ELECTRONICS TEST CENTRE
MPB TECHNOLOGIES INC.

ACCREDITED
TESTING CERT#2750.01

Test Report Prepared By:

Electronics Test Centre
27 East Lake Hill
Airdrie, Alberta
Canada
T4A 2K3

sales@etc-mpbtech.com
http://www.etc-mpb.com

Telephone: 1-403-912-0037

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EMC testing of the Tektelic Communication Inc. BLE Sensor GEN2 in accordance with FCC Part 15.247, ANSI C63.4: 2014 and ANSI C63.10: 2013 as referenced by FCC OET KDB 558074 D01 15.247 Measurement Guidance v05r02.

FCC ID: 2ALEPT0007796

Tested by: Imran Akram, Janet Mijares

Prepared for: Tektelic Communication Inc.

7657 10th Street NE
Calgary, Alberta
Canada
T2E 8X2

Telephone: 1-403-338-6910

Imran Akram
iakram@etc-mpbtech.com
EMC Technologist
Electronics Test Centre (Airdrie)

Marc Rousseau
marc.rousseau@mpbc.ca
QA Manager
Electronics Test Centre (Airdrie)

REVISION RECORD

ISSUE	DATE	AUTHOR	REVISIONS
DRAFT 1	2021-07-30	I. Akram	Initial draft submitted for review.
Release 1	2021-09-15	M. Rousseau I. Akram	Sign off

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1.0 INTRODUCTION

1.1 Scope

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 15.247, ANSI C63.4-2014 and ANSI C63.10-2013 to gain FCC Certification Authorization for Low-Power License-Exempt transmitters. All test procedures, limits, criteria, and results described in this report apply only to the Tektelic Communication Inc. BLE Sensor GEN2 test sample, referred to herein as the EUT (Equipment Under Test).

The sample has been provided by the customer.

This report does not imply product endorsement by the Electronics Test Centre, A2LA, nor any Canadian Government agency.

1.2 Applicant

This test report has been prepared for Tektelic Communication Inc., located in Calgary, Alberta, Canada.

1.3 Test Sample Description

As provided to ETC (Airdrie) by Tektelic Communication Inc.:

Product Name:		BLE Sensor GEN2
LoRa Radio	**Frequency Band**	902 – 928 MHz
	Type of Modulation	Chirp Spread Spectrum
	BW/Frequency Range	DTS 500kHz, 903 – 914.2 MHz
	Associated Antenna	Mfr: Fractus Antennas S.L, p/n: NN02-224, omni-directional, Gain 2.8dBi
	Detachable/Non Detachable	Non-Detachable (internal to product) Compliant FCC15.203 requirements)
	Model# / Serial#	T0007378 / 2048A0224
BLE Radio	**Frequency Band**	2400 – 2483.5 MHz
	Type of Modulation	DTS
	BW/Frequency Range	2402 – 2480 MHz
	Associated Antenna	Mfr: Pulse Larsen Antennas, p/n: W3008, Omnidirectional, Gain: 1.1dBi
	Detachable/Non Detachable	Non-Detachable (internal to product) Compliant FCC15.203 requirements)
	Model# / Serial#	T0007128 / 2048A0049
Power supply:		Internal Battery

Note: All three channels / axis for worse selected variant were evaluated. Worse channel and axis were selected for detail analysis for radiated emission. Differences in variant are given in product family document.

1.4 Multiple Models with different form factors

The BLE Generation 2 product family portable device variants share the same PCB and have the same RF circuitry, antenna, and output power. The differences between the variants in the product family are strictly functional - the sensor transducers and batteries supported for each variant are dependent on the use case it will address.
The enclosures of all variant are made of the same plastic. The only difference is the size to accommodate the battery and battery type (AA cell, or C cell) it holds. During our initial analysis of the product variants, we performed worst case power emission on both enclosure types for both radios and all modulation on each channel and axis's. The result of our worst-case engineering measurement is shown below.

Enclosure	Mode	Frequency (MHz)	Field Strength (dBµV/m)
AA Enclosure	LoRa (DTS)	903	104.16
		907.8	101.71
		914.2	102.12
	LoRa (DSS)	902.33	102.49
		908.7	102.96
		914.9	101.79
	BLE	2402	89.0
		2438	91.0
		2480	81.0
C Enclosure	LoRa (DTS)	903	106.0
		907.8	108.0
		914.2	106.0
	LoRa (DSS)	902.33	110.0
		908.7	108.0
		914.9	107.0
	BLE	2402	84.37
		2438	83.28
		2480	81.35

1.5 General Test Conditions

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated.
In this report, the EUT is only tested for the DTS transmission. Test results regarding Hybrid 125 kHz transmission mode is provided in the separate report. The environmental conditions are recorded during each test and are reported in the relevant sections of this document.

1.6 Scope of Testing

Tests were performed in accordance with FCC Part 15.247, ANSI C63.4: 2014, ANSI C63.10: 2013 as referenced in FCC OET KDB 558074 D01 15.247 Measurement Guidance v05r02.

The EUT was also tested as an unintentional radiator, as reported separately.

1.6.1 Test Methodology

Test methods are specified in the Basic Standard as referenced and/or modified by the Product Standard in the part of Section 2 of this report associated with each particular test case.

1.6.2 Variations in Test Methodology

Any variance in methodology or deviation from the reference Standard is documented in the part of Section 2 of this report associated with each particular Test Case.

1.6.3 Test Sample Verification, Configuration & Modifications

EUT setup, configuration, protocols for operation and monitoring of EUT functions, and any modifications performed in order to meet the requirements, are detailed in each Test Case of Section 2 of this report.

1.6.4 Uncertainty of Measurement:

The factors contributing to measurement uncertainty are identified and calculated in accordance with CISPR 16-4-2: 2011.

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of k = 2.

Test Method	Uncertainty
Radiated Emissions Level (9 KHz – 1 GHz)	±5.8 dB
Radiated Emissions Level (1 GHz – 18 GHz)	±4.9 dB
Radiated Emissions Level (18 GHz – 26.5 GHz)	±5.0 dB
Conducted Emissions Level (150 KHz – 30 MHz)	±3.0 dB
Uncertainty Conducted Power level	±0.5 dB
Uncertainty Conducted Spurious emission level	±0.6 dB
Uncertainty for Bandwidth test	±1.5 %

2.0 TEST CONCLUSION

STATEMENT OF COMPLIANCE

The customer equipment referred to in this report was found to comply with the requirements, as summarized below.

The measurement uncertainty is not accounted for determination of the statement of compliance. The statement of compliance is based only on the measurement value recorded.

The EUT was subjected to the following tests. Compliance status is reported as **Compliant** or **Non-compliant**. **N/A** indicates the test was Not Applicable to the EUT.

Note: Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the tests performed in terms of the specification, class or performance criterion applied, and the EUT modification state.

Test Case	Test Type	Specification	Test Sample	Modifications	Config.	Result
Frequency Range = (903 – 914.2) MHz 500 KHz DTS Mode Max. Conducted Average Tx Power = 18.67dBm (0.074 Watt)						
2.1	AC Conducted Emissions (Tx)	15.207	BLE Sensor GEN2	none	see § 2.1	**n/a**
2.2	Occupied Bandwidth	15.247(a)(1) 15.247(2)(2)	BLE Sensor GEN2	none	see § 2.2	**Compliant**
2.3	Max Average Output Power Conducted	15.247(b)	BLE Sensor GEN2	none	see § 2.3	**Compliant**
2.4	Power Spectral Density	15.247(e) 15.247(f)	BLE Sensor GEN2	none	see § 2.4	**Compliant**
2.5	Band Edge	15.247(d)	BLE Sensor GEN2	none	see § 2.5	**Compliant**
2.6	Conducted Spurious Emission in Non-Restricted Band	15.247(d)	BLE Sensor GEN2	none	see § 2.6	**Compliant**
2.7	EUT Position	ANSI C63.4	BLE Sensor GEN2	none	see § 2.7	**Assessed**
2.8	Radiated Spurious Emission in Restricted Band (Tx Mode)	15.205, 15.209 15.247(d)	BLE Sensor GEN2	none	see § 2.8	**Compliant**
2.9	RF Exposure	15.247(i)	BLE Sensor GEN2	none	see § 2.9	**Exempt**

Refer to the test data for applicable test conditions.

2.1 AC Power Line Conducted Emissions

Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel:	**Standard: FCC Part 15.207**
Date:	**Basic Standard: ANSI C63.10: 2013**

EUT status: n/a

Comments: Comments: BLE Sensor GEN2 is battery powered and there is no direct connection to Main.

2.2 Channel Occupied Bandwidth (DTS Mode)

Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel: Imran Akram	**Standard: FCC PART 15.247**
Date: 2020-12-23 (21.6°C,14 % RH) **2021-01-15 (21.0°C,17.8 % RH)**	**Basic Standard: ANSI C63.10-2013** **KDB 558074 D01 15.247 Measurement Guidance v05r02**

EUT status: Compliant

Specification: FCC Part 15.247 (a, 2), FCC 15.215 (c)

Criteria: Systems using digital modulation techniques may operate in the 902-928 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

2.2.1 Test Guidance: FCC KDB 558074 D01 15.247 Measurement Guidance v05r02/ ANSI C63.10 clause 11.8

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Use the following spectrum analyzer settings:	
Span	between two times and five times the channel center frequency OBW
RBW	100 KHz
VBW	Set the VBW ≥ [3 × RBW].
Sweep	Auto Couple
Detector function	peak
Trace mode	max hold
Allow the trace to stabilize. The automatic bandwidth measurement capability of an instrument employed using the X dB bandwidth mode with X set to 6 dB	

2.2.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.2.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.2.4 Test Sample Verification, Configuration & Modifications

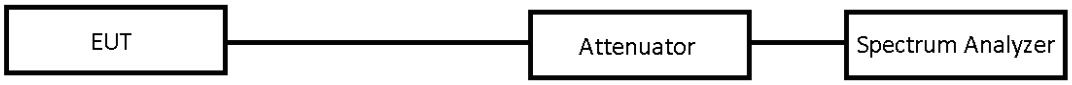
The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT modified to provide the direct access to antenna port for conducted measurements.

For compliance purposes EUT met requirements without any modification

There is no Deviation and exclusions from test specifications.

Test setup diagrams for Occupied Bandwidth testing:

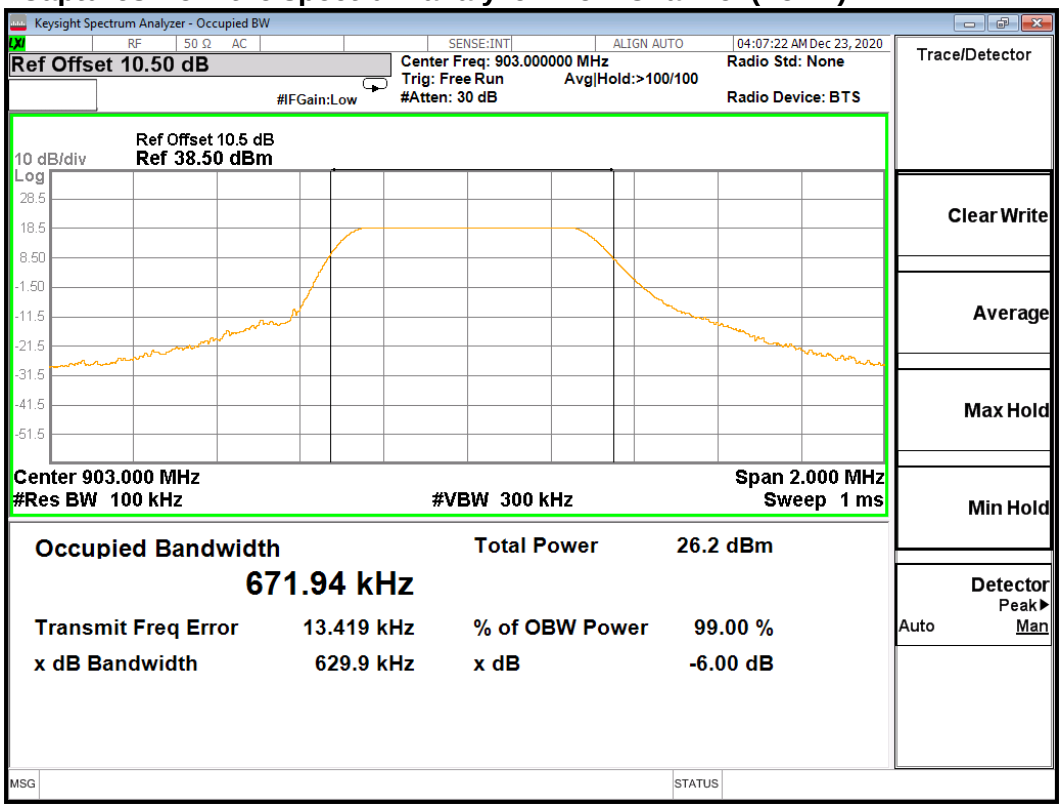
Conducted:



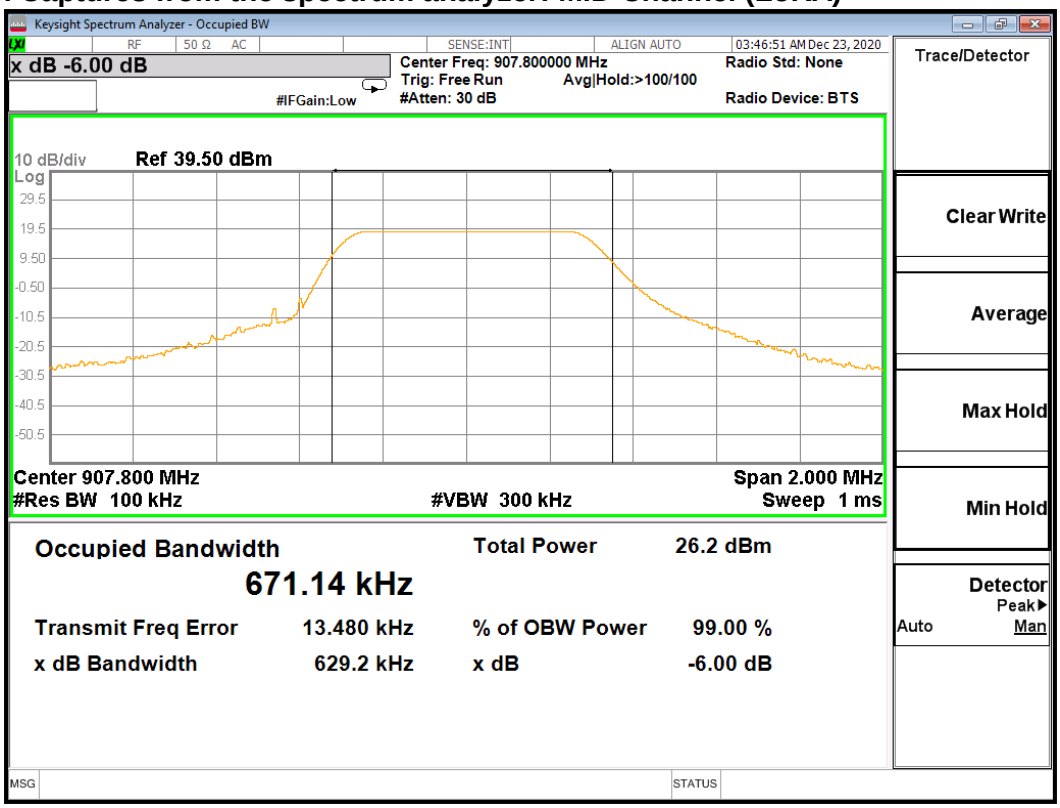
2.2.5 Channel Occupied Bandwidth Data: (LoRa)

Channel	Freq. [MHz]	6 dB OBW [kHz]	99% OBW [KHz]	Limit 6 dB OBW
Low	903	629.9	671.94	≥ 500 KHz
Mid	907.8	629.2	671.14	≥ 500 KHz
High	914.2	634.1	677.19	≥ 500 KHz

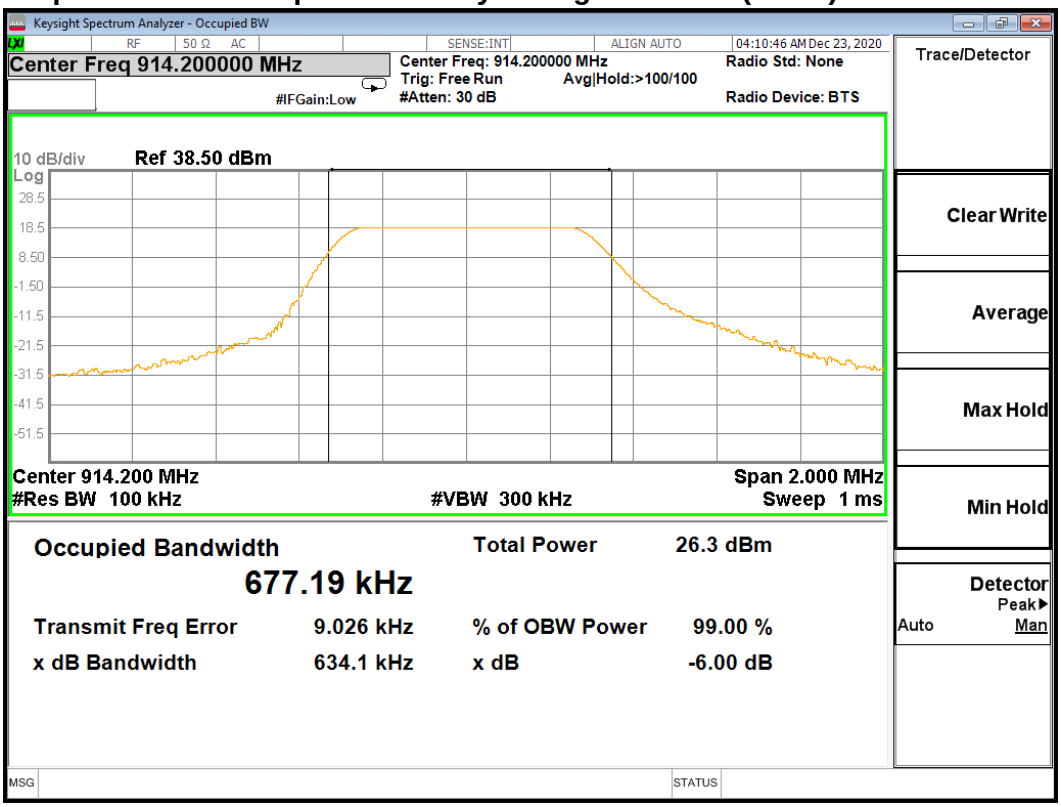
Screen Captures from the spectrum analyzer: Low Channel (LoRA)



Screen Captures from the spectrum analyzer: MID Channel (LoRA)



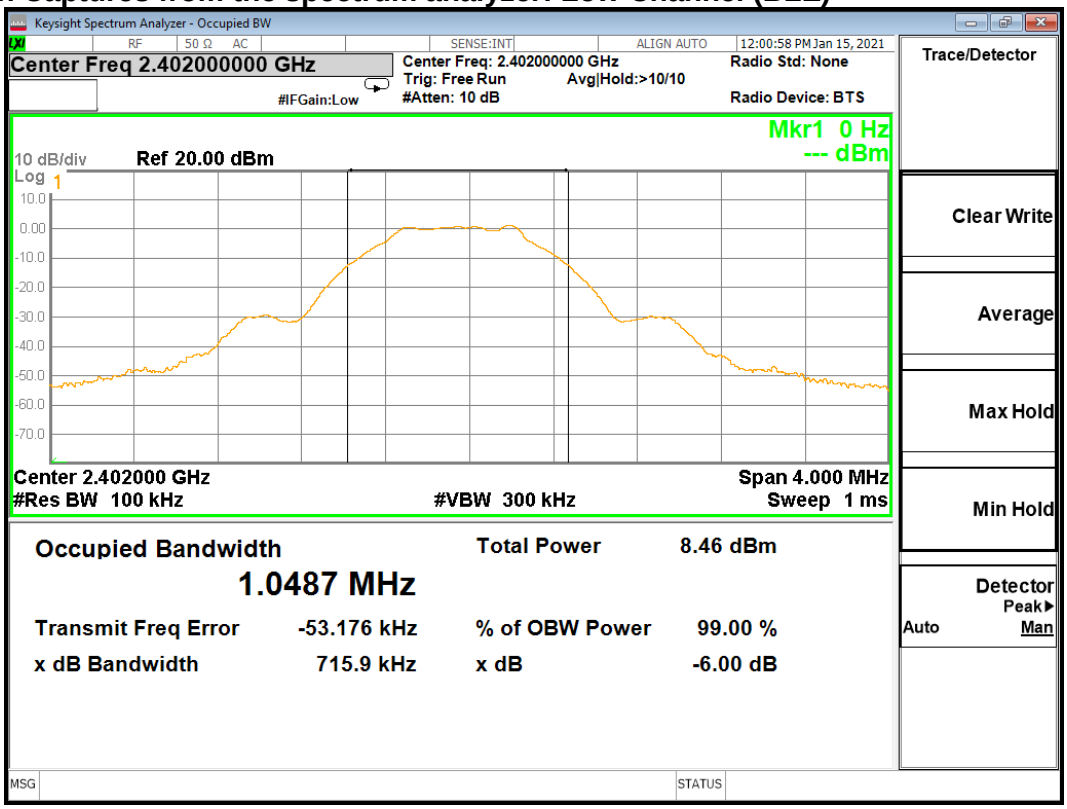
Screen captures from the spectrum analyzer High Channel (LoRA)



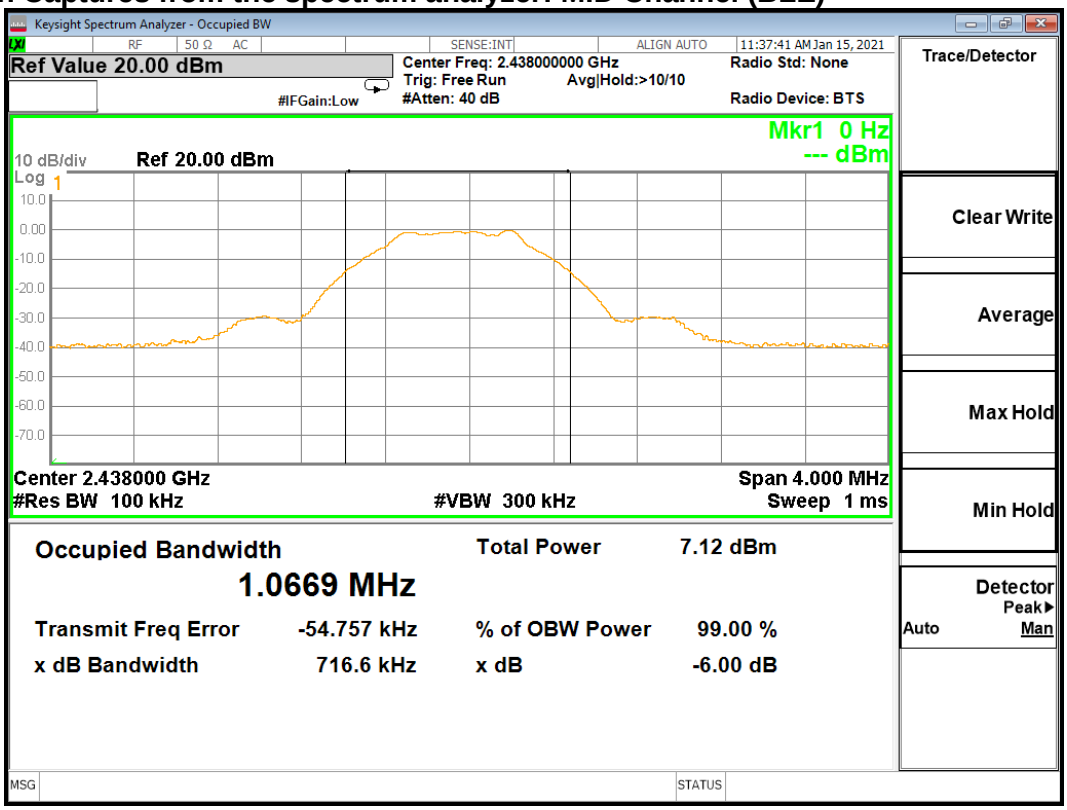
2.2.6 Channel Occupied Bandwidth Data: (BLE)

Channel	Freq. [MHz]	6 dB OBW [kHz]	99% OBW [MHz]	Limit 6 dB OBW
Low	2402	715.9	1.0487	≥ 500 KHz
Mid	2438	716.6	1.0669	≥ 500 KHz
High	2480	710.2	1.0524	≥ 500 KHz

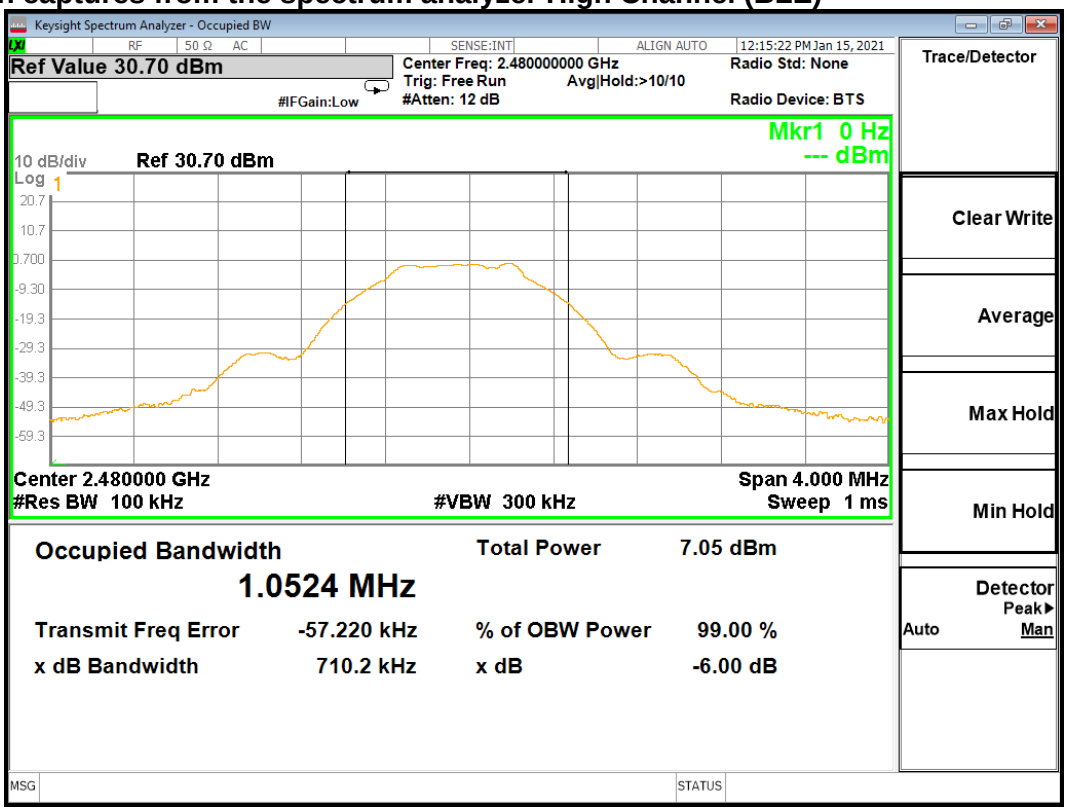
Screen Captures from the spectrum analyzer: Low Channel (BLE)



Screen Captures from the spectrum analyzer: MID Channel (BLE)



Screen captures from the spectrum analyzer High Channel (BLE)



2.3 Maximum conducted (average) output power (DTS Mode)

Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel: Imran Akram	**Standard: FCC PART 15.247**
Date: 2020-12-23 (21.6°C,14 % RH) **2021-01-15 (21.0°C,17.8 % RH)**	**Basic Standard: ANSI C63.10: 2013** **KDB 558074 D01 15.247 Measurement Guidance v05r02**

EUT status: Compliant

Specification: FCC Part 15.247(b, 3)

Criteria	For systems using digital modulation in the 902-928 MHz bands: 1 Watt.

