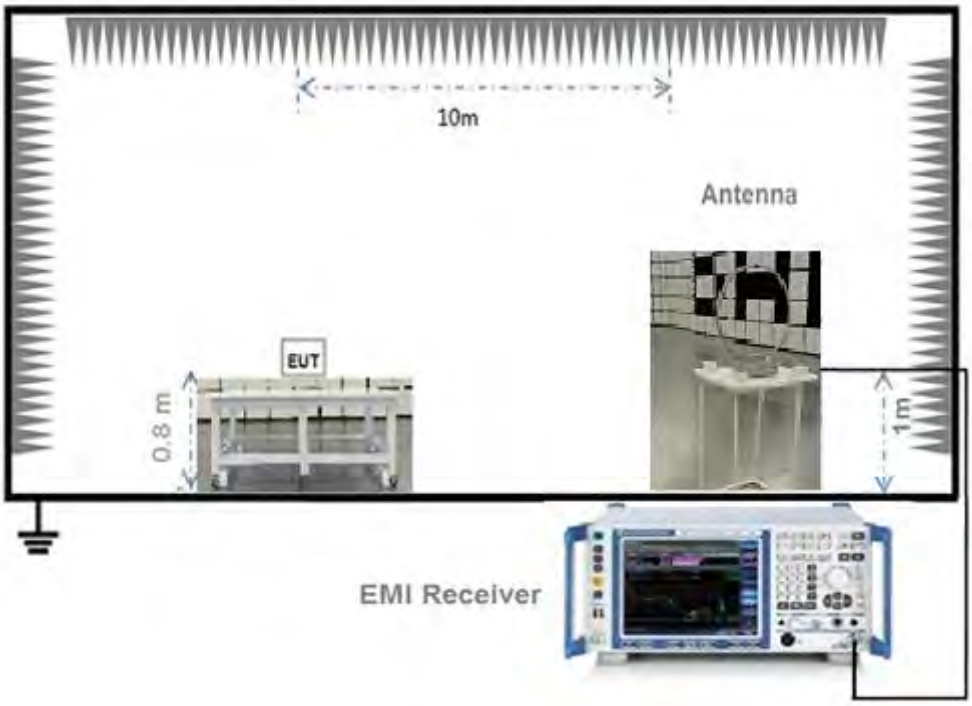
(Diagram 1)

4.5.2 For AC Power Supply Port Test



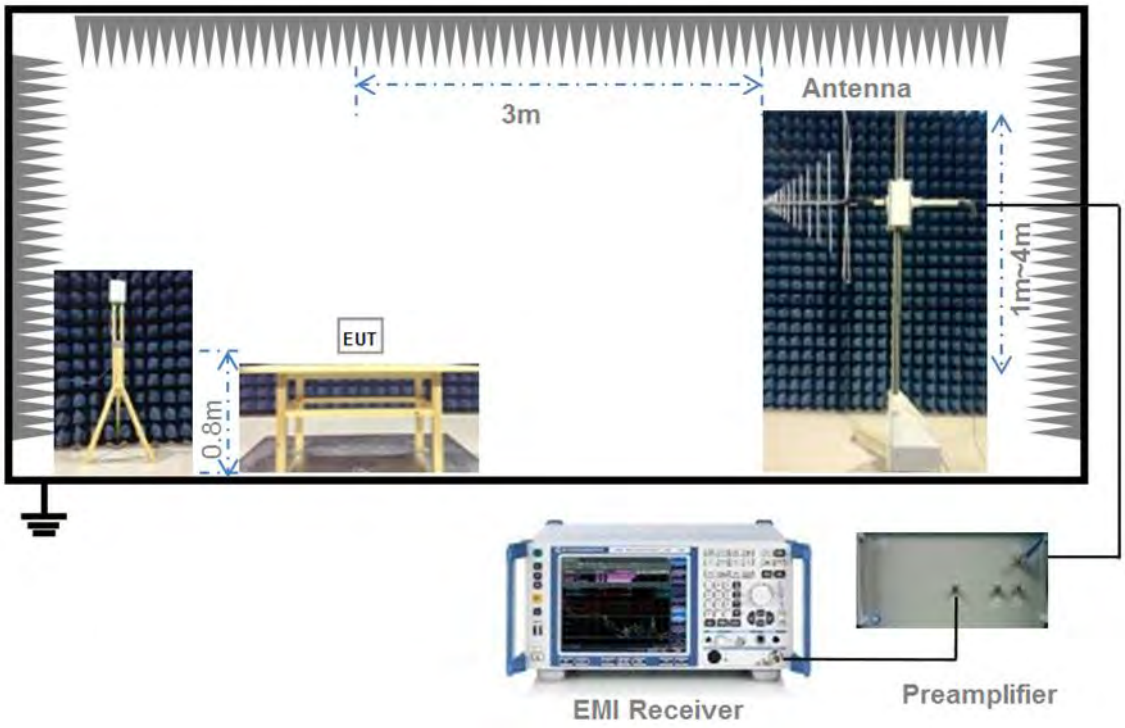
(Diagram 2)

4.5.3 For Radiated Test (Below 30 MHz)



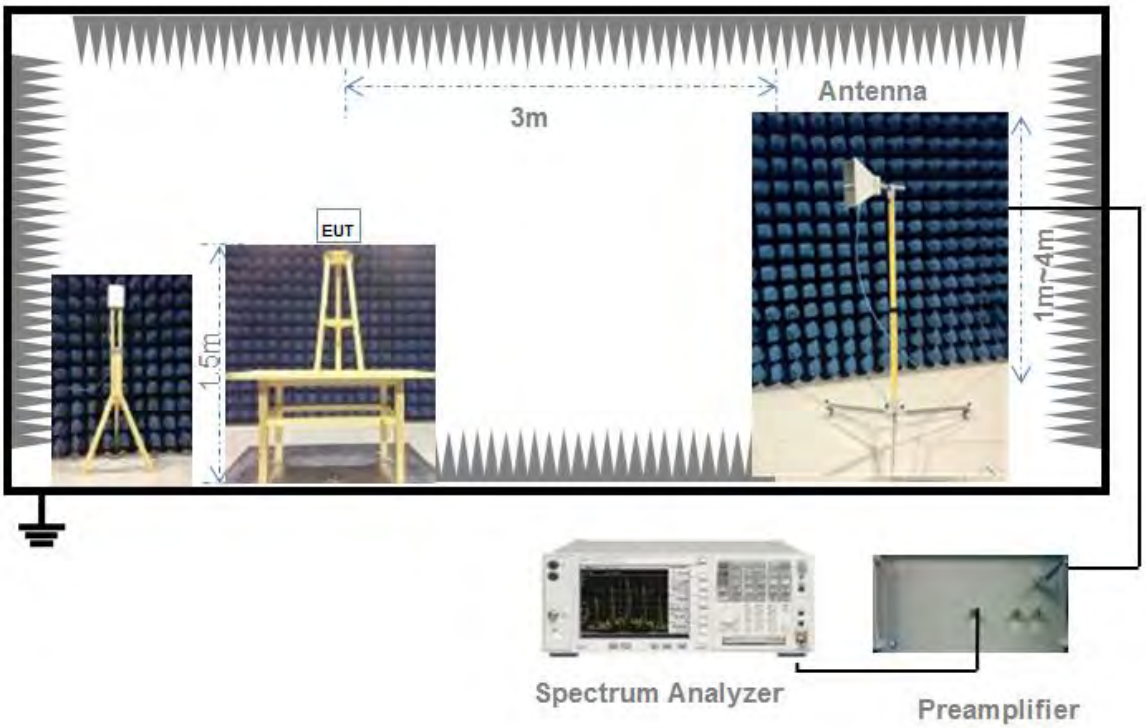
(Diagram 3)

4.5.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.5.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.6 Measurement Results Explanation Example

4.6.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.

4.6.2 For radiated band edges and spurious emission test:

$$E = EIRP - 20\log D + 104.8$$

where:

E = electric field strength in dBμV/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203 & 15.247(b); RSS-247, 5.4 (f)
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.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product.	An embedded-in antenna design is used.

Reference Documents	Item
Photo	Please refer to the EUT Photo documents.

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Output Power

5.2.1 Test Limit

FCC § 15.247(b)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements.

RSS-247, 5.4 (d)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

5.2.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

a) Maximum peak conducted output power

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

Set the RBW ≥ DTS bandwidth.

Set VBW ≥ 3 x RBW.

Set span ≥ 3 x RBW

Sweep time = auto couple.

Detector = peak.

Trace mode = max hold.

Allow trace to fully stabilize.

Use peak marker function to determine the peak amplitude level.

b) Measurements of duty cycle

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

Set the center frequency of the instrument to the center frequency of the transmission.

Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.

Set VBW ≥ RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Occupied Bandwidth

5.3.1 Limit

FCC §15.247(a); RSS-247, 5.2 (a); RSS-GEN, 6.7

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW. The 6 dB bandwidth must be greater than 500 kHz.

5.3.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

Use the following spectrum analyzer settings:

Set RBW = 100 kHz.

Set the video bandwidth (VBW) ≥ 3 RBW.

Detector = Peak.

Trace mode = max hold.

Sweep = auto couple.

Allow the trace to stabilize.

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Conducted Spurious Emission

5.4.1 Limit

FCC §15.247(d); RSS-247, 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.4.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

a) If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

c) In either case, attenuation to levels below the 15.209 general radiated emissions limits is not required.

The following procedures shall be used to demonstrate compliance to these limits. Note that these procedures can be used in either an antenna-port conducted or radiated test set-up. Radiated tests must conform to the test site requirements and utilize maximization procedures defined herein.

Reference level measurement:

Establish a reference level by using the following procedure:

Set instrument center frequency to DTS channel center frequency.

Set the span to ≥ 1.5 times the DTS bandwidth.

Set the RBW = 100 kHz.

Set the VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum PSD level.

Emission level measurement:

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

Set the RBW = 100 kHz.

Set the VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Band Edge (Authorized-band band-edge)

5.5.1 Limit

FCC §15.247(d); RSS-247, 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.5.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The following procedures may be used to determine the peak or average field strength or power of an unwanted emission that is within 2 MHz of the authorized band edge. If a peak detector is utilized, use the procedure described in 13.2.1. Use the procedure described in 13.2.2 when using an average detector and the EUT can be configured to transmit continuously (i.e., duty cycle ≥ 98%). Use the procedure described in 13.2.3 when using an average detector and the EUT cannot be configured to transmit continuously but the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent). Use the procedure described in 13.2.4 when using an average detector for those cases where the EUT cannot be configured to transmit continuously and the duty cycle is not constant (duty cycle variations equal or exceed 2 percent).

When using a peak detector to measure unwanted emissions at or near the band edge (within 2 MHz of the authorized band), the following integration procedure can be used.

Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).

Set span to 2 MHz

RBW = 100 kHz.

VBW ≥ 3 x RBW.

Detector = peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweep to continue until the trace stabilizes (required measurement time may increase for low duty cycle applications)

Compute the power by integrating the spectrum over 1 MHz using the analyzer's band power measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the instrument does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission ± 0.5 MHz.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Conducted Emission

5.6.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.6.2 Test Setup

See section 4.5.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.
Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

5.6.4 Test Result

Please refer to ANNEX A.5.

5.7 Radiated Spurious Emission

5.7.1 Limit

FCC §15.209&15.247(d); RSS-GEN, 8.9; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
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

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.7.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

Since the emission limits are specified in terms of radiated field strength levels, measurements performed to demonstrate compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for demonstrating compliance to the specified limits; however antenna-port conducted measurements are also now acceptable to demonstrate compliance (see below for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 shall be followed.

Antenna-port conducted measurements may also be used as an alternative to radiated measurements

for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

General Procedure for conducted measurements in restricted bands:

a) Measure the conducted output power (in dBm) using the detector specified (see guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$E = EIRP – 20\log D + 104.8$

where:

E = electric field strength in dBμV/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

f) Compare the resultant electric field strength level to the applicable limit.

g) Perform radiated spurious emission test.

Quasi-Peak measurement procedure

The specifications for measurements using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Frequency Interference (CISPR) of the International Electrotechnical Commission.

As an alternative to CISPR quasi-peak measurement, compliance can be demonstrated to the applicable emission limits using a peak detector.

Peak power measurement procedure:

Peak emission levels are measured by setting the instrument as follows:

a) RBW = as specified in Table 1.

b) VBW ≥ 3 x RBW.

c) Detector = Peak.

d) Sweep time = auto.

e) Trace mode = max hold.

f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be longer for low duty cycle applications).

Table 1—RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction:

If continuous transmission of the EUT (i.e., duty cycle ≥ 98 percent) cannot be achieved and the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then the following procedure shall be used:

a) The EUT shall be configured to operate at the maximum achievable duty cycle.

b) Measure the duty cycle, x, of the transmitter output signal as described in section 6.0.

c) RBW = 1 MHz (unless otherwise specified).

d) VBW ≥ 3 x RBW.

e) Detector = RMS, if span/(# of points in sweep) ≤ (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

f) Averaging type = power (i.e., RMS).

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.

g) Sweep time = auto.

h) Perform a trace average of at least 100 traces.

i) A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is 10 log(1/x), where x is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is 20 log(1/x), where x is the duty cycle.

3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

NOTE: Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Determining the applicable transmit antenna gain:

A conducted power measurement will determine the maximum output power associated with a restricted band emission; however, in order to determine the associated EIRP level, the gain of the transmitting antenna (in dBi) must be added to the measured output power (in dBm).

Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

See KDB 662911 for guidance on calculating the additional array gain term when determining the effective antenna gain for a EUT with multiple outputs occupying the same or overlapping frequency ranges in the same band.

Radiated spurious emission test:

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the

Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Band Edge (Restricted-band band-edge)

5.8.1 Limit

FCC §15.209&15.247(d); RSS-GEN, 8.10; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.8.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

For transmitters operating above 1 GHz repeat the measurement with an average detector.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Power Spectral density (PSD)

5.9.1 Limit

FCC §15.247(e); RSS-247, 5.2 (b)

The same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used.

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.9.2 Test Setup

See section 4.5.1 (Diagram 1) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.

