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EMC testing of the Tektelic Communication Inc. *Kona Enterprise Gateway & Kona Photon Gateway in accordance with FCC Part 15.247 and ANSI C63.10: 2013 as referenced by FCC OET KDB 558074 D01 15.247 Meas Guidance v05r02.

FCC ID: 2ALEPT0009193

Test Dates: July 22 - 30, 2024, Aug. 2 - 5, 2024, Oct 25, 2024

Test Personnel: Janet Mijares, Brendan Van Hee, Imran Akram

Prepared for: Tektelic Communication Inc.

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* Both Gateways contain LTE pre-certified modules.

REVISION RECORD

ISSUE	DATE	AUTHOR	REVISIONS
DRAFT 1	2024-08-16	I. Akram/JM	Initial draft submitted for review.
DRAFT 2	2024-09-24	I. Akram	Added FCC ID
DRAFT 3	2024-11-19	I. Akram	Added radiated spurious emission above 1.4GHz test result for internal antennas in section 2.8.6 and internal antenna information for enterprise gateway in section 1.3.
Release 1	2024-11-22	I. Akram	Sign Off
Release 2	2024-12-03	I. Akram	Cable calibration dates added in sections 2.1.3, 2.2.3, 2.3.3, 2.4.3, 2.5.3 and 2.6.3.
			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 and ANSI C63.10:2013/2020 to gain FCC new 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. Kona Enterprise Gateway & Kona Photon Gateway test sample, referred to herein as the EUT (Equipment Under Test).

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:		Kona Enterprise Gateway & Kona Photon Gateway
Radio		LoRa
Frequency Band		902 – 928 MHz
Frequency Range		903 – 927.5 MHz
TX Operating Mode		500KHz DTS
Max Transmit Power (Conducted)		0.473 W (26.75 dBm)
LoRa	**Associated External Antennas**	WTTX-OMNI08600930-8-NJ, Polarization Vertical, Gain= 8dBi (highest gain antenna) , WTTX-OMNI08600930-6-NJ, Gain = 6dBi , WTTX-OMNI08600930-2.5-NJ, Gain = 2.5dBi
	Associated Internal Antennas(Only for Enterprise variant)	Montana SRF2I019, Polarization Linear, Gain=1.9dBi Peak
	Detachable/Non Detachable	External Antenna are detachable (Professional Installation)
Model#		T0007430, T0008479
Serial#		**2308J0012, 2431K0002**
Power supply:		Kona Enterprise Gateway powered via POE and Kona Photon Gateway Variant powered via Solar Panel

Note: There are two main variant of the EUT named as

1 **Kona Enterprise Gateway (POE**) T0007430 (With LTE module), T0007432 (without LTE capability)
2 **Kona Photon Gateway (Solar power)**. T0008479

The Kona Enterprise Gateway (POE) has two variant with LTE option and without LTE option. There is no difference in radio circuitry between the variants except Kona Enterprise Gateway powered by POE and Kona Photon Gateway variant powered by solar panel. The Kona photon Gateway enclosure is bigger than Enterprise to accommodate the internal batteries. The Kona Enterprise with LTE option and Photon Gateway both tested for radiated spurious emission. Both units are installed in one fix position at final installation. All three channels (LOW, MID, High) are analyzed to determine the worse channel at their final installation position. Full emission scan is performed on worse channel with highest external gain antenna. Enterprise gateway can be used with internal antennas. Enterprise gateway was tested with internal antennas as well for radiated spurious emission. During radiated Spurious emission analysis both LTE (Pre-certified) radio and LoRa radio are transmitting simultaneously to cover the co-location requirements.

1.4 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 order to meet the operational requirements during testing as per KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10-2013 clause 5.11 the device was programmed with a special firmware to transmit at a continuous transmit mode (100% duty cycle). Special firmware is strictly for testing purpose only and not available to end user. This special test case represents the worst-case duty cycle. Both Kona Gateways contain pre-certified LTE modules. All radiated spurious emission and antenna port conducted emission tests performed when both radios are transmitting simultaneously LTE port terminated in 50Ω termination during antenna port measurements. The environmental conditions are recorded during each test, and are reported in the relevant sections of this document.

1.5 Reference Standards

Standards	Description
FCC, title 47 CFR § 15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
FCC, title 47 CFR § 15.207	Conducted limits for an intentional radiator that is designed to be connected to the public utility (AC) power line.
FCC, title 47 CFR § 15.107	Conducted limits for equipment that is designed to be connected to the public utility (AC) power line.
FCC, title 47 CFR § 15.209	Radiated emission limits; general requirements
FCC, title 47 CFR § 15.109	Radiated emission limits; from unintentional radiators digital devices.
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio – Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 KHz to 40 GHz
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

1.6 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. EUT is tested in RX mode to cover FCC Part 15 Sub Part B (Digital Circuitry), and the result is included in this test report.

1.6.1 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.

1.6.2 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.

1.6.3 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 – 30 MHz)	±4.72 dB
Radiated Emissions Level (9 KHz – 1 GHz)	±5.55 dB
Radiated Emissions Level (1 GHz – 18 GHz)	±4.90 dB
Conducted Emissions Level (150 KHz – 30 MHz)	±2.36 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 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.

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.

> **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	Result
2.1	AC Main Conducted Emissions	15.207 / 15.107	Kona Enterprise Gateway	**Compliant**
2.2	6dB Bandwidth	15.247(a)	Kona Enterprise Gateway Kona Photon Gateway	**Compliant**
2.3	Max Output Power	15.247(d)	Kona Enterprise Gateway Kona Photon Gateway	**Compliant**
2.4	Band Edge	15.247(d)	Kona Enterprise Gateway Kona Photon Gateway	**Compliant**
2.5	Power Spectral Density	15.247(e)	Kona Enterprise Gateway Kona Photon Gateway	**Compliant**
2.6	Conducted Spurious Emissions (Non-Restricted Band)	15.247(d)	Kona Enterprise Gateway Kona Photon Gateway	**Compliant**
2.7	EUT Position	ANSI C63.4	Kona Enterprise Gateway Kona Photon Gateway	**N/A**
2.8	Radiated Spurious Emission (Restricted Band)	15.205, 15.209 15.247(d)	Kona Enterprise Gateway Kona Photon Gateway	**Compliant**
2.9	Radiated Emission	15.109	Kona Enterprise Gateway Kona Photon Gateway	**Compliant**
2.10	RF Exposure	15.247(i)	Kona Enterprise Gateway Kona Photon Gateway	**Exempt**

Refer to the test data for applicable test conditions.

2.1 AC Main Power Line Conducted Emissions:

Test Lab: Electronics Test Centre, Airdrie	**EUT: Kona Enterprise Gateway**
Test Personnel: Janet Mijares	**Standard: FCC Part 15.207, FCC Part 15.107**
Date: 2024-07-26 (21.0°C, 34.1% RH)	**Basic Standard: ANSI C63.10: 2013** **Basic Standard: ANSI C63.4: 2014**

EUT status: Compliant

Note: Test not applicable to Kona photon gateway. Photon variant is solar powered.

Specification: FCC Part 15.207

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50
Criteria: The conducted emissions produced by a device shall not exceed the limits as specified. ***Limits decrease linearly with the logarithm of the frequency*		

Specification: FCC Part 15.107

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)
0.15 – 0.5	79	66
0.5 – 5	73	60
5 – 30	73	60
Criteria: The conducted emissions produced by a device shall not exceed the limits as specified. **Note:** The more stringent limit applies at transition frequencies.		

2.1.1 Test Guidance

Before any testing is performed, the Ambient (measurement noise floor) is recorded, and a QC check is performed to show that the system is functioning correctly.

The EUT is powered through a 50µH Line Impedance Stabilizing Network (LISN) which is placed 80cm away from the EUT. For tabletop equipment, a vertical ground plane is placed 40cm from the edge of the table. Lastly, the spectrum analyzer is connected to the LISN via armored cable run from the control room to the test chamber. Both the LISN and vertical ground plane are grounded to the reference ground plane on the chamber floor.

Testing starts with a scan, performed under software control. After this is complete, the list of frequencies of interest is generated. These frequencies are then investigated for quasi-peak and average amplitude, as applicable. Emissions measured with a QP detector that fall below the Average limit are deemed to meet both requirements.

2.1.2 Deviations From The Standard

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

2.1.3 Test Equipment

Testing was performed with the following equipment:

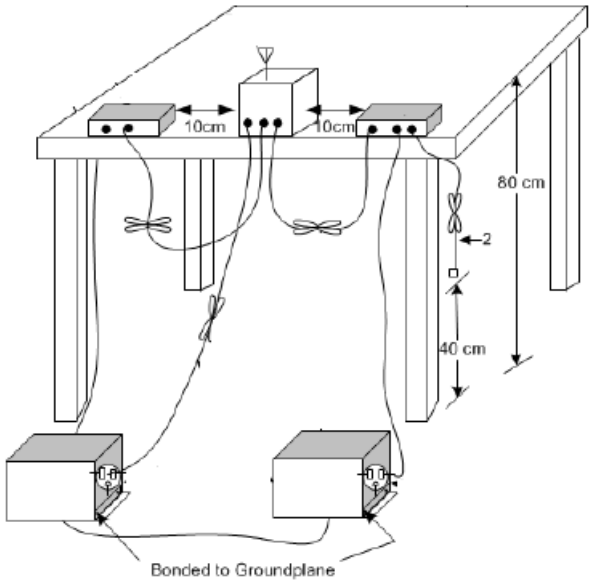
Equipment	Manufacturer	Model #	Asset #	Calibration Date	Calibration Due
EMC Software	UL	Ver. 9.5	SWE021	N/A	
EMI receiver	Agilent	N9038A FW A.25.05	6130	2023-08-11	2024-08-11
LISN 150kHz to 30MHz	Com-Power	LI-215A	6180	2022-08-09	2024-08-09
T/H Data Logger	Extech Ins.	42270	5892	2024-04-08	2025-04-08
CE Cable	Insulated Wire Incorporated	KPS-1501A-3600-KPS 01102006	4436	2024-01-09	2025-01-09

2.1.4 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. EUT has option of POE. EUT tested for conducted emission on AC side of POE adaptor model#PD-9501GO-ET/AC and serial#C19026674000302. Customer is not providing POE adaptor with EUT.

The EUT met the requirements without modification.

Diagram of setup for Conducted Emissions testing:



2.1.5 Conducted Emissions Data TX Mode

The emissions data is presented in tabular form, showing the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value(s) of limit at the frequency measured, and the Delta between the result and the limit.

Freq. Marker	Freq. (MHz)	Raw reading (dBµv)	Det.	LISN Factor (dB/m)	Cable Loss (dB)	Corrected Reading (dBµV)	FCC 207 Limit (dBµV)	Delta (dB)	L / N
1	0.497	26.72	AV	0	9.7	36.42	46.05	-9.63	Line
2	0.519	27.26	AV	0	9.7	36.96	46	-9.04	Line
3	3.34	26.15	AV	0	9.8	35.96	46	-10.05	Line
4	3.86	24.96	AV	0	9.9	34.86	46	-11.14	Line
5	7.375	23.37	AV	0	10	33.37	50	-16.63	Line
6	15.91	23.11	AV	0.1	10.5	33.71	50	-16.29	Line
7	0.155	21.89	AV	0.1	9.7	31.69	55.73	-24.04	Line
1	0.155	24.22	AV	0.1	9.7	34.02	55.73	-21.71	Neutral
2	0.520	28.77	AV	0	9.7	38.47	46	-7.53	Neutral
3	3.34	26.14	AV	0	9.8	35.94	46	-10.06	Neutral
4	3.79	25.65	AV	0	9.9	35.55	46	-10.45	Neutral
5	7.35	22.63	AV	0	10	32.63	50	-17.37	Neutral
6	16.18	21.85	AV	0	10.5	32.35	50	-17.65	Neutral