2.3.1 Test Guidance: FCC KDB 558074 D01 15.247 Measurement Guidance v05r02/ ANSI C63.10 Sub clause 11.9.2.2

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Output Power Method AVGSA-1	
Span	≥ 1.5 times the OBW
RBW	1 – 5 % of the OBW, ≤ 1 MHz
VBW	≥ 3 x RBW
Number of Points in sweep	≥ 2 x Span / RBW
Sweep time	Auto
Detector	RMS (Power Averaging)
Sweep trigger	Free Run (If Duty Cycle ≥98%)
Trace Average	At least 100 traces in power Averaging (RMS)
Power measured	Integrated the spectrum across the OBW of the signal using the S/A band power measurement function, with band limit set equal to the OBW band edge.

2.3.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.3.3 Test Equipment

Testing was performed with the following equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.3.4 Test Sample Verification, Configuration & Modifications

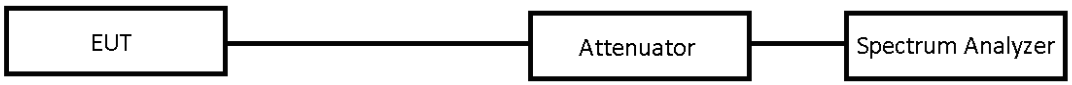
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT modified to provide the direct access to antenna port for conducted measurements.

For compliance purposes EUT met requirements without any modification

Test setup diagrams for Peak Power testing:

Conducted:

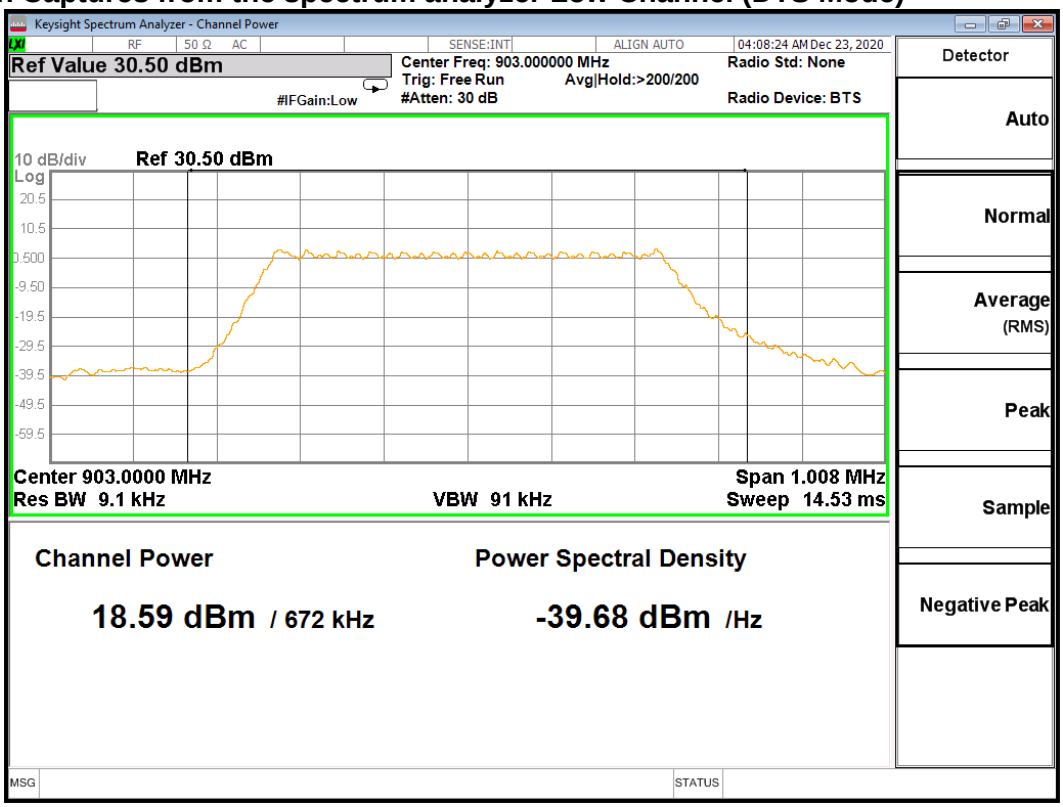


2.3.5 Average Output Power Data (LoRa)

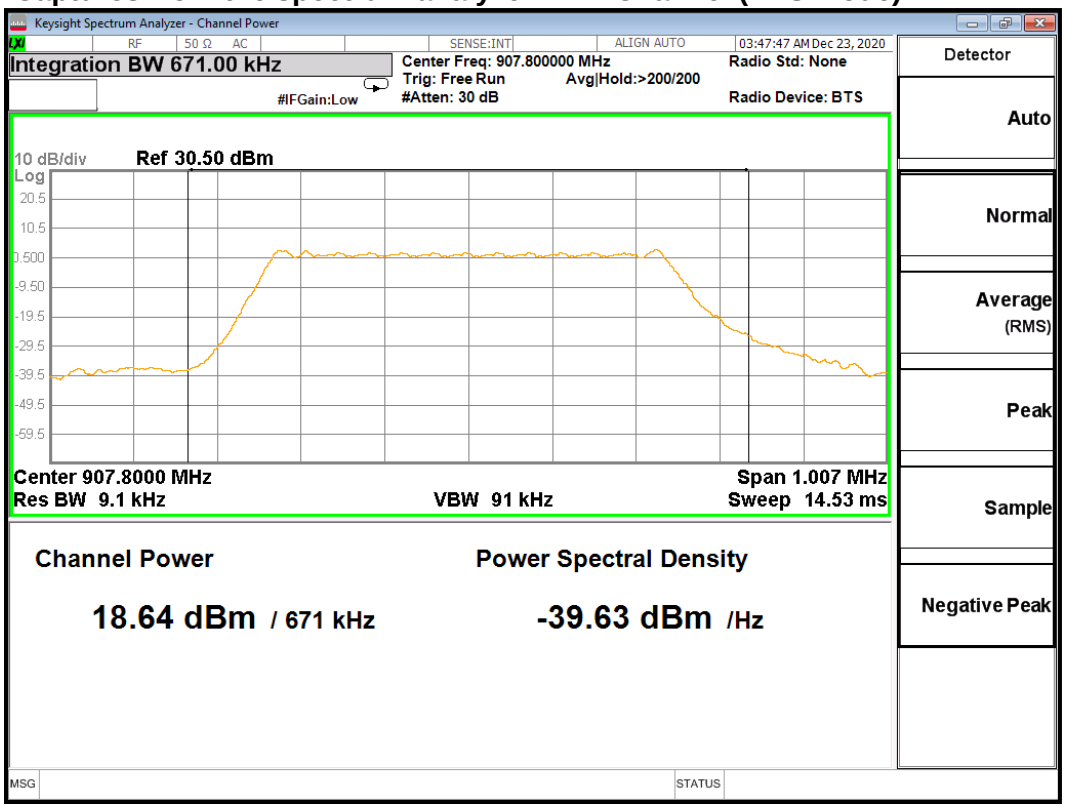
LoRa 500 KHz

Channel	Freq. [MHz]	Out Put Power (dBm)	Out Put Power Limit (dBm)	Margin (dB)
Low	903	18.59	30	11.41
Mid	907.8	18.64	30	11.36
High	914.2	18.67	30	11.33

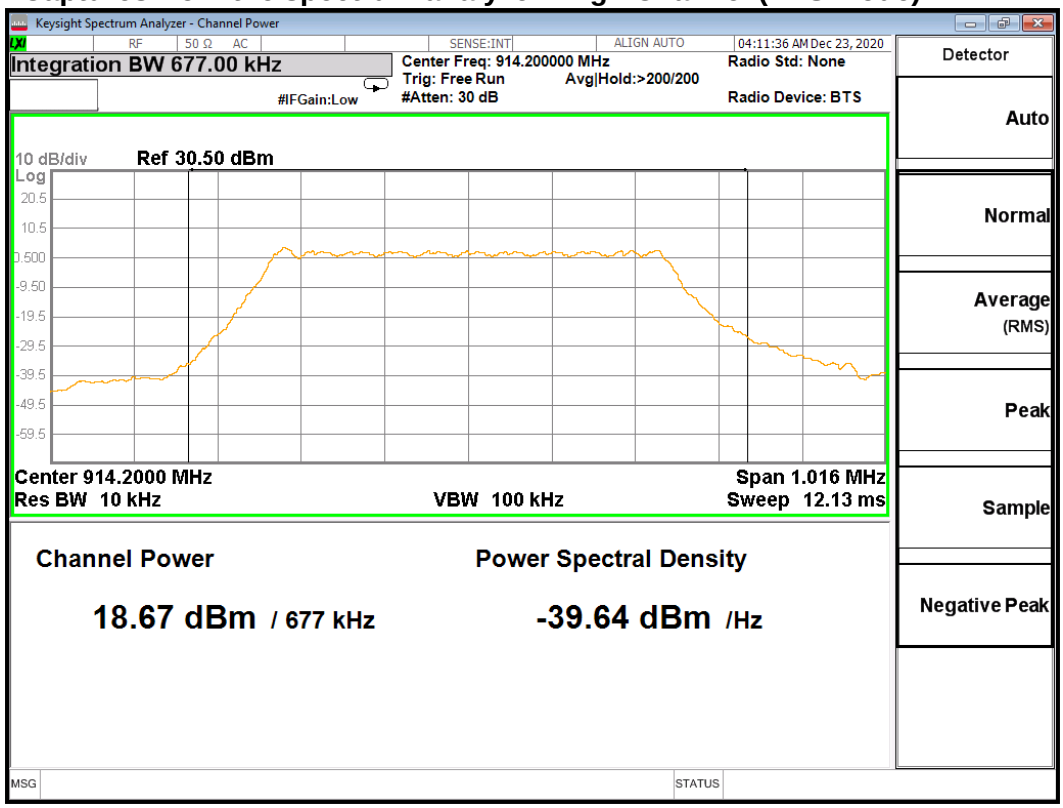
Screen Captures from the spectrum analyzer Low Channel (DTS Mode)



Screen Captures from the spectrum analyzer: MID Channel (DTS Mode)



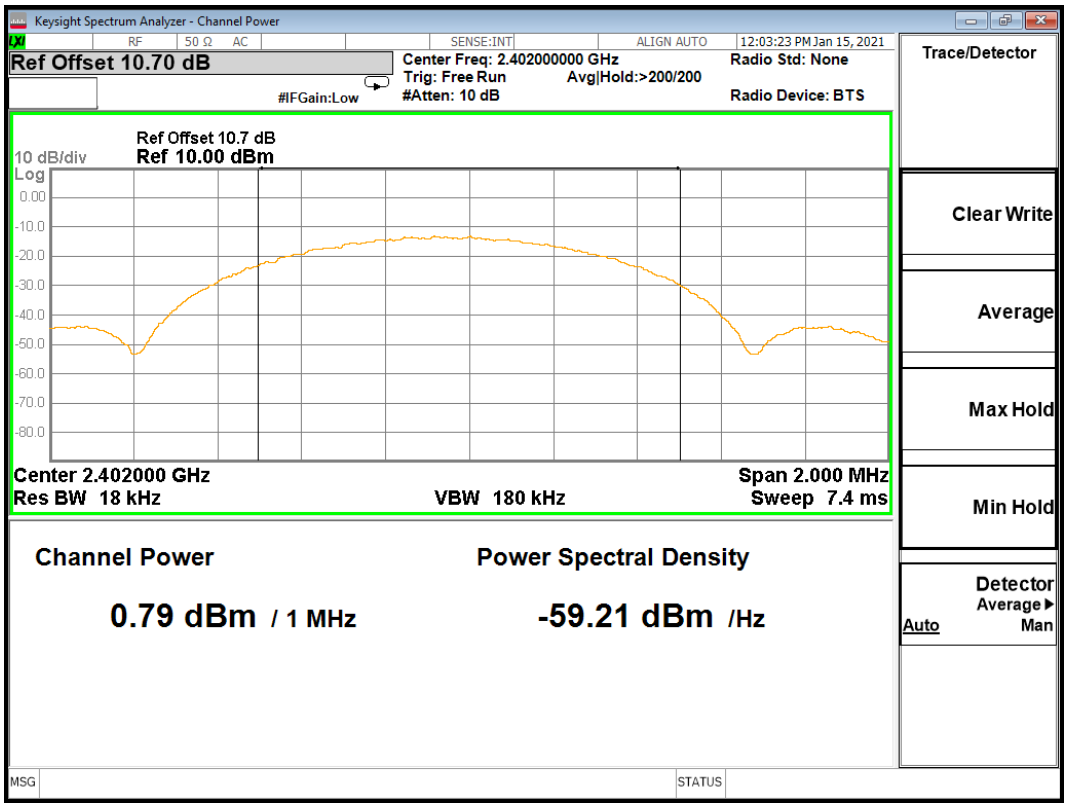
Screen Captures from the spectrum analyzer: High Channel (DTS Mode)



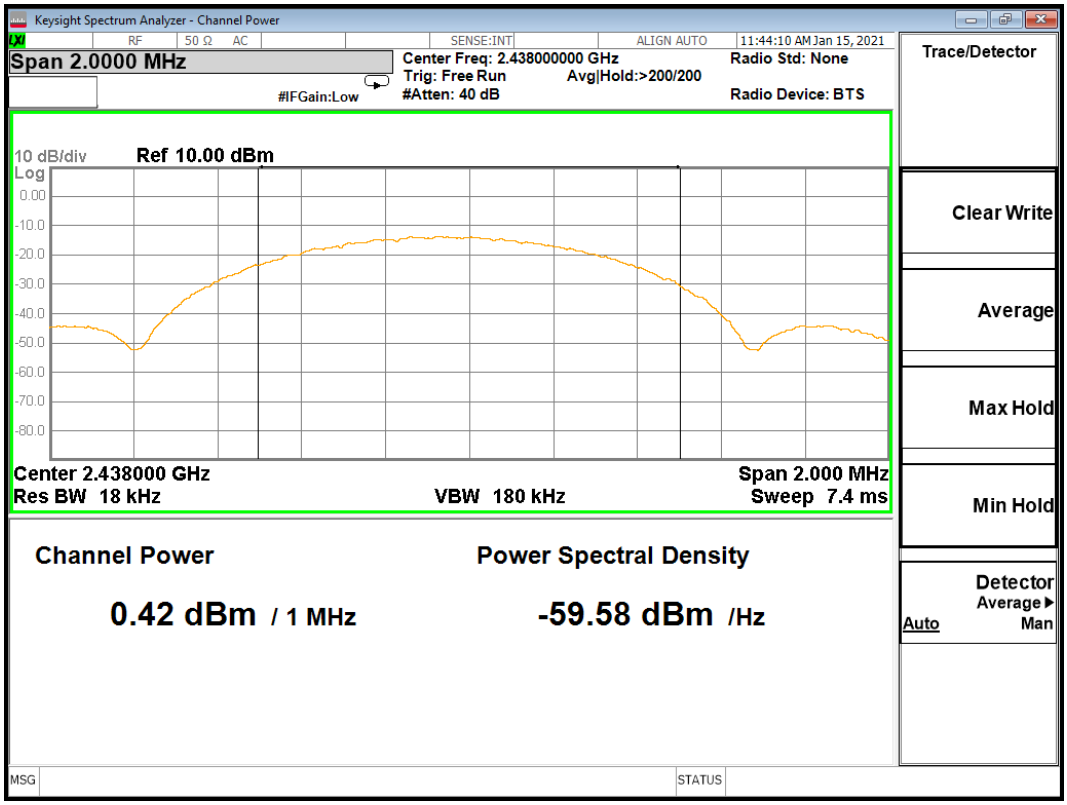
2.3.6 Average Output Power Data (BLE)

Channel	Freq. [MHz]	Out Put Power (dBm)	Out Put Power Limit (dBm)	Margin (dB)
Low	2402	0.79	30	29.21
Mid	2438	0.42	30	29.58
High	2480	0.38	30	29.62

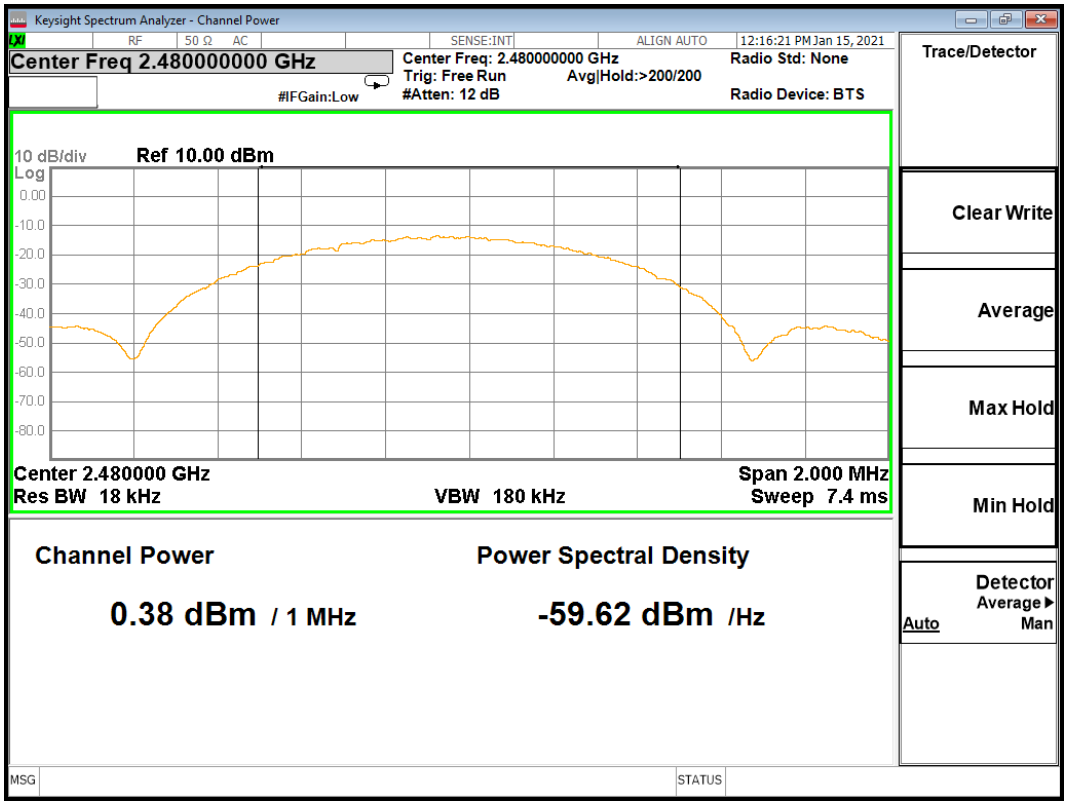
Screen Captures from the spectrum analyzer Low Channel (BLE)



Screen Captures from the spectrum analyzer: MID Channel (BLE)



Screen Captures from the spectrum analyzer: High Channel (BLE)



2.4 Power Spectral Density (DTS Mode)

Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel: Imran Akram	**Standard: FCC PART 15.247**
Date: 2020-12-23 (21.6°C,14 % RH) **2021-01-15 (21.0°C,17.8 % RH)**	**Basic Standard: ANSI C63.10: 2013** **KDB 558074 D01 15.247 Measurement Guidance v05r02**

EUT status: Compliant

Specification: FCC Part 15.247(e)

Criteria For digitally modulated systems the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

2.4.1 Test Guidance: FCC KDB 558074 D01 15.247 Measurement Guidance v05r02/ Sub clause 11.10 of ANSI C63.10

This measurement is performed at low, mid and high frequencies, in continuous transmission, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Use the following spectrum analyzer settings:	
Span	At least 1.5 times the OBW.
RBW	3 KHz
VBW	Set the VBW ≥ [3 × RBW].
Sweep	Auto Couple
Detector function	Power averaging (RMS) or sample detector (when RMS not available).
Trace mode	Employ trace averaging (RMS) mode over a minimum of 100 traces.
Allow the trace to stabilize. Use the peak marker function to determine the maximum amplitude level.	