Set the VBW ≥ 3 RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.9.4 Test Result

Please refer to ANNEX A.8.

ANNEX A TEST RESULT

A.1 Output Power, E.I.R.P

Antenna 8

Peak Power Test Data

Channel	Measured Output Peak Power		Limit		Verdict
	GFSK (BLE 1Mbps)		dBm	mW	
	dBm	mW			
Low Channel	7.99	6.30	30	1000	Pass
Middle Channel	8.49	7.06			Pass
High Channel	5.45	3.51			Pass

Channel	Measured Output Peak Power		Limit		Verdict
	GFSK (BLE 2Mbps)		dBm	mW	
	dBm	mW			
Low Channel	8.26	6.70	30	1000	Pass
Middle Channel	8.73	7.46			Pass
High Channel	6.12	4.09			Pass

E.I.R.P Test Data (For ISED)

Channel	E.I.R.P		Limit		Verdict
	GFSK (BLE 1Mbps)		dBm	mW	
	dBm	mW			
Low Channel	8.94	7.83	36	4000	Pass
Middle Channel	9.44	8.79			Pass
High Channel	6.40	4.37			Pass

Channel	E.I.R.P		Limit		Verdict
	GFSK (BLE 2Mbps)		dBm	mW	
	dBm	mW			
Low Channel	9.21	8.34	36	4000	Pass
Middle Channel	9.68	9.29			Pass
High Channel	7.07	5.09			Pass

Antenna 9

Peak Power Test Data

Channel	Measured Output Peak Power		Limit		Verdict
	GFSK (BLE 1Mbps)		dBm	mW	
	dBm	mW			
Low Channel	6.42	4.39	30	1000	Pass
Middle Channel	7.39	5.48			Pass
High Channel	6.56	4.53			Pass

Channel	Measured Output Peak Power		Limit		Verdict
	GFSK (BLE 2Mbps)		dBm	mW	
	dBm	mW			
Low Channel	6.58	4.55	30	1000	Pass
Middle Channel	7.53	5.66			Pass
High Channel	7.10	5.13			Pass

E.I.R.P Test Data (For ISED)

Channel	E.I.R.P		Limit		Verdict
	GFSK (BLE 1Mbps)		dBm	mW	
	dBm	mW			
Low Channel	9.25	8.41	36	4000	Pass
Middle Channel	10.22	10.52			Pass
High Channel	9.39	8.69			Pass

Channel	E.I.R.P		Limit		Verdict
	GFSK (BLE 2Mbps)		dBm	mW	
	dBm	mW			
Low Channel	9.41	8.73	36	4000	Pass
Middle Channel	10.36	10.86			Pass
High Channel	9.93	9.84			Pass

Test Plots

Antenna 8

GFSK (BLE 1Mbps) LOW CHANNEL

GFSK (BLE 1Mbps) MIDDLE CHANNEL

GFSK (BLE 1Mbps) HIGH CHANNEL

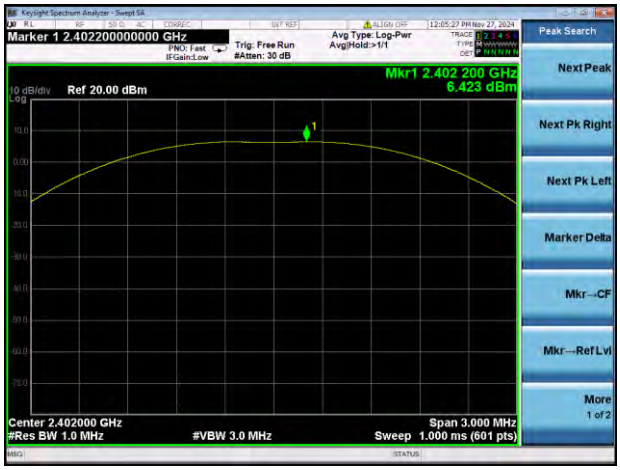
GFSK (BLE 2Mbps) LOW CHANNEL

GFSK (BLE 2Mbps) MIDDLE CHANNEL

GFSK (BLE 2Mbps) HIGH CHANNEL

Antenna 9

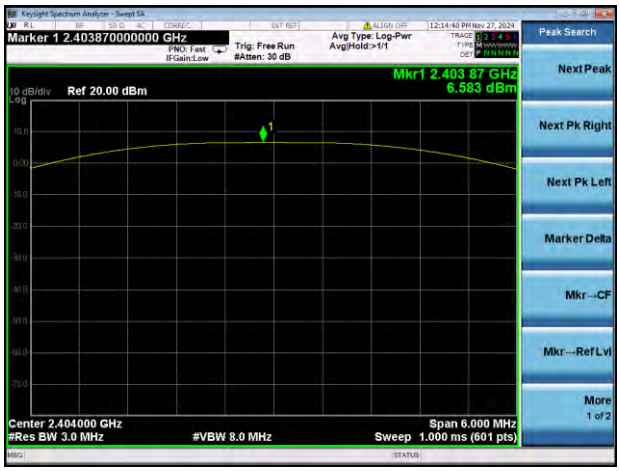
GFSK (BLE 1Mbps) LOW CHANNEL



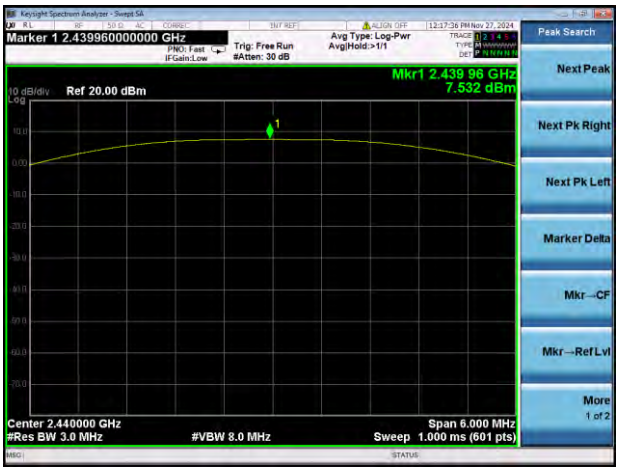
GFSK (BLE 1Mbps) MIDDLE CHANNEL

GFSK (BLE 1Mbps) HIGH CHANNEL

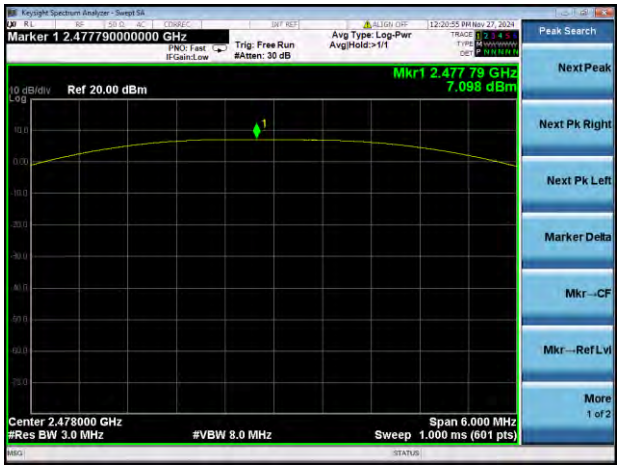
GFSK (BLE 2Mbps) LOW CHANNEL



GFSK (BLE 2Mbps) MIDDLE CHANNEL



GFSK (BLE 2Mbps) HIGH CHANNEL



A.2 Occupied Bandwidth

Test Data

Antenna 8

Test Mode	GFSK (BLE 1Mbps)		
Channel	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)	6 dB Bandwidth Limits (kHz)
Low Channel	689.900	1029.900	≥500
Middle Channel	689.900	1031.200	≥500
High Channel	689.900	1036.600	≥500

Test Mode	GFSK (BLE 2Mbps)		
Channel	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)	6 dB Bandwidth Limits (kHz)
Low Channel	1185.000	2029.400	≥500
Middle Channel	1200.000	2018.500	≥500
High Channel	1185.000	2004.900	≥500

Antenna 9

Test Mode	GFSK (BLE 1Mbps)		
Channel	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)	6 dB Bandwidth Limits (kHz)
Low Channel	682.400	1024.400	≥500
Middle Channel	682.400	1030.000	≥500
High Channel	682.400	1025.100	≥500

Test Mode	GFSK (BLE 2Mbps)		
Channel	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)	6 dB Bandwidth Limits (kHz)
Low Channel	1170.000	2023.000	≥500
Middle Channel	1185.000	2023.400	≥500
High Channel	1185.000	1993.100	≥500

Test Plots

Antenna 8

6 dB Bandwidth

GFSK (BLE 1Mbps) LOW CHANNEL

GFSK (BLE 1Mbps) MIDDLE CHANNEL

GFSK (BLE 1Mbps) HIGH CHANNEL

GFSK (BLE 2Mbps) LOW CHANNEL

GFSK (BLE 2Mbps) MIDDLE CHANNEL

GFSK (BLE 2Mbps) HIGH CHANNEL

99% Bandwidth

GFSK (BLE 1Mbps) LOW CHANNEL

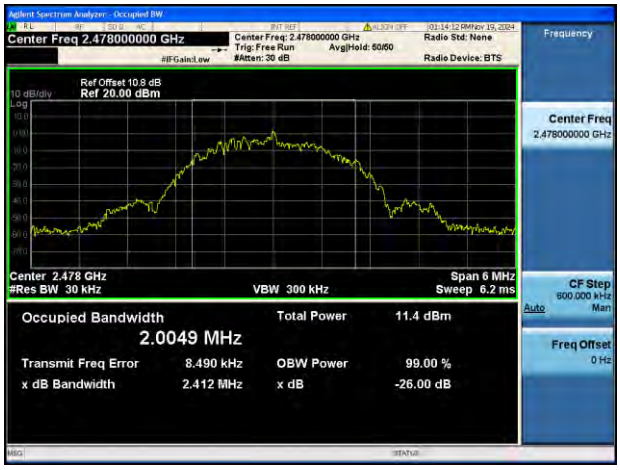
GFSK (BLE 1Mbps) MIDDLE CHANNEL

GFSK (BLE 1Mbps) HIGH CHANNEL

GFSK (BLE 2Mbps) LOW CHANNEL

GFSK (BLE 2Mbps) MIDDLE CHANNEL

GFSK (BLE 2Mbps) HIGH CHANNEL



Antenna 9

6 dB Bandwidth

GFSK (BLE 1Mbps) LOW CHANNEL

GFSK (BLE 1Mbps) MIDDLE CHANNEL

GFSK (BLE 1Mbps) HIGH CHANNEL

GFSK (BLE 2Mbps) LOW CHANNEL

GFSK (BLE 2Mbps) MIDDLE CHANNEL

GFSK (BLE 2Mbps) HIGH CHANNEL

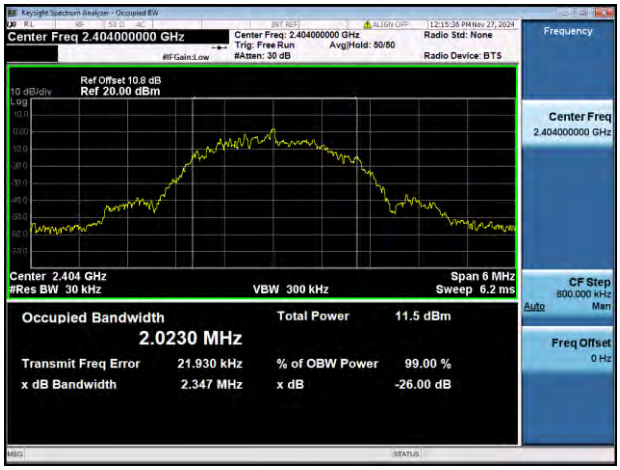
99% Bandwidth

GFSK (BLE 1Mbps) LOW CHANNEL

GFSK (BLE 1Mbps) MIDDLE CHANNEL

GFSK (BLE 1Mbps) HIGH CHANNEL

GFSK (BLE 2Mbps) LOW CHANNEL



GFSK (BLE 2Mbps) MIDDLE CHANNEL

GFSK (BLE 2Mbps) HIGH CHANNEL

A.3 Conducted Spurious Emissions

Test Data

Antenna 8

GFSK (BLE 1Mbps)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-36.51	7.55	-12.45	Pass
Middle Channel	-37.88	8.06	-11.94	Pass
High Channel	-36.33	5.03	-14.97	Pass

GFSK (BLE 2Mbps)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-37.38	7.69	-12.31	Pass
Middle Channel	-37.65	8.17	-11.83	Pass
High Channel	-39.11	5.42	-14.58	Pass

Antenna 9

GFSK (BLE 1Mbps)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-34.04	5.92	-14.08	Pass
Middle Channel	-34.13	6.88	-13.12	Pass
High Channel	-33.41	6.02	-13.98	Pass

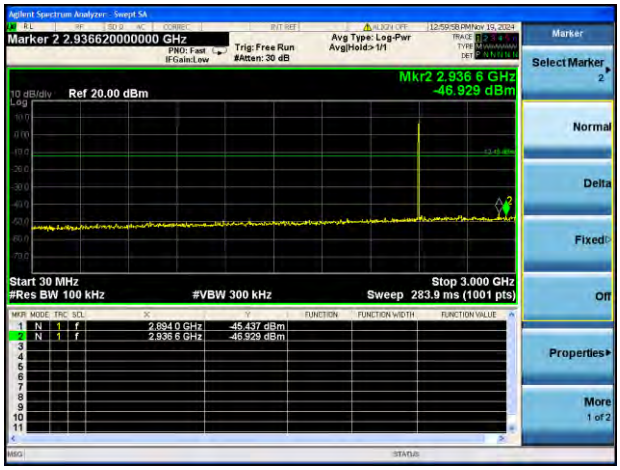
GFSK (BLE 2Mbps)				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-33.27	5.94	-14.06	Pass
Middle Channel	-35.44	6.88	-13.12	Pass
High Channel	-34.38	6.44	-13.56	Pass