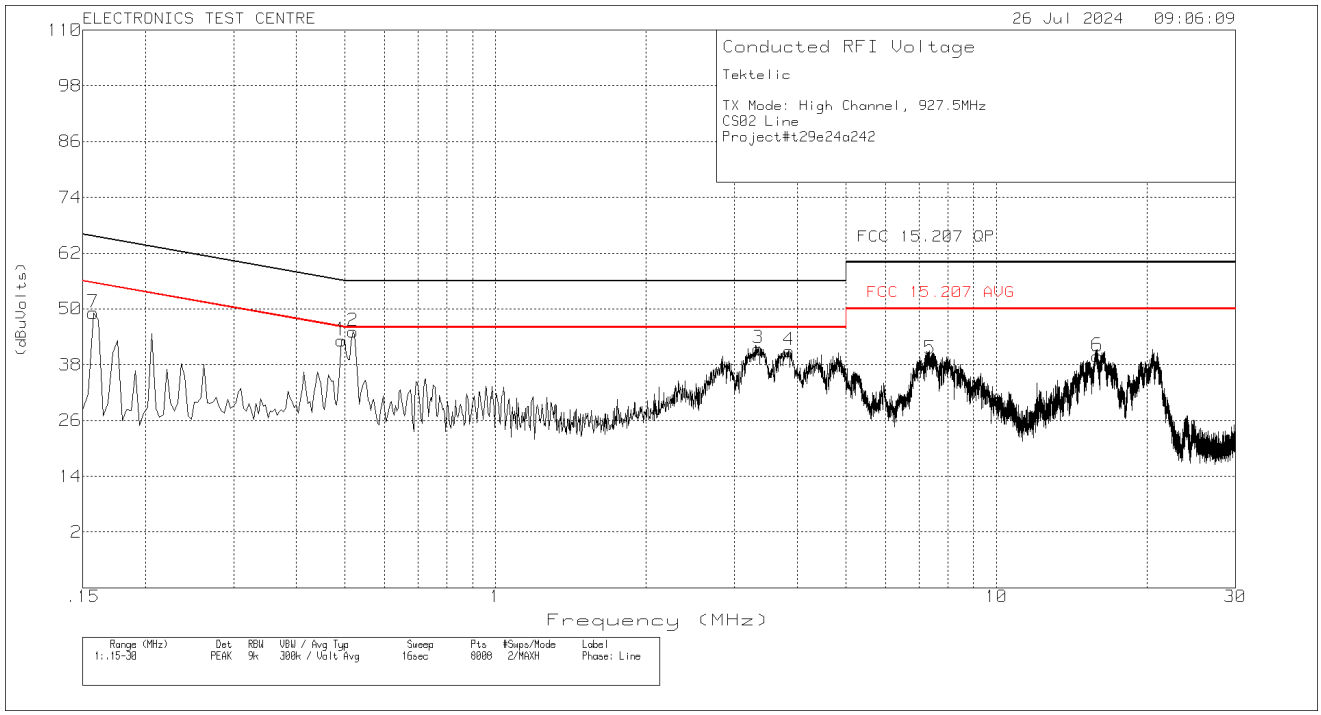
Meter Reading in dBµV + LISN Factor in dB + Gain/Loss Factor in dB = Corrected Emission Strength in dBµV.

Notes:

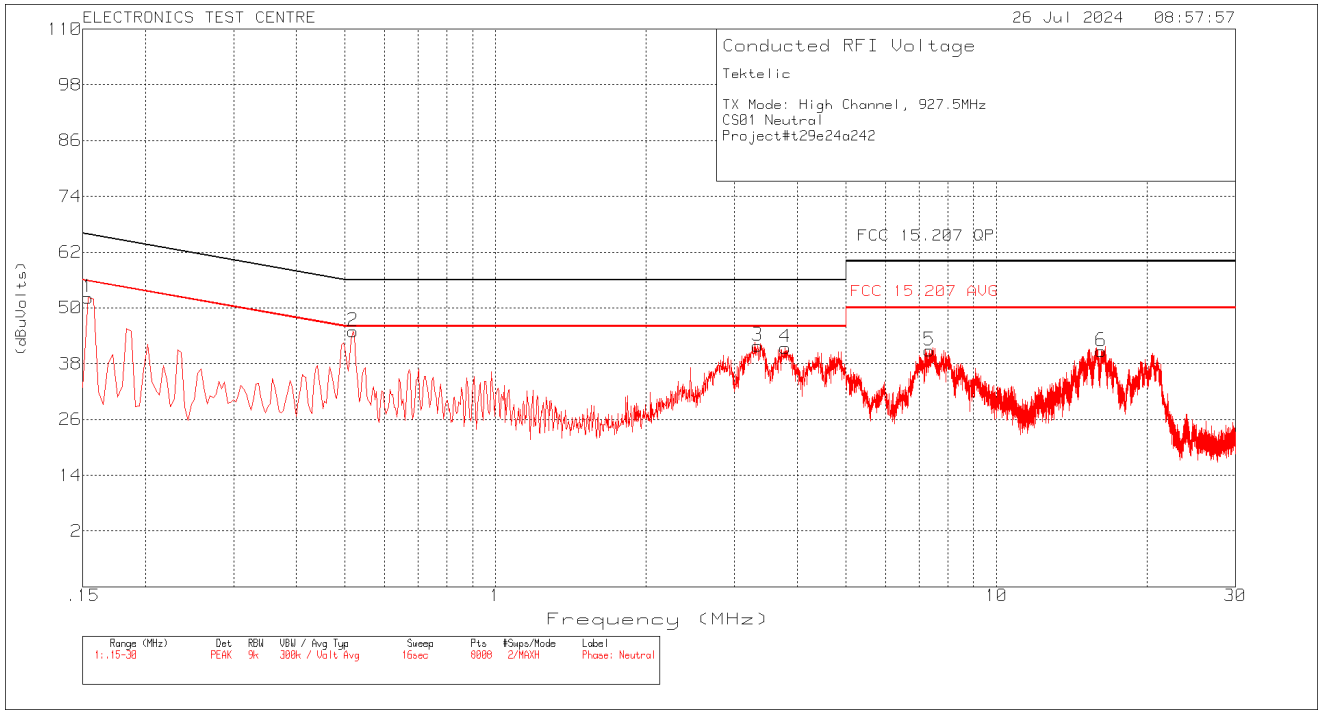
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Av = Linear Average detector

Negative values for Delta indicate compliance.

Plot of Conducted Emissions: LINE



Plot of Conducted Emissions: Neutral



2.1.6 Conducted Emissions Data RX Mode

The emissions data is presented in tabular form, showing the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value(s) of limit at the frequency measured, and the Delta between the result and the limit.

Freq. Marker	Freq. (MHz)	Raw reading (dBµv)	Det.	LISN Factor (dB/m)	Cable Loss (dB)	Corrected Reading (dBµV)	Class A AV Limit (dBµV)	Delta (dB)	L / N
1	0.154	20.98	AV	.1	9.7	30.78	66	-35.22	Line
2	0.181	14.28	AV	.1	9.7	24.08	66	-41.92	Line
3	0.5	23.73	AV	0	9.7	33.43	60	-26.57	Line
4	0.520	23.15	AV	0	9.7	32.85	60	-27.15	Line
5	3.36	26.43	AV	0	9.8	36.23	60	-23.77	Line
6	3.74	24.28	AV	0	9.9	34.18	60	-25.82	Line
1	0.156	20.0	AV	0.1	9.7	29.8	66	-36.2	Neutral
2	0.181	16.81	AV	0.1	9.7	26.61	66	-39.39	Neutral
3	0.499	22.58	AV	0	9.7	32.28	60	-27.72	Neutral
4	0.521	23.01	AV	0	9.7	32.71	60	-27.29	Neutral
5	3.34	26.16	AV	0	9.8	35.96	60	-24.02	Neutral
6	3.84	25.37	AV	0	9.9	35.27	60	-24.73	Neutral

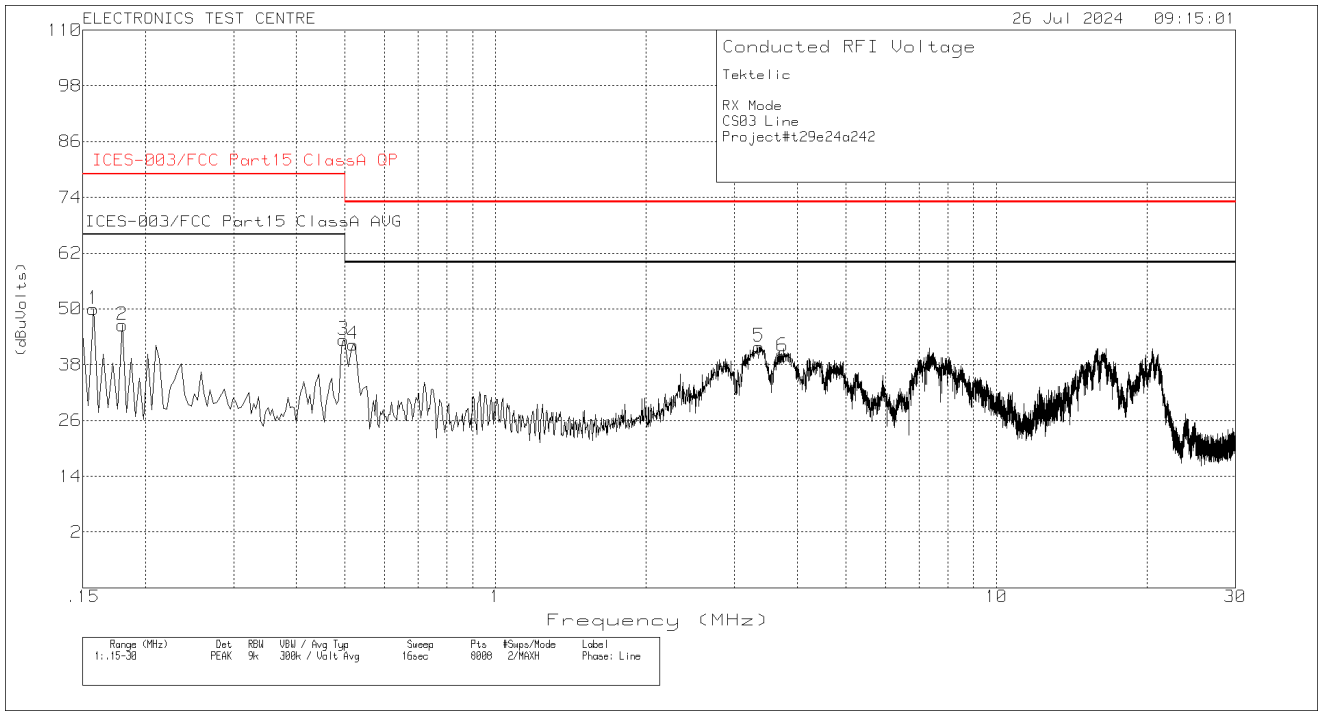
Meter Reading in dBµV + LISN Factor in dB + Gain/Loss Factor in dB = Corrected Emission Strength in dBµV.

Notes:

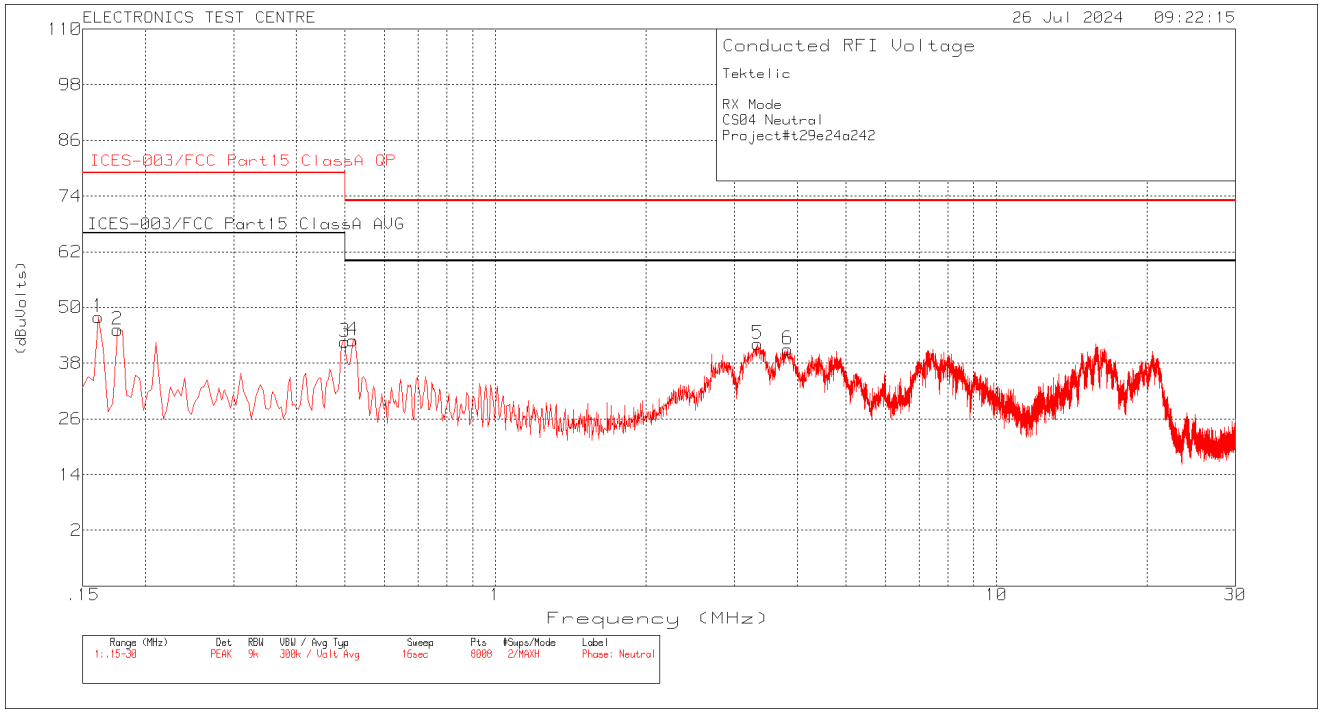
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Av = Linear Average detector

Negative values for Delta indicate compliance.