2.4.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.4.3 Test Equipment

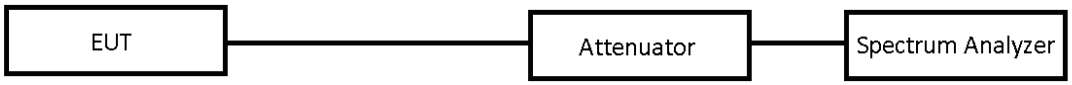
Testing was performed with this equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.4.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagrams for Peak Power Spectral Density testing:
Conducted:

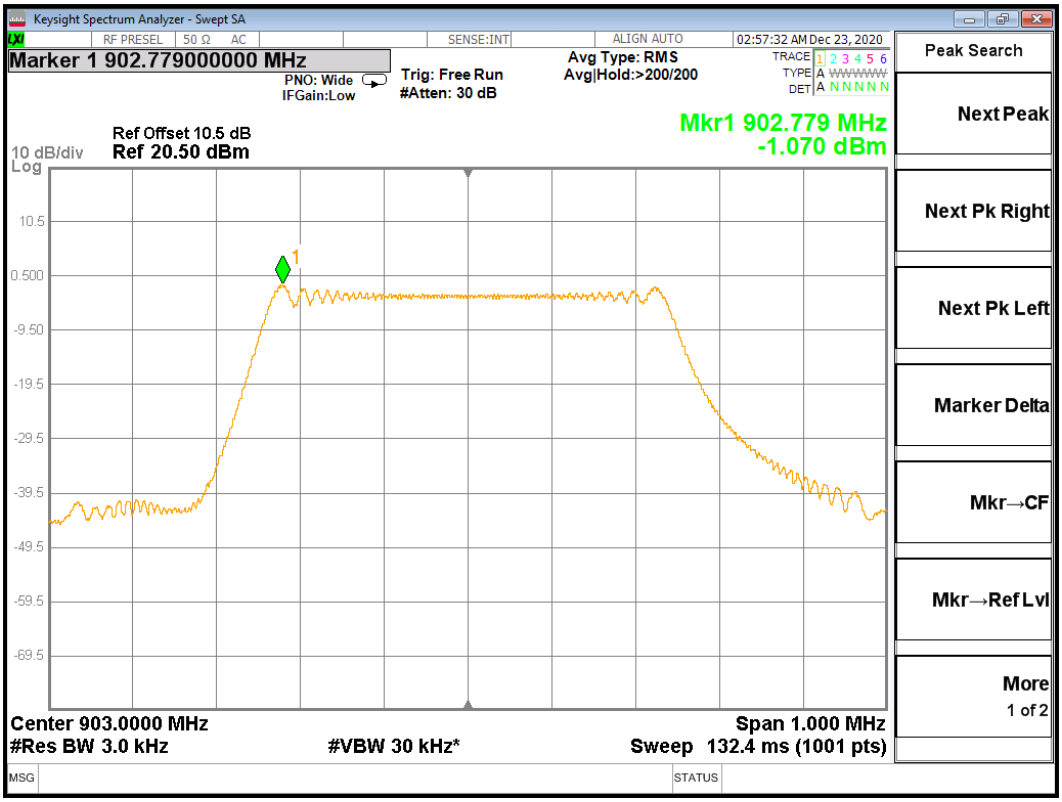


2.4.5 Peak PSD Data (LoRa DTS MODE)

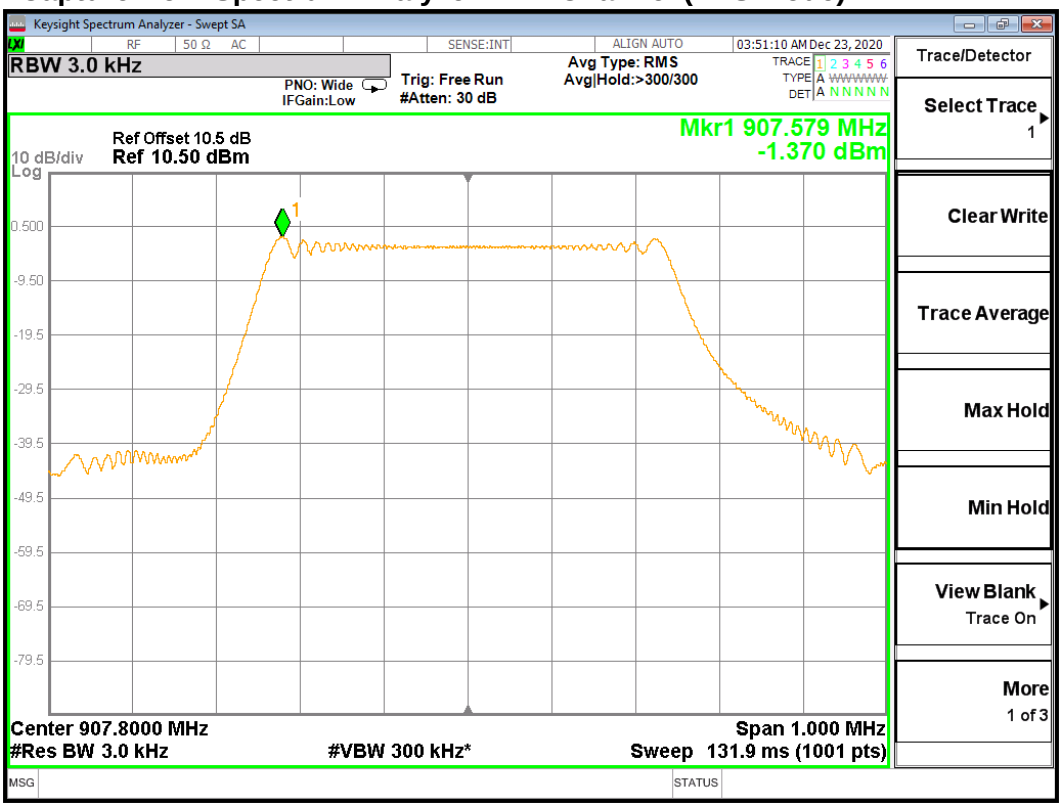
500 KHZ Channels

Channel	Freq. [MHz]	PSD (dBm/3KHz)	PSD Limit (dBm/3KHz)
Low	903	-1.070	8
Mid	907.8	-1.370	8
High	914.2	-1.179	8

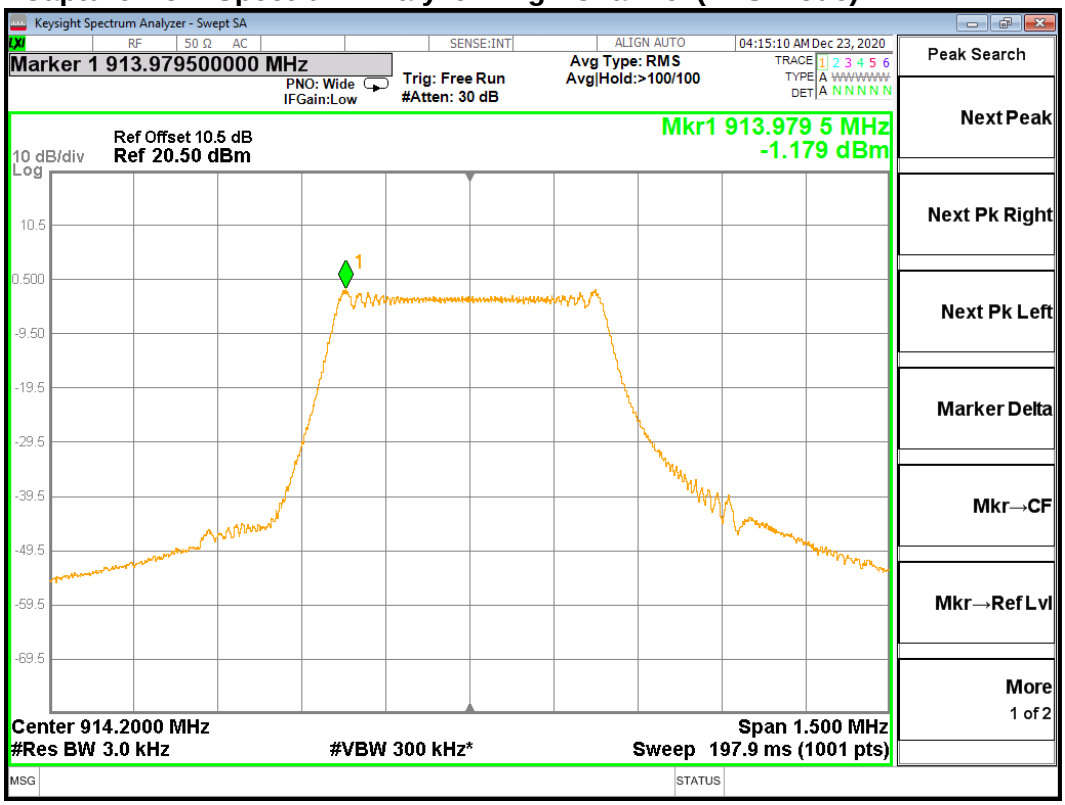
Screen Capture from Spectrum Analyzer: LOW Channel (DTS Mode)



Screen Capture from Spectrum Analyzer: MID Channel (DTS Mode)



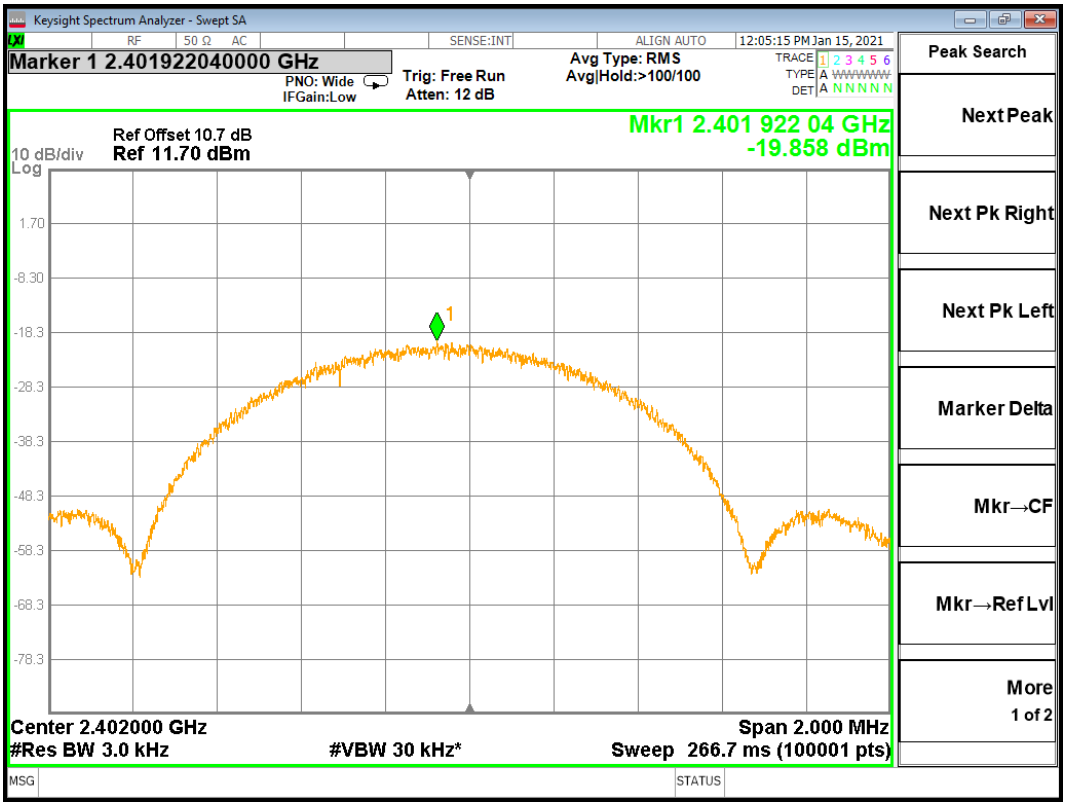
Screen Capture from Spectrum Analyzer: High Channel (DTS Mode)



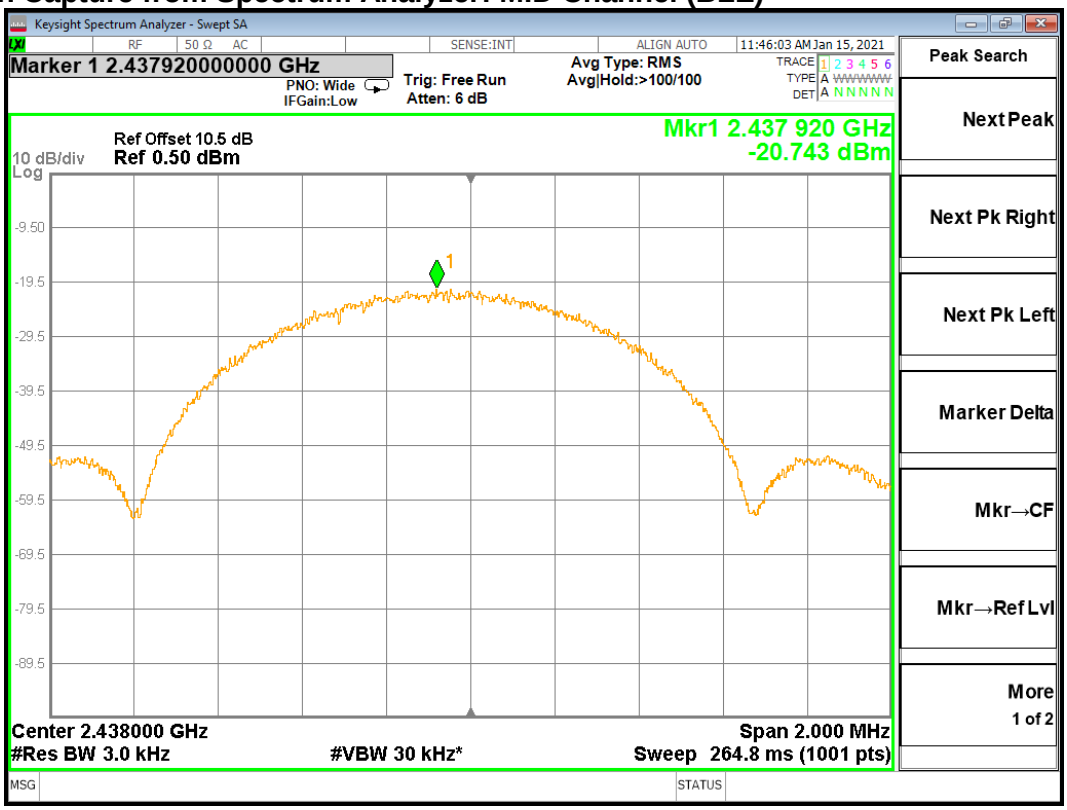
2.4.6 Peak PSD Data (BLE DTS MODE)

Channel	Freq. [MHz]	PSD (dBm/3KHz)	PSD Limit (dBm/3KHz)
Low	2402	-19.858	8
Mid	2438	-20.743	8
High	2480	-20.614	8

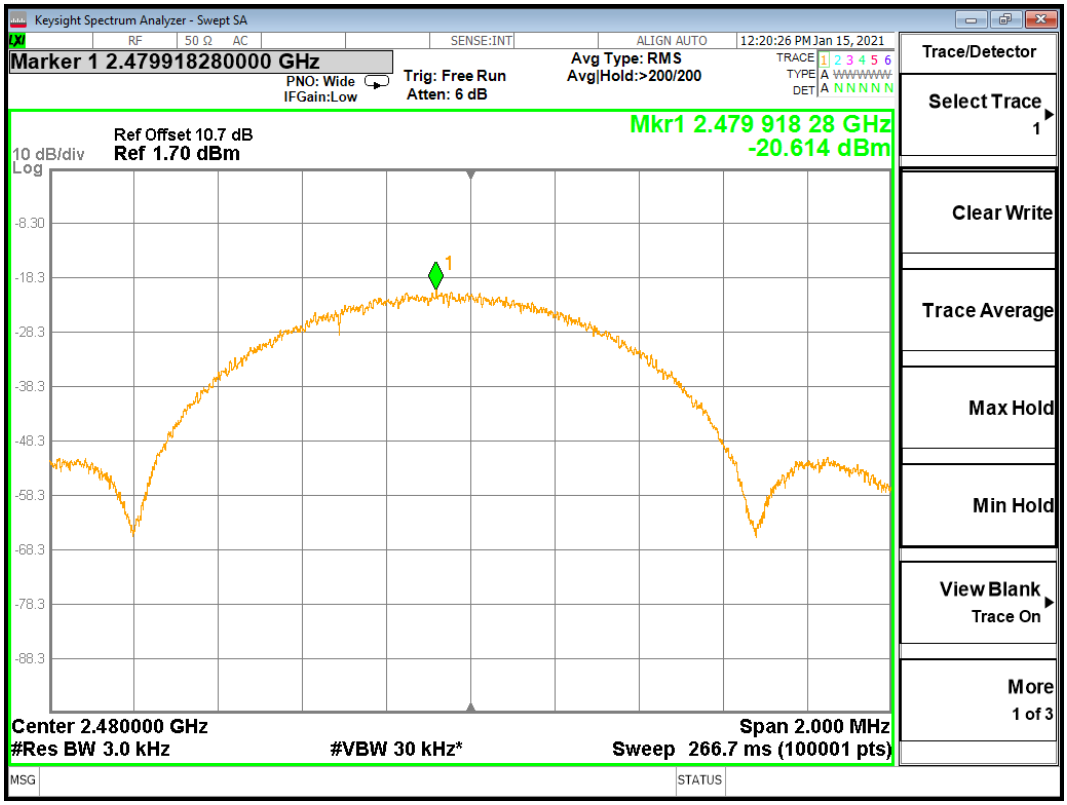
Screen Capture from Spectrum Analyzer: LOW Channel (BLE)



Screen Capture from Spectrum Analyzer: MID Channel (BLE)



Screen Capture from Spectrum Analyzer: High Channel (BLE)



2.5 Band Edge Attenuation (DTS Mode)

Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel: Imran Akram	**Standard: FCC PART 15.247**
Date: 2020-12-23 (21.6°C,14 % RH) **2021-01-15 (21.0°C,17.8 % RH)**	**Basic Standard: ANSI C63.10: 2013** **KDB 558074 D01 15.247 Measurement Guidance v05r02**

EUT status: Compliant

Specification: FCC Part 15.247(d)

Criteria: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.5.1 Test Guidance: ANSI C63.10-2013 Clause 11.11, 11.13.2 / FCC KDB 558074 D01 15.247 Measurement Guidance v05r02 Clause 8.7

This measurement is performed at the low and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.

Use the following spectrum analyzer settings:	
Span	That encompasses both the peak of the fundamental emission and the band-edge emission under investigation.
RBW	1% of the total span
VBW	Set the VBW ≥ [3 × RBW].
Sweep	Auto Couple
Detector function	Peak
Trace mode	Max Hold.
Allow the trace to stabilize. Use the peak marker function to determine the maximum amplitude level.	

2.5.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.5.3 Test Equipment

Testing was performed with the following equipment:

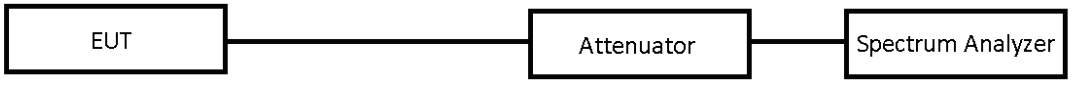
Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.5.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

Test setup diagrams for Band Edge Attenuation testing:

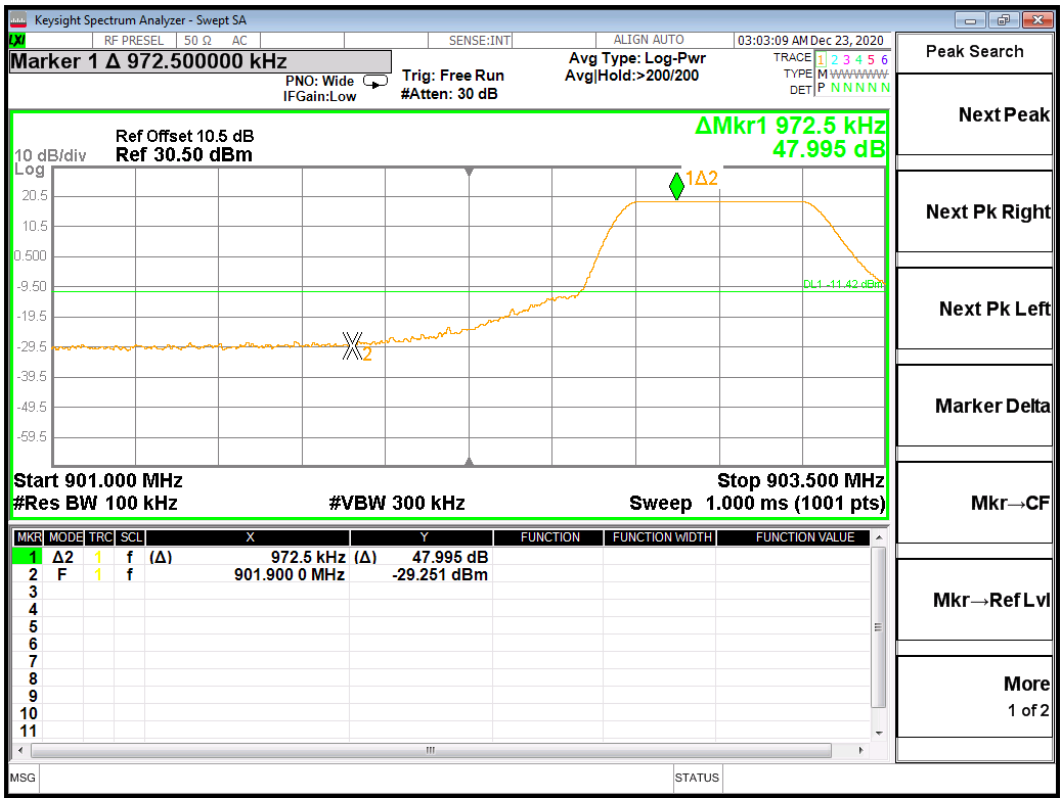
Conducted:



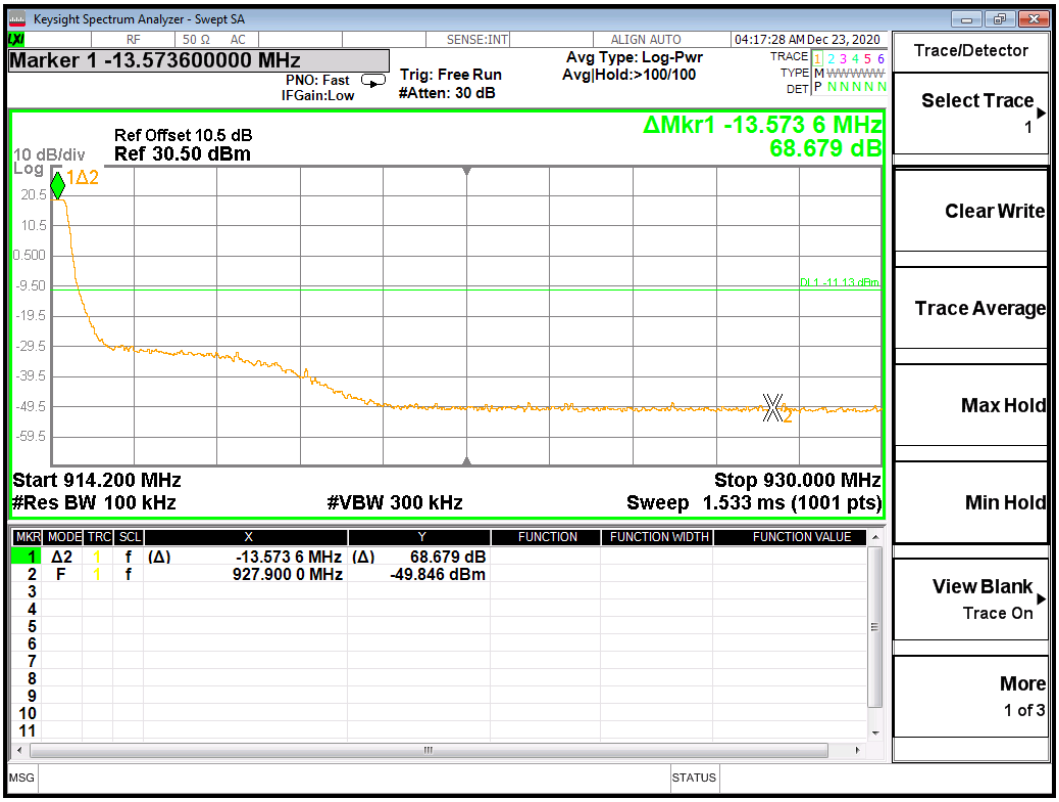
2.5.5 Band Edge Data (DTS MODE)

Modulation	Channel	Attenuation at Band Edge	Attenuation Limit at Band Edge
Lora 500KHz Channels	903	47.995 dBc	30 dBc
	914.2	68.679 dBc	30 dBc

Screen Capture from the spectrum analyzer: Lower Band Edge (DTS Mode)