Test Plots

Antenna 8

GFSK (BLE 1Mbps) LOW CHANNEL,
CARRIER LEVEL

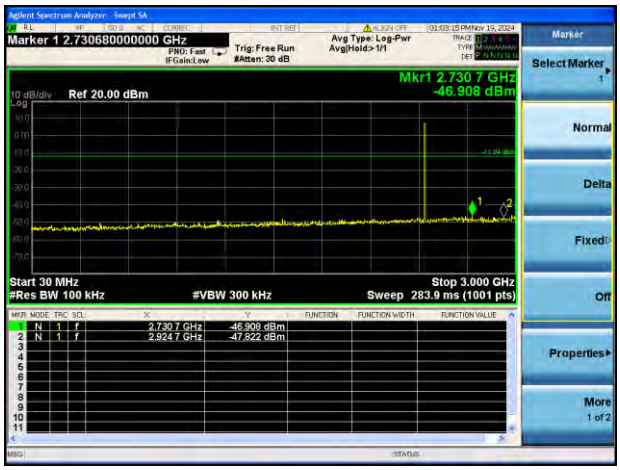
GFSK (BLE 1Mbps) LOW CHANNEL,
SPURIOUS 30 MHz ~ 3 GHz



GFSK (BLE 1Mbps) LOW CHANNEL,
SPURIOUS 2 GHz ~ 25 GHz

GFSK (BLE 1Mbps) MIDDLE CHANNEL,
CARRIER LEVEL

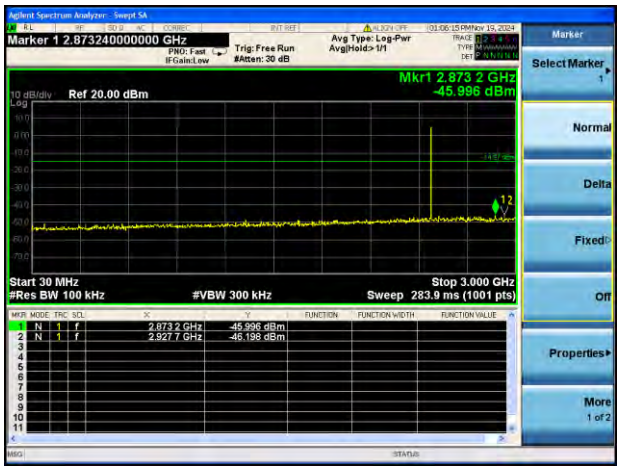
GFSK (BLE 1Mbps) MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



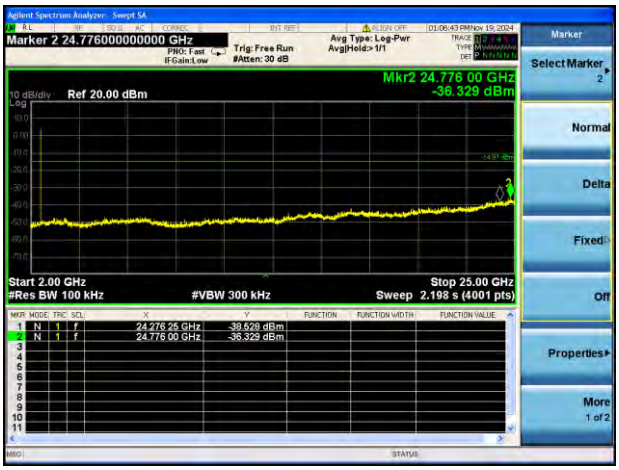
GFSK (BLE 1Mbps) MIDDLE CHANNEL, SPURIOUS 2 GHz ~ 25 GHz

GFSK (BLE 1Mbps) HIGH CHANNEL, CARRIER LEVEL

GFSK (BLE 1Mbps) HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

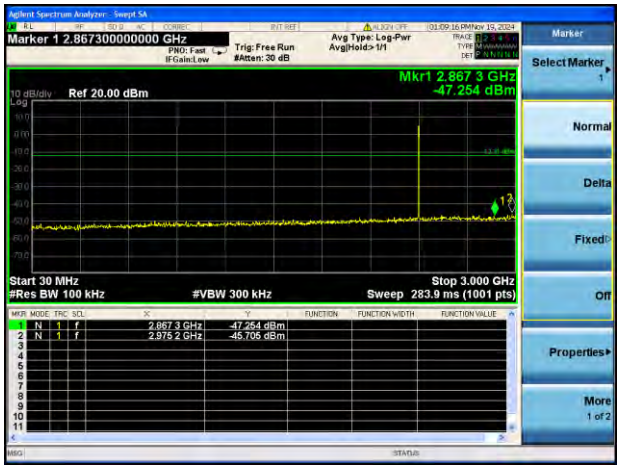


GFSK (BLE 1Mbps) HIGH CHANNEL, SPURIOUS 2 GHz ~ 25 GHz



GFSK (BLE 2Mbps) LOW CHANNEL,
CARRIER LEVEL

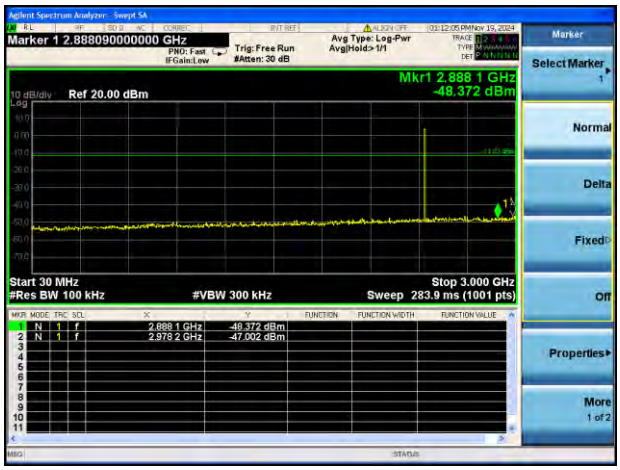
GFSK (BLE 2Mbps) LOW CHANNEL,
SPURIOUS 30 MHz ~ 3 GHz



GFSK (BLE 2Mbps) LOW CHANNEL,
SPURIOUS 2 GHz ~ 25 GHz

GFSK (BLE 2Mbps) MIDDLE CHANNEL,
CARRIER LEVEL

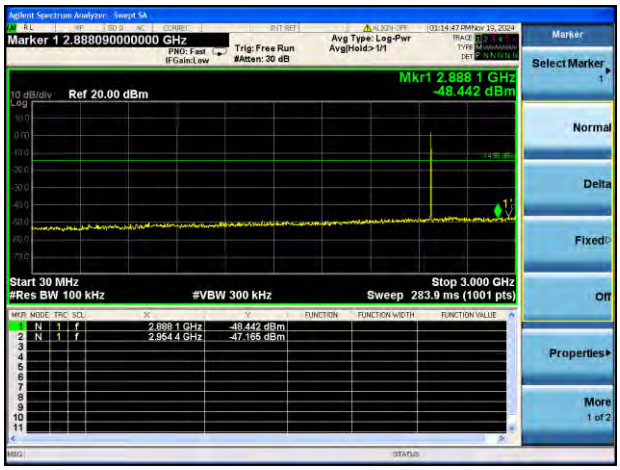
GFSK (BLE 2Mbps) MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



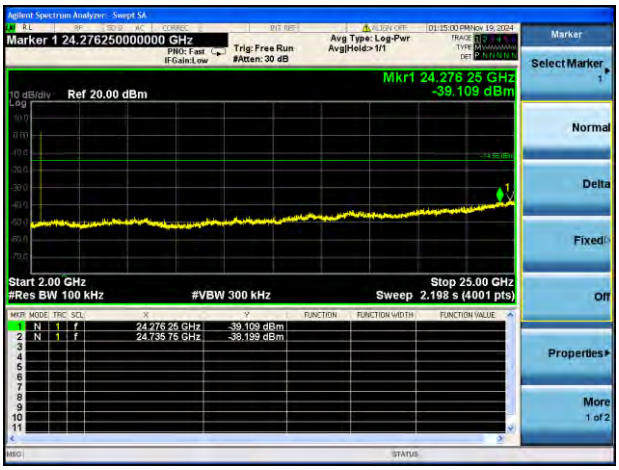
GFSK (BLE 2Mbps) MIDDLE CHANNEL, SPURIOUS 2 GHz ~ 25 GHz

GFSK (BLE 2Mbps) HIGH CHANNEL, CARRIER LEVEL

GFSK (BLE 2Mbps) HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



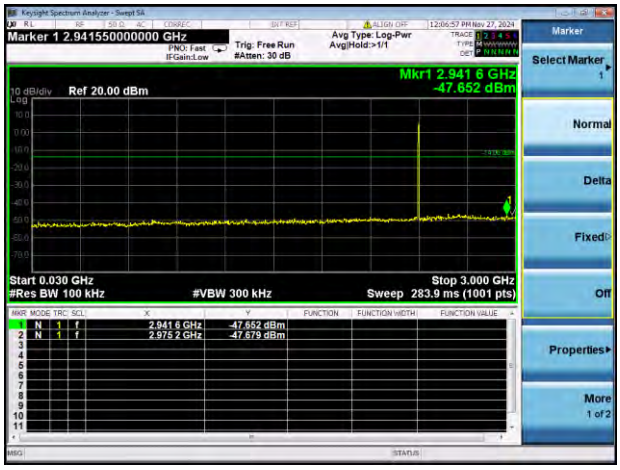
GFSK (BLE 2Mbps) HIGH CHANNEL, SPURIOUS 2 GHz ~ 25 GHz