Plot of Conducted Emissions: LINE



Plot of Conducted Emissions: Neutral



2.2 6dB Bandwidth

Test Lab: Electronics Test Centre, Airdrie	**EUT: Kona Enterprise Gateway** **Kona Photon Gateway**
Test Personnel: Janet Mijares	**Standard: FCC PART 15.247**
Date: 2024-07-22 (25.5°C, 41.8% RH)	**Basic Standard: ANSI C63.10-2013** **FCC OET KDB 558074**

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: ANSI C63.10-2013, Clause 11.8 / FCC OET KDB 558074

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.

For DTS the spectrum analyzer is set for a frequency span ≥ (2 * OBW), ≤ (5 * OBW), selected to clearly display the channel. The RBW is set to 100 kHz. The VBW is set to ≥ (3 * RBW). The Peak detector is used, with the trace set to Max Hold.

The automated 99% BW function of the spectrum analyzer is engaged, and the 6 dB OBW and/or 20 dB OBW is measured with the x dB function.

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	Cal. Due
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2023-08-11	2024-08-11
Temp/Humidity	Extech	42270	5871	2024-04-08	2025-04-08
Attenuator (DC to 26 GHz)	Mini-Circuits	BW-S10-2W263+	6932	2022-12-10	2025-12-10
Coaxial Cables (RF)	W.L. GORE	PGR01R01036	7024	2024-01-09	2025-01-09
DC Blocker (9 KHz - 27 GHz)	Centric RF	C0927 SMA	6987	2024-01-19	2025-01-19

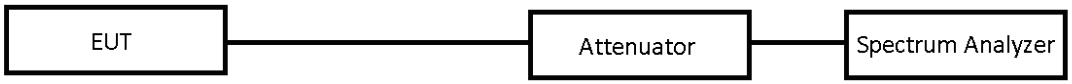
2.2.4 Test Sample Verification, Configuration & Modifications

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 met the requirements without modification.

Test setup diagrams for Occupied Bandwidth testing:

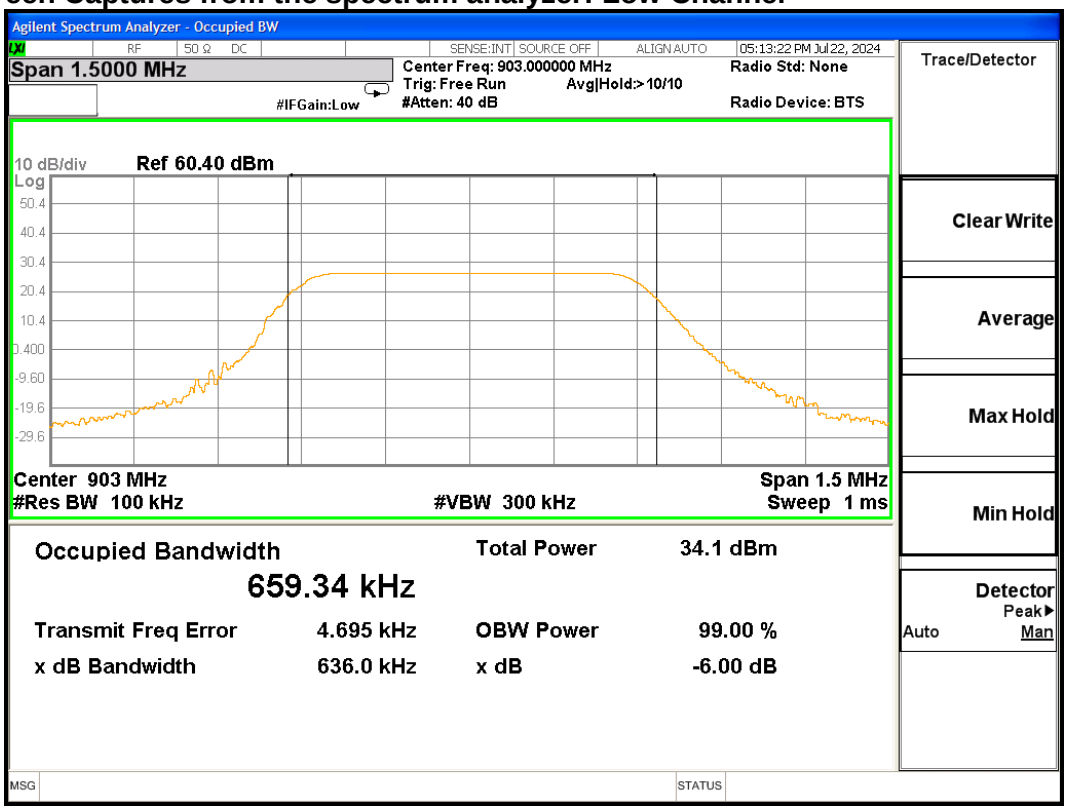
Conducted:



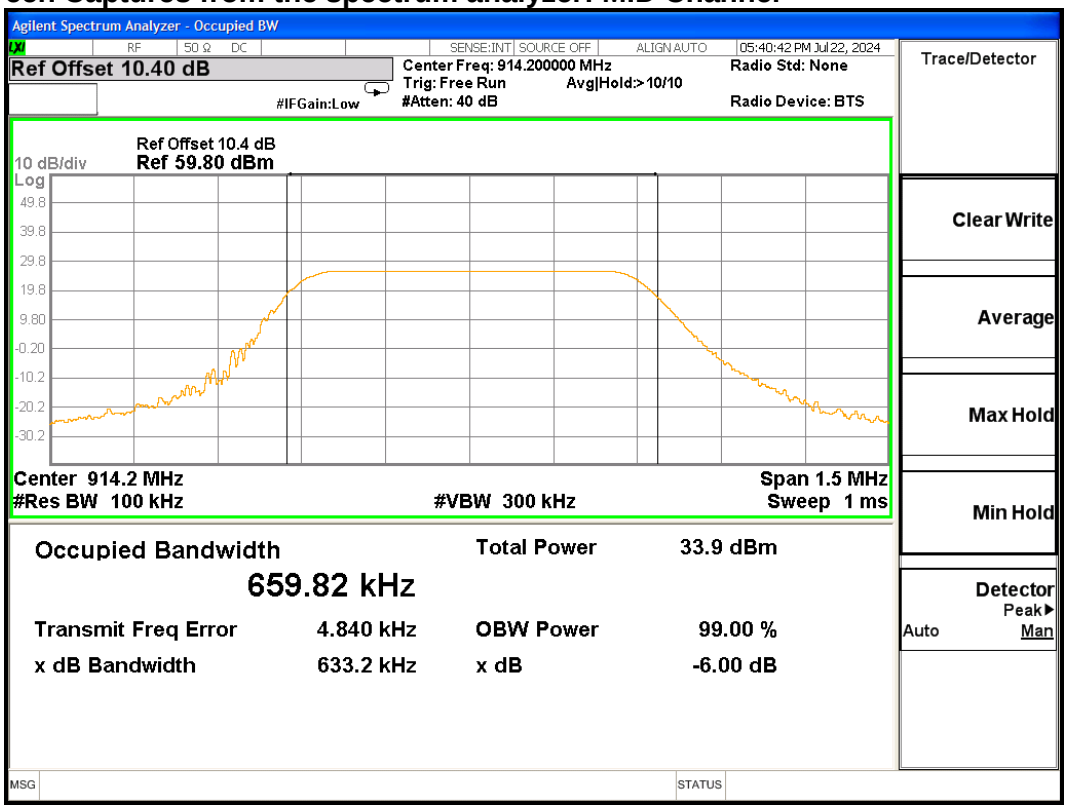
2.2.5 Channel Bandwidth Data: LoRa DTS

Mode of operation	Channel	Freq. [MHz]	6 dB BW [kHz]	Limit BW [KHz]
LoRa 500 KHz	Low	903.0	636.0	≥ 500
	Mid	914.2	633.2	
	High	927.5	629.1	

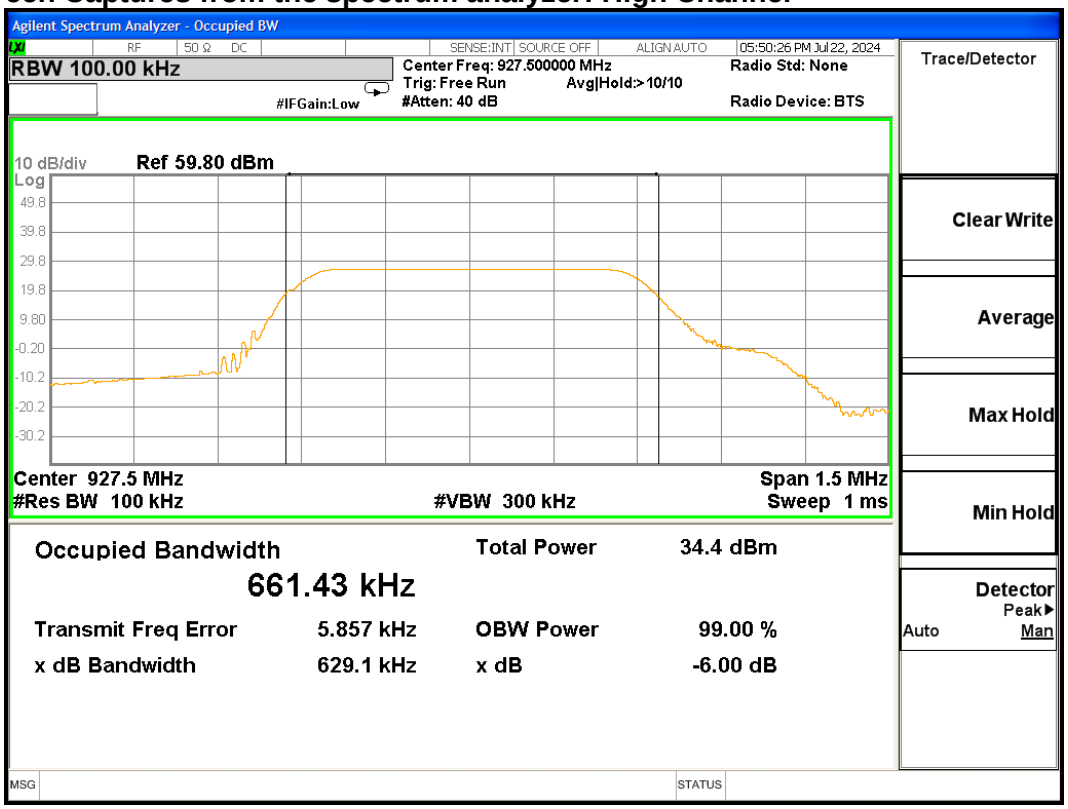
Screen Captures from the spectrum analyzer: Low Channel



Screen Captures from the spectrum analyzer: MID Channel



Screen Captures from the spectrum analyzer: High Channel



2.3 Max Average Output Power

Test Lab: Electronics Test Centre, Airdrie	**EUT: Kona Enterprise Gateway Kona Photon Gateway**
Test Personnel: Janet Mijares	**Standard: FCC PART 15.247**
Date: 2024-07-22 (25.5°C, 41.8% RH)	**Basic Standard: ANSI C63.10: 2013 FCC OET KDB 558074**

EUT status: Compliant

Specification: FCC Part 15.247(b, 3)

Criteria (3) For systems using digital modulation in the 902-928 MHz bands: 1 Watt.