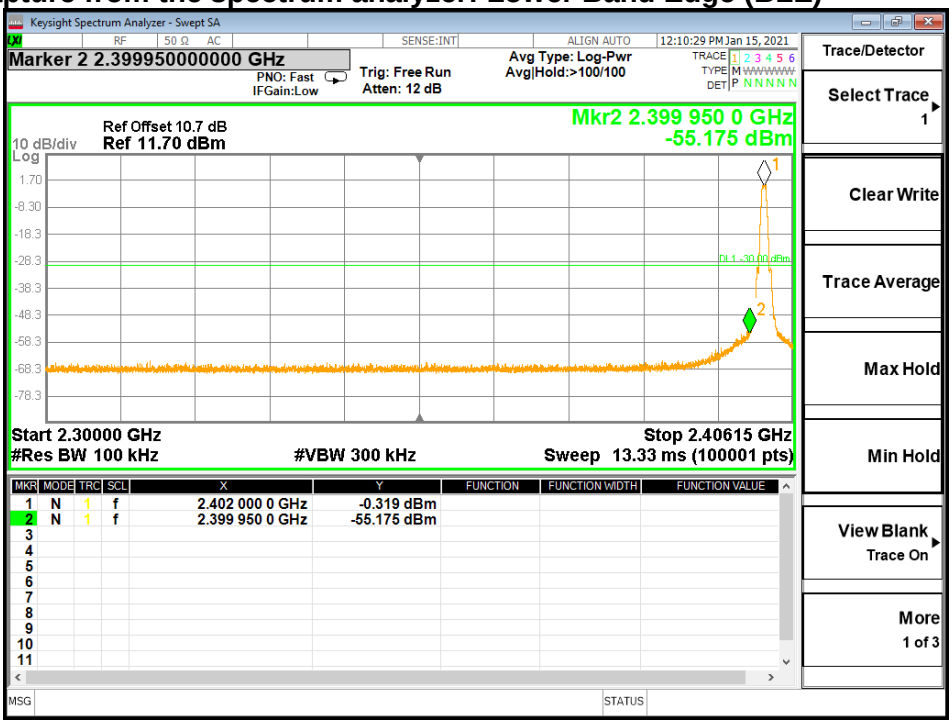
Screen Capture from the spectrum analyzer: Upper Band Edge (DTS Mode)



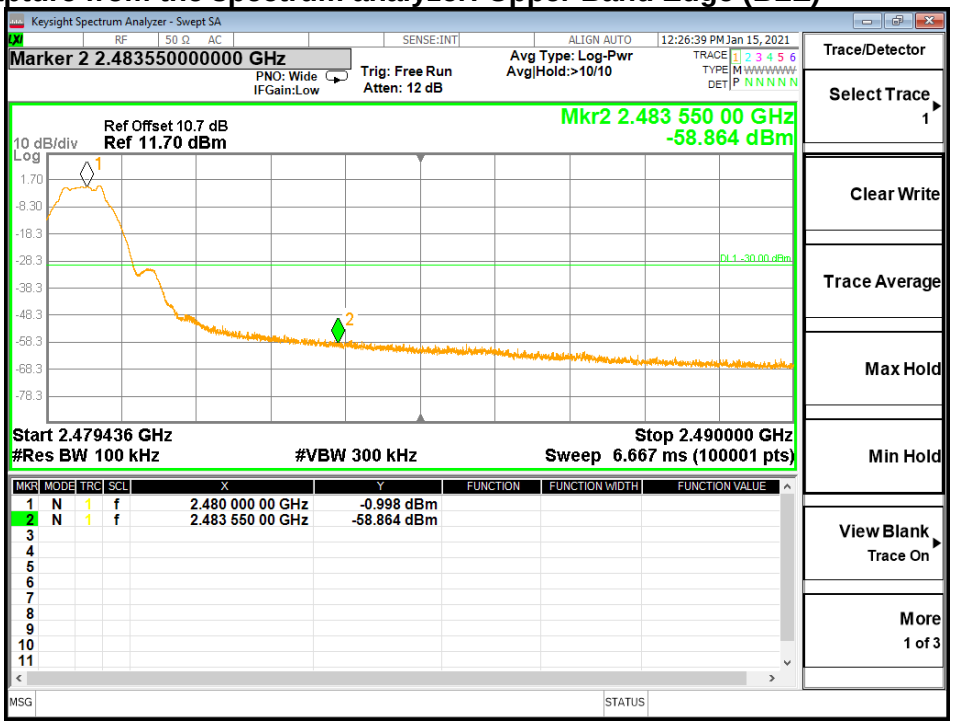
2.5.6 Band Edge Data (BLE DTS MODE)

Modulation	Channel	Attenuation at Band Edge	Attenuation Limit at Band Edge
BLE	2402	54.856 dBc	30 dBc
	2480	57.866 dBc	30 dBc

Screen Capture from the spectrum analyzer: Lower Band Edge (BLE)



Screen Capture from the spectrum analyzer: Upper Band Edge (BLE)



2.6 Conducted Spurious Emissions in non-restricted frequency bands (DTS Mode)

Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel: Imran Akram	**Standard: FCC PART 15.247**
Date: 2020-12-23 (21.6°C,14 % RH) **2021-01-15 (21.0°C,17.8 % RH)**	**Basic Standard: ANSI C63.4-2014** **KDB 558074 D01 15.247 Measurement Guidance v05r02**

EUT status: Compliant

Specification: FCC Part 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

2.6.1 Test Guidance: ANSI C63.10-2013, Clause 11.11, FCC KDB 558074 D01 15.247 Measurement Guidance v05r02 Clause 8.5

This measurement is performed at the low, mid and high frequencies, with modulation.
The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, without the need for any further corrections.
The spectrum analyzer is stepped through the spectrum in frequency spans selected to ensure acceptable frequency resolution. The RBW is set to 100 kHz. The VBW is set to ≥ 300 kHz. The Peak detector is used, with the trace set to Max Hold.

2.6.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.6.3 Test Equipment

Testing was performed with the following equipment:

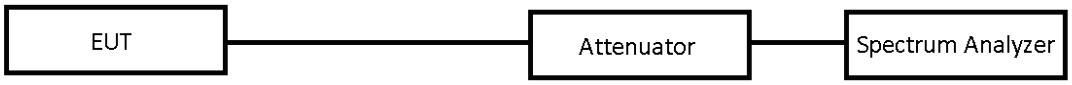
Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
MXE EMI Receiver	Keysight Technologies Inc	N9038A FW A 22.08	6906	2019-10-29	2020-10-29
Temp/Humidity	Extech	42270	5892	2019-04-05	2020-04-05
Attenuator	FairView Microwave	SA18N5WA-10	6886	2020-02-01	2021-02-01
DC Blocker	MCL	BLK-89-S+	-	2020-02-01	2021-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2020-02-01	2021-02-01

2.6.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

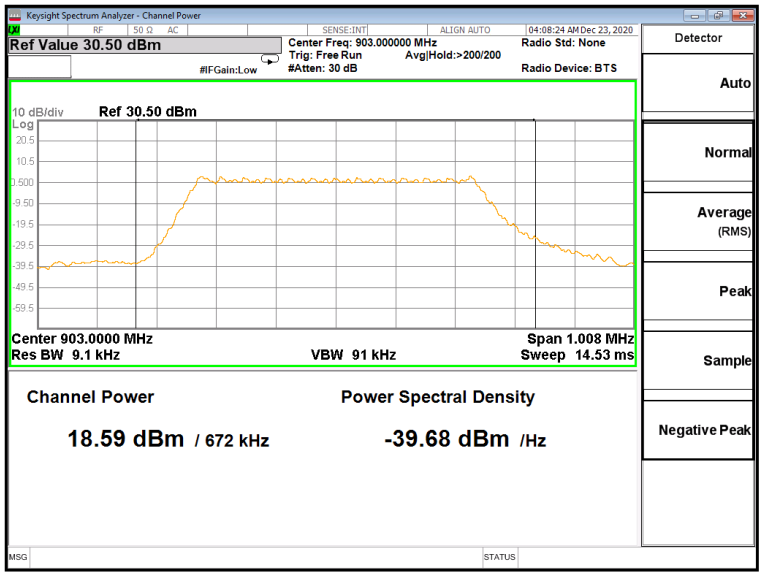
The EUT modified to provide the direct access to antenna port for conducted measurements

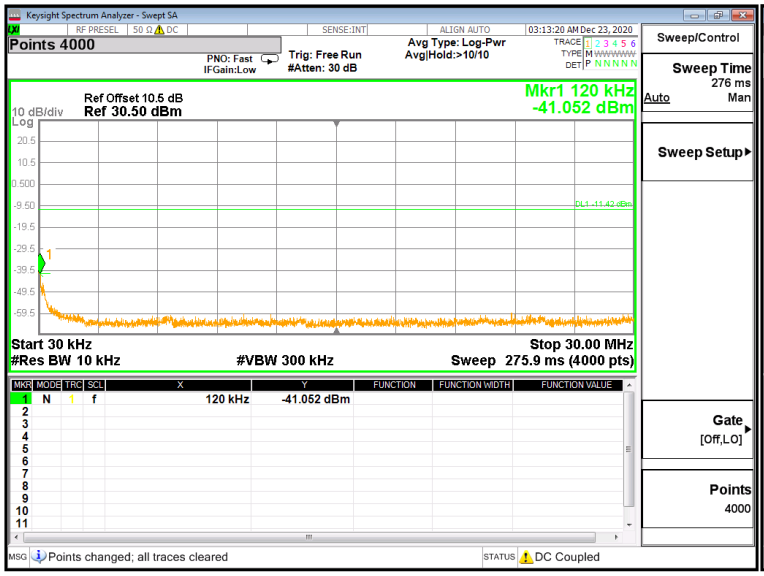
Test setup diagram for Conducted Spurious Emissions testing:

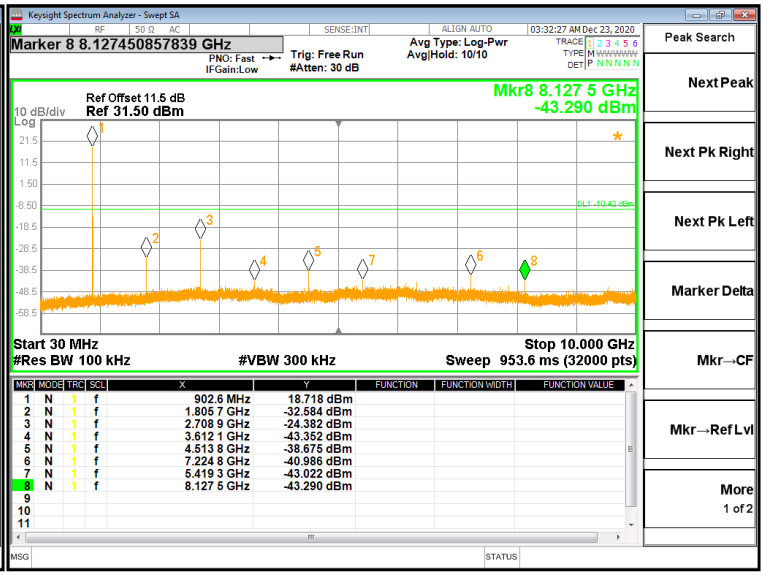


2.6.5 Conducted Suprious Emissions Data: LoRa

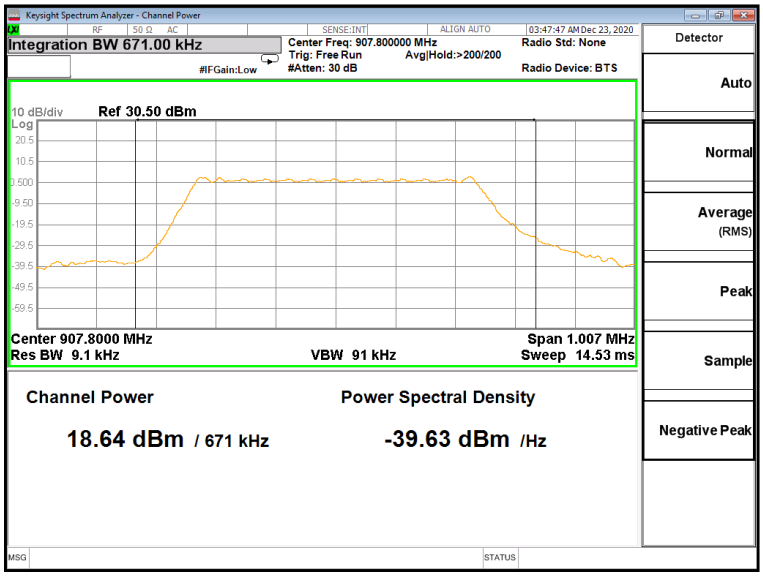
LOW Channel



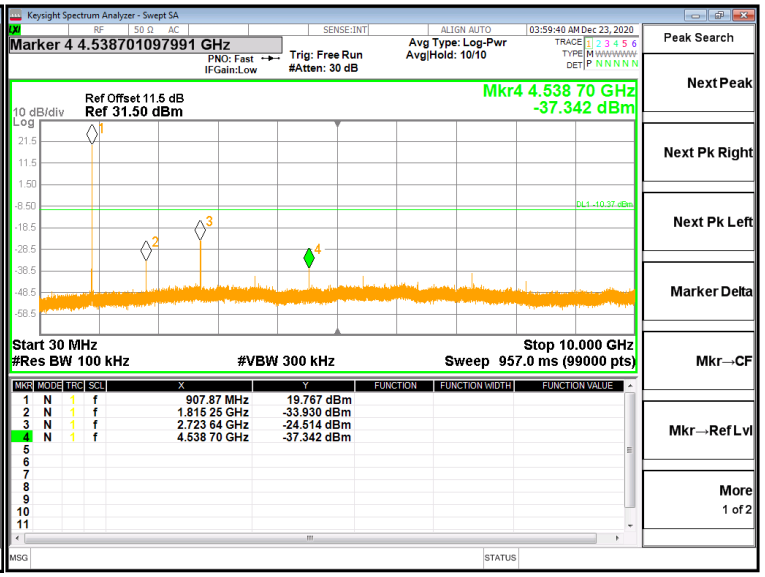




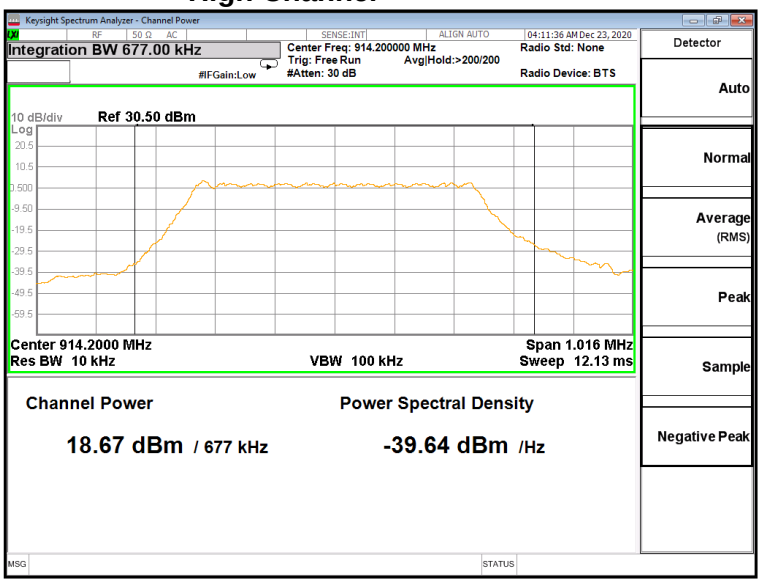
MID Channel

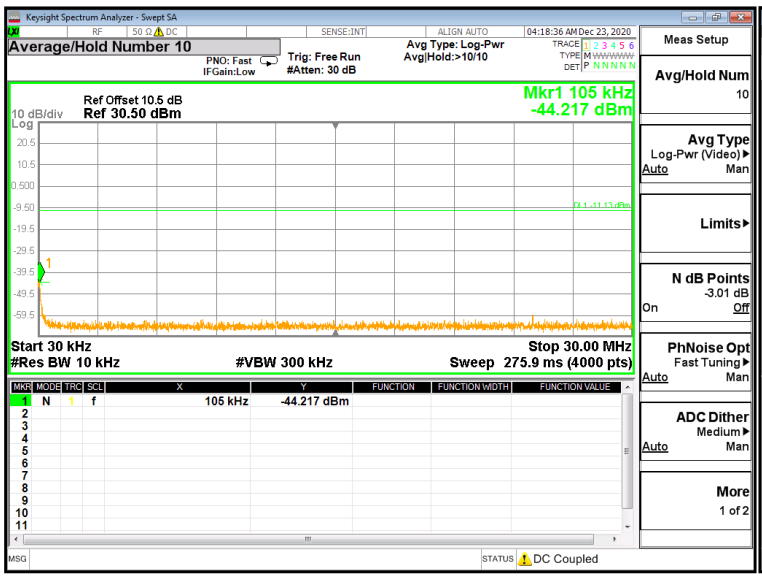

Keysight Spectrum Analyzer - Channel Power
Integration BW 671.00 kHz
Center Freq: 907.800000 MHz
Trig: Free Run
Avg|Hold:>200/200
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
03:47:47 AM Dec 23, 2020
10 dB/div
Ref 30.50 dBm
Log
Center 907.8000 MHz
Res BW 9.1 kHz
VBW 91 kHz
Span 1.007 MHz
Sweep 14.53 ms
Channel Power
18.64 dBm / 671 kHz
Power Spectral Density
-39.63 dBm /Hz
Detector
Auto
Normal
Average (RMS)
Peak
Sample
Negative Peak
MSG
STATUS

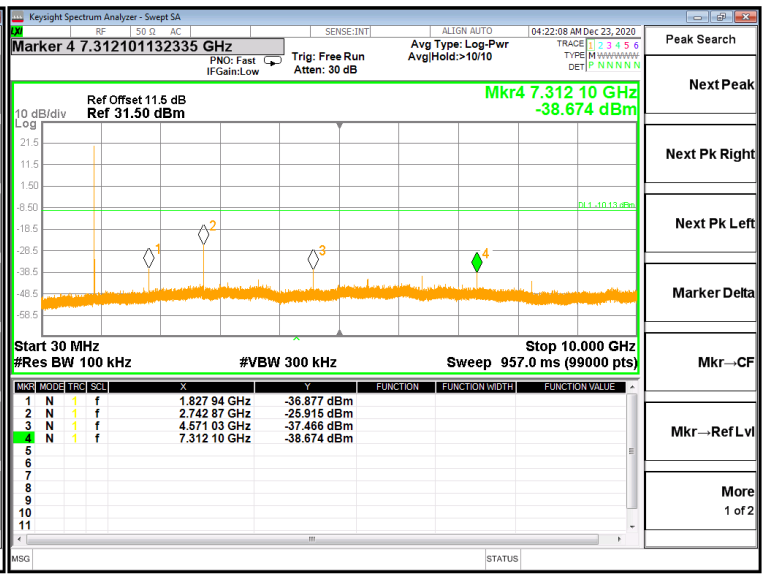

Keysight Spectrum Analyzer - Swept SA
Marker 1 89.954989 kHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
03:53:52 AM Dec 23, 2020
Ref Offset 10.5 dB
10 dB/div
Ref 20.50 dBm
Log
Mkr1 90 kHz
-43.799 dBm
Start 30 kHz
#Res BW 10 kHz
#VBW 300 kHz
Stop 30.00 MHz
Sweep 275.9 ms (4000 pts)
1 N 1 f 90 kHz -43.799 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS
DC Coupled


Keysight Spectrum Analyzer - Swept SA
Marker 4 4.538701097991 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 10/10
03:59:40 AM Dec 23, 2020
Ref Offset 11.5 dB
10 dB/div
Ref 31.50 dBm
Log
Mkr4 4.538 70 GHz
-37.342 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 957.0 ms (99000 pts)
1 N 1 f 907.87 MHz 19.767 dBm
2 N 1 f 1.815 25 GHz -33.930 dBm
3 N 1 f 2.723 64 GHz -24.514 dBm
4 N 1 f 4.538 70 GHz -37.342 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

High Channel

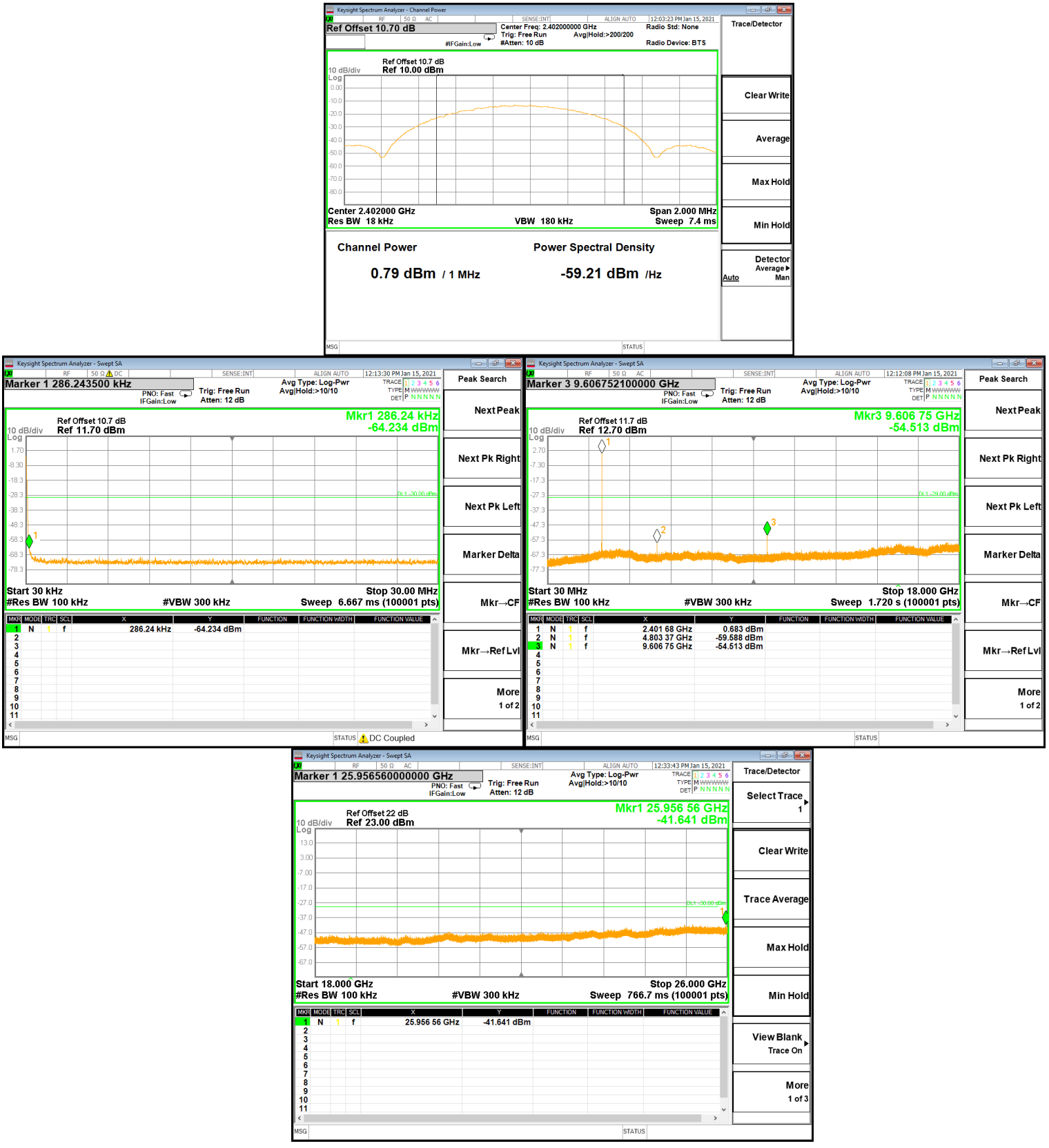




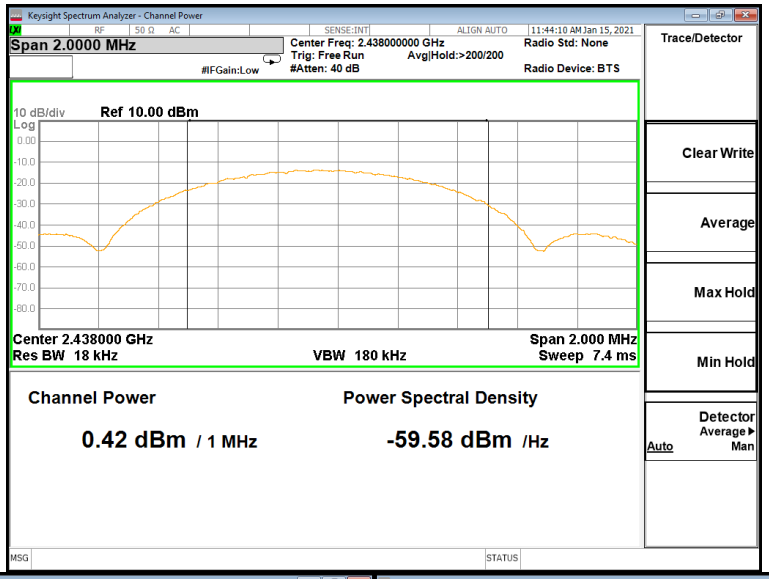


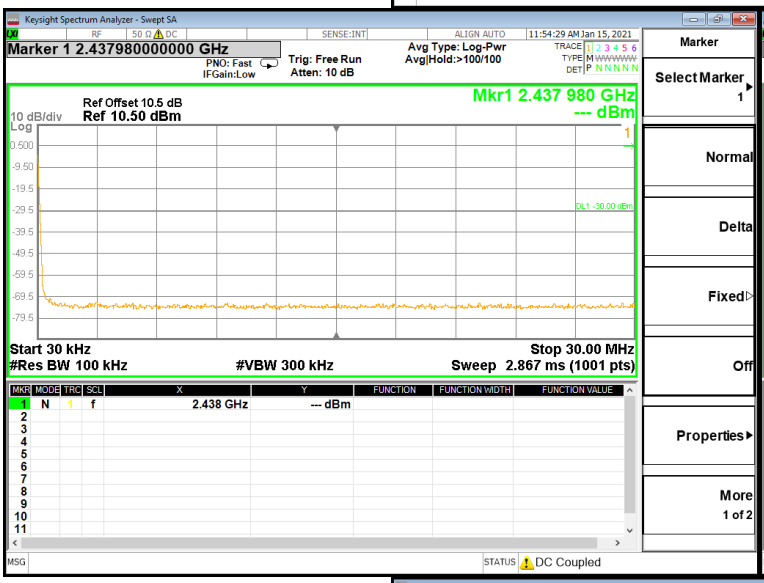
2.6.6 Conducted Spurious Emissions Data: BLE