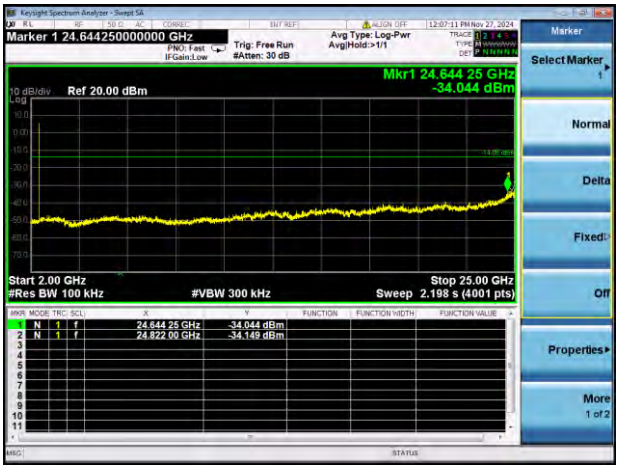
Antenna 9

GFSK (BLE 1Mbps) LOW CHANNEL,
CARRIER LEVEL

GFSK (BLE 1Mbps) LOW CHANNEL,
SPURIOUS 30 MHz ~ 3 GHz

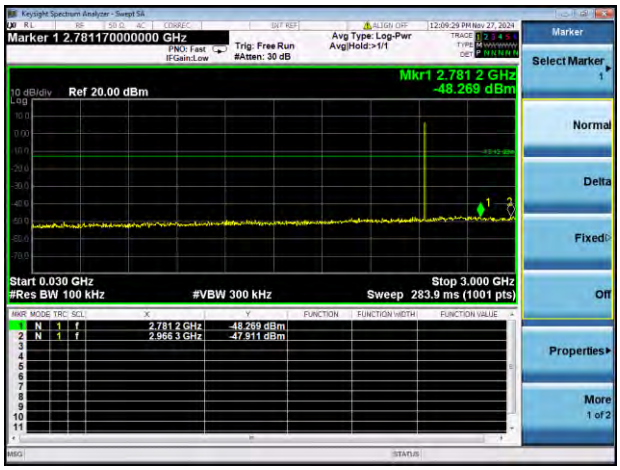


GFSK (BLE 1Mbps) LOW CHANNEL,
SPURIOUS 2 GHz ~ 25 GHz

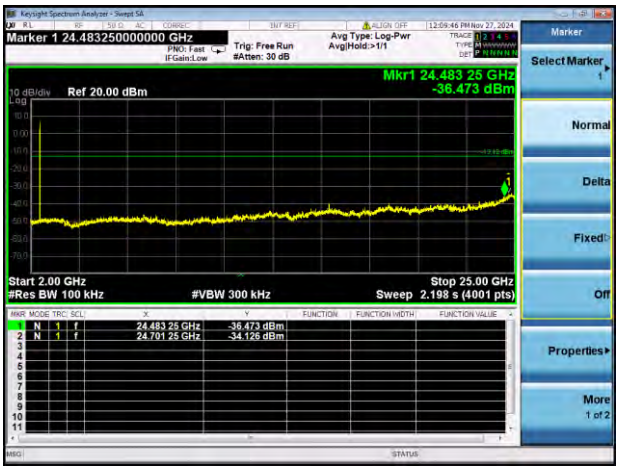


GFSK (BLE 1Mbps) MIDDLE CHANNEL,
CARRIER LEVEL

GFSK (BLE 1Mbps) MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

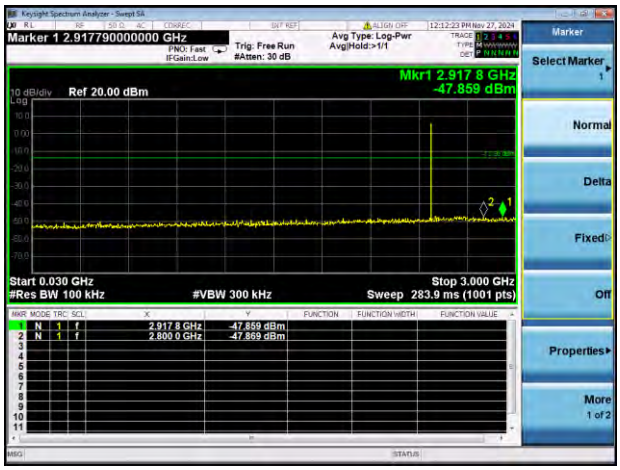


GFSK (BLE 1Mbps) MIDDLE CHANNEL, SPURIOUS 2 GHz ~ 25 GHz

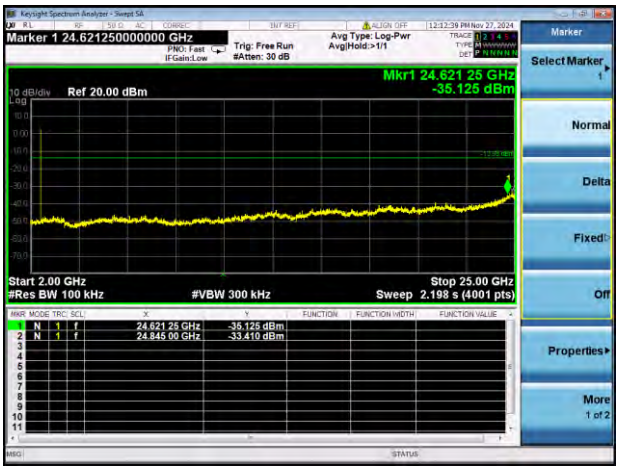


GFSK (BLE 1Mbps) HIGH CHANNEL, CARRIER LEVEL

GFSK (BLE 1Mbps) HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

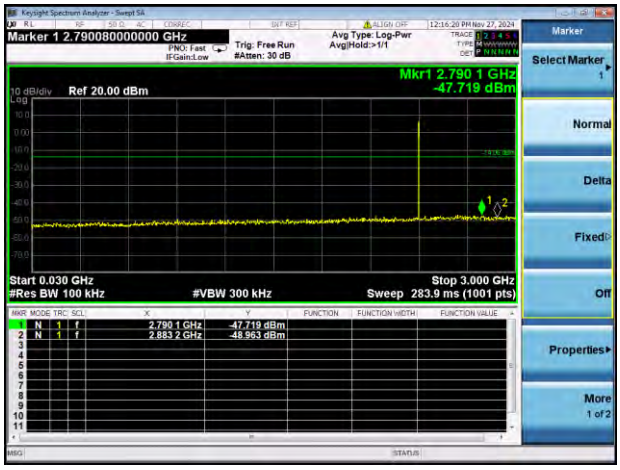


GFSK (BLE 1Mbps) HIGH CHANNEL, SPURIOUS 2 GHz ~ 25 GHz

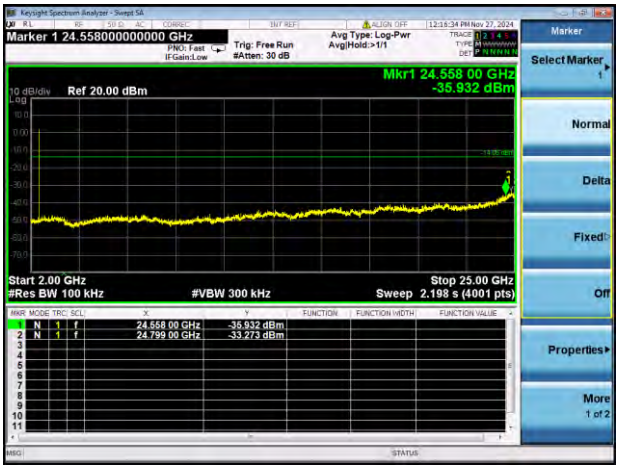


GFSK (BLE 2Mbps) LOW CHANNEL,
CARRIER LEVEL

GFSK (BLE 2Mbps) LOW CHANNEL,
SPURIOUS 30 MHz ~ 3 GHz

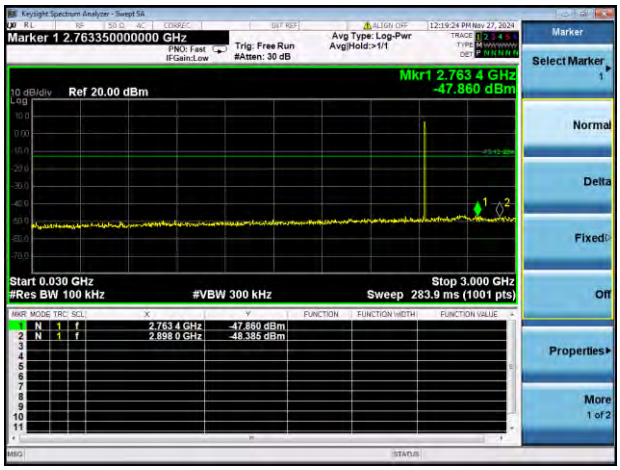


GFSK (BLE 2Mbps) LOW CHANNEL,
SPURIOUS 2 GHz ~ 25 GHz

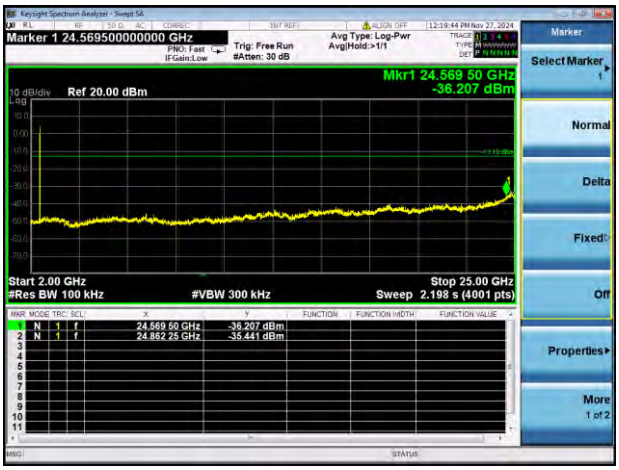


GFSK (BLE 2Mbps) MIDDLE CHANNEL,
CARRIER LEVEL

GFSK (BLE 2Mbps) MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

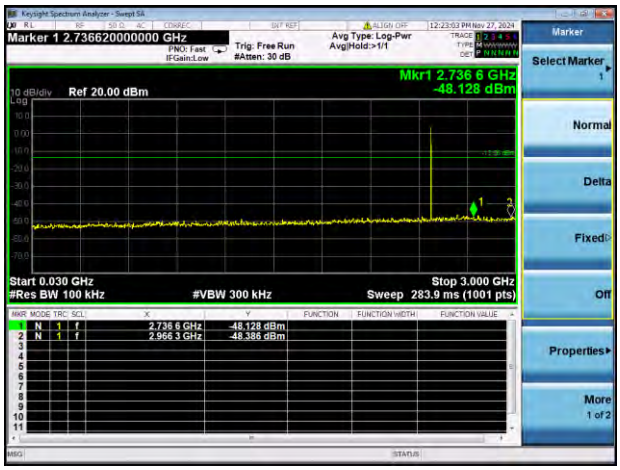


GFSK (BLE 2Mbps) MIDDLE CHANNEL, SPURIOUS 2 GHz ~ 25 GHz

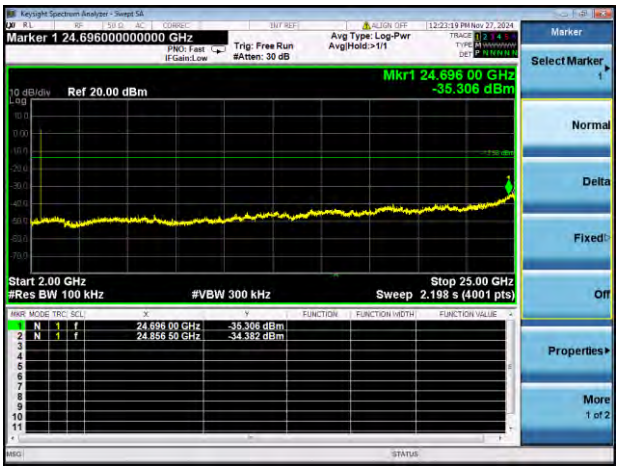


GFSK (BLE 2Mbps) HIGH CHANNEL, CARRIER LEVEL

GFSK (BLE 2Mbps) HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



GFSK (BLE 2Mbps) HIGH CHANNEL, SPURIOUS 2 GHz ~ 25 GHz



A.4 Band Edge (Authorized-band band-edge)

Note: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Test Data

Antenna 8

GFSK (BLE 1Mbps)				
Channel	Measured Max. Band Edge Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-49.11	7.55	-12.45	Pass
High Channel	-49.30	5.03	-14.97	Pass

GFSK (BLE 2Mbps)				
Channel	Measured Max. Band Edge Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-49.75	7.69	-12.31	Pass
High Channel	-49.12	5.42	-14.58	Pass

Antenna 9

GFSK (BLE 1Mbps)				
Channel	Measured Max. Band Edge Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-48.92	5.92	-14.08	Pass
High Channel	-48.31	6.02	-13.98	Pass

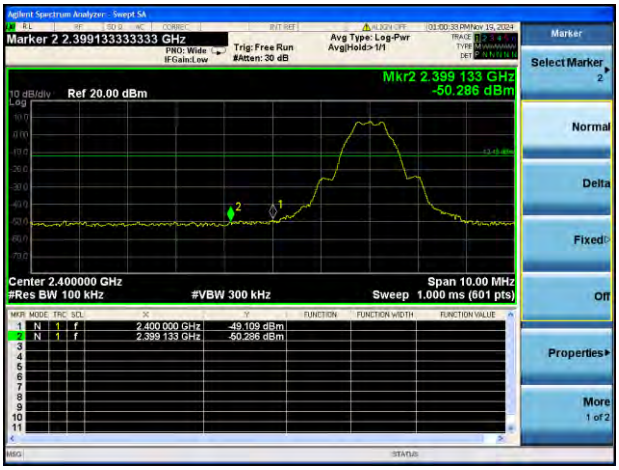
GFSK (BLE 2Mbps)				
Channel	Measured Max. Band Edge Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low Channel	-48.24	5.94	-14.06	Pass
High Channel	-48.95	6.44	-13.56	Pass

Test Plots

Antenna 8

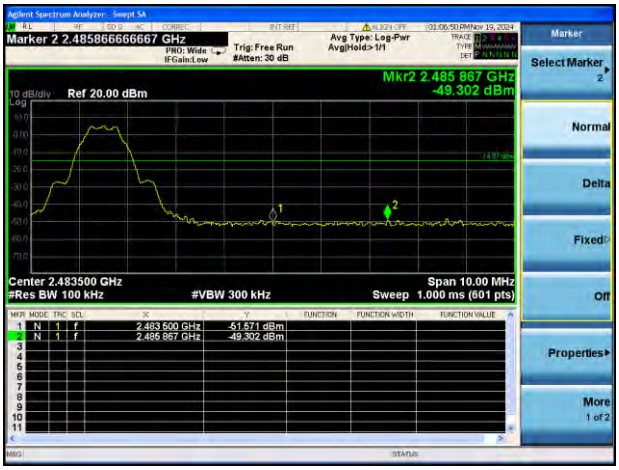
GFSK (BLE 1Mbps) LOW CHANNEL, CARRIER LEVEL

GFSK (BLE 1Mbps) LOW CHANNEL, BAND EDGE

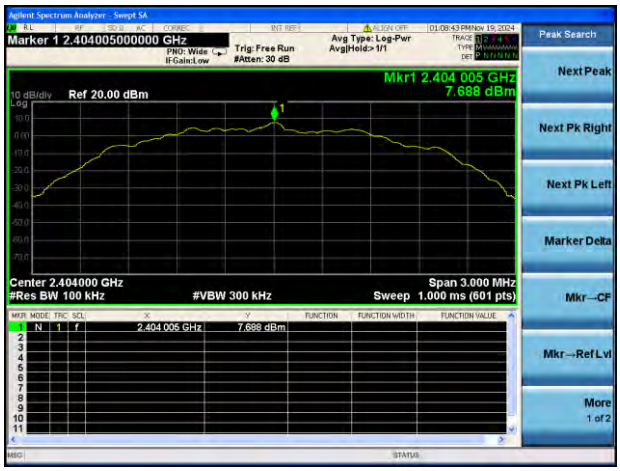


GFSK (BLE 1Mbps) HIGH CHANNEL, CARRIER LEVEL

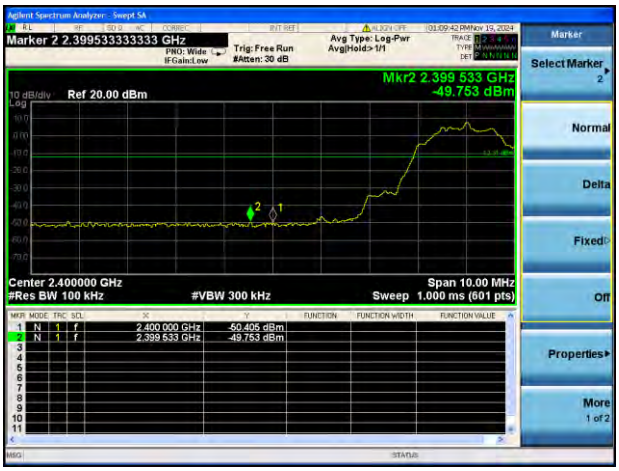
GFSK (BLE 1Mbps) HIGH CHANNEL, BAND EDGE



GFSK (BLE 2Mbps) LOW CHANNEL, CARRIER LEVEL

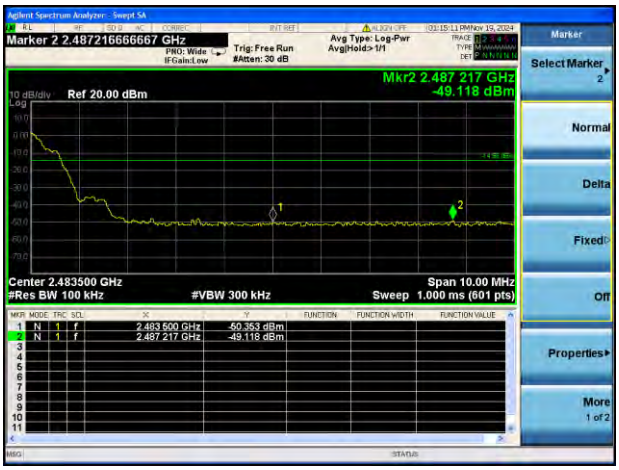


GFSK (BLE 2Mbps) LOW CHANNEL, BAND EDGE



GFSK (BLE 2Mbps) HIGH CHANNEL, CARRIER LEVEL

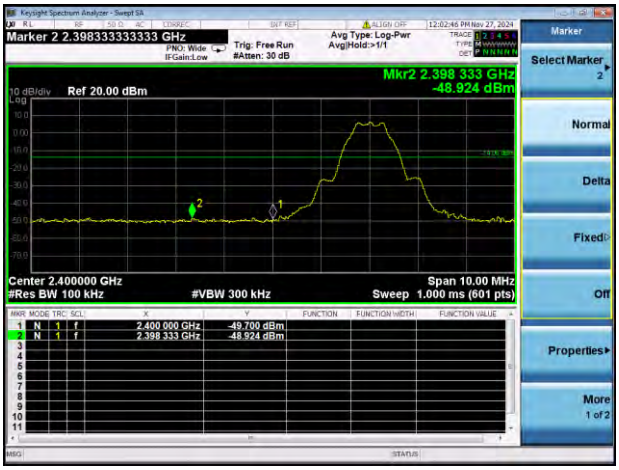
GFSK (BLE 2Mbps) HIGH CHANNEL, BAND EDGE