2.3.1 Test Guidance: ANSI C63.10-2013, Clause 11.9.2.2.2/ FCC OET KDB 558074

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 For LoRa DTS	
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 (Duty Cycle ≥98%)
Trace Average	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	Cal. Due
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2023-08-11	2024-08-11
Temp/Humidity	Extech	42270	5871	2024-04-08	2025-04-08
Attenuator (DC to 26 GHz)	Mini-Circuits	BW-S10-2W263+	6932	2022-12-10	2025-12-10
Coaxial Cables (RF)	W.L. GORE	PGR01R01036	7024	2024-01-09	2025-01-09
DC Blocker (9 KHz - 27 GHz)	Centric RF	C0927 SMA	6987	2024-01-19	2025-01-19

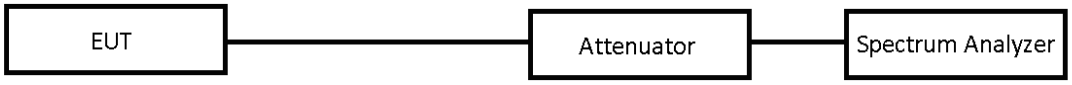
2.3.4 Test Sample Verification, Configuration & Modifications

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

The EUT met the requirements without modification.

Test setup diagrams for Power testing:

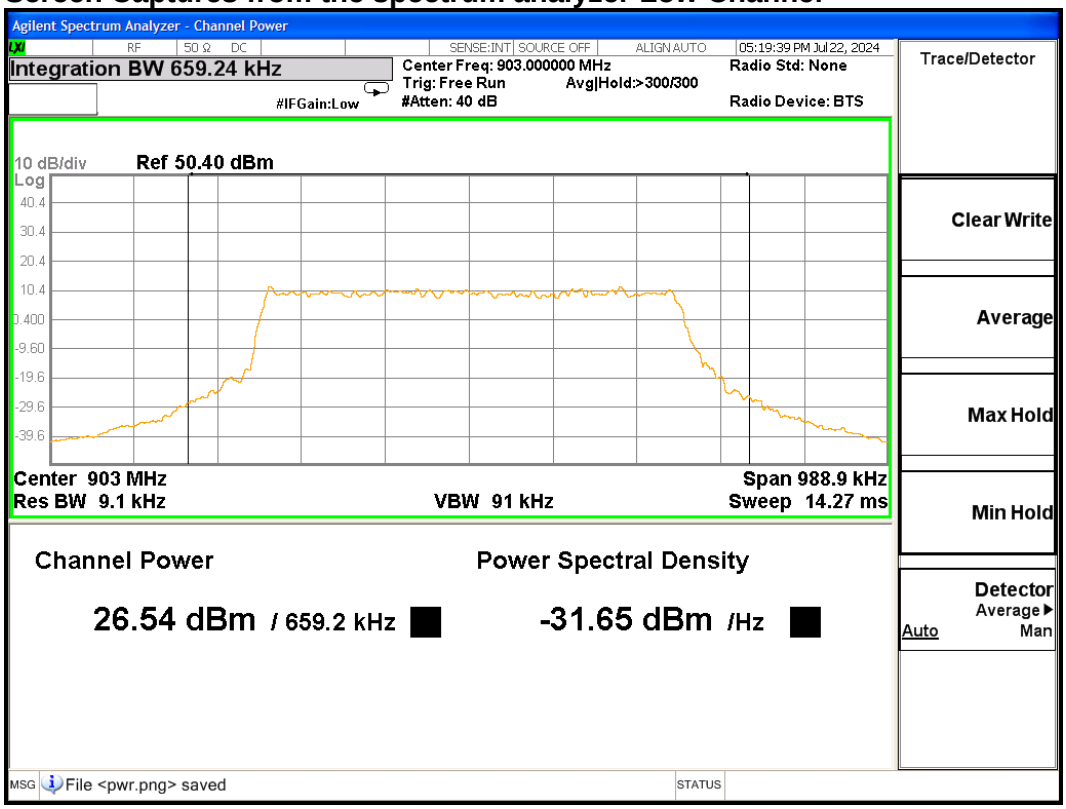
Conducted:



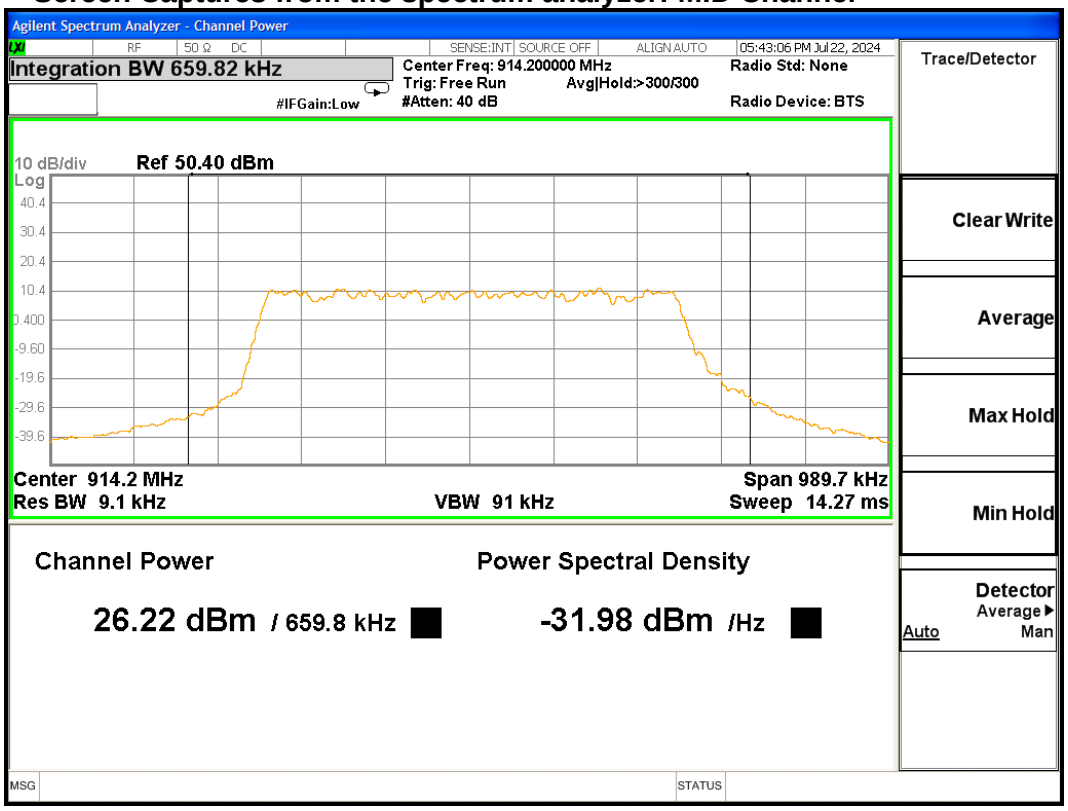
2.3.5 Max Average Output Power Data: LoRa DTS

Mode of operation	Channel	Freq. [MHz]	Max Average Power [dBm]	Limit Power [dBm]
LoRa 500 KHz	Low	903.0	26.54	≤ 30 (1Watt)
	Mid	914.2	26.22	
	High	927.5	26.75	

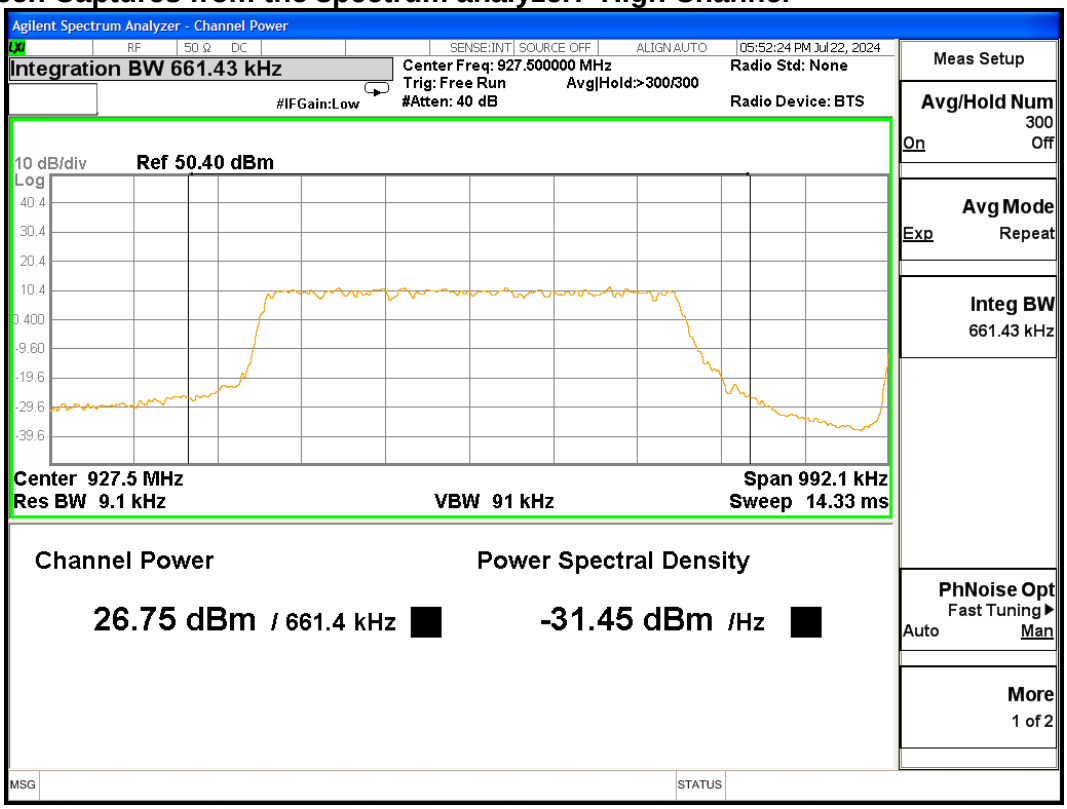
Screen Captures from the spectrum analyzer Low Channel



Screen Captures from the spectrum analyzer: MID Channel



Screen Captures from the spectrum analyzer: High Channel



2.4 Band Edge Attenuation

Test Lab: Electronics Test Centre, Airdrie	**EUT: Kona Enterprise Gateway Kona Photon Gateway**
Test Personnel: Janet Mijares	**Standard: FCC PART 15.247**
Date: 2024-07-22 (25.5°C, 41.8% RH)	**Basic Standard: ANSI C63.10: 2013 FCC OET KDB 558074**

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 dBc 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 dBc instead of 20 dBc. 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)).

2.4.1 Test Guidance: ANSI C63.10-2013 Clause 11.13.2 & 6.10.4, 6.10.6 / FCC OET KDB 558074

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.

The spectrum analyzer is set for a frequency span to show the band edge and the nearest channel. The RBW is set to ≥ 100 kHz. The VBW is set to ≥ (RBW * 3). The Peak detector is used, with the trace set to Max Hold.

The attenuation is measured with the Marker Delta function.