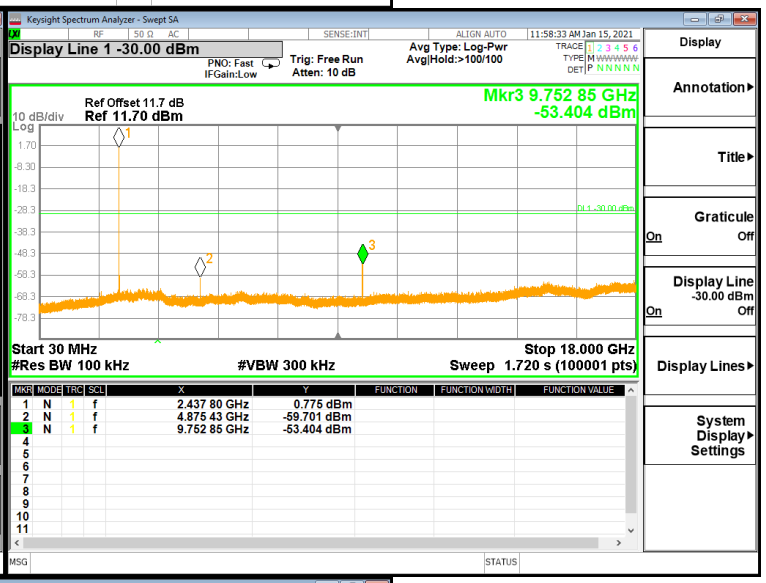
LOW Channel

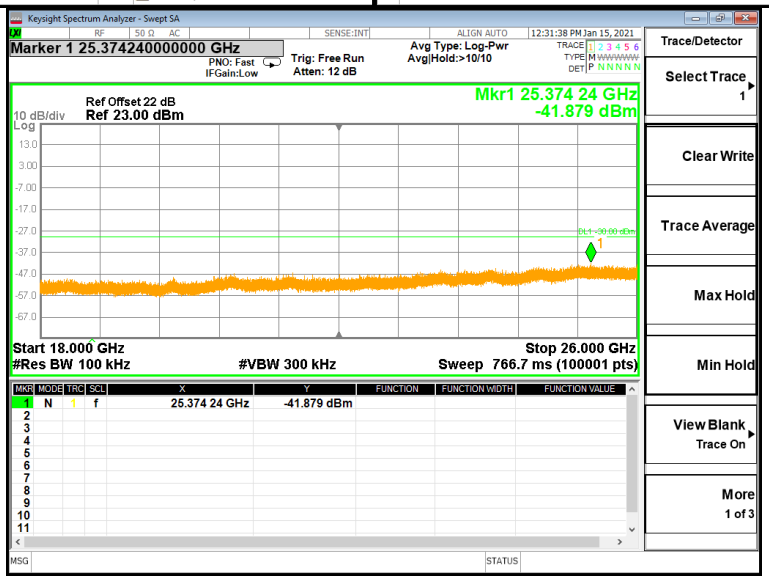


MID Channel

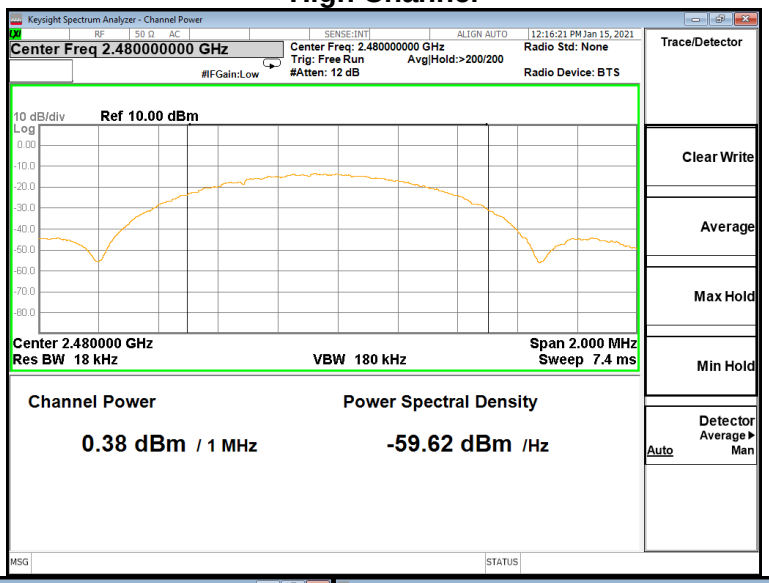

Keysight Spectrum Analyzer - Channel Power
Span 2.0000 MHz
Center Freq: 2.438000000 GHz
Trig: Free Run
Avg|Hold:>200/200
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
Trace/Detector
10 dB/div
Ref 10.00 dBm
Clear Write
Average
Max Hold
Min Hold
Center 2.438000 GHz
Res BW 18 kHz
VBW 180 kHz
Span 2.000 MHz
Sweep 7.4 ms
Channel Power
0.42 dBm / 1 MHz
Power Spectral Density
-59.58 dBm /Hz
Detector
Average
Auto
Man

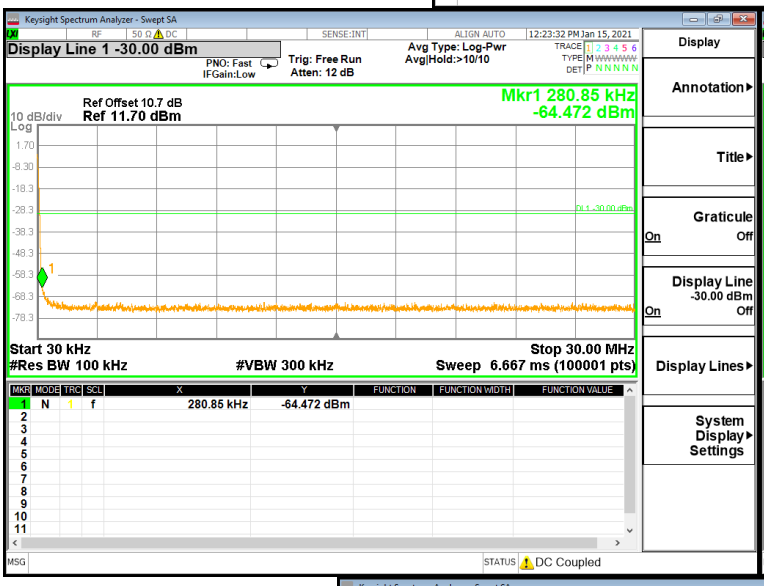

Keysight Spectrum Analyzer - Swept SA
Marker 1 2.437980000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:54:29 AM Jan 15, 2021
Marker
Select Marker
1
Ref Offset 10.5 dB
10 dB/div
Ref 10.50 dBm
Mkr1 2.437 980 GHz
--- dBm
Normal
Delta
Fixed
Off
Properties
More
1 of 2
Start 30 kHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 30.00 MHz
Sweep 2.867 ms (1001 pts)
1 N 1 f 2.438 GHz --- dBm
STATUS
DC Coupled

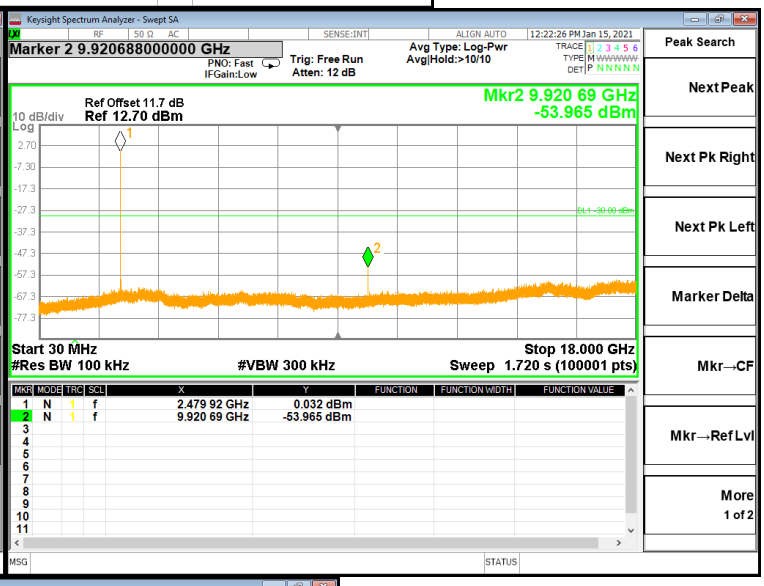

Keysight Spectrum Analyzer - Swept SA
Display Line 1 -30.00 dBm
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:58:33 AM Jan 15, 2021
Display
Ref Offset 11.7 dB
10 dB/div
Ref 11.70 dBm
Mkr3 9.752 85 GHz
-53.404 dBm
Annotation
Title
Graticule
On
Off
Display Line
-30.00 dBm
On
Off
Display Lines
System Display Settings
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 18.000 GHz
Sweep 1.720 s (100001 pts)
1 N 1 f 2.437 80 GHz 0.775 dBm
2 N 1 f 4.875 43 GHz -59.701 dBm
3 N 1 f 9.752 85 GHz -53.404 dBm
STATUS

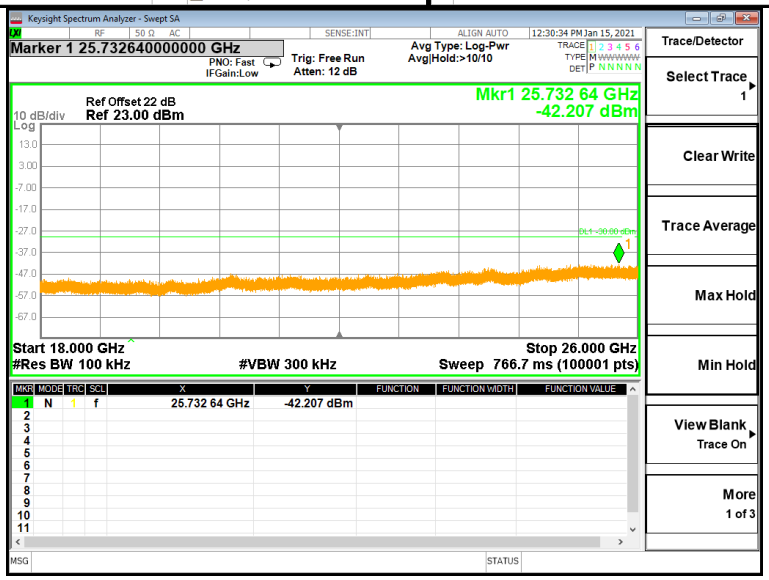

Keysight Spectrum Analyzer - Swept SA
Marker 1 25.374240000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 12 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
12:31:38 PM Jan 15, 2021
Trace/Detector
Select Trace
1
Ref Offset 22 dB
10 dB/div
Ref 23.00 dBm
Mkr1 25.374 24 GHz
-41.879 dBm
Clear Write
Trace Average
Max Hold
Min Hold
View Blank
Trace On
More
1 of 3
Start 18.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 766.7 ms (100001 pts)
1 N 1 f 25.374 24 GHz -41.879 dBm
STATUS

High Channel









2.7 EUT Positioning Assessment

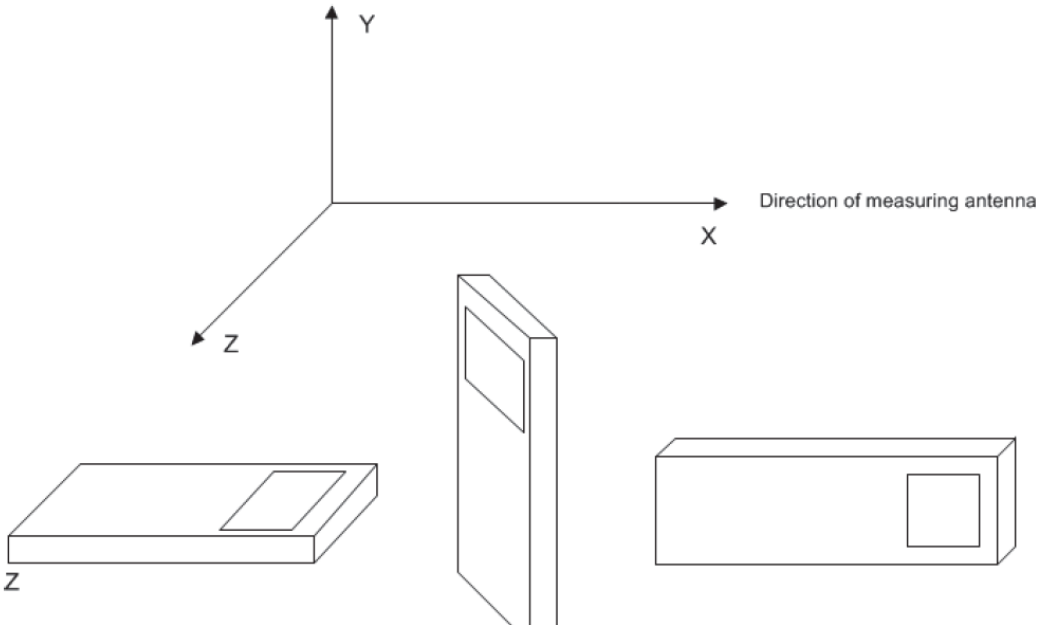
Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel: Janet Mijares	**Standard: FCC PART 15.247**
Date: 2020-12-21/22 (20.1°C,16.3% RH)	**Basic Standard: ANSI C63.4-2014**

X-Axis Found worse

Comments: EUT oriented in three axis's and X- axis found to be worse emission axis. .

Specification: ANSI C63.4-2014, Clause 6.3.2.1

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, but it may be larger or smaller to accommodate various sized EUTs (see Figure 6, Figure 7, and Figure 9). For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.



Refer to Test Setup photo exhibit.

2.8 Radiated Spurious Emissions in restricted frequency bands (TX Mode)

Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel:, Imran Akram, Janeth Mijares	**Standard: FCC PART 15.247**
Date: 2020-12-22/23 (21.6°C,14 % RH)	**Basic Standard: ANSI C63.10-2013**

EUT status: Compliant

Specification: FCC PART 15.247(d)

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

2.8.1 Test Guidance: ANSI C63.10-2013, Clause 11.12 / KDB 558074 D01 15.247 Measurement Guidance v05r02 Clause 8.6

From 9 kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna (as per KDB 460108).

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discrete increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

2.8.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

2.8.3 Test Equipment

Testing was performed with the following equipment:

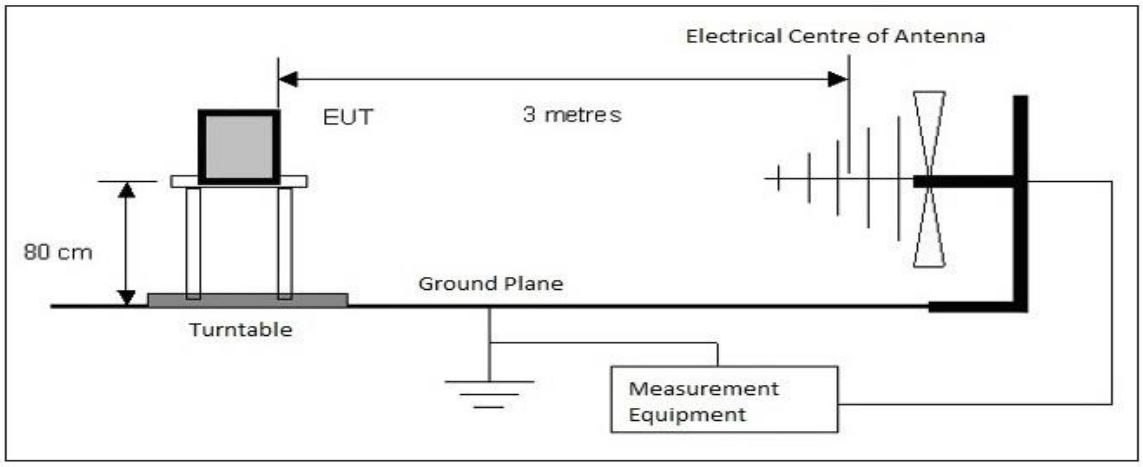
Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	N/A	
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2019-05-10	2020-05-10
Loop Antenna	EMCO	6502	10868	2019-04-11	2021-04-11
Biconilog Antenna	ARA	LPB-2520/A	4318	2018-09-19	2020-09-19
DRG Horn	EMCO	3115	19357	2018-09-12	2020-09-12
Humidity/Temp Logger	Extech Ins. Corp.	42270	5892	2019-04-05	2020-04-05
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800-21-5P	4354	2020-01-03	2021-01-03
Pre-Amplifier (30 – 1300 MHz)	HP	8447D	9291	2020-01-03	2021-01-03
RE Cable below 1GHz	Insulated Wire Inc.	KPS-1501A-3600-KPA-01102006	4419	2020-01-03	2021-01-03
Re Cable Above 1 GHz	A.H. System Inc.	SAC-26G-8.23	6187	2020-01-03	2021-01-03
Notch filter 2.45GHz	Micro-Tronix	BRM50702	s/n 088	2020-01-03	2021-01-03
High Pass Filter	K&L	4DH21	-	2020-01-03	2021-01-03

2.8.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

Test setup diagram for Radiated Spurious Emissions testing (below 1GHz):



Above 1GHz, the EUT is raised using a low permittivity material (polystyrene) to a height of 1.5m.

FCC Part 15.205 Restricted Bands of Operation:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	*4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	*108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	*2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	*3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz, [2] Above 38.6

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in 15.209 shall be demonstrated based on the average value of the measured emissions.

Specification: FCC15.209 Radiated emission limits.

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 (microvolts/meter)	Measurement distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

2.8.5 Radiated Emissions Data: LoRa DTS

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

Meter Reading in dBμV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbμV/m.

Delta = Field Strength - Limit

Notes: When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.

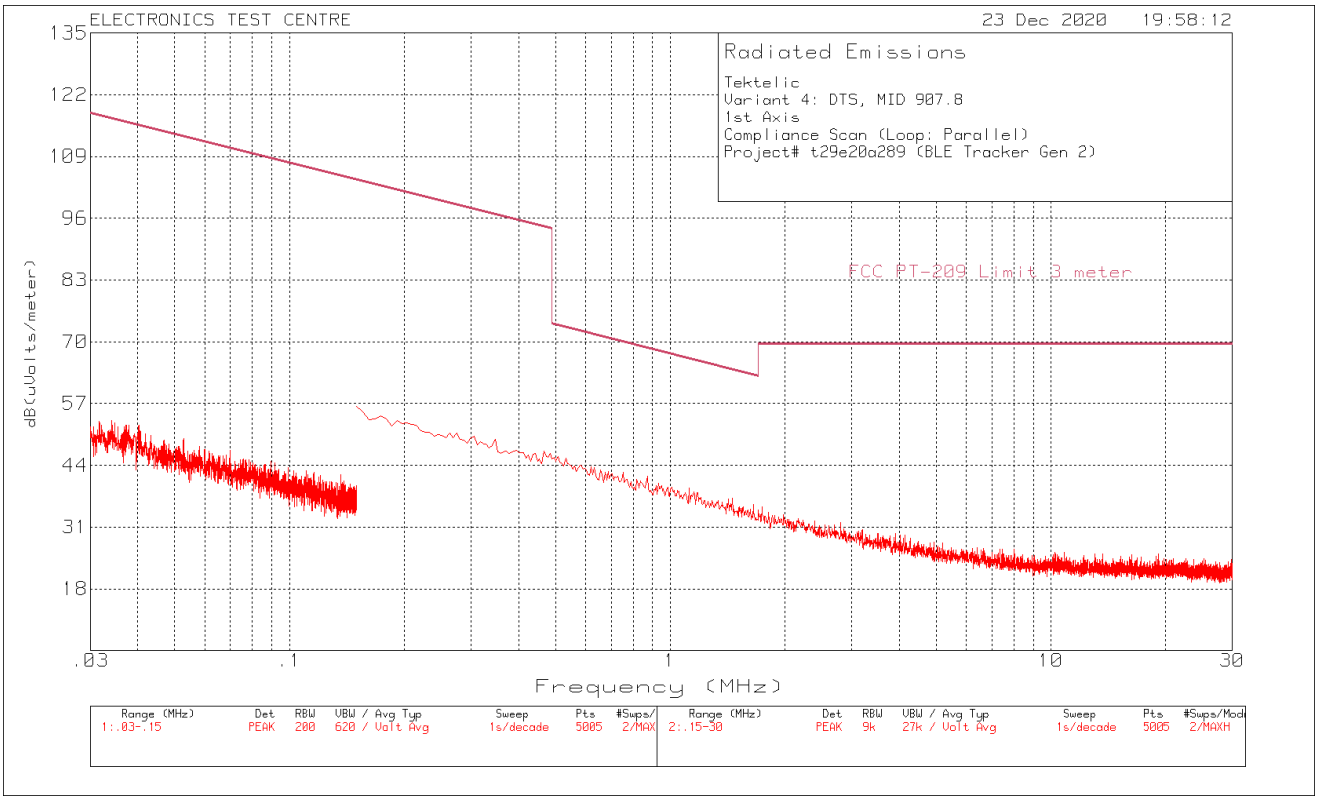
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discrete increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- Preliminary scans were performed for all channels in Transmit modes. The MID band channel 907.8 MHz was selected as the worst-case condition for detailed examination.
- In Transmit mode, the EUT was assessed up to 10.0 GHz.

Negative values for Delta indicate compliance.