Antenna 9

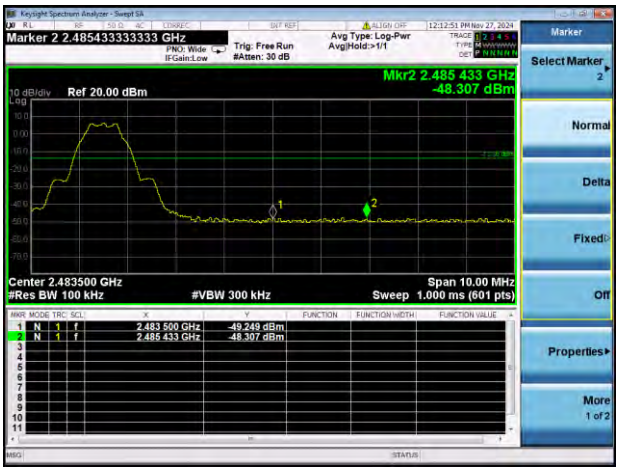
GFSK (BLE 1Mbps) LOW CHANNEL, CARRIER LEVEL

GFSK (BLE 1Mbps) LOW CHANNEL, BAND EDGE



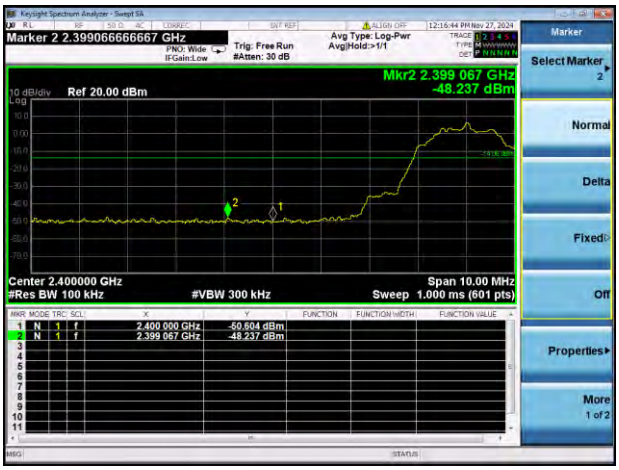
GFSK (BLE 1Mbps) HIGH CHANNEL, CARRIER LEVEL

GFSK (BLE 1Mbps) HIGH CHANNEL, BAND EDGE



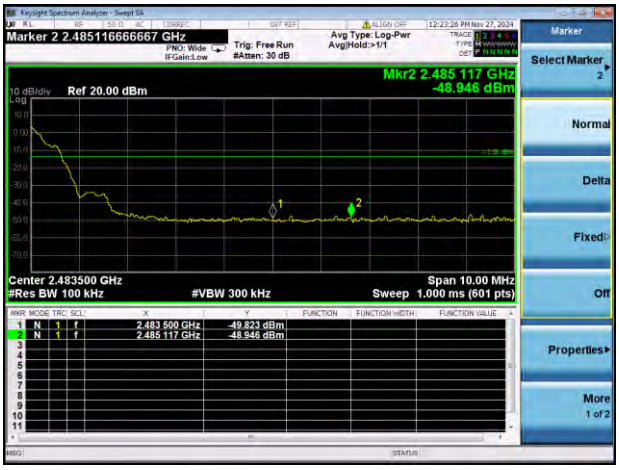
GFSK (BLE 2Mbps) LOW CHANNEL, CARRIER LEVEL

GFSK (BLE 2Mbps) LOW CHANNEL, BAND EDGE



GFSK (BLE 2Mbps) HIGH CHANNEL, CARRIER LEVEL

GFSK (BLE 2Mbps) HIGH CHANNEL, BAND EDGE



A.5 Conducted Emissions

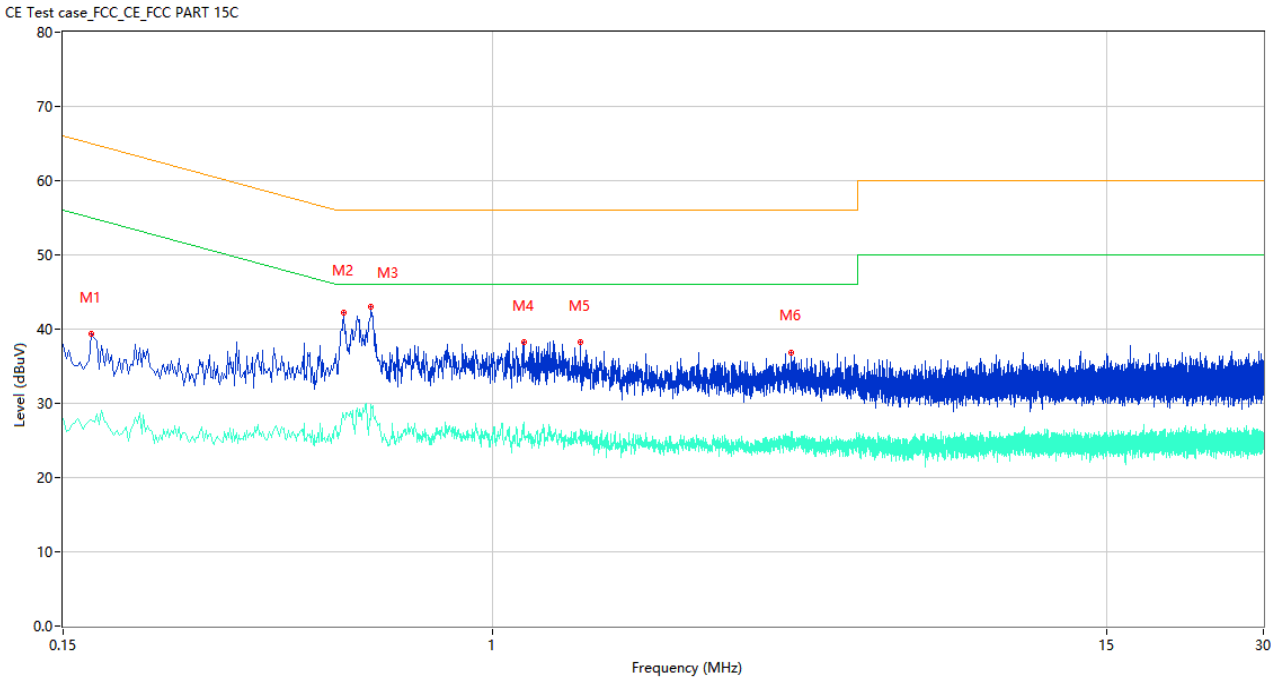
Note [1]: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.

Note [2]: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.

Note [3]: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

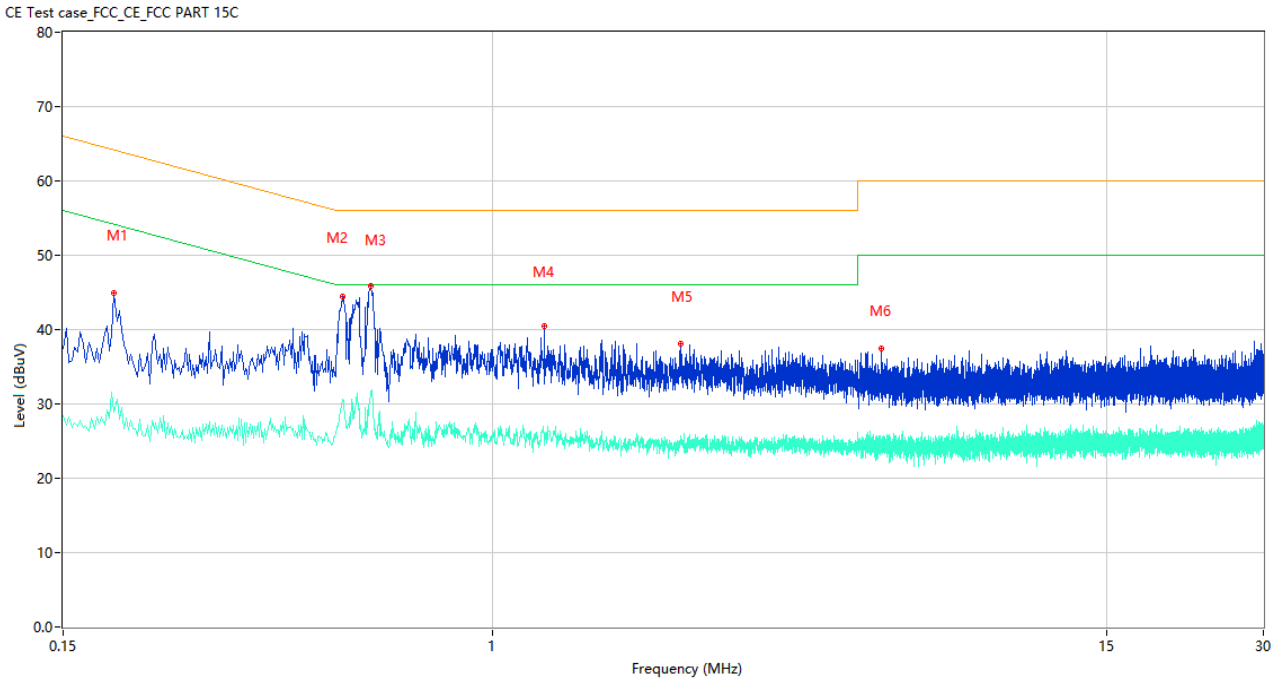
Test Data and Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.170	39.44	9.78	64.96	25.52	Peak	L	Pass
1**	0.170	27.82	9.78	54.96	27.14	AV	L	Pass
2	0.518	42.18	10.00	56.00	13.82	Peak	L	Pass
2**	0.518	28.41	10.00	46.00	17.59	AV	L	Pass
3	0.584	43.07	10.12	56.00	12.93	Peak	L	Pass
3**	0.584	29.85	10.12	46.00	16.15	AV	L	Pass
4	1.146	38.32	10.38	56.00	17.68	Peak	L	Pass
4**	1.146	27.45	10.38	46.00	18.55	AV	L	Pass
5	1.470	38.21	10.15	56.00	17.79	Peak	L	Pass
5**	1.470	25.91	10.15	46.00	20.09	AV	L	Pass
6	3.734	36.85	10.42	56.00	19.15	Peak	L	Pass
6**	3.734	26.23	10.42	46.00	19.77	AV	L	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.188	44.91	9.78	64.12	19.21	Peak	N	Pass
1**	0.188	28.92	9.78	54.12	25.20	AV	N	Pass
2	0.514	44.51	9.99	56.00	11.49	Peak	N	Pass
2**	0.514	30.69	9.99	46.00	15.31	AV	N	Pass
3	0.584	45.80	10.12	56.00	10.20	Peak	N	Pass
3**	0.584	31.56	10.12	46.00	14.44	AV	N	Pass
4	1.254	40.41	10.45	56.00	15.59	Peak	N	Pass
4**	1.254	25.97	10.45	46.00	20.03	AV	N	Pass
5	2.296	38.10	10.34	56.00	17.90	Peak	N	Pass
5**	2.296	25.30	10.34	46.00	20.70	AV	N	Pass
6	5.552	37.52	10.50	60.00	22.48	Peak	N	Pass
6**	5.552	23.92	10.50	50.00	26.08	AV	N	Pass

A.6 Radiated Spurious Emission

Note [1]: The symbol of "--" in the table which means not application.

Note [2]: For the test data above 1 GHz, according the ANSI C63.4-2014, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

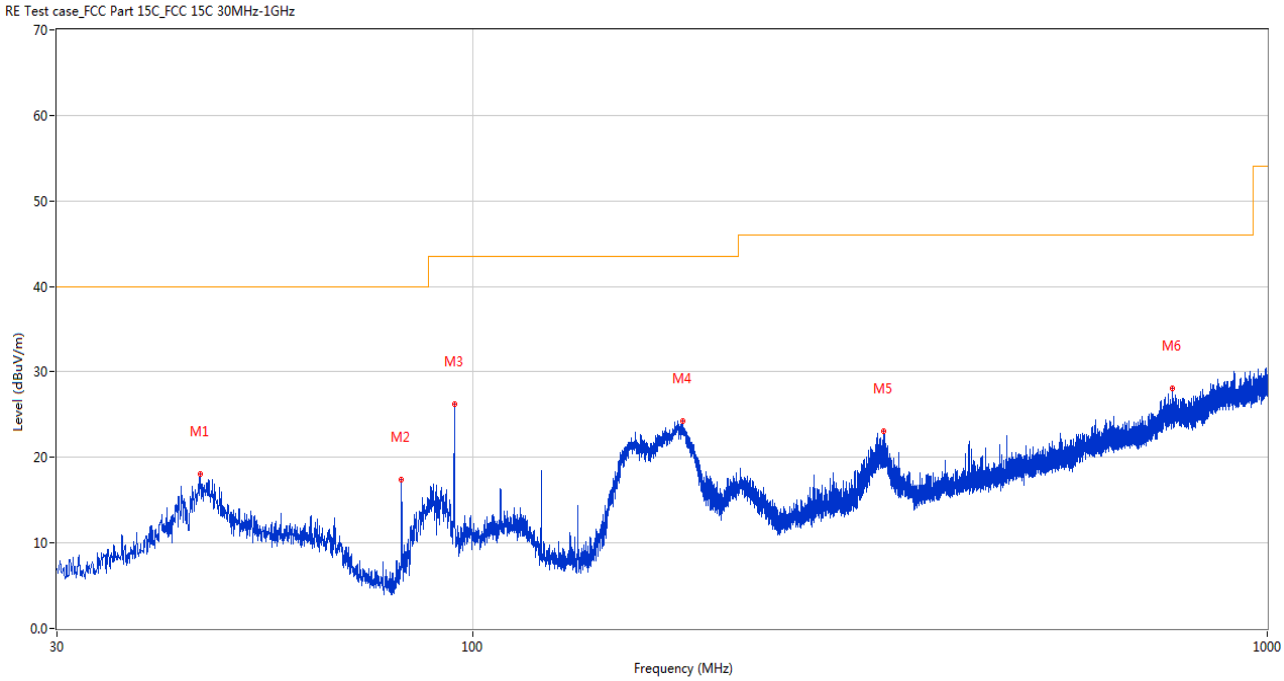
Note [3]: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

Note [4]: The EUT is working in the Normal link mode below 1 GHz. All modes have been tested and BLE 2-Middle mode is the worst.