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 the following equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date	Cal. Due
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2023-08-11	2024-08-11
Temp/Humidity	Extech	42270	5871	2024-04-08	2025-04-08
Attenuator (DC to 26 GHz)	Mini-Circuits	BW-S10-2W263+	6932	2022-12-10	2025-12-10
Coaxial Cables (RF)	W.L. GORE	PGR01R01036	7024	2024-01-09	2025-01-09
DC Blocker (9 KHz - 27 GHz)	Centric RF	C0927 SMA	6987	2024-01-19	2025-01-19

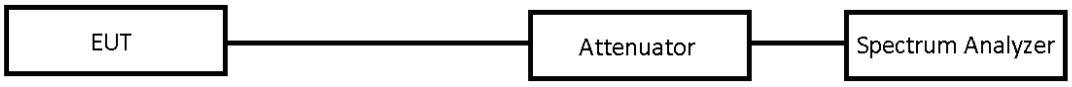
2.4.4 Test Sample Verification, Configuration & Modifications

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 Band Edge Attenuation testing:

Conducted:

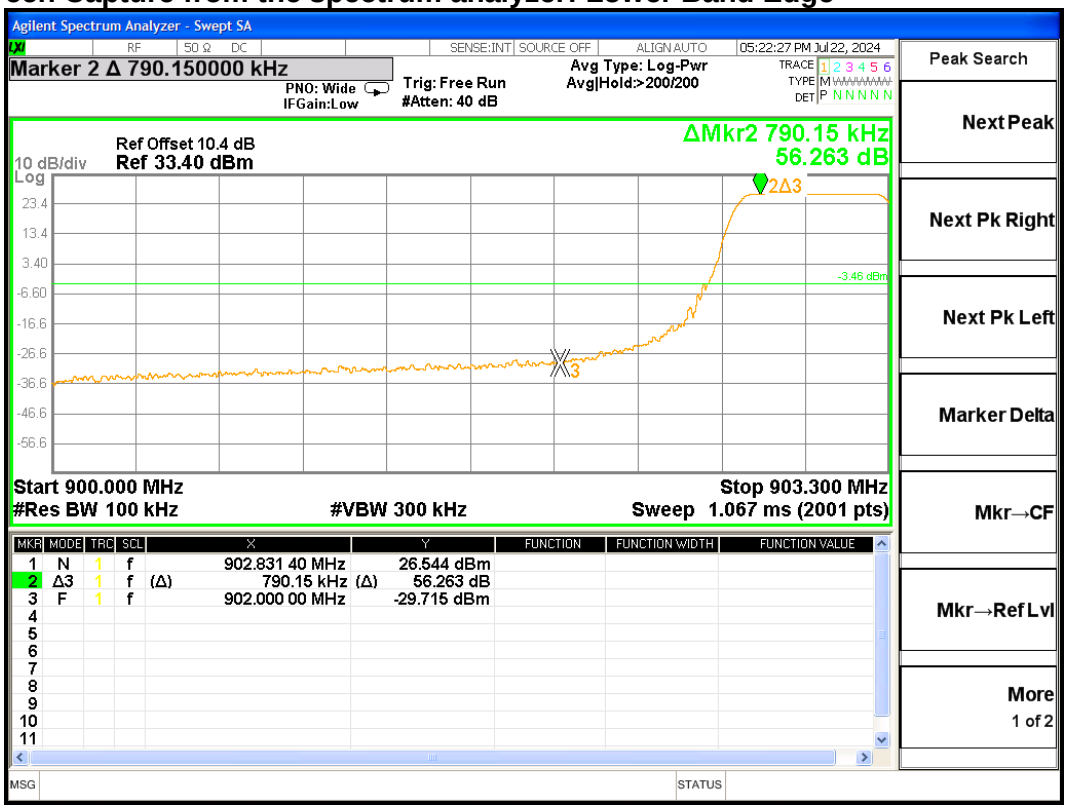


2.4.5 Band Edge Data LoRa DTS

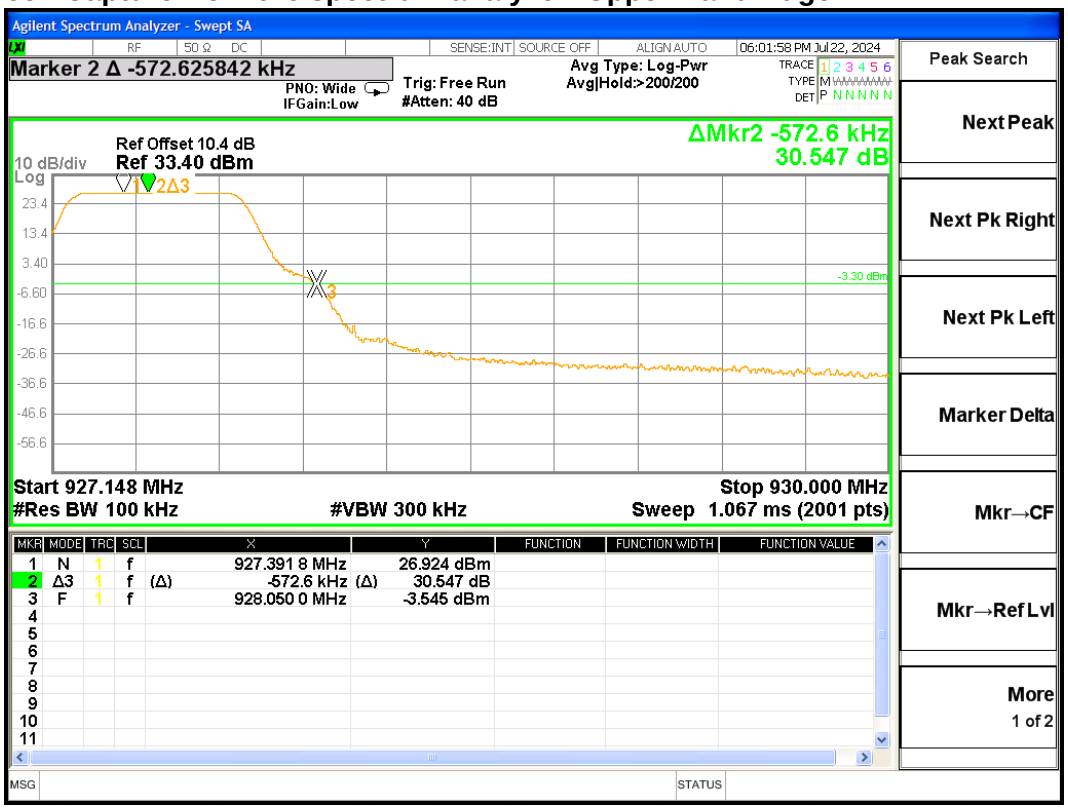
Worse Case Data

Mode of operation	Channel	Attenuation at Band Edge	Attenuation Limit at Band Edge
Lora 500KHz	903.0	56.263dBc	≥30 dBc
	927.5	30.547dBc	

Screen Capture from the spectrum analyzer: Lower Band Edge



Screen Capture from the spectrum analyzer: Upper Band Edge



2.5 Power Spectral Density

Test Lab: Electronics Test Centre, Airdrie	**EUT: Kona Enterprise Gateway Kona Photon Gateway**
Test Personnel: Janet Mijares	**Standard: FCC PART 15.247**
Date: 2024-07-22 (25.5°C, 41.8% RH)	**Basic Standard: ANSI C63.10: 2013**

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.

2.5.1 Test Guidance: ANSI C63.10-2013, Clause 11.10.3 / FCC OET KDB 558074

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.

Method AVGPSD-1 For DTS	
Span	≥ 1.5 times the OBW
RBW	3 kHz ≤ RBW ≥ 100 kHz.
VBW	≥ 3 x RBW
Number of Points in sweep	≥ 2 x Span / RBW
Sweep time	auto couple
Detector	RMS (Power Averaging)
Sweep trigger	Free Run (Duty Cycle ≥98%)
Trace Average	Minimum 100 traces in power Averaging (RMS)
PSD measured	Use the peak marker function to determine the maximum amplitude level.
If the measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).	

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 this equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date	Cal. Due
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2023-08-11	2024-08-11
Temp/Humidity	Extech	42270	5871	2024-04-08	2025-04-08
Attenuator (DC to 26 GHz)	Mini-Circuits	BW-S10-2W263+	6932	2022-12-10	2025-12-10
Coaxial Cables (RF)	W.L. GORE	PGR01R01036	7024	2024-01-09	2025-01-09
DC Blocker (9 KHz - 27 GHz)	Centric RF	C0927 SMA	6987	2024-01-19	2025-01-19

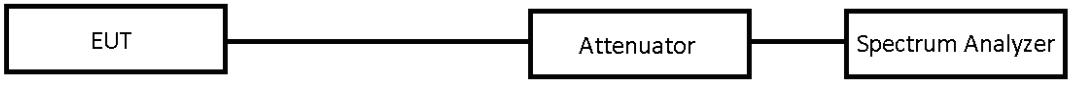
2.5.4 Test Sample Verification, Configuration & Modifications

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 Power Spectral Density testing:

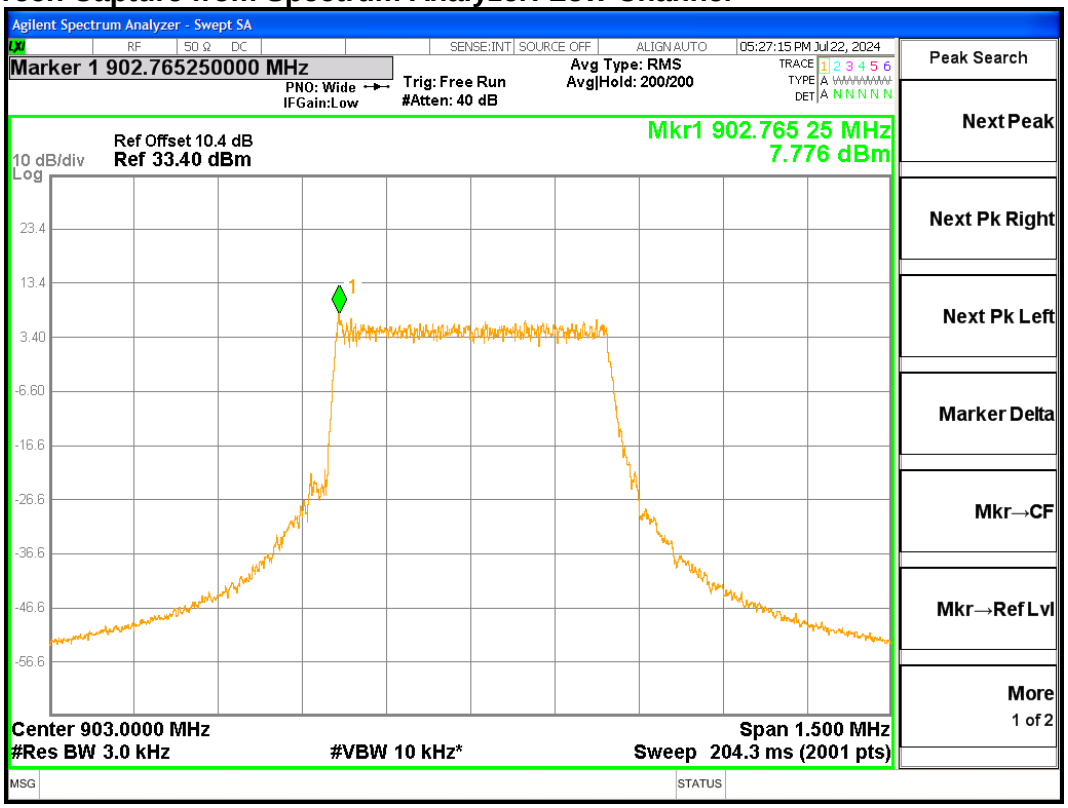
Conducted:



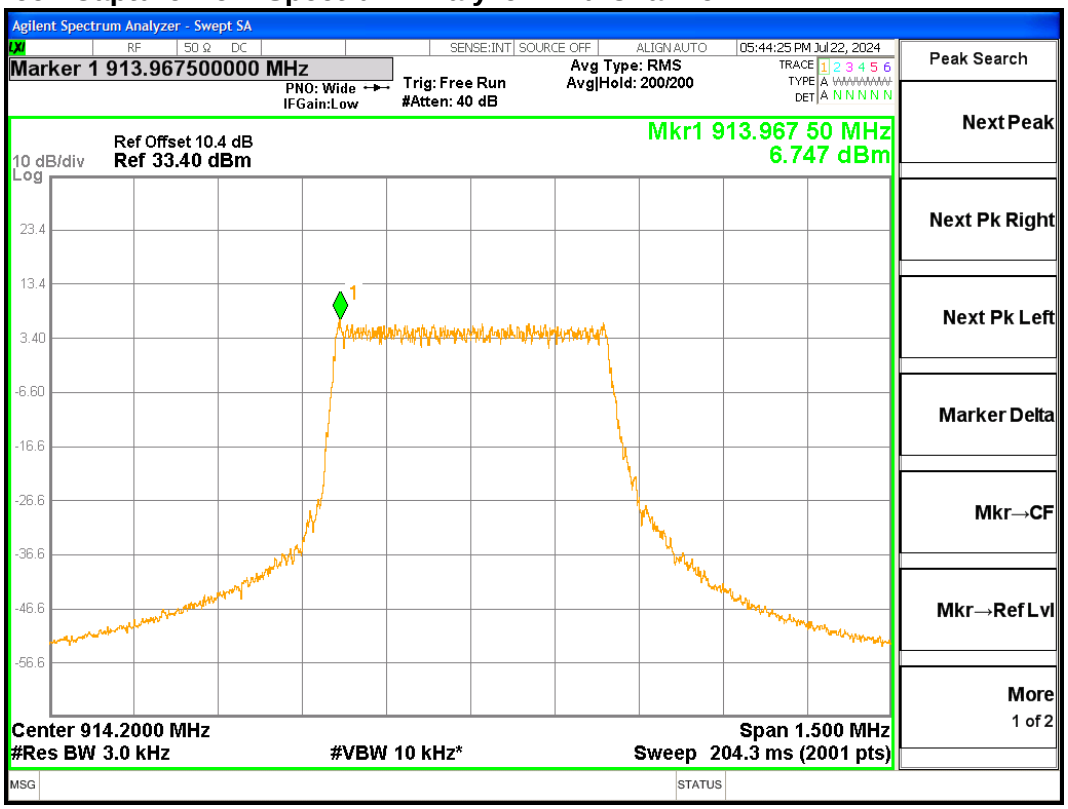
2.5.5 Average PSD Data LoRa DTS

Mode	Channel	Frequency (MHz)	Average PSD (dBm)	Limit
LoRa 500 KHz	Low	903.0	7.776	≤ 8 / 3KHz
	Mid	914.2	6.747	
	High	927.5	7.952	