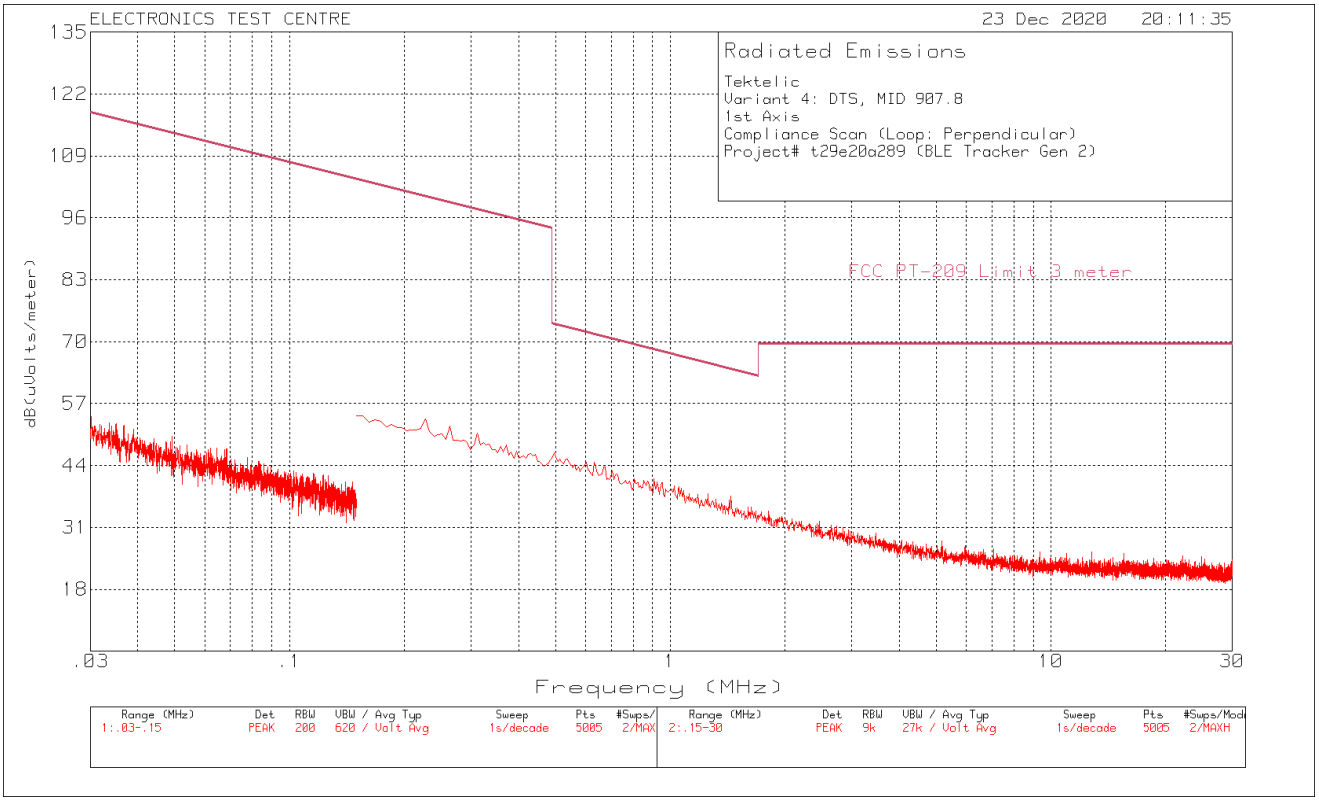
Freq. Marker	Freq. [MHz]	Raw reading [dBμv]	Det	Antenna Factor [dB/m]	Pre amp Gain [dB]	Corrected Reading [dBμv/m]	FCC 15.209 Limit [dBμv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	278.88	22.62	QP	17.4	-21.9	18.12	46.02	-27.9	18	103	Horizontal
2	124.25	26.78	QP	18.1	-23.2	21.68	43.5	-21.82	90	105	Vertical
3	689.74	26.44	QP	24.1	-19.3	31.24	46.02	-17.78	290	115	Vertical
1	*2723.8	50.07	AV	29.7	-33.8	45.97	54	-8.03	41	322	Horizontal
1	*2723.8	56.16	PK	29.7	-33.8	52.06	74	-21.94	41	322	Horizontal
2	*2723.8	47.57	AV	29.7	-33.8	43.47	54	-10.53	77	321	Vertical
2	*2723.8	54.03	PK	29.7	-33.8	49.93	74	-24.07	77	321	Vertical
1	*5464.4	29.86	AV	34	-30.4	33.46	54	-20.54	189	232	Horizontal
1	*5446.4	41.5	PK	34	-30.4	45.1	74	-28.9	189	232	Horizontal
2	*7262.8	24.59	AV	36.3	-27.5	33.39	54	-20.61	320	296	Horizontal
2	*7262.8	37.26	PK	36.3	-27.5	46.06	74	-27.94	320	296	Horizontal
3	*8169.3	26.95	AV	36.7	-26.2	37.45	54	-16.55	11	207	Horizontal
3	*8169.3	40.54	PK	36.7	-26.2	51.04	74	-22.96	11	207	Horizontal
4	*9079.3	24.7	AV	37.5	-26.4	35.8	54	-18.2	45	143	Horizontal
4	*9079.3	37.84	PK	37.5	-26.4	48.94	74	-25.06	45	143	Horizontal
5	*5446.4	31.66	AV	34	-30.4	35.26	54	-18.74	143	238	Vertical
5	*5446.4	42.83	PK	34	-30.4	46.43	74	-27.57	143	238	Vertical
6	*7261.4	27.45	AV	36.3	-27.5	36.25	54	-17.75	206	111	Vertical
6	*7261.4	40.18	PK	36.3	-27.5	48.98	74	-25.02	206	111	Vertical
7	*8172.3	25.75	AV	36.7	-26.2	36.25	54	-17.75	318	156	Vertical
7	*8172.3	40.67	PK	36.7	-26.2	51.17	74	-22.83	318	156	Vertical
8	*9079.7	23.69	AV	37.5	-26.4	34.79	54	-19.21	306	154	Vertical
8	*9079.7	36.87	PK	37.5	-26.4	47.97	74	-26.03	306	154	Vertical

AV: Average Detector, PK: Peak Detector, * Restricted Band (RB) Non Restricted Band (NRB)

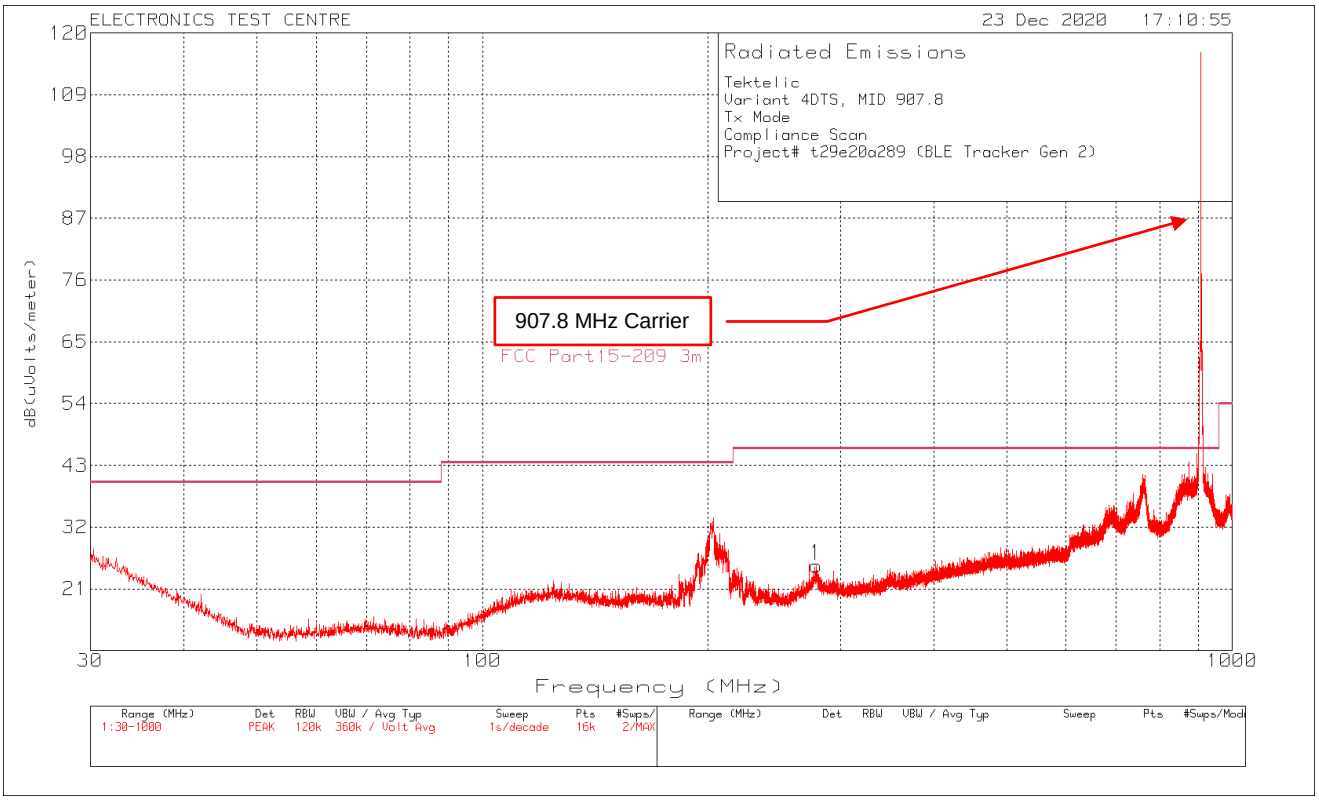
Plot of Radiated Emissions LoRa: Measuring Antenna Parallel



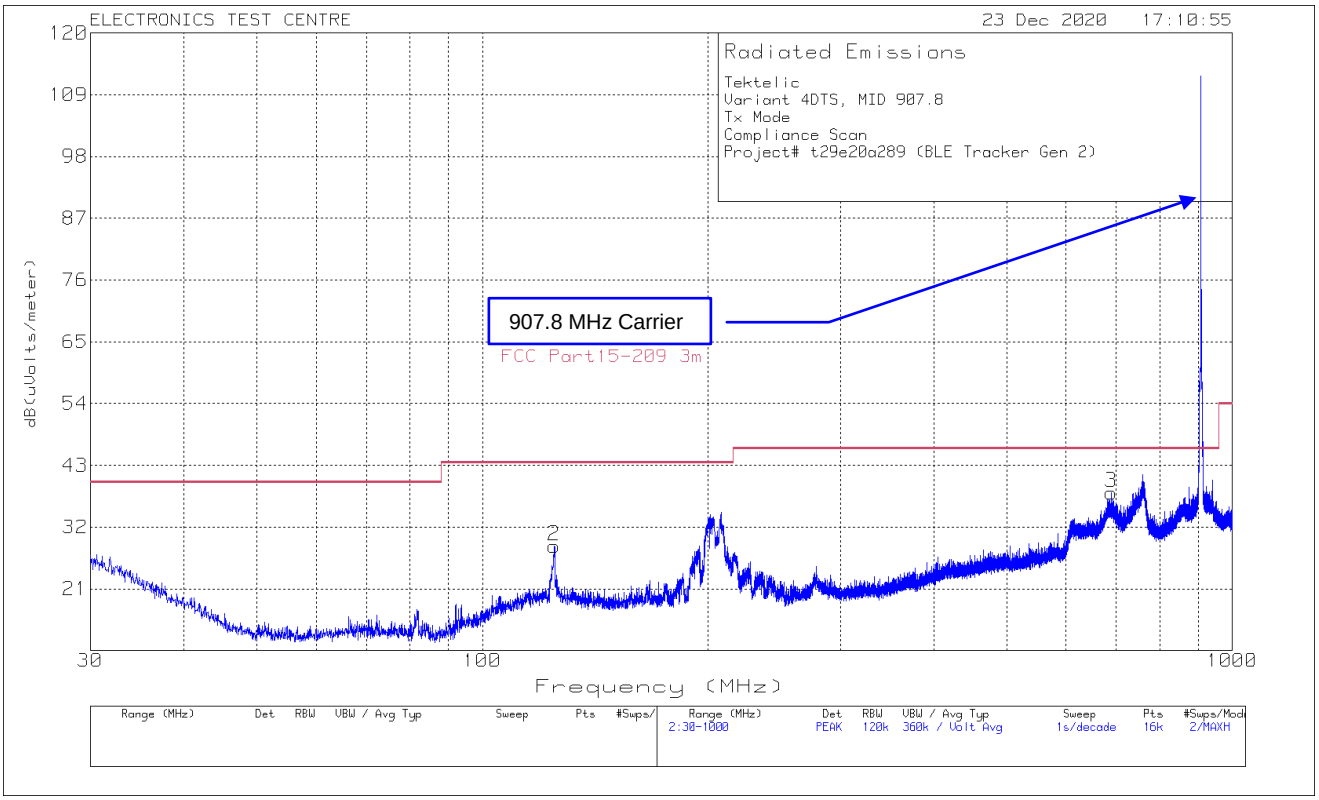
Plot of Radiated Emissions LoRa: Measuring Antenna Perpendicular



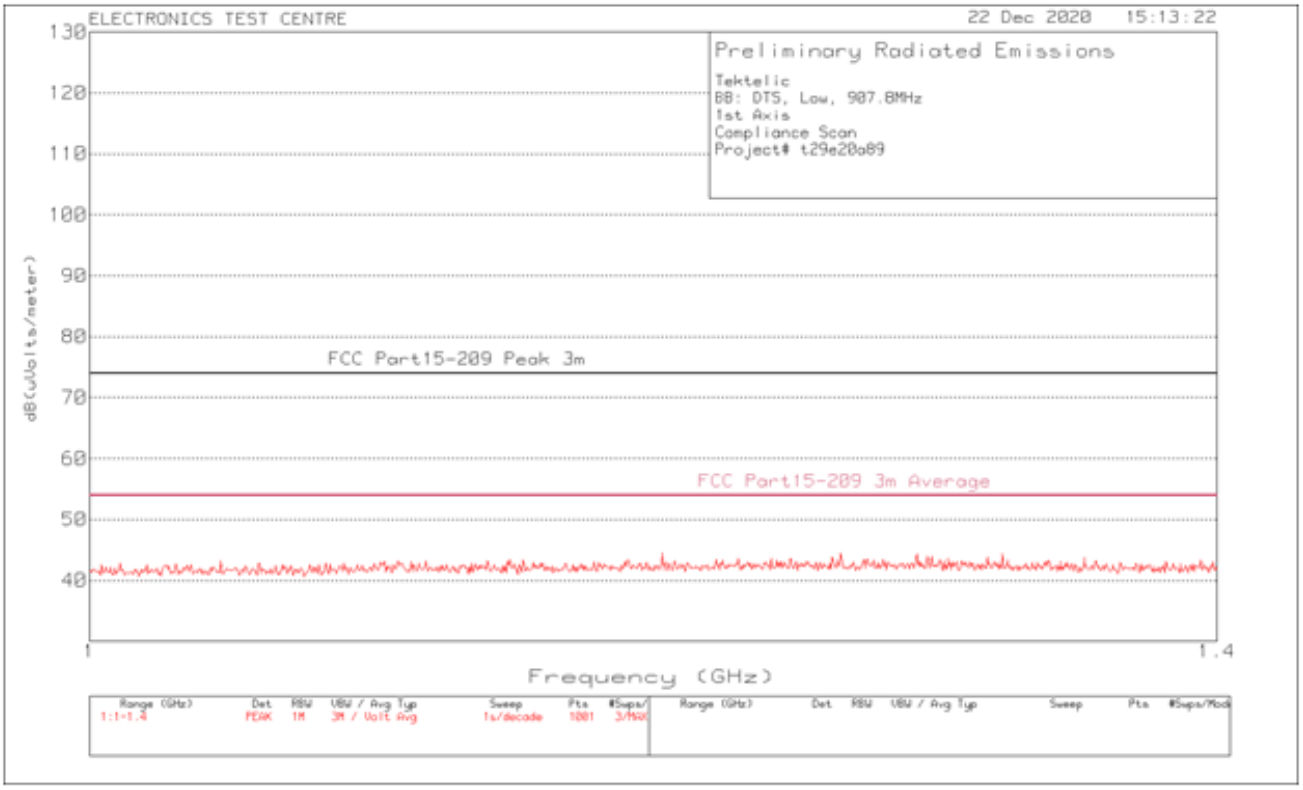
Plot of Radiated Emissions LoRa: Horizontal polarization



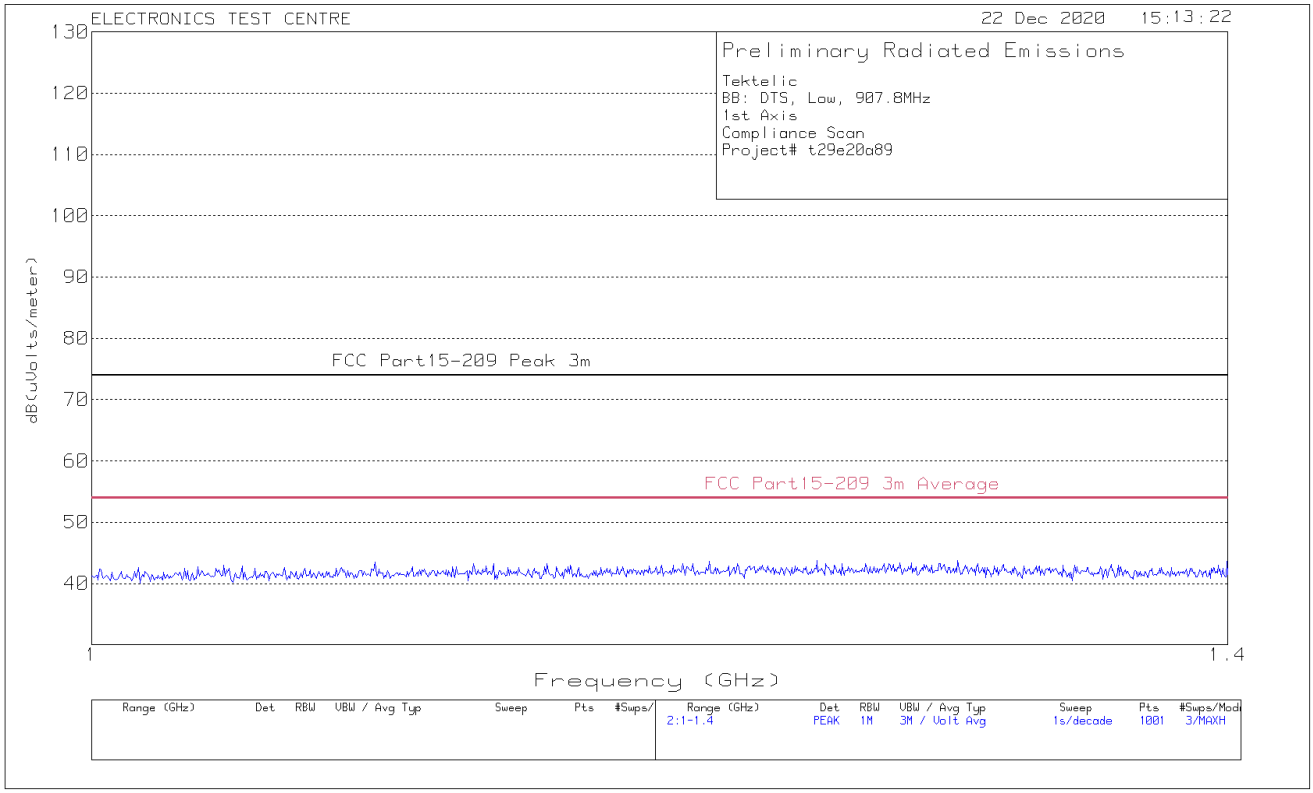
Plot of Radiated Emissions LoRa: Vertical polarization



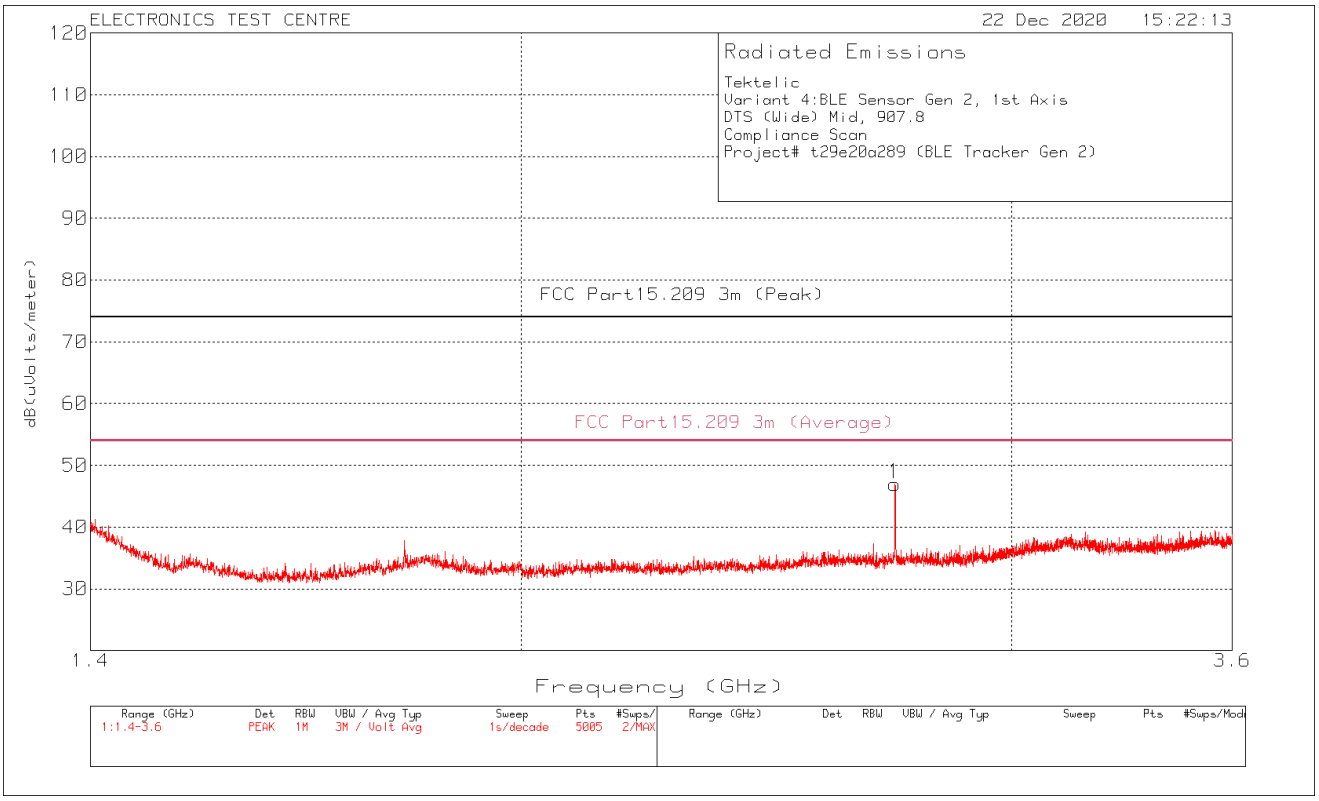
Plot of Radiated Emissions LoRa: Horizontal polarization



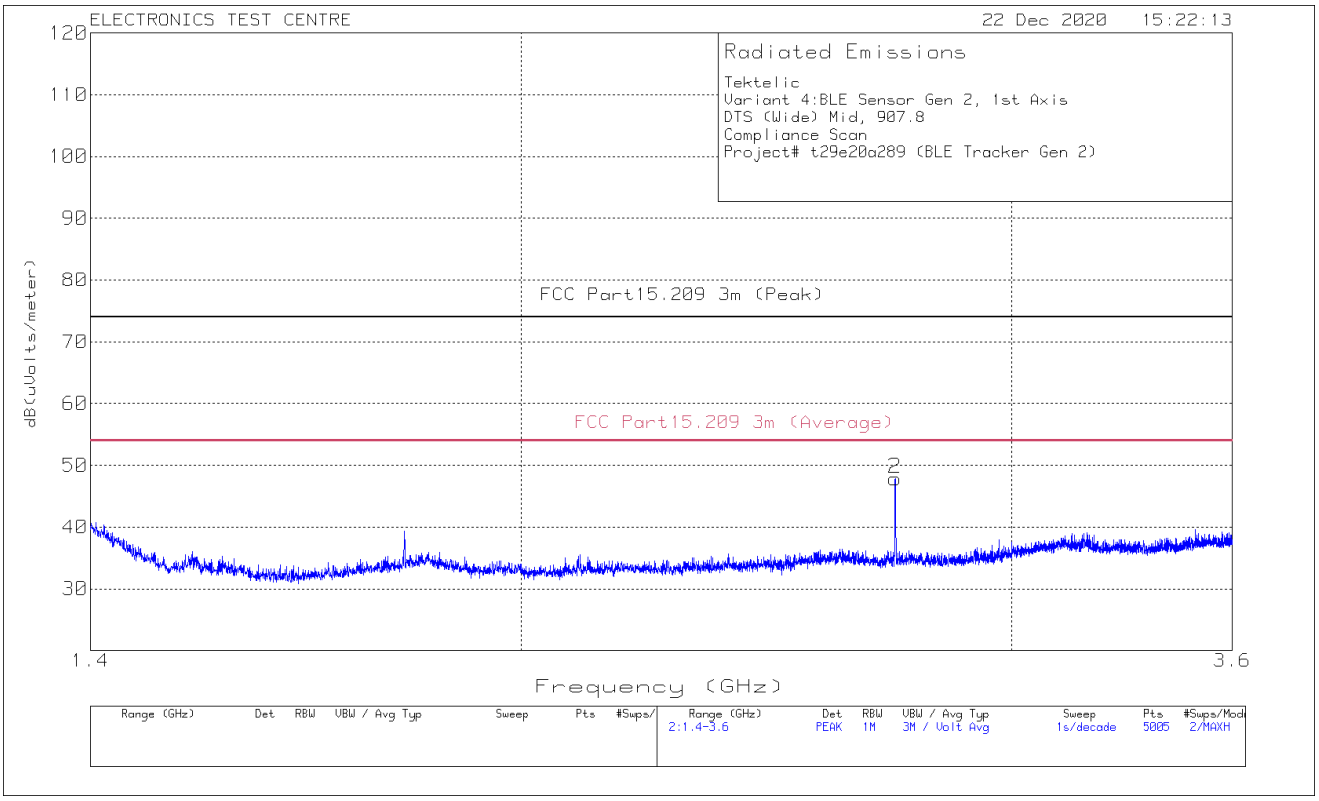
Plot of Radiated Emissions LoRa: Vertical polarization