Note [5]: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

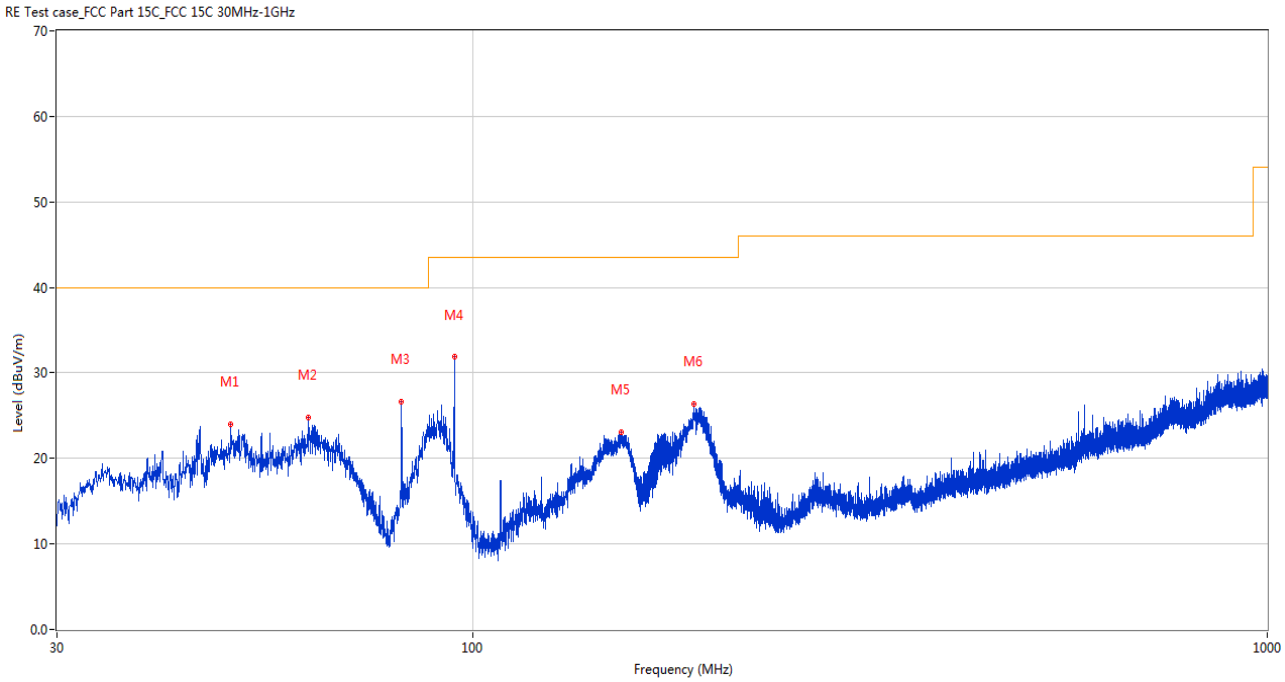
Test Data and Plots

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	45.423	18.05	-25.23	40.0	21.95	Peak	38.60	200	Horizontal	Pass
2	81.362	17.37	-31.42	40.0	22.63	Peak	36.10	200	Horizontal	Pass
3	94.941	26.18	-27.59	43.5	17.32	Peak	182.20	200	Horizontal	Pass
4	183.842	24.25	-27.40	43.5	19.25	Peak	94.20	200	Horizontal	Pass
5	329.536	23.07	-22.44	46.0	22.93	Peak	115.10	100	Horizontal	Pass
6	759.682	28.14	-11.76	46.0	17.86	Peak	32.00	200	Horizontal	Pass

30 MHz to 1 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	49.642	23.96	-25.09	40.0	16.04	Peak	189.20	100	Vertical	Pass
2	62.107	24.73	-26.44	40.0	15.27	Peak	97.20	100	Vertical	Pass
3	81.362	26.57	-31.42	40.0	13.43	Peak	226.60	100	Vertical	Pass
4	94.941	31.84	-27.59	43.5	11.66	Peak	70.40	100	Vertical	Pass
5	153.772	23.03	-29.35	43.5	20.47	Peak	134.60	100	Vertical	Pass
6	189.807	26.42	-26.56	43.5	17.08	Peak	48.30	100	Vertical	Pass

Note [1]: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note [2]: The spurious from 18GHz-25GHz is noise only, do not show on the report.

Antenna 8

GFSK (BLE 1Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1334.897	45.35	74.0	28.65	Peak	274.00	200	Horizontal	Pass
1**	1334.897	29.80	54.0	24.20	AV	274.00	200	Horizontal	Pass
2	2973.472	49.59	74.0	24.41	Peak	326.00	300	Horizontal	Pass
2**	2973.472	38.98	54.0	15.02	AV	326.00	300	Horizontal	Pass
3	4914.394	52.83	74.0	21.17	Peak	170.00	200	Horizontal	Pass
3**	4914.394	41.90	54.0	12.10	AV	170.00	200	Horizontal	Pass
4	7625.823	52.34	74.0	21.66	Peak	119.00	400	Horizontal	Pass
4**	7625.823	41.95	54.0	12.05	AV	119.00	400	Horizontal	Pass
5	12475.155	50.21	74.0	23.79	Peak	165.00	100	Horizontal	Pass
5**	12475.155	46.65	54.0	7.35	AV	165.00	100	Horizontal	Pass
6	16854.442	53.51	74.0	20.49	Peak	258.00	200	Horizontal	Pass
6**	16854.442	42.91	54.0	11.09	AV	258.00	200	Horizontal	Pass

GFSK (BLE 1Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1462.231	42.17	74.0	31.83	Peak	129.00	300	Vertical	Pass
1**	1462.231	31.70	54.0	22.30	AV	129.00	300	Vertical	Pass
2	2990.733	50.00	74.0	24.00	Peak	127.00	300	Vertical	Pass
2**	2990.733	41.20	54.0	12.80	AV	127.00	300	Vertical	Pass
3	4823.227	53.52	74.0	20.48	Peak	60.00	200	Vertical	Pass
3**	4823.227	38.44	54.0	15.56	AV	60.00	200	Vertical	Pass
4	7963.314	55.64	74.0	18.36	Peak	242.00	200	Vertical	Pass
4**	7963.314	45.33	54.0	8.67	AV	242.00	200	Vertical	Pass
5	12446.614	50.17	74.0	23.83	Peak	62.00	200	Vertical	Pass
5**	12446.614	44.26	54.0	9.74	AV	62.00	200	Vertical	Pass
6	17457.428	58.33	74.0	15.67	Peak	320.00	400	Vertical	Pass
6**	17457.428	43.21	54.0	10.79	AV	320.00	400	Vertical	Pass

GFSK (BLE 1Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1335.480	44.28	74.0	29.72	Peak	6.00	300	Horizontal	Pass
1**	1335.480	27.46	54.0	26.54	AV	6.00	300	Horizontal	Pass
2	2970.489	53.32	74.0	20.68	Peak	162.00	100	Horizontal	Pass
2**	2970.489	38.87	54.0	15.13	AV	162.00	100	Horizontal	Pass
3	4913.645	51.03	74.0	22.97	Peak	259.00	200	Horizontal	Pass
3**	4913.645	40.64	54.0	13.36	AV	259.00	200	Horizontal	Pass
4	7622.500	55.89	74.0	18.11	Peak	195.00	400	Horizontal	Pass
4**	7622.500	41.44	54.0	12.56	AV	195.00	400	Horizontal	Pass
5	12472.806	54.08	74.0	19.92	Peak	323.00	400	Horizontal	Pass
5**	12472.806	46.24	54.0	7.76	AV	323.00	400	Horizontal	Pass
6	16857.430	52.40	74.0	21.60	Peak	281.00	100	Horizontal	Pass
6**	16857.430	44.68	54.0	9.32	AV	281.00	100	Horizontal	Pass

GFSK (BLE 1Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1464.871	42.75	74.0	31.25	Peak	69.00	400	Vertical	Pass
1**	1464.871	32.49	54.0	21.51	AV	69.00	400	Vertical	Pass
2	2992.964	51.31	74.0	22.69	Peak	149.00	300	Vertical	Pass
2**	2992.964	36.72	54.0	17.28	AV	149.00	300	Vertical	Pass
3	4819.566	54.15	74.0	19.85	Peak	240.00	200	Vertical	Pass
3**	4819.566	42.64	54.0	11.36	AV	240.00	200	Vertical	Pass
4	7964.624	55.11	74.0	18.89	Peak	196.00	100	Vertical	Pass
4**	7964.624	42.10	54.0	11.90	AV	196.00	100	Vertical	Pass
5	12444.376	49.46	74.0	24.54	Peak	274.00	200	Vertical	Pass
5**	12444.376	45.39	54.0	8.61	AV	274.00	200	Vertical	Pass
6	17455.697	53.36	74.0	20.64	Peak	334.00	200	Vertical	Pass
6**	17455.697	47.04	54.0	6.96	AV	334.00	200	Vertical	Pass

GFSK (BLE 1Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1335.977	44.91	74.0	29.09	Peak	150.00	300	Horizontal	Pass
1**	1335.977	29.67	54.0	24.33	AV	150.00	300	Horizontal	Pass
2	2973.050	51.32	74.0	22.68	Peak	47.00	300	Horizontal	Pass
2**	2973.050	41.94	54.0	12.06	AV	47.00	300	Horizontal	Pass
3	4914.390	49.12	74.0	24.88	Peak	59.00	200	Horizontal	Pass
3**	4914.390	44.81	54.0	9.19	AV	59.00	200	Horizontal	Pass
4	7623.311	54.00	74.0	20.00	Peak	58.00	400	Horizontal	Pass
4**	7623.311	40.60	54.0	13.40	AV	58.00	400	Horizontal	Pass
5	12472.511	53.14	74.0	20.86	Peak	136.00	100	Horizontal	Pass
5**	12472.511	43.19	54.0	10.81	AV	136.00	100	Horizontal	Pass
6	16853.907	53.44	74.0	20.56	Peak	83.00	300	Horizontal	Pass
6**	16853.907	44.47	54.0	9.53	AV	83.00	300	Horizontal	Pass

GFSK (BLE 1Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1467.954	41.49	74.0	32.51	Peak	151.00	100	Vertical	Pass
1**	1467.954	29.10	54.0	24.90	AV	151.00	100	Vertical	Pass
2	2991.411	47.90	74.0	26.10	Peak	110.00	300	Vertical	Pass
2**	2991.411	39.36	54.0	14.64	AV	110.00	300	Vertical	Pass
3	4826.565	54.75	74.0	19.25	Peak	73.00	200	Vertical	Pass
3**	4826.565	39.12	54.0	14.88	AV	73.00	200	Vertical	Pass
4	7969.181	58.12	74.0	15.88	Peak	108.00	400	Vertical	Pass
4**	7969.181	43.57	54.0	10.43	AV	108.00	400	Vertical	Pass
5	12445.849	48.61	74.0	25.39	Peak	73.00	200	Vertical	Pass
5**	12445.849	45.87	54.0	8.13	AV	73.00	200	Vertical	Pass
6	17456.453	57.30	74.0	16.70	Peak	109.00	400	Vertical	Pass
6**	17456.453	46.03	54.0	7.97	AV	109.00	400	Vertical	Pass

GFSK (BLE 2Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1281.867	43.66	74.0	30.34	Peak	331.00	300	Horizontal	Pass
1**	1281.867	35.76	54.0	18.24	AV	331.00	300	Horizontal	Pass
2	2772.706	54.23	74.0	19.77	Peak	174.00	100	Horizontal	Pass
2**	2772.706	42.54	54.0	11.46	AV	174.00	100	Horizontal	Pass
3	5166.853	50.38	74.0	23.62	Peak	207.00	200	Horizontal	Pass
3**	5166.853	41.21	54.0	12.79	AV	207.00	200	Horizontal	Pass
4	6805.421	53.67	74.0	20.33	Peak	227.00	200	Horizontal	Pass
4**	6805.421	46.53	54.0	7.47	AV	227.00	200	Horizontal	Pass
5	13468.651	53.43	74.0	20.57	Peak	276.00	400	Horizontal	Pass
5**	13468.651	47.70	54.0	6.30	AV	276.00	400	Horizontal	Pass
6	17465.212	55.84	74.0	18.16	Peak	279.00	400	Horizontal	Pass
6**	17465.212	43.62	54.0	10.38	AV	279.00	400	Horizontal	Pass