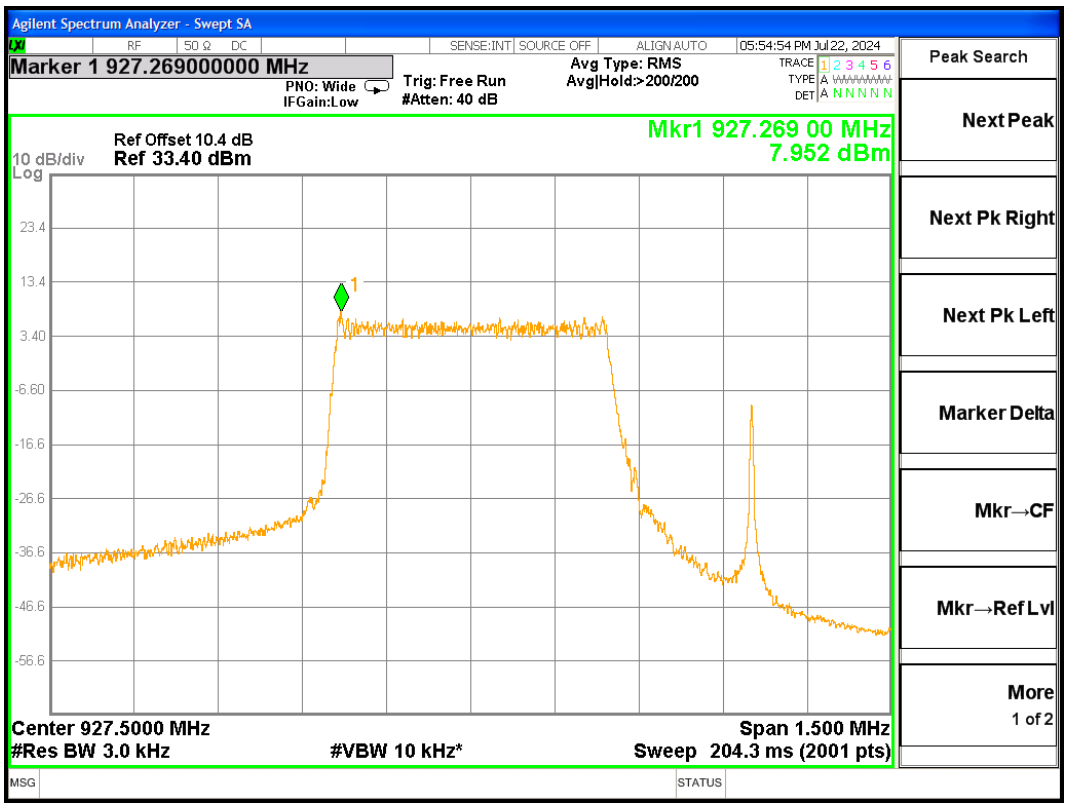
Screen Capture from Spectrum Analyzer: Low Channel



Screen Capture from Spectrum Analyzer: Mid Channel



Screen Capture from Spectrum Analyzer: High Channel



2.6 Conducted Spurious Emissions (Non-Restricted Band)

Test Lab: Electronics Test Centre, Airdrie	**EUT: Kona Enterprise Gateway Kona Photon Gateway**
Test Personnel: Janet Mijares	**Standard: FCC PART 15.247**
Date: 2024-07-22 (25.5°C, 41.8% RH)	**Basic Standard: ANSI C63.4-2014 FCC OET KDB 558470 v04 DTS**

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 6.7

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:

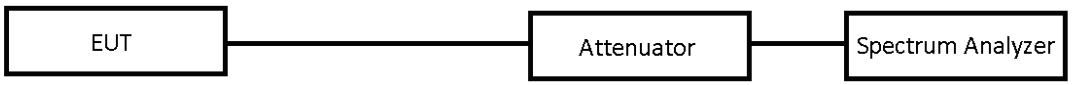
Equipment	Manufacturer	Model #	Asset #	Cal. Date	Cal. Due
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2023-08-11	2024-08-11
Temp/Humidity	Extech	42270	5871	2024-04-08	2025-04-08
Attenuator (DC to 26 GHz)	Mini-Circuits	BW-S10-2W263+	6932	2022-12-10	2025-12-10
Coaxial Cables (RF)	W.L. GORE	PGR01R01036	7024	2024-01-09	2025-01-09
DC Blocker (9 KHz - 27 GHz)	Centric RF	C0927 SMA	6987	2024-01-19	2025-01-19

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.

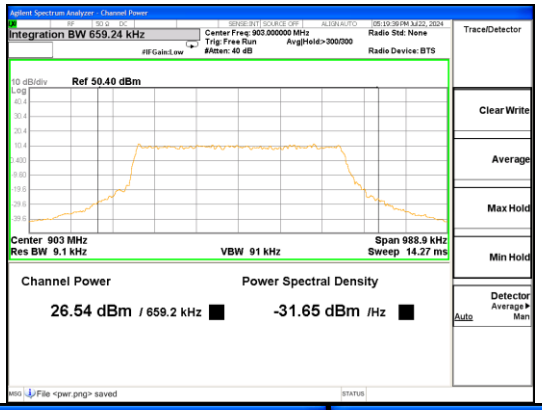
The EUT met the requirements without modification.

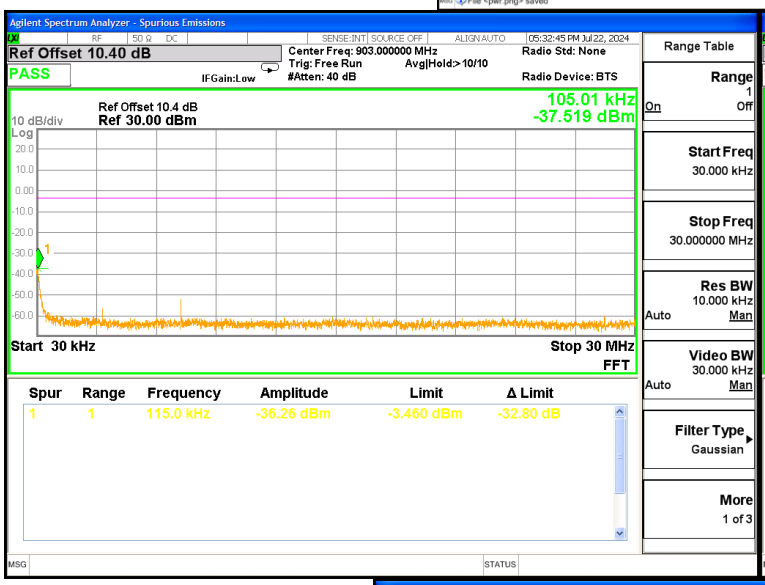
Test setup diagram for Conducted Spurious Emissions testing:

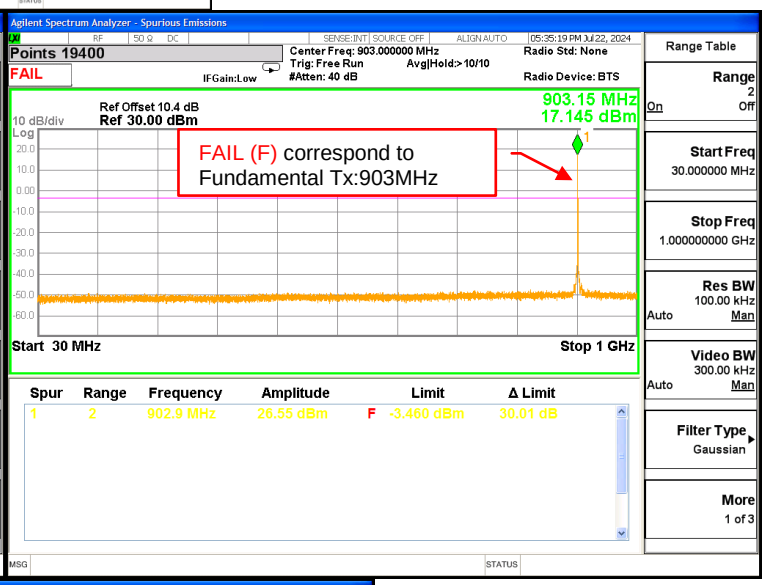


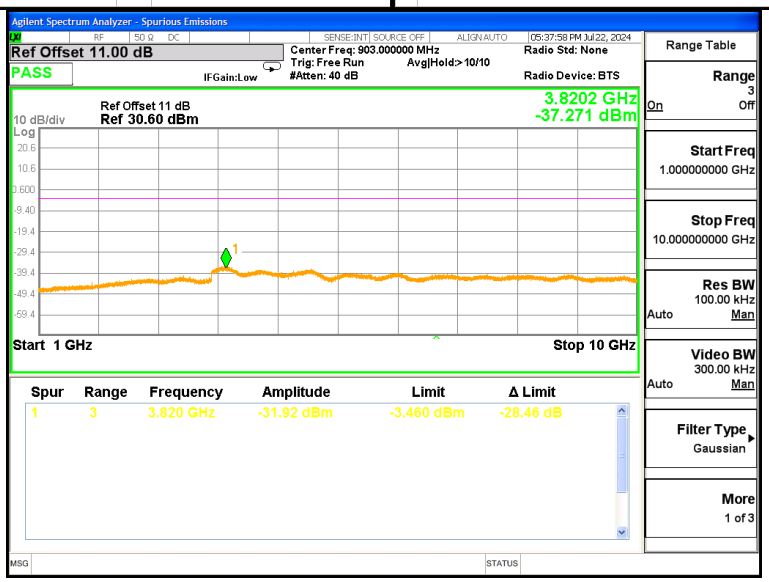
2.6.5 Conducted Emissions Data: LoRa DTS