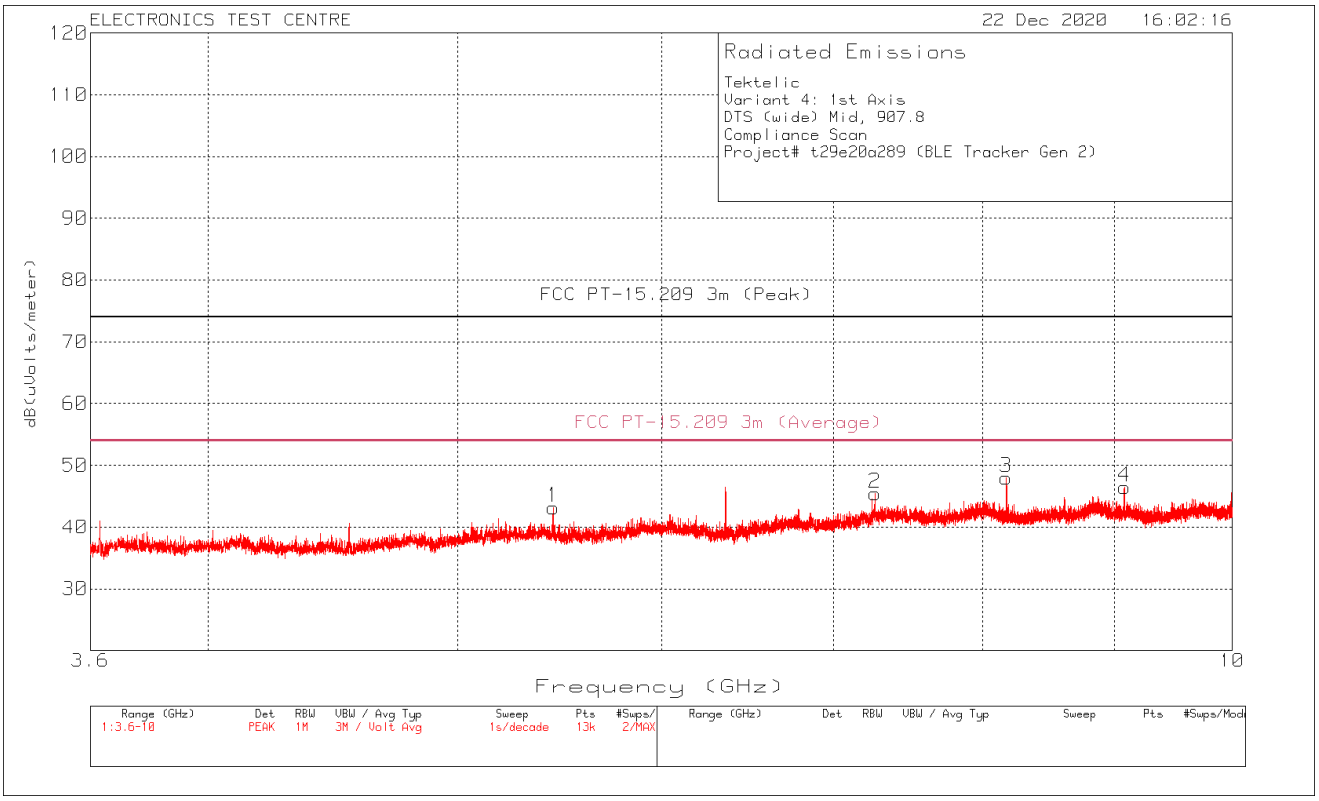
Plot of Radiated Emissions LoRa: Horizontal polarization



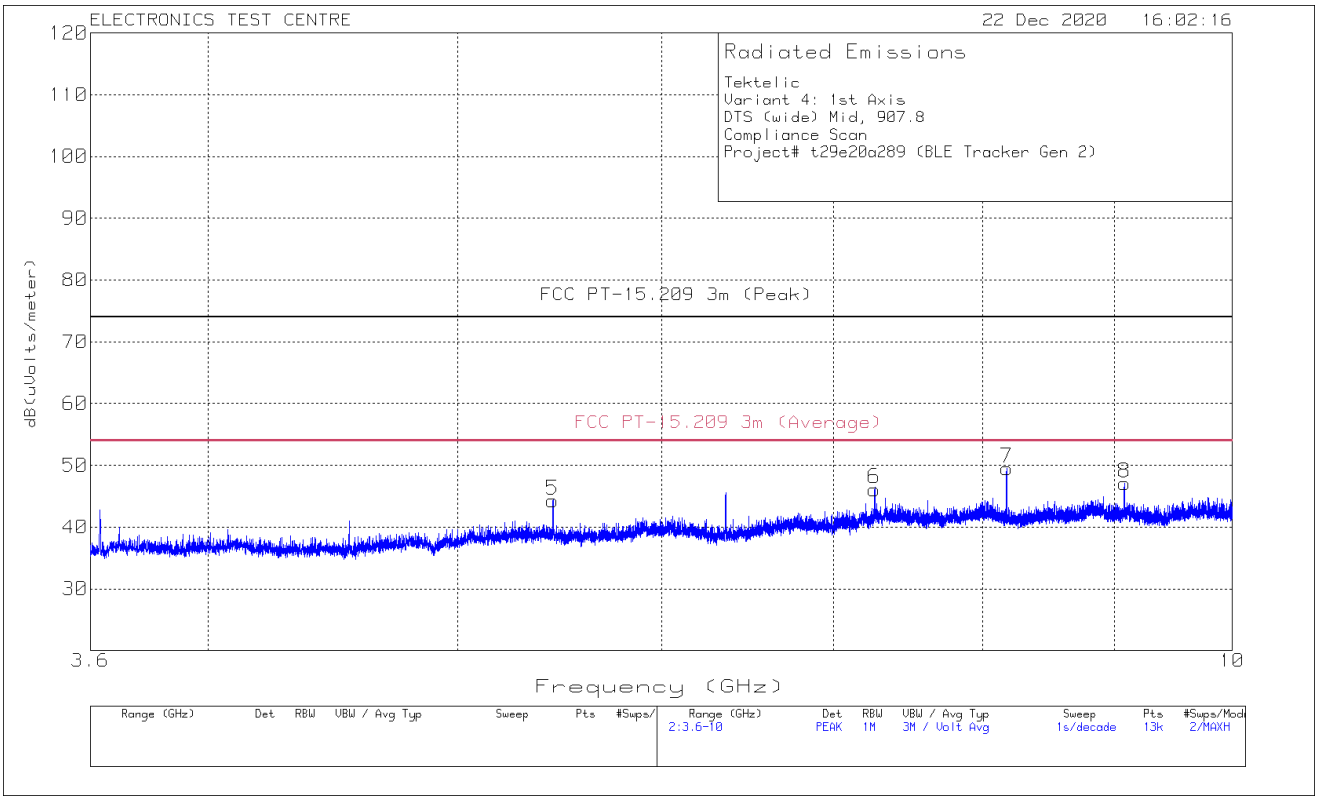
Plot of Radiated Emissions LoRa: Vertical polarization



Plot of Radiated Emissions LoRa: Horizontal polarization



Plot of Radiated Emissions LoRa: Vertical polarization



2.8.6 Radiated Emissions Data: BLE

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

Meter Reading in dBμV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbμV/m.

Delta = Field Strength - Limit

Notes: When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.

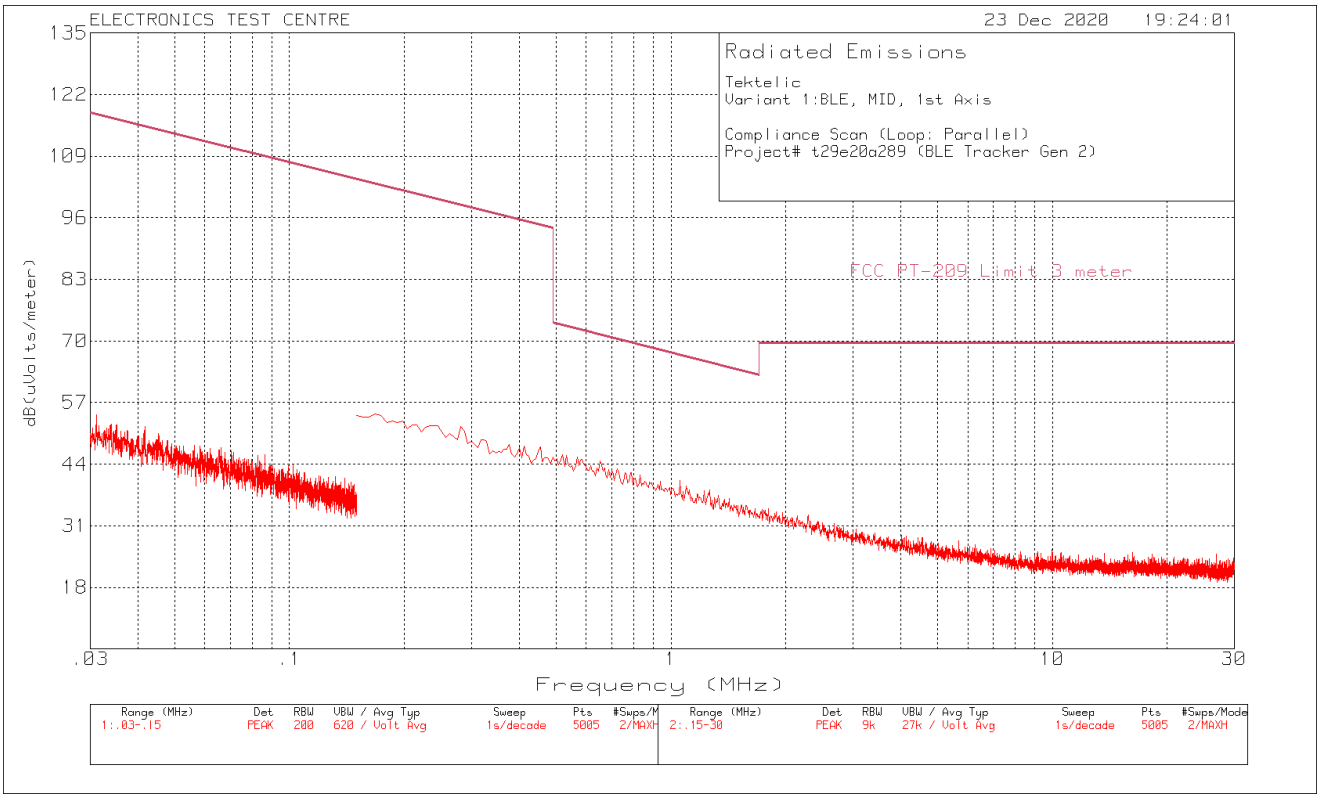
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discrete increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- Preliminary scans were performed for all channels in Transmit modes. The MID band channel 2438 MHz was selected as the worst-case condition for detailed examination.
- In Transmit mode, the EUT was assessed up to 26.5 GHz.

Negative values for Delta indicate compliance.

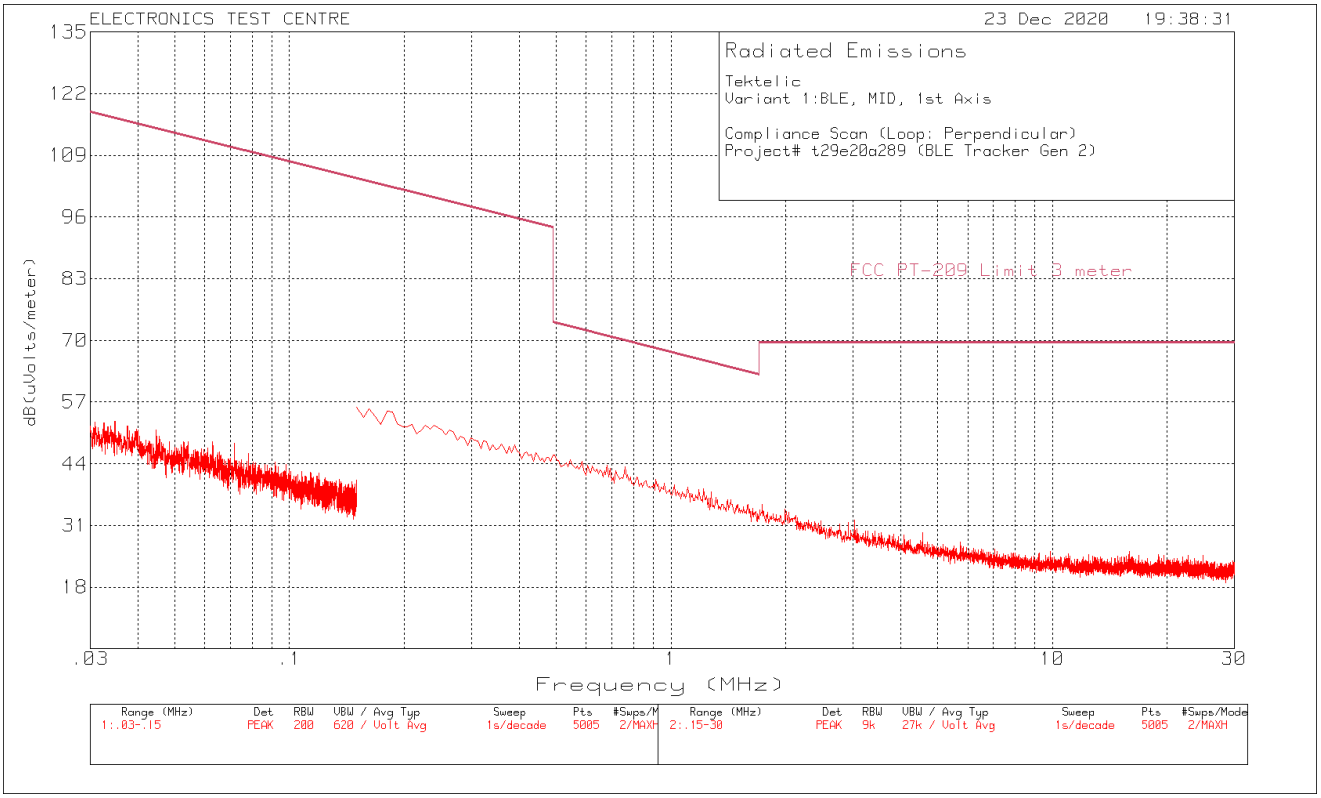
Freq. Marker	Freq. [GHz]	Raw reading [dBμv]	Det	Antenna Factor [dB/m]	Pre amp Gain [dB]	Corrected Reading [dBμv/m]	FCC 15.209 Limit [dBμv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	*4.876	39.41	AV	33	-31.9	40.51	54	-13.49	202	121	Horizontal
1	*4.876	44.1	PK	33	-31.9	45.28	74	-28.74	202	121	Horizontal
4	*17.86	19.8	AV	46.2	-20	46	54	-8.0	39	103	Horizontal
4	*17.86	31.16	PK	46.2	-20	57.36	74	-16.64	39	103	Horizontal
2	*4.876	39.26	AV	33	-31.9	40.36	54	-13.64	132	107	Vertical
2	*4.876	43.76	PK	33	-31.9	44.86	74	-29.14	132	107	Vertical
3	*17.86	19.81	AV	46.2	-19.9	46.11	54	-7.89	17	102	Vertical
3	*17.86	31.59	PK	46.2	--19.9	57.89	74	-16.11	17	102	Vertical

AV: Average Detector, PK: Peak Detector, * Restricted Band (RB) Non Restricted Band (NRB)

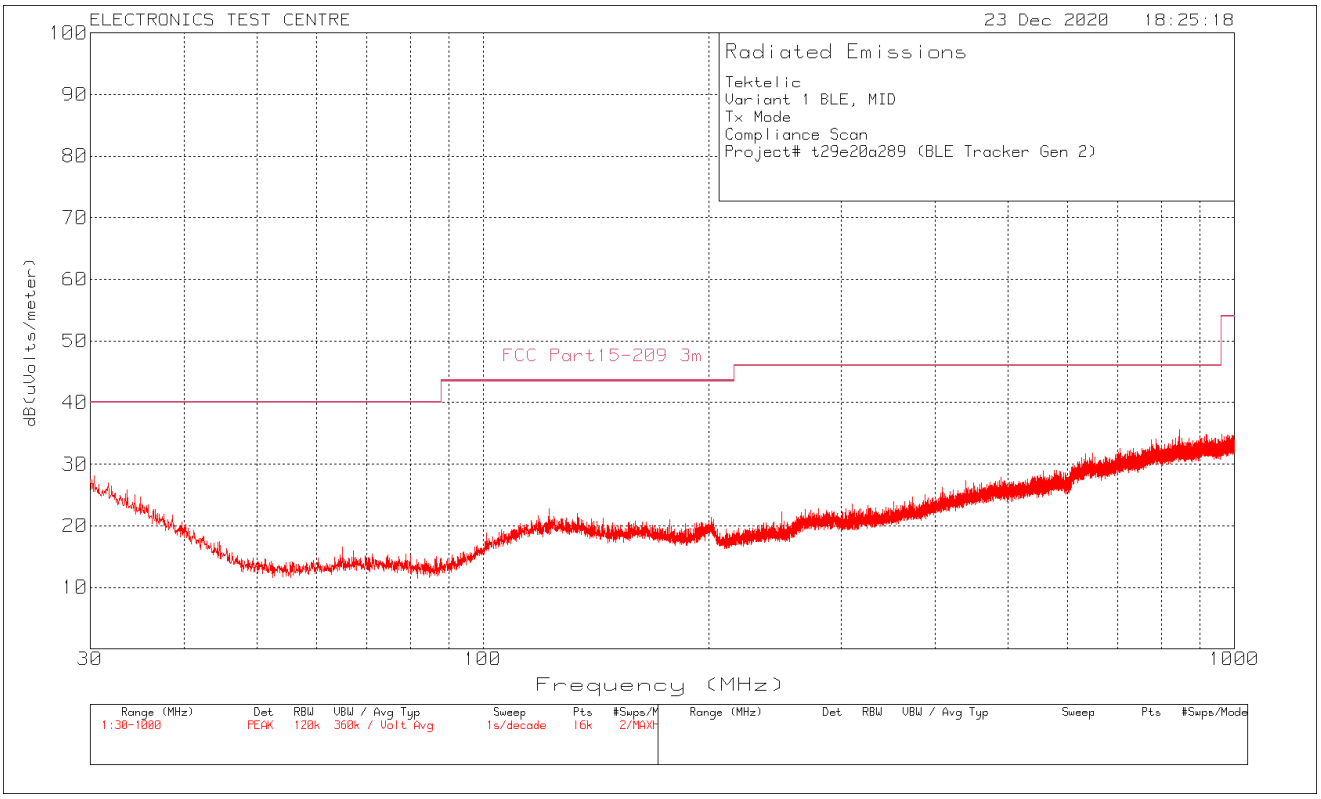
Plot of Radiated Emissions BLE: Measuring Antenna Parallel



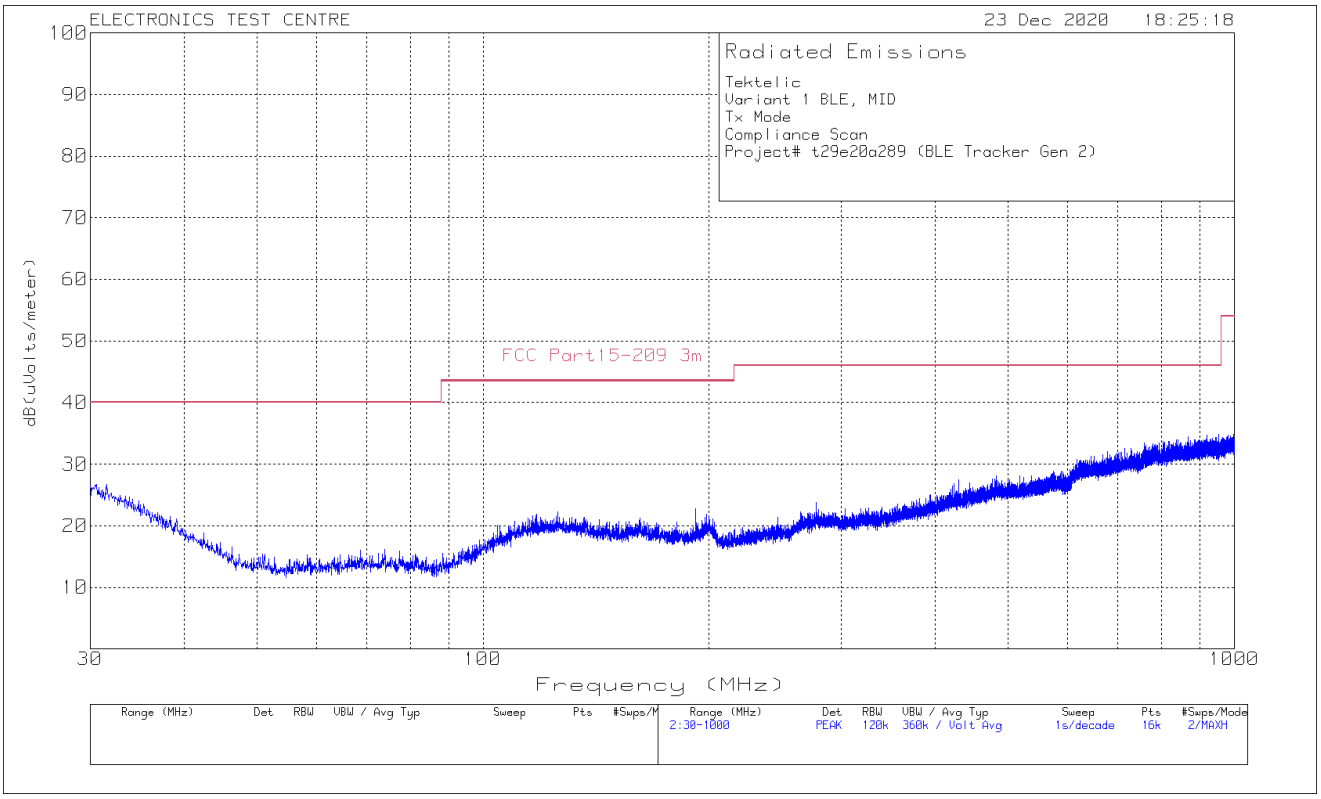
Plot of Radiated Emissions BLE: Measuring Antenna Perpendicular