GFSK (BLE 2Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1286.913	43.48	74.0	30.52	Peak	295.00	300	Vertical	Pass
1**	1286.913	35.61	54.0	18.39	AV	295.00	300	Vertical	Pass
2	2772.665	51.73	74.0	22.27	Peak	318.00	100	Vertical	Pass
2**	2772.665	40.88	54.0	13.12	AV	318.00	100	Vertical	Pass
3	5169.509	51.45	74.0	22.55	Peak	291.00	200	Vertical	Pass
3**	5169.509	41.06	54.0	12.94	AV	291.00	200	Vertical	Pass
4	6805.466	55.82	74.0	18.18	Peak	84.00	400	Vertical	Pass
4**	6805.466	43.17	54.0	10.83	AV	84.00	400	Vertical	Pass
5	13468.530	54.96	74.0	19.04	Peak	69.00	400	Vertical	Pass
5**	13468.530	44.22	54.0	9.78	AV	69.00	400	Vertical	Pass
6	17468.614	58.50	74.0	15.50	Peak	248.00	400	Vertical	Pass
6**	17468.614	46.02	54.0	7.98	AV	248.00	400	Vertical	Pass

GFSK (BLE 2Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1283.074	42.06	74.0	31.94	Peak	202.00	300	Horizontal	Pass
1**	1283.074	32.28	54.0	21.72	AV	202.00	300	Horizontal	Pass
2	2769.527	49.96	74.0	24.04	Peak	337.00	300	Horizontal	Pass
2**	2769.527	42.48	54.0	11.52	AV	337.00	300	Horizontal	Pass
3	5165.388	51.08	74.0	22.92	Peak	322.00	200	Horizontal	Pass
3**	5165.388	42.27	54.0	11.73	AV	322.00	200	Horizontal	Pass
4	6806.797	57.58	74.0	16.42	Peak	142.00	300	Horizontal	Pass
4**	6806.797	48.97	54.0	5.03	AV	142.00	300	Horizontal	Pass
5	13468.059	55.44	74.0	18.56	Peak	68.00	100	Horizontal	Pass
5**	13468.059	45.48	54.0	8.52	AV	68.00	100	Horizontal	Pass
6	17470.267	56.29	74.0	17.71	Peak	322.00	200	Horizontal	Pass
6**	17470.267	47.20	54.0	6.80	AV	322.00	200	Horizontal	Pass

GFSK (BLE 2Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1287.349	41.51	74.0	32.49	Peak	43.00	100	Vertical	Pass
1**	1287.349	34.10	54.0	19.90	AV	43.00	100	Vertical	Pass
2	2772.369	53.18	74.0	20.82	Peak	232.00	300	Vertical	Pass
2**	2772.369	44.67	54.0	9.33	AV	232.00	300	Vertical	Pass
3	5165.707	51.09	74.0	22.91	Peak	129.00	200	Vertical	Pass
3**	5165.707	42.99	54.0	11.01	AV	129.00	200	Vertical	Pass
4	6805.045	54.22	74.0	19.78	Peak	239.00	100	Vertical	Pass
4**	6805.045	47.00	54.0	7.00	AV	239.00	100	Vertical	Pass
5	13465.936	54.29	74.0	19.71	Peak	327.00	300	Vertical	Pass
5**	13465.936	42.79	54.0	11.21	AV	327.00	300	Vertical	Pass
6	17465.051	56.80	74.0	17.20	Peak	233.00	400	Vertical	Pass
6**	17465.051	48.59	54.0	5.41	AV	233.00	400	Vertical	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1287.341	44.45	74.0	29.55	Peak	26.00	400	Horizontal	Pass
1**	1287.341	30.43	54.0	23.57	AV	26.00	400	Horizontal	Pass
2	2770.714	52.37	74.0	21.63	Peak	283.00	100	Horizontal	Pass
2**	2770.714	40.45	54.0	13.55	AV	283.00	100	Horizontal	Pass
3	5394.988	53.27	74.0	20.73	Peak	335.00	200	Horizontal	Pass
3**	5394.988	41.21	54.0	12.79	AV	335.00	200	Horizontal	Pass
4	6516.538	54.27	74.0	19.73	Peak	290.00	400	Horizontal	Pass
4**	6516.538	47.45	54.0	6.55	AV	290.00	400	Horizontal	Pass
5	13355.063	54.27	74.0	19.73	Peak	219.00	200	Horizontal	Pass
5**	13355.063	47.07	54.0	6.93	AV	219.00	200	Horizontal	Pass
6	17438.708	55.41	74.0	18.59	Peak	170.00	100	Horizontal	Pass
6**	17438.708	47.44	54.0	6.56	AV	170.00	100	Horizontal	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1283.362	43.60	74.0	30.40	Peak	232.00	400	Vertical	Pass
1**	1283.362	31.24	54.0	22.76	AV	232.00	400	Vertical	Pass
2	2772.106	51.41	74.0	22.59	Peak	51.00	100	Vertical	Pass
2**	2772.106	45.82	54.0	8.18	AV	51.00	100	Vertical	Pass
3	5283.686	51.61	74.0	22.39	Peak	293.00	200	Vertical	Pass
3**	5283.686	42.68	54.0	11.32	AV	293.00	200	Vertical	Pass
4	6653.591	55.77	74.0	18.23	Peak	44.00	300	Vertical	Pass
4**	6653.591	47.74	54.0	6.26	AV	44.00	300	Vertical	Pass
5	13310.640	57.62	74.0	16.38	Peak	200.00	100	Vertical	Pass
5**	13310.640	47.23	54.0	6.77	AV	200.00	100	Vertical	Pass
6	17417.183	58.29	74.0	15.71	Peak	77.00	400	Vertical	Pass
6**	17417.183	46.81	54.0	7.19	AV	77.00	400	Vertical	Pass

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GFSK (BLE 1Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1334.182	45.05	74.0	28.95	Peak	113.00	400	Horizontal	Pass
1**	1334.182	28.10	54.0	25.90	AV	113.00	400	Horizontal	Pass
2	2977.020	47.72	74.0	26.28	Peak	270.00	100	Horizontal	Pass
2**	2977.020	38.17	54.0	15.83	AV	270.00	100	Horizontal	Pass
3	4910.028	49.08	74.0	24.92	Peak	224.00	200	Horizontal	Pass
3**	4910.028	42.35	54.0	11.65	AV	224.00	200	Horizontal	Pass
4	7629.608	55.57	74.0	18.43	Peak	218.00	300	Horizontal	Pass
4**	7629.608	38.14	54.0	15.86	AV	218.00	300	Horizontal	Pass
5	12475.116	55.29	74.0	18.71	Peak	294.00	300	Horizontal	Pass
5**	12475.116	43.77	54.0	10.23	AV	294.00	300	Horizontal	Pass
6	16859.349	53.14	74.0	20.86	Peak	342.00	200	Horizontal	Pass
6**	16859.349	42.43	54.0	11.57	AV	342.00	200	Horizontal	Pass

GFSK (BLE 1Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1465.454	43.03	74.0	30.97	Peak	319.00	200	Vertical	Pass
1**	1465.454	28.83	54.0	25.17	AV	319.00	200	Vertical	Pass
2	2991.531	52.94	74.0	21.06	Peak	193.00	100	Vertical	Pass
2**	2991.531	38.95	54.0	15.05	AV	193.00	100	Vertical	Pass
3	4821.030	50.63	74.0	23.37	Peak	338.00	200	Vertical	Pass
3**	4821.030	39.44	54.0	14.56	AV	338.00	200	Vertical	Pass
4	7963.422	57.59	74.0	16.41	Peak	19.00	200	Vertical	Pass
4**	7963.422	42.03	54.0	11.97	AV	19.00	200	Vertical	Pass
5	12440.308	50.55	74.0	23.45	Peak	239.00	200	Vertical	Pass
5**	12440.308	43.46	54.0	10.54	AV	239.00	200	Vertical	Pass
6	17460.617	54.35	74.0	19.65	Peak	31.00	300	Vertical	Pass
6**	17460.617	44.81	54.0	9.19	AV	31.00	300	Vertical	Pass

GFSK (BLE 1Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1333.665	41.88	74.0	32.12	Peak	210.00	300	Horizontal	Pass
1**	1333.665	30.99	54.0	23.01	AV	210.00	300	Horizontal	Pass
2	2971.372	52.52	74.0	21.48	Peak	202.00	400	Horizontal	Pass
2**	2971.372	41.55	54.0	12.45	AV	202.00	400	Horizontal	Pass
3	4916.905	48.88	74.0	25.12	Peak	59.00	200	Horizontal	Pass
3**	4916.905	39.73	54.0	14.27	AV	59.00	200	Horizontal	Pass
4	7629.357	56.06	74.0	17.94	Peak	103.00	200	Horizontal	Pass
4**	7629.357	37.82	54.0	16.18	AV	103.00	200	Horizontal	Pass
5	12476.943	51.95	74.0	22.05	Peak	91.00	300	Horizontal	Pass
5**	12476.943	42.73	54.0	11.27	AV	91.00	300	Horizontal	Pass
6	16860.414	56.63	74.0	17.37	Peak	103.00	300	Horizontal	Pass
6**	16860.414	42.17	54.0	11.83	AV	103.00	300	Horizontal	Pass

GFSK (BLE 1Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1469.479	44.86	74.0	29.14	Peak	79.00	300	Vertical	Pass
1**	1469.479	31.50	54.0	22.50	AV	79.00	300	Vertical	Pass
2	2988.082	51.66	74.0	22.34	Peak	34.00	100	Vertical	Pass
2**	2988.082	39.15	54.0	14.85	AV	34.00	100	Vertical	Pass
3	4823.663	49.32	74.0	24.68	Peak	297.00	200	Vertical	Pass
3**	4823.663	39.70	54.0	14.30	AV	297.00	200	Vertical	Pass
4	7970.962	57.19	74.0	16.81	Peak	112.00	100	Vertical	Pass
4**	7970.962	41.14	54.0	12.86	AV	112.00	100	Vertical	Pass
5	12443.001	49.39	74.0	24.61	Peak	356.00	400	Vertical	Pass
5**	12443.001	45.20	54.0	8.80	AV	356.00	400	Vertical	Pass
6	17455.640	55.78	74.0	18.22	Peak	220.00	100	Vertical	Pass
6**	17455.640	43.01	54.0	10.99	AV	220.00	100	Vertical	Pass

GFSK (BLE 1Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1334.435	42.92	74.0	31.08	Peak	78.00	300	Horizontal	Pass
1**	1334.435	27.58	54.0	26.42	AV	78.00	300	Horizontal	Pass
2	2974.533	49.27	74.0	24.73	Peak	276.00	300	Horizontal	Pass
2**	2974.533	40.33	54.0	13.67	AV	276.00	300	Horizontal	Pass
3	4915.972	49.92	74.0	24.08	Peak	242.00	200	Horizontal	Pass
3**	4915.972	45.30	54.0	8.70	AV	242.00	200	Horizontal	Pass
4	7627.231	55.33	74.0	18.67	Peak	59.00	300	Horizontal	Pass
4**	7627.231	41.23	54.0	12.77	AV	59.00	300	Horizontal	Pass
5	12476.141	50.61	74.0	23.39	Peak	311.00	400	Horizontal	Pass
5**	12476.141	44.41	54.0	9.59	AV	311.00	400	Horizontal	Pass
6	16855.979	56.05	74.0	17.95	Peak	108.00	200	Horizontal	Pass
6**	16855.979	40.74	54.0	13.26	AV	108.00	200	Horizontal	Pass

GFSK (BLE 1Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1467.295	45.11	74.0	28.89	Peak	201.00	400	Vertical	Pass
1**	1467.295	30.32	54.0	23.68	AV	201.00	400	Vertical	Pass
2	2992.144	48.73	74.0	25.27	Peak	31.00	300	Vertical	Pass
2**	2992.144	39.34	54.0	14.66	AV	31.00	300	Vertical	Pass
3	4824.343	51.29	74.0	22.71	Peak	131.00	200	Vertical	Pass
3**	4824.343	43.25	54.0	10.75	AV	131.00	200	Vertical	Pass
4	7969.900	54.97	74.0	19.03	Peak	83.00	200	Vertical	Pass
4**	7969.900	41.45	54.0	12.55	AV	83.00	200	Vertical	Pass
5	12440.784	52.95	74.0	21.05	Peak	115.00	400	Vertical	Pass
5**	12440.784	45.31	54.0	8.69	AV	115.00	400	Vertical	Pass
6	17456.456	54.61	74.0	19.39	Peak	199.00	200	Vertical	Pass
6**	17456.456	43.81	54.0	10.19	AV	199.00	200	Vertical	Pass

GFSK (BLE 2Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1289.589	43.42	74.0	30.58	Peak	105.00	200	Horizontal	Pass
1**	1289.589	34.07	54.0	19.93	AV	105.00	200	Horizontal	Pass
2	2767.211	53.68	74.0	20.32	Peak	72.00	300	Horizontal	Pass
2**	2767.211	44.49	54.0	9.51	AV	72.00	300	Horizontal	Pass
3	5164.491	52.48	74.0	21.52	Peak	117.00	200	Horizontal	Pass
3**	5164.491	40.87	54.0	13.13	AV	117.00	200	Horizontal	Pass
4	6804.513	54.23	74.0	19.77	Peak	295.00	400	Horizontal	Pass
4**	6804.513	43.65	54.0	10.35	AV	295.00	400	Horizontal	Pass
5	13466.692	55.65	74.0	18.35	Peak	275.00	400	Horizontal	Pass
5**	13466.692	42.65	54.0	11.35	AV	275.00	400	Horizontal	Pass
6	17470.458	57.77	74.0	16.23	Peak	232.00	200	Horizontal	Pass
6**	17470.458	45.35	54.0	8.65	AV	232.00	200	Horizontal	Pass

GFSK (BLE 2Mbps) LOW CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1285.909	44.10	74.0	29.90	Peak	353.00	400	Vertical	Pass
1**	1285.909	30.27	54.0	23.73	AV	353.00	400	Vertical	Pass
2	2767.355	53.84	74.0	20.16	Peak	108.00	100	Vertical	Pass
2**	2767.355	45.26	54.0	8.74	AV	108.00	100	Vertical	Pass
3	5167.593	50.39	74.0	23.61	Peak	219.00	200	Vertical	Pass
3**	5167.593	40.25	54.0	13.75	AV	219.00	200	Vertical	Pass
4	6806.556	54.13	74.0	19.87	Peak	171.00	300	Vertical	Pass
4**	6806.556	48.79	54.0	5.21	AV	171.00	300	Vertical	Pass
5	13468.137	54.73	74.0	19.27	Peak	37.00	100	Vertical	Pass
5**	13468.137	45.95	54.0	8.05	AV	37.00	100	Vertical	Pass
6	17469.016	58.55	74.0	15.45	Peak	177.00	100	Vertical	Pass
6**	17469.016	43.80	54.0	10.20	AV	177.00	100	Vertical	Pass