Low Channel

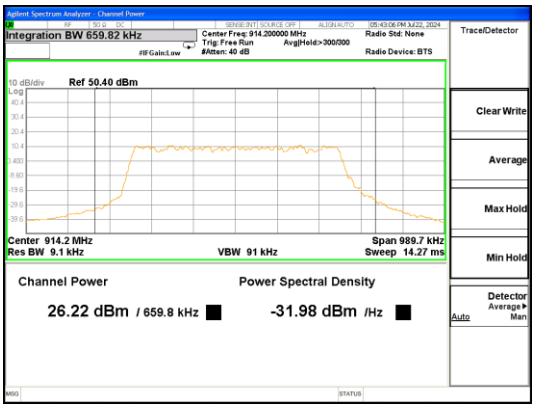


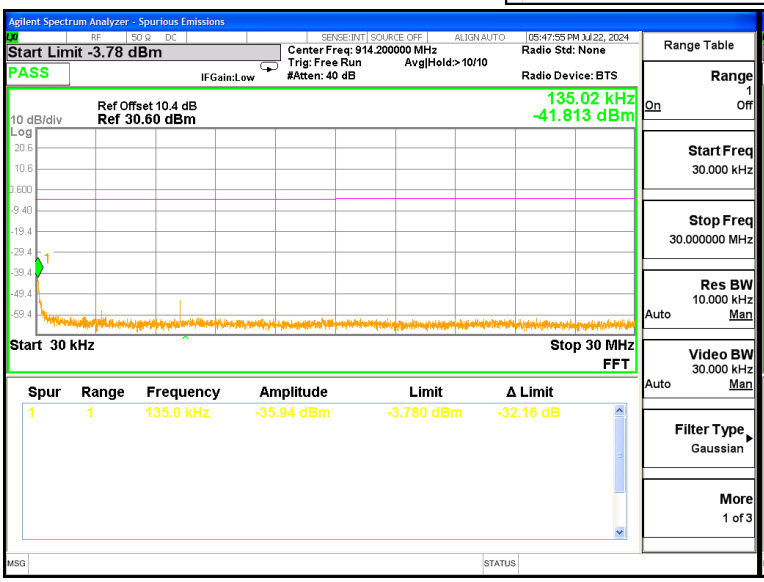


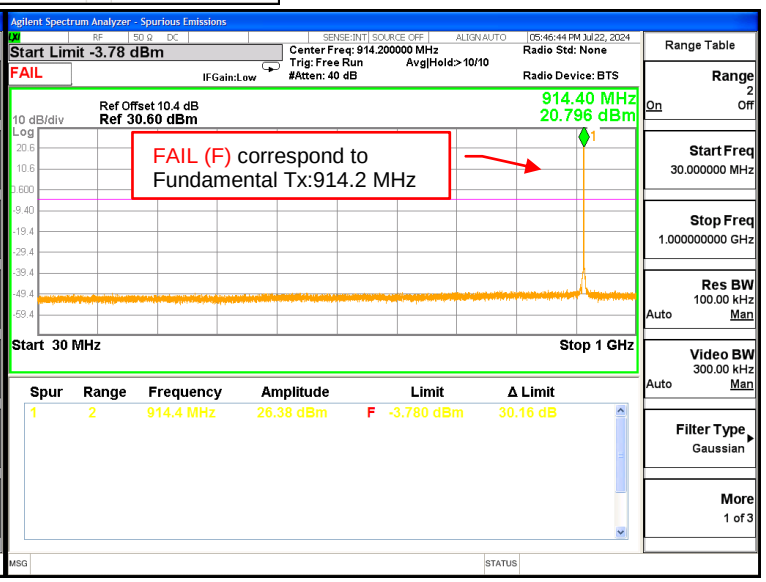


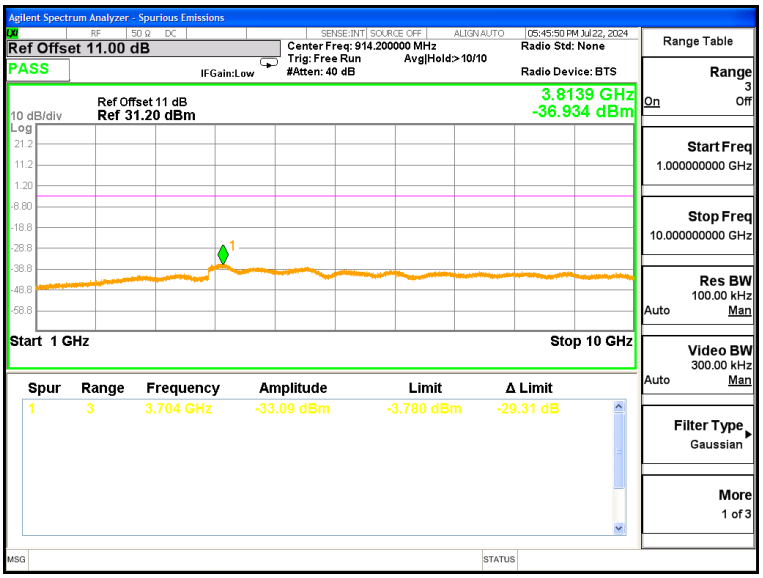


MID Channel

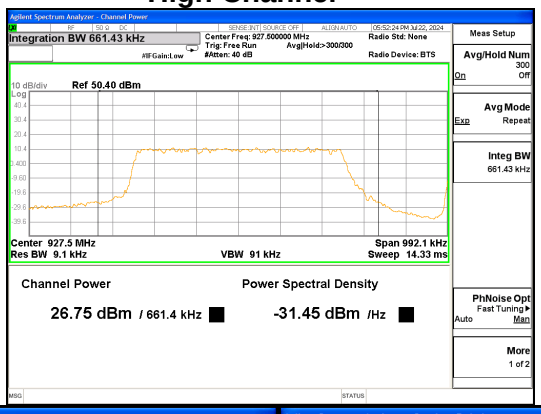

Agilent Spectrum Analyzer - Channel Power
Integration BW 659.82 kHz
Center Freq: 914.200000 MHz
Trig: Free Run
Avg|Hold:>300/300
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
Trace/Detector
Ref 50.40 dBm
Center 914.2 MHz
Res BW 9.1 kHz
VBW 91 kHz
Span 989.7 kHz
Sweep 14.27 ms
Channel Power
26.22 dBm / 659.8 kHz
Power Spectral Density
-31.98 dBm /Hz
Clear Write
Average
Max Hold
Min Hold
Detector

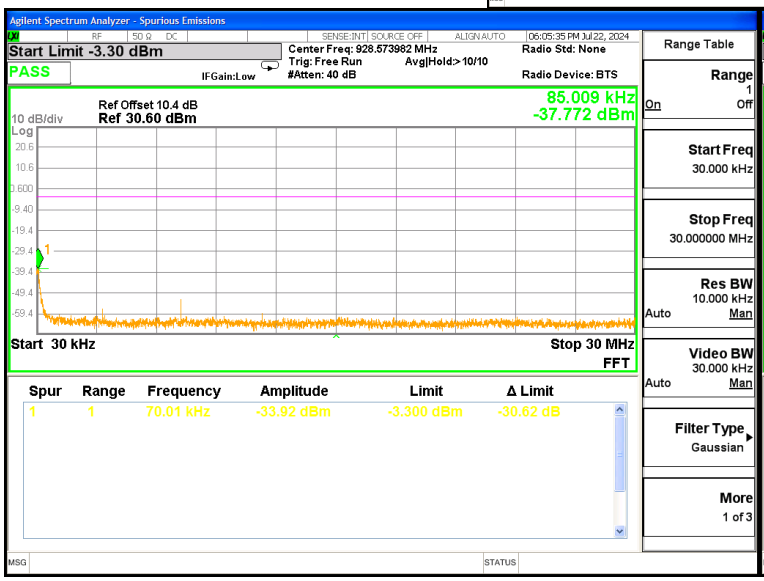

Agilent Spectrum Analyzer - Spurious Emissions
Start Limit -3.78 dBm
PASS
Center Freq: 914.200000 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
Ref Offset 10.4 dB
10 dB/div
Ref 30.60 dBm
135.02 kHz
-41.813 dBm
Start 30 kHz
Stop 30 MHz
FFT
Range Table
Range 1
Start Freq 30.000 kHz
Stop Freq 30.000000 MHz
Res BW 10.000 kHz
Video BW 30.000 kHz
Filter Type Gaussian
More 1 of 3
Spur Range Frequency Amplitude Limit Δ Limit
1 1 135.0 kHz -35.94 dBm -3.780 dBm -32.16 dB

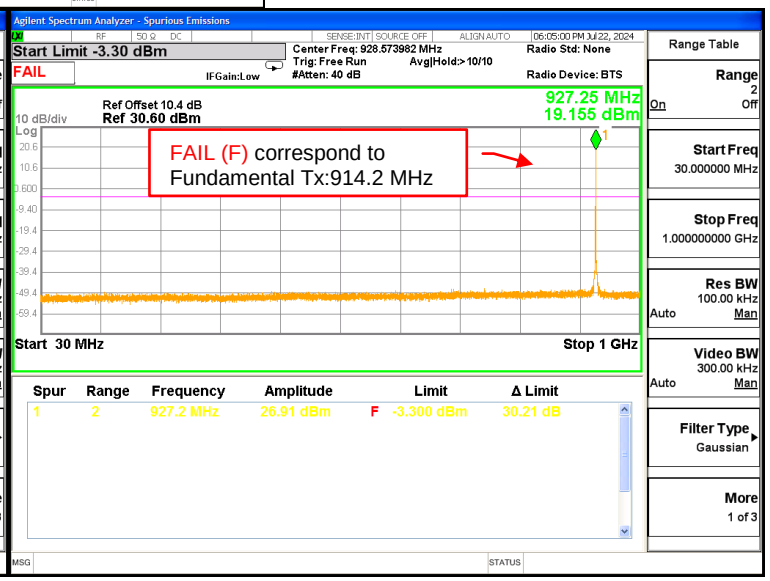

Agilent Spectrum Analyzer - Spurious Emissions
Start Limit -3.78 dBm
FAIL
Center Freq: 914.200000 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
Ref Offset 10.4 dB
10 dB/div
Ref 30.60 dBm
914.40 MHz
20.796 dBm
FAIL (F) correspond to
Fundamental Tx:914.2 MHz
Start 30 MHz
Stop 1 GHz
Range Table
Range 2
Start Freq 30.000000 MHz
Stop Freq 1.000000000 GHz
Res BW 100.00 kHz
Video BW 300.00 kHz
Filter Type Gaussian
More 1 of 3
Spur Range Frequency Amplitude Limit Δ Limit
1 2 914.4 MHz 26.38 dBm F -3.780 dBm 30.16 dB

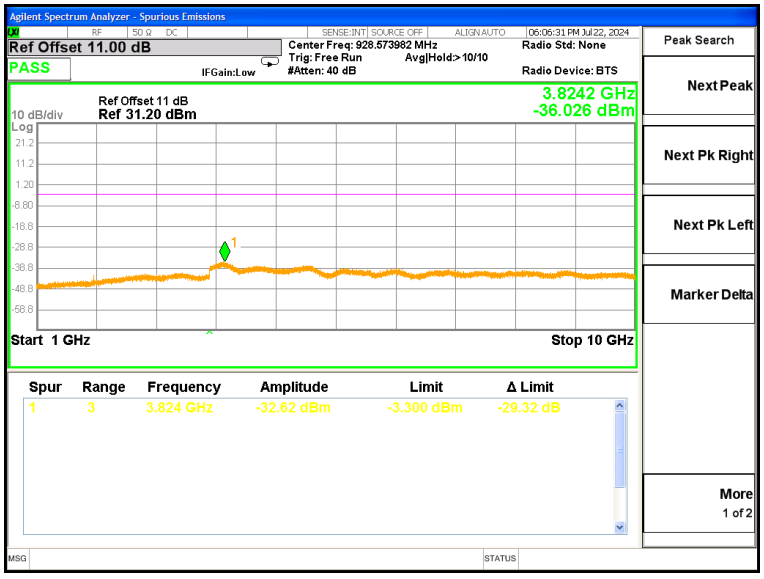

Agilent Spectrum Analyzer - Spurious Emissions
Ref Offset 11.00 dB
PASS
Center Freq: 914.200000 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
Ref Offset 11 dB
10 dB/div
Ref 31.20 dBm
3.8139 GHz
-36.934 dBm
Start 1 GHz
Stop 10 GHz
Range Table
Range 3
Start Freq 1.000000000 GHz
Stop Freq 10.000000000 GHz
Res BW 100.00 kHz
Video BW 300.00 kHz
Filter Type Gaussian
More 1 of 3
Spur Range Frequency Amplitude Limit Δ Limit
1 3 3.704 GHz -33.09 dBm -3.780 dBm -29.31 dB

High Channel







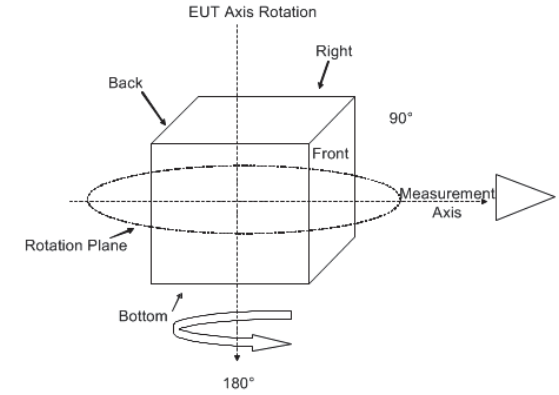


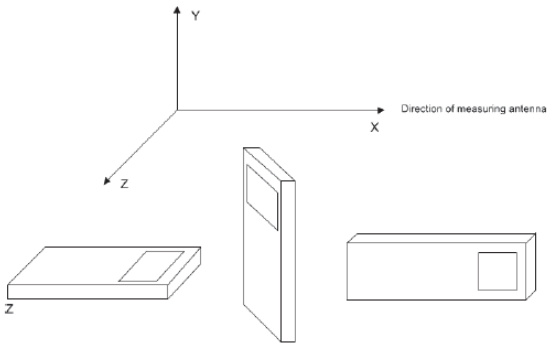
2.7 EUT Positioning Assessment

Test Lab: Electronics Test Centre, Airdrie **Test Personnel:** **Date:**	**EUT: Kona Enterprise Gateway** **Kona Photon Gateway** **Standard: FCC PART 15.247** **Basic Standard: ANSI C63.4-2014**
Comments: N/A (EUT will be install on 1 fix position)	

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.