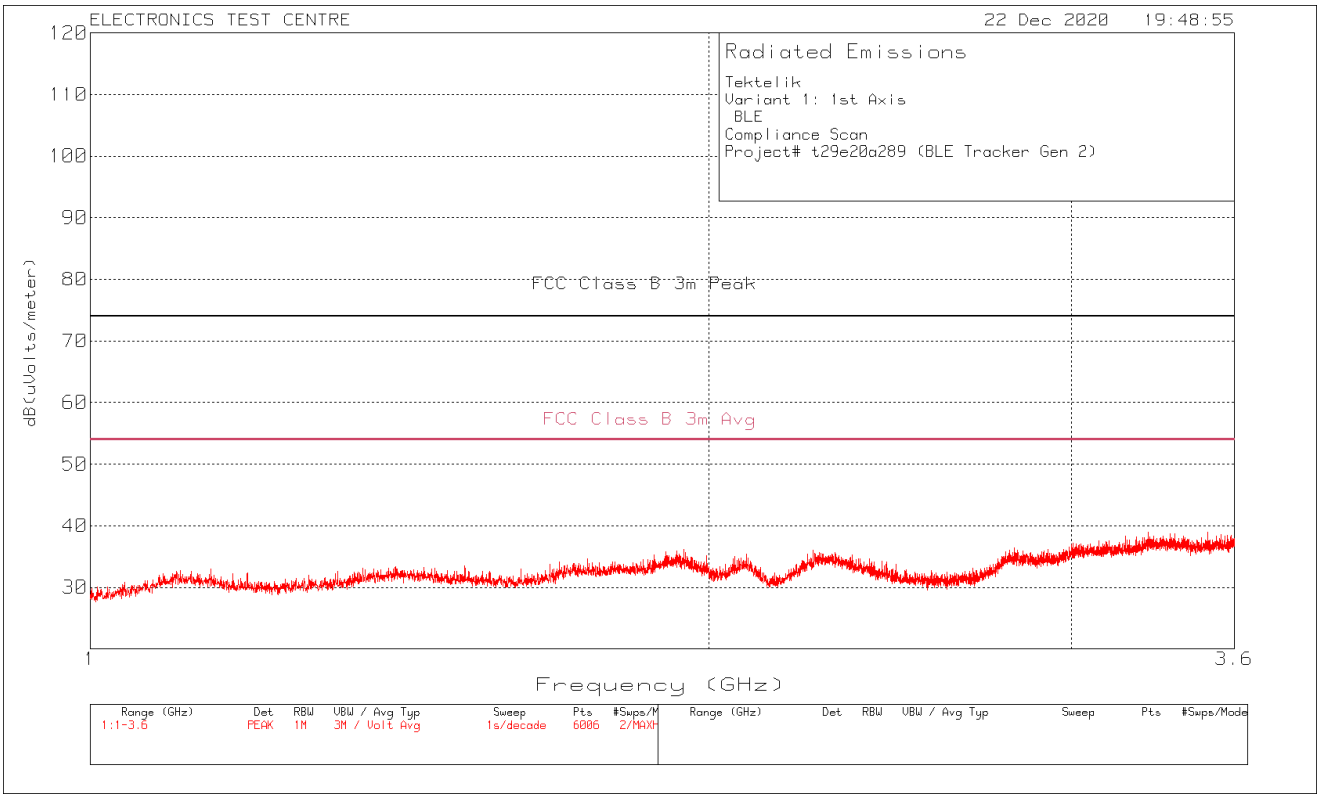
Plot of Radiated Emissions BLE: Horizontal polarization



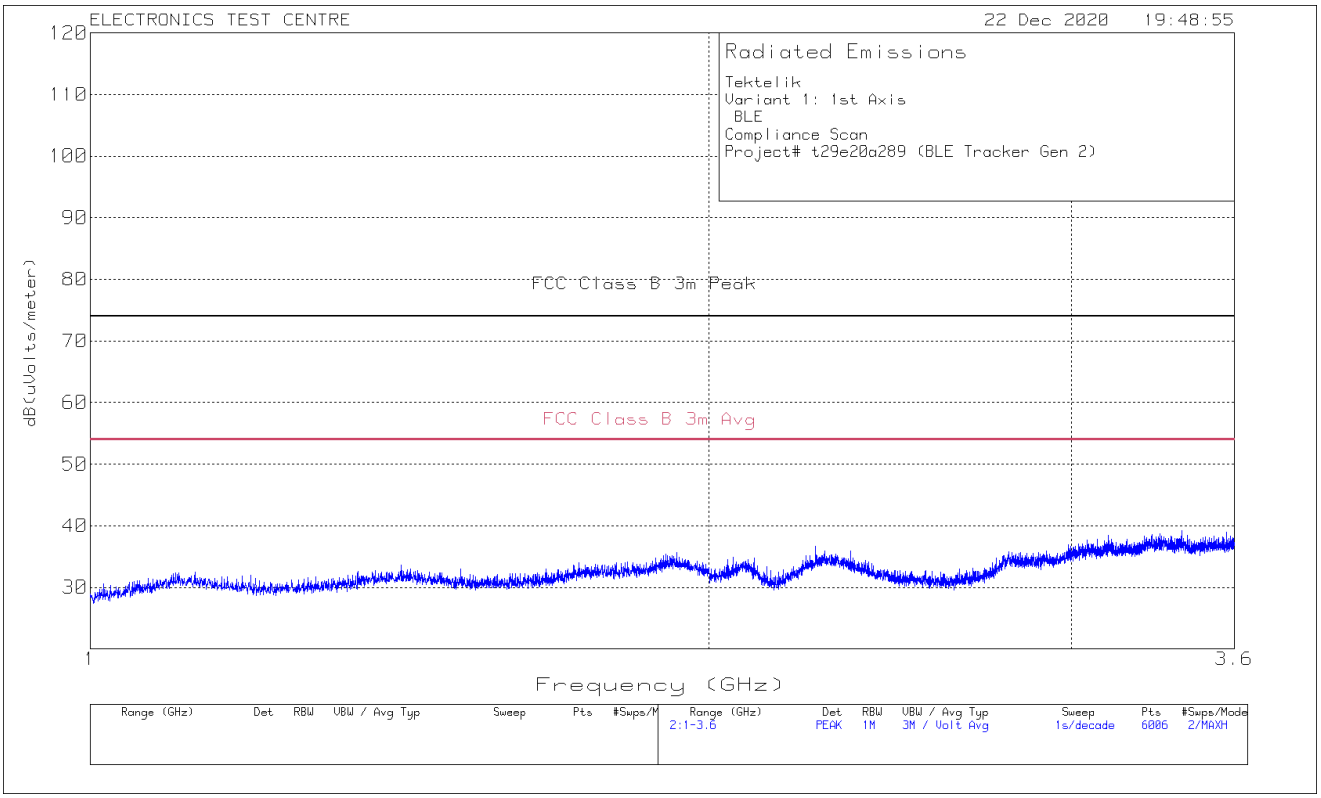
Plot of Radiated Emissions BLE: Vertical polarization



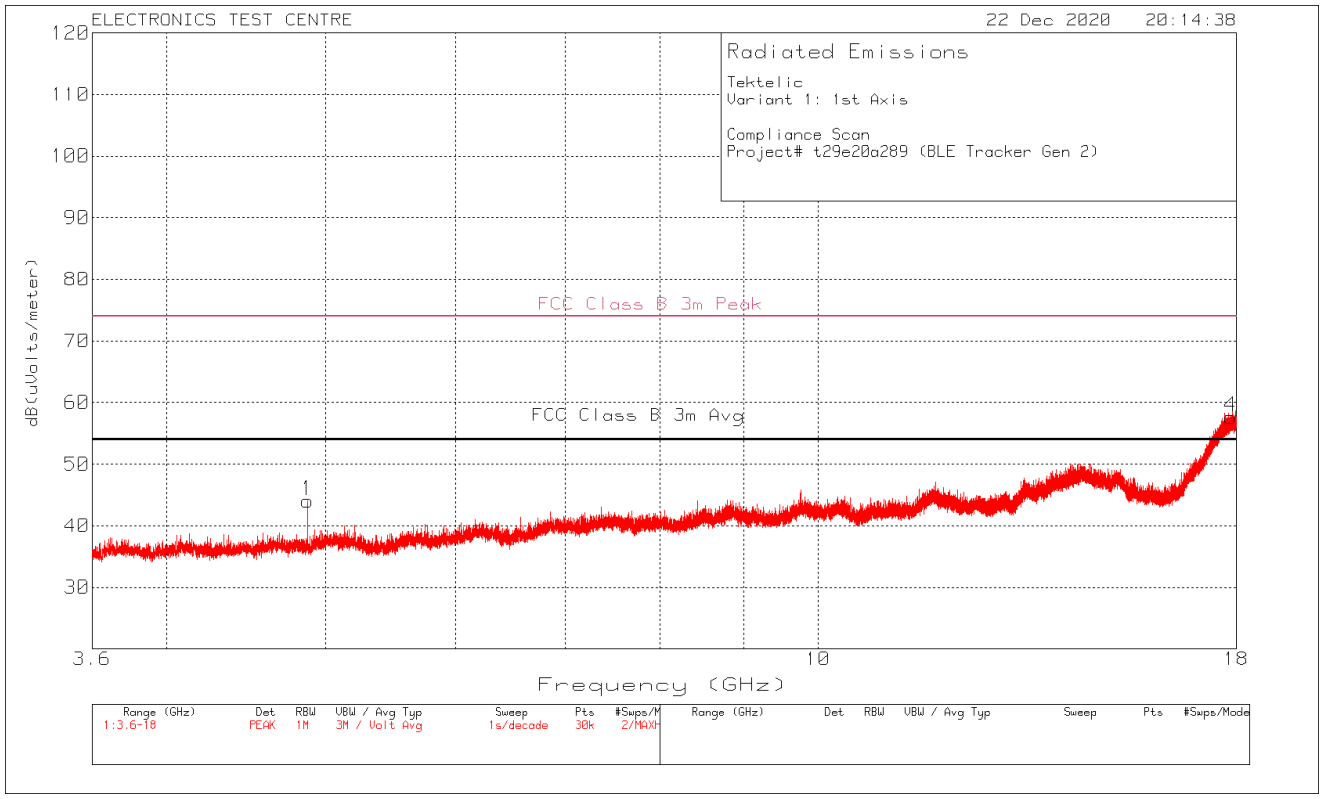
Plot of Radiated Emissions BLE: Horizontal polarization



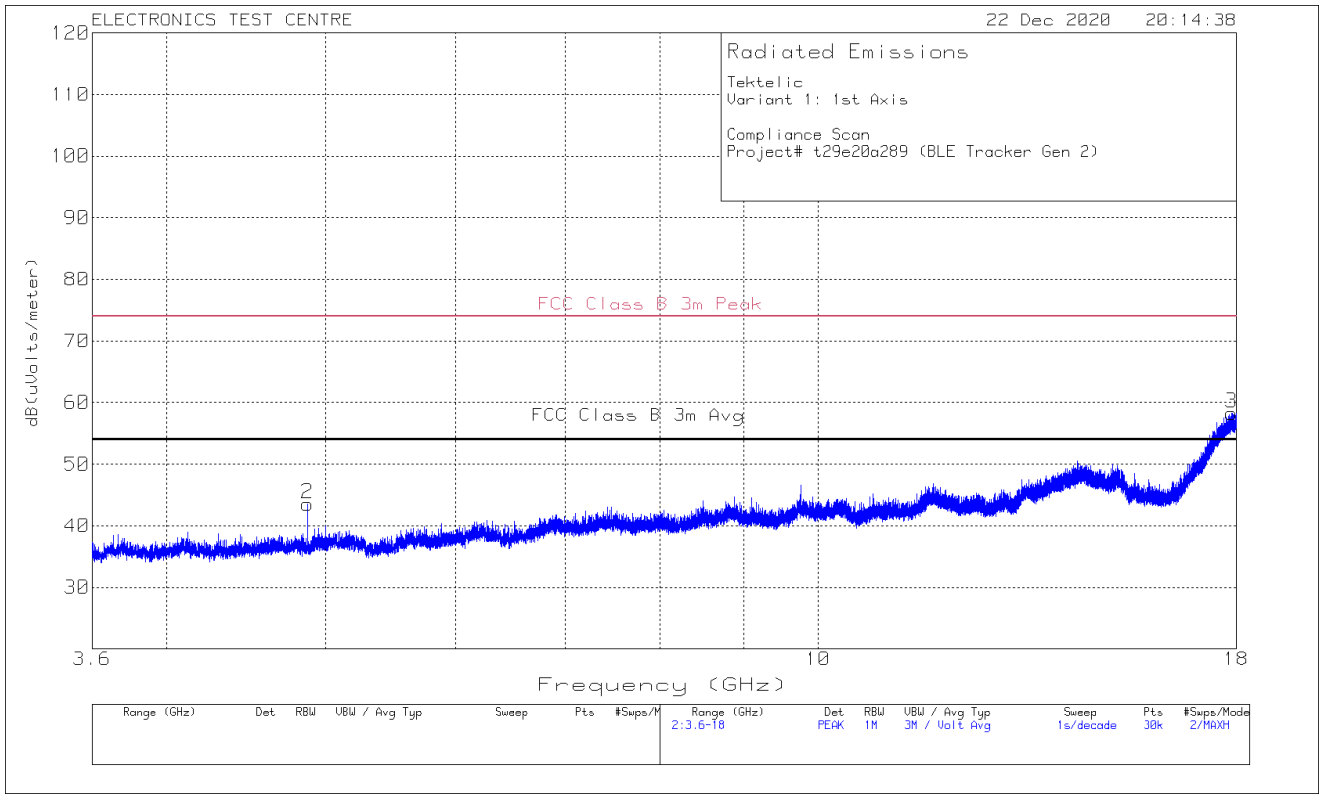
Plot of Radiated Emissions BLE: Vertical polarization



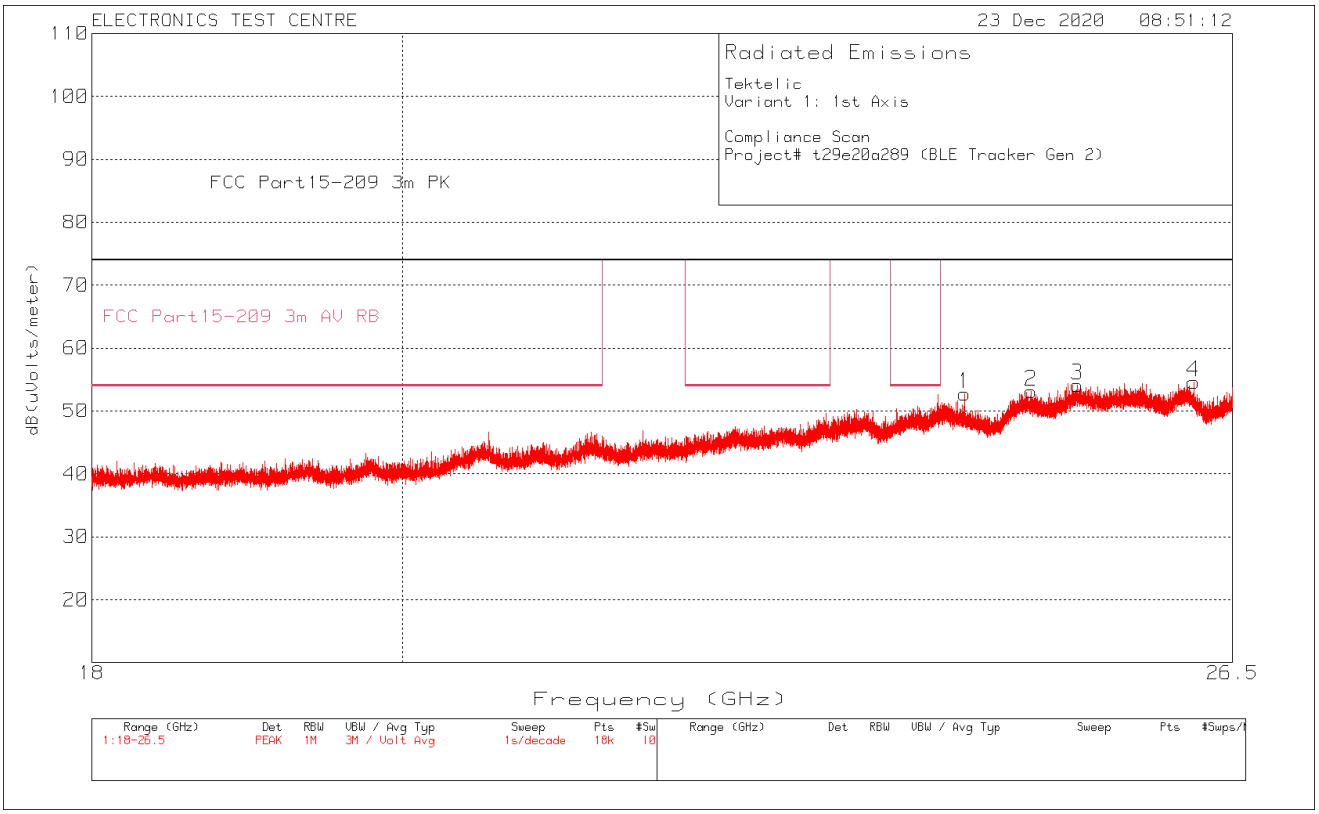
Plot of Radiated Emissions BLE: Horizontal polarization



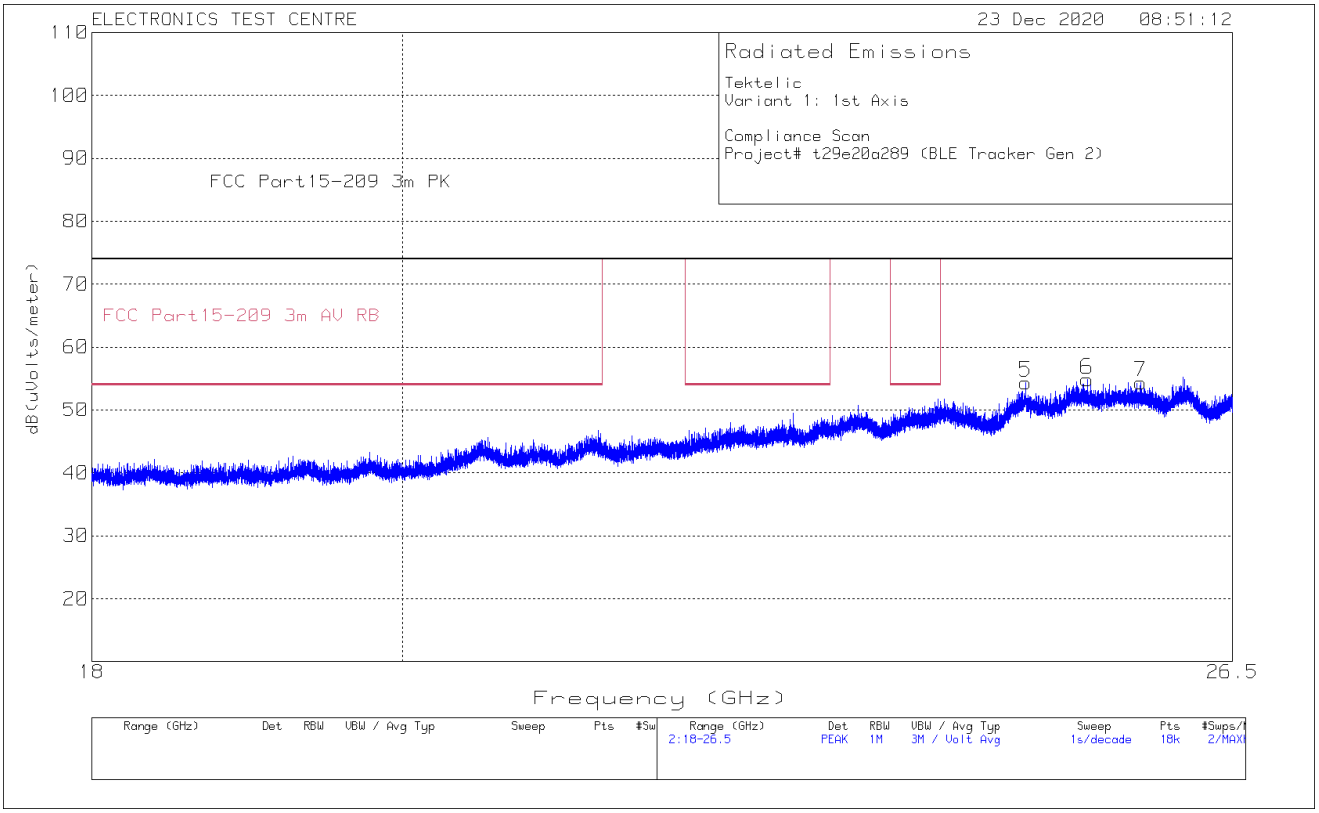
Plot of Radiated Emissions BLE: Vertical polarization



Plot of Radiated Emissions BLE: Horizontal polarization



Plot of Radiated Emissions BLE: Vertical polarization



2.9 RF Exposure

Test Lab: Electronics Test Centre, Airdrie	**EUT: BLE Sensor GEN2**
Test Personnel:	**Standard: FCC PART 15.247**
Date:	

EUT status: Exempt

Compliant: RF exposure assessment to be provided in a separate Exhibit.

3.0 TEST FACILITY

3.1 Location

The BLE Sensor GEN2 was tested for emissions at the Electronics Test Centre laboratory located in Airdrie, Alberta, Canada. The Radio Frequency Anechoic Chamber (RFAC), identified as Chamber 1, has a usable working space measuring 10.6 m long x 7.3 m wide x 6.5 m high.

Measurements taken at this site are accepted by Industry Canada as evidence of conformity per registration file # 2046A. This site is also listed with the FCC under Registration Number CA2046.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment located in the Control Room. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in the Control Room, consisting of two shielded vestibules joined together at the side of the main room. Cables are routed through bulkhead panels between the rooms and the test chamber as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

Either floor mounted or table-top equipment can be tested at this facility.

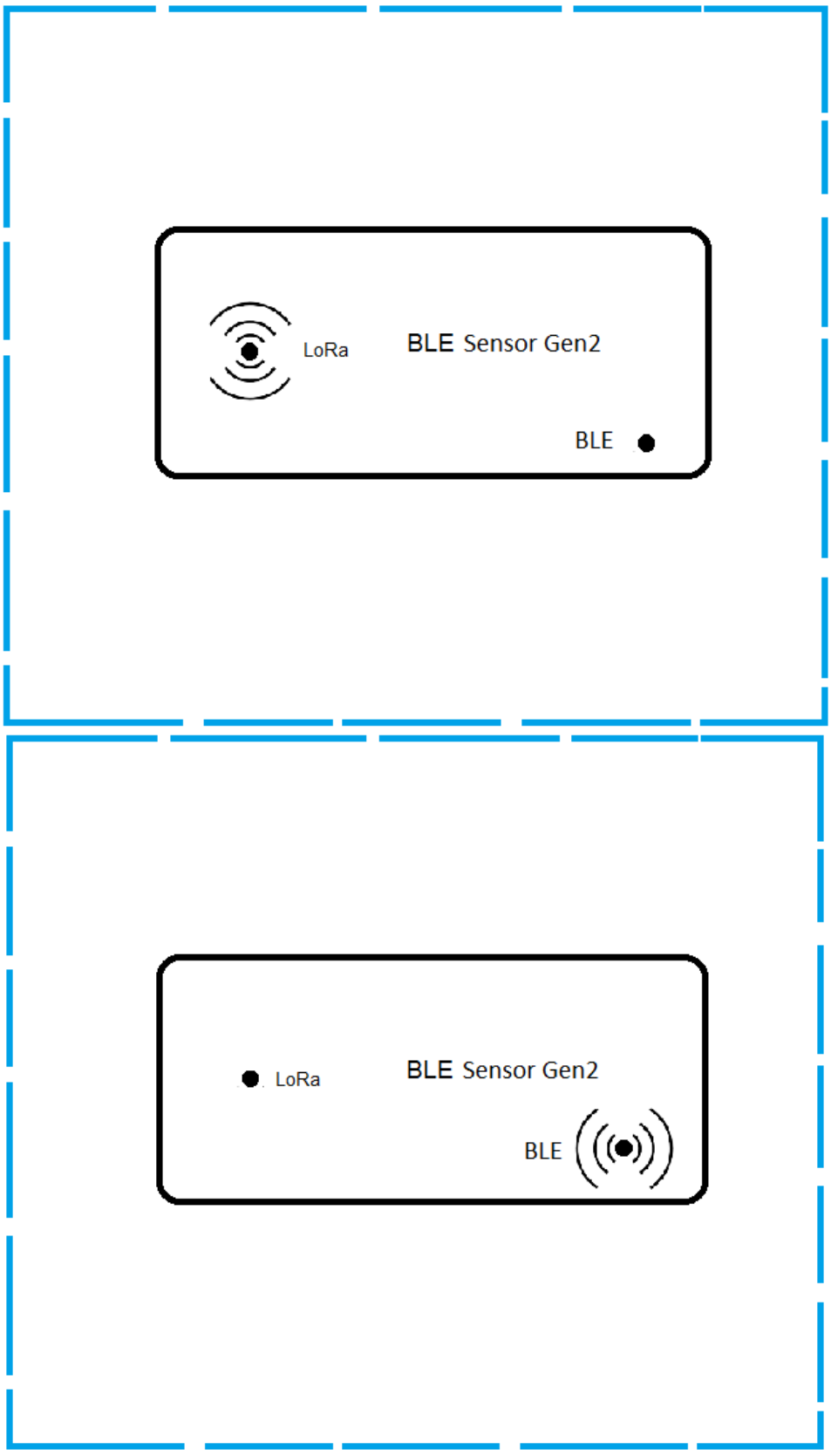
3.2 Grounding Plan

The BLE Sensor GEN2 was placed at the center of the test chamber turntable on top of polystyrene foam table. No provision is made within the BLE Sensor GEN2 for an earth ground connection.

3.3 Power Supply

All EUT power was supplied by a DC power supply (3.6 V).

Appendix A (Worse Emission test Setup Block Diagram)



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