GFSK (BLE 2Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1282.017	42.88	74.0	31.12	Peak	71.00	300	Horizontal	Pass
1**	1282.017	34.83	54.0	19.17	AV	71.00	300	Horizontal	Pass
2	2768.855	50.30	74.0	23.70	Peak	172.00	100	Horizontal	Pass
2**	2768.855	43.91	54.0	10.09	AV	172.00	100	Horizontal	Pass
3	5167.053	54.53	74.0	19.47	Peak	160.00	200	Horizontal	Pass
3**	5167.053	45.89	54.0	8.11	AV	160.00	200	Horizontal	Pass
4	6806.509	55.69	74.0	18.31	Peak	145.00	400	Horizontal	Pass
4**	6806.509	44.21	54.0	9.79	AV	145.00	400	Horizontal	Pass
5	13466.518	55.56	74.0	18.44	Peak	347.00	100	Horizontal	Pass
5**	13466.518	47.44	54.0	6.56	AV	347.00	100	Horizontal	Pass
6	17470.142	56.44	74.0	17.56	Peak	183.00	300	Horizontal	Pass
6**	17470.142	45.43	54.0	8.57	AV	183.00	300	Horizontal	Pass

GFSK (BLE 2Mbps) MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1285.987	39.76	74.0	34.24	Peak	25.00	200	Vertical	Pass
1**	1285.987	35.61	54.0	18.39	AV	25.00	200	Vertical	Pass
2	2774.348	48.80	74.0	25.20	Peak	97.00	200	Vertical	Pass
2**	2774.348	42.53	54.0	11.47	AV	97.00	200	Vertical	Pass
3	5167.378	53.87	74.0	20.13	Peak	111.00	200	Vertical	Pass
3**	5167.378	40.58	54.0	13.42	AV	111.00	200	Vertical	Pass
4	6803.227	54.73	74.0	19.27	Peak	337.00	300	Vertical	Pass
4**	6803.227	45.32	54.0	8.68	AV	337.00	300	Vertical	Pass
5	13467.715	52.68	74.0	21.32	Peak	131.00	100	Vertical	Pass
5**	13467.715	45.38	54.0	8.62	AV	131.00	100	Vertical	Pass
6	17463.413	57.05	74.0	16.95	Peak	53.00	200	Vertical	Pass
6**	17463.413	45.34	54.0	8.66	AV	53.00	200	Vertical	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1284.725	39.77	74.0	34.23	Peak	268.00	100	Horizontal	Pass
1**	1284.725	32.13	54.0	21.87	AV	268.00	100	Horizontal	Pass
2	2769.560	50.77	74.0	23.23	Peak	263.00	400	Horizontal	Pass
2**	2769.560	41.30	54.0	12.70	AV	263.00	400	Horizontal	Pass
3	5391.480	53.24	74.0	20.76	Peak	277.00	200	Horizontal	Pass
3**	5391.480	44.50	54.0	9.50	AV	277.00	200	Horizontal	Pass
4	6513.936	52.07	74.0	21.93	Peak	261.00	300	Horizontal	Pass
4**	6513.936	46.98	54.0	7.02	AV	261.00	300	Horizontal	Pass
5	13350.666	53.22	74.0	20.78	Peak	141.00	100	Horizontal	Pass
5**	13350.666	49.90	54.0	4.10	AV	141.00	100	Horizontal	Pass
6	17444.967	53.70	74.0	20.30	Peak	49.00	100	Horizontal	Pass
6**	17444.967	45.67	54.0	8.33	AV	49.00	100	Horizontal	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL 1 GHz to 18 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1282.122	41.31	74.0	32.69	Peak	13.00	200	Vertical	Pass
1**	1282.122	33.78	54.0	20.22	AV	13.00	200	Vertical	Pass
2	2773.995	49.12	74.0	24.88	Peak	308.00	400	Vertical	Pass
2**	2773.995	44.22	54.0	9.78	AV	308.00	400	Vertical	Pass
3	5286.730	55.02	74.0	18.98	Peak	111.00	200	Vertical	Pass
3**	5286.730	42.73	54.0	11.27	AV	111.00	200	Vertical	Pass
4	6652.830	52.09	74.0	21.91	Peak	114.00	400	Vertical	Pass
4**	6652.830	46.61	54.0	7.39	AV	114.00	400	Vertical	Pass
5	13310.518	52.88	74.0	21.12	Peak	291.00	400	Vertical	Pass
5**	13310.518	47.48	54.0	6.52	AV	291.00	400	Vertical	Pass
6	17417.852	57.64	74.0	16.36	Peak	247.00	200	Vertical	Pass
6**	17417.852	46.57	54.0	7.43	AV	247.00	200	Vertical	Pass

A.7 Band Edge (Restricted-band band-edge)

Note [1]: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Note [2]: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

Note [3]: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note [4]: The Level (dBuV/m) has been corrected by factor.

Test Data

Antenna 8

GFSK (BLE 1Mbps) LOW CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2335.425	55.93	74.0	18.07	Peak	113.00	100	Horizontal	Pass
1**	2335.425	42.44	54.0	11.56	AV	113.00	100	Horizontal	Pass
2	2390.000	52.15	74.0	21.85	Peak	135.00	100	Horizontal	Pass
2**	2390.000	40.83	54.0	13.17	AV	135.00	100	Horizontal	Pass

GFSK (BLE 1Mbps) HIGH CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.500	52.99	74.0	21.01	Peak	176.00	200	Horizontal	Pass
1**	2483.500	45	54.0	9.00	AV	176.00	200	Horizontal	Pass
2	2486.689	53.22	74.0	20.78	Peak	194.00	100	Horizontal	Pass
2**	2486.689	45.4	54.0	8.60	AV	194.00	100	Horizontal	Pass

GFSK (BLE 2Mbps) LOW CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2319.309	56.89	74.0	17.11	Peak	355.00	200	Horizontal	Pass
1**	2319.309	46.83	54.0	7.17	AV	355.00	200	Horizontal	Pass
2	2390.000	53.39	74.0	20.61	Peak	82.00	300	Horizontal	Pass
2**	2390.000	45.06	54.0	8.94	AV	82.00	300	Horizontal	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.500	55.94	74.0	18.06	Peak	182.00	200	Horizontal	Pass
1**	2483.500	44.37	54.0	9.63	AV	182.00	200	Horizontal	Pass
2	2484.476	56.42	74.0	17.58	Peak	271.00	200	Horizontal	Pass
2**	2484.476	45.42	54.0	8.58	AV	271.00	200	Horizontal	Pass

Antenna 9

GFSK (BLE 1Mbps) LOW CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2336.454	54.26	74.0	19.74	Peak	260.00	300	Horizontal	Pass
1**	2336.454	43.91	54.0	10.09	AV	260.00	300	Horizontal	Pass
2	2390.000	52.91	74.0	21.09	Peak	271.00	200	Horizontal	Pass
2**	2390.000	41.88	54.0	12.12	AV	271.00	200	Horizontal	Pass

GFSK (BLE 1Mbps) HIGH CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.500	55.07	74.0	18.93	Peak	91.00	100	Horizontal	Pass
1**	2483.500	46.26	54.0	7.74	AV	91.00	100	Horizontal	Pass
2	2484.309	55.54	74.0	18.46	Peak	174.00	300	Horizontal	Pass
2**	2484.309	44.64	54.0	9.36	AV	174.00	300	Horizontal	Pass

GFSK (BLE 2Mbps) LOW CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2318.258	55.25	74.0	18.75	Peak	216.00	100	Horizontal	Pass
1**	2318.258	46.85	54.0	7.15	AV	216.00	100	Horizontal	Pass
2	2390.000	53.97	74.0	20.03	Peak	268.00	200	Horizontal	Pass
2**	2390.000	44.6	54.0	9.40	AV	268.00	200	Horizontal	Pass

GFSK (BLE 2Mbps) HIGH CHANNEL

No.	Frequency (MHz)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.500	53.77	74.0	20.23	Peak	138.00	300	Horizontal	Pass
1**	2483.500	46.63	54.0	7.37	AV	138.00	300	Horizontal	Pass
2	2483.759	55.31	74.0	18.69	Peak	193.00	300	Horizontal	Pass
2**	2483.759	45.64	54.0	8.36	AV	193.00	300	Horizontal	Pass

A.8 Power Spectral Density (PSD)

Test Data

Antenna 8

GFSK (BLE 1Mbps)			
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	-6.54	8	Pass
Middle Channel	-6.05	8	Pass
High Channel	-9.08	8	Pass

GFSK (BLE 2Mbps)			
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	-9.27	8	Pass
Middle Channel	-9.02	8	Pass
High Channel	-11.57	8	Pass

Antenna 9

GFSK (BLE 1Mbps)			
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	-8.42	8	Pass
Middle Channel	-7.50	8	Pass
High Channel	-8.34	8	Pass

GFSK (BLE 2Mbps)			
Channel	Spectral power density (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	-11.37	8	Pass
Middle Channel	-10.36	8	Pass
High Channel	-10.84	8	Pass

Test Plots

Antenna 8

GFSK (BLE 1Mbps) LOW CHANNEL

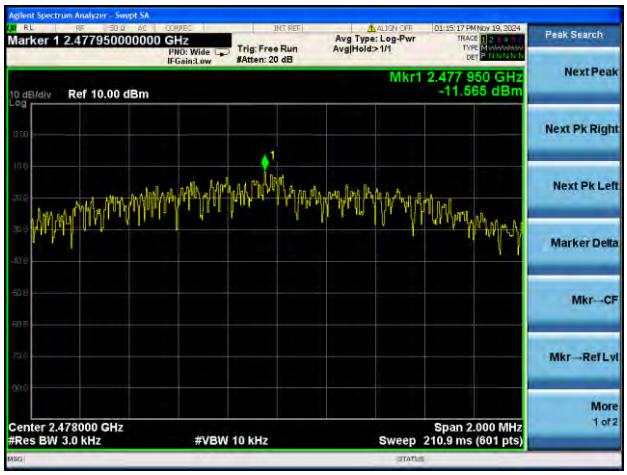
GFSK (BLE 1Mbps) MIDDLE CHANNEL

GFSK (BLE 1Mbps) HIGH CHANNEL

GFSK (BLE 2Mbps) LOW CHANNEL

GFSK (BLE 2Mbps) MIDDLE CHANNEL

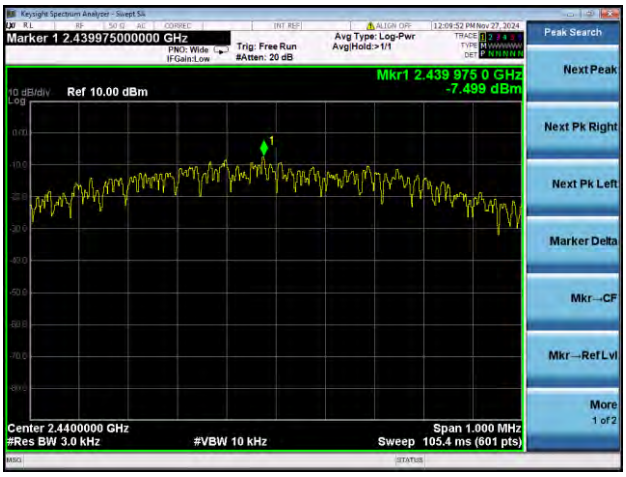
GFSK (BLE 2Mbps) HIGH CHANNEL



Antenna 9

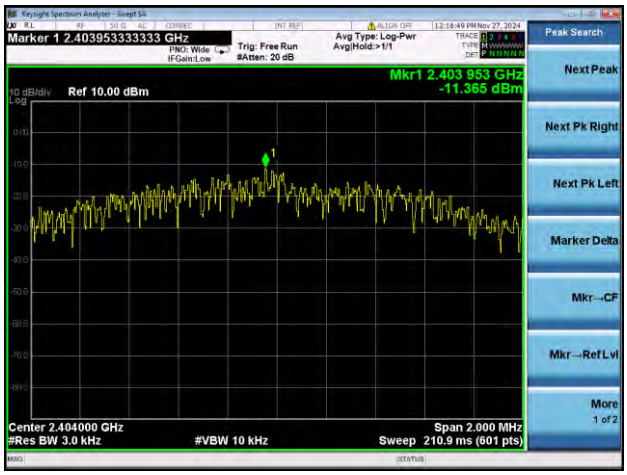
GFSK (BLE 1Mbps) LOW CHANNEL

GFSK (BLE 1Mbps) MIDDLE CHANNEL

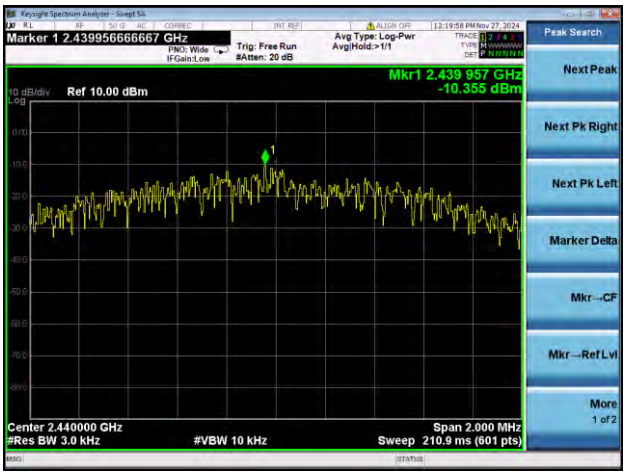


GFSK (BLE 1Mbps) HIGH CHANNEL

GFSK (BLE 2Mbps) LOW CHANNEL



GFSK (BLE 2Mbps) MIDDLE CHANNEL



GFSK (BLE 2Mbps) HIGH CHANNEL

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ24B0764-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ24B0764-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ24B0764-AI.PDF”.

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--END OF REPORT--