2.8 Radiated Spurious Emissions (within restricted band/Co-location)

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Janet Mijares /Brendan Van Hee
Imran Akram

Date: 2024-07-25/26 (21.0° C,34.1 % RH)
2024-08-2/5 (23.2° C,42.7 % RH)
2024-10-25 (20.7° C,32.7 % RH)

EUT: Kona Enterprise Gateway
Kona Photon Gateway

Standard: FCC PART 15.247/15.209

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)).

Restricted Bands of Operation:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.0900000 – 0.1100000	8.2910000 - 8.2940000	16.804250 - 16.804750	162.01250 - 167.17000 *	1660.0000 – 1710.0000	3.6000000 – 4.4000000	14.470000 – 14.500000
0.4950000 - 0.5050000 *	8.3620000 - 8.3660000	25.500000 - 25.670000	167.72000 - 173.20000 *	1718.8000 – 1722.2000	4.5000000 – 5.1500000	15.350000 – 16.200000
2.1735000 - 2.1905000	8.3762500 - 8.3867500	37.500000 - 38.250000	240.00000 – 285.00000	2200.0000 – 2300.0000	5.3500000 – 5.4600000	17.700000 – 21.400000
4.1250000 - 4.1280000	8.4142500 - 8.4147500	73.000000 - 74.600000	322.00000 - 335.40000	2310.0000 – 2390.0000	7.2500000 – 7.7500000	22.010000 – 23.120000
4.1772500 - 4.1777500	12.290000 - 12.293000	74.800000 - 75.200000	399.90000 – 410.00000	2483.5000 – 2500.0000 *	8.0250000 – 8.5000000	23.600000 – 24.000000
4.2072500 - 4.2077500	12.519750 - 12.520250	108.00000 - 121.94000 **	608.00000 – 614.00000	2655.0000 – 2900.0000	9.0000000 – 9.2000000	31.200000 – 31.800000
5.6770000 - 5.6830000	12.576750 - 12.577250	123.00000 - 138.00000 **	960.00000 – 1240.0000 ***	3260..0000 – 3267.0000	9.3000000 – 9.5000000	36.430000 – 36.500000
6.2150000 - 6.2180000	13.360000 - 13.410000	149.90000 - 150.05000 *	1300.0000 – 1427.0000 ***	3332.0000 – 3339.0000	10.600000 – 12.700000	Above 38.600000
6.2677500 - 6.2682500	16.420000 - 16.423000	156.52475- 156.52525	1435.0000 – 1626.5000	3345.8000 – 3358.0000	13.250000 – 13.400000	
6.3117500 - 6.3122500	16.694750 - 16.695250	156.70000 - 156.90000	1645.5000 – 1646.5000	3500.0000 – 3600.0000 ****		

* US only ** Canada 108 – 138 MHz *** Canada 960 – 1427 MHz **** Canada only

2.8.1 Test Guidance: ANSI C63.10-2013, Clause 13.4.2

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 discreet 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	SWE021	N/A	
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2023-08-11	2024-08-11
EMI receiver	Agilent	N9038A (FW A.22.08)	6906	2024-01-02	2025-01-02
Loop Antenna (9KHz – 30MHz)	EMCO	6502	10868	2023-06-21	2025-06-21
Biconilog Antenna (30 – 1000 MHz)	AR	JB1	6905	2023-11-29	2025-11-29
DRG Horn (1 – 18 GHz)	EMCO	3115	19357	2022-10-05	2025-10-05
STD Horn (18-26 GHz)	Quinstar	QWH-KRPS00	6163	2022-10-10	2025-10-10
Humidity/Temp Logger	Extech Ins. Corp.	42270	5892	2024-04-08	2025-04-08
Pre-Amplifier (30 – 1400 MHz)	HP	8447D	9291	2024-01-23	2025-01-23
L.N. Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800-21-5P	4354	2024-01-23	2025-01-23
L.N. Amplifier (18 – 26 GHz)	MITEQ	JS44-01002650-33-3P	6163	2024-01-23	2025-01-23
RE Cable below 1GHz	Insulated Wire Inc.	KPS-1501A-3600-KPA-01102006	4419	2024-01-23	2025-01-23
Re Cable Above 1 GHz	A.H. System Inc.	SAC-26G-8.23	6187	2024-01-23	2025-01-23
0.9GHz Notch Filter	Microtronics	BRM20784	6947	2024-01-23	2025-01-23

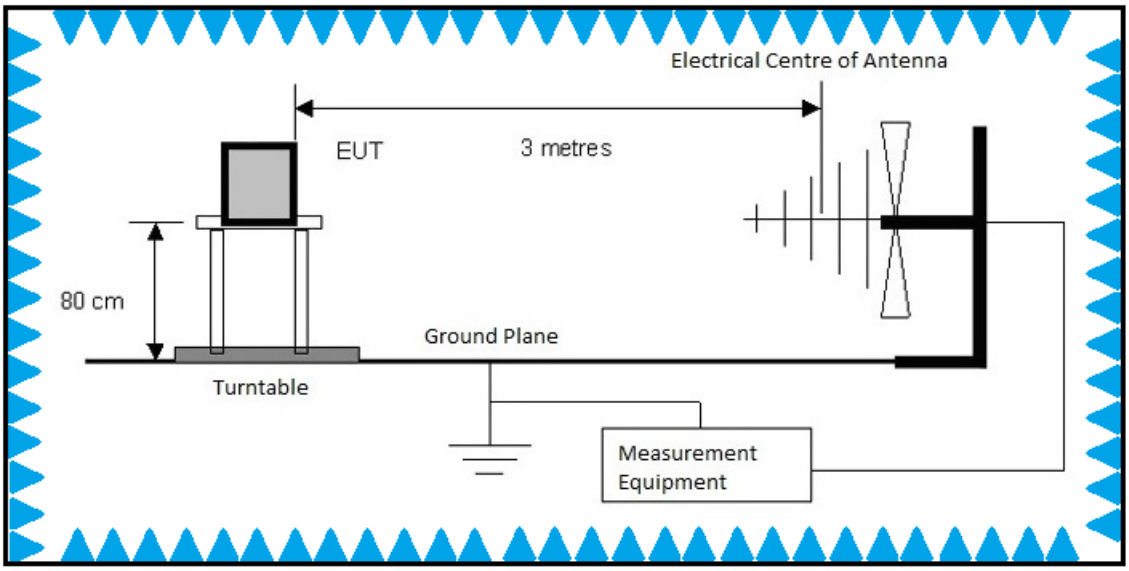
***** In-house verification

2.8.4 Test Sample Verification, Configuration & Modifications

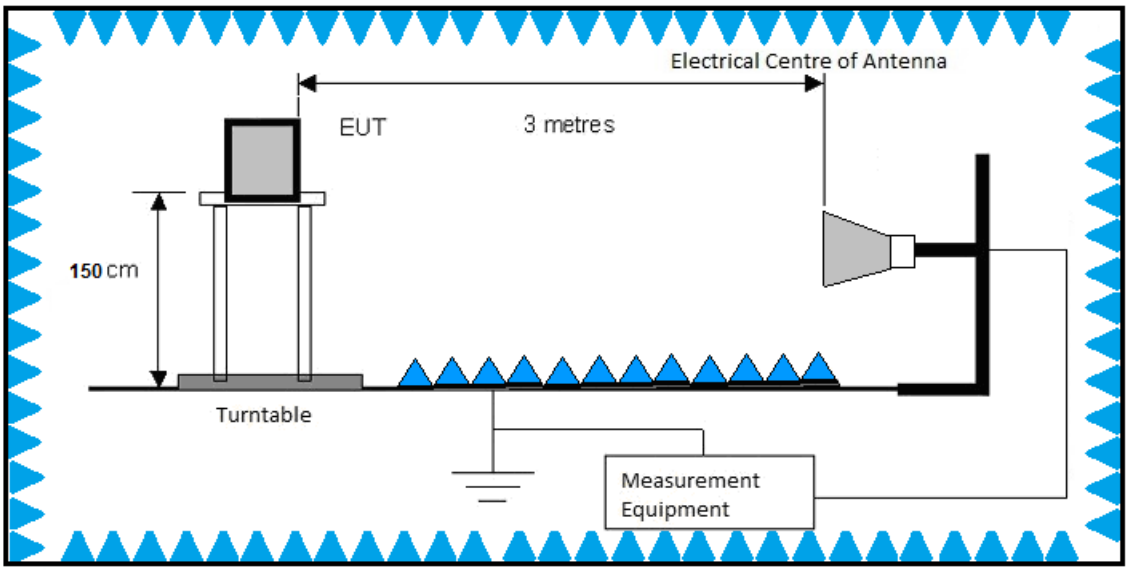
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. LoRa radio is transmitting at high channel for Enterprise and mid channel for Photon. LoRa and LTE was transmitting simultaneously.

The EUT met the requirements without modification.

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



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



2.8.5 Radiated Emissions Data: Enterprise (Both LTE/LoRa transmitting simultaneously with external antenna)

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:

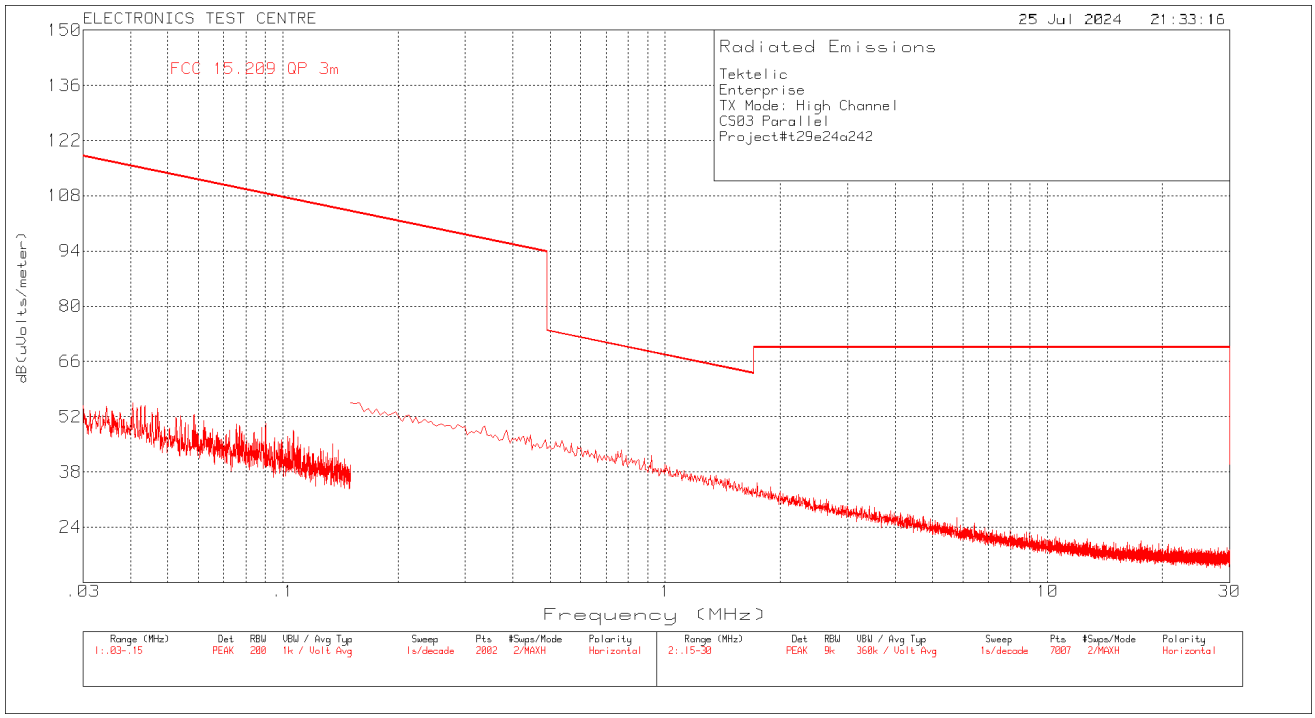
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet 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 High band channel 927.5 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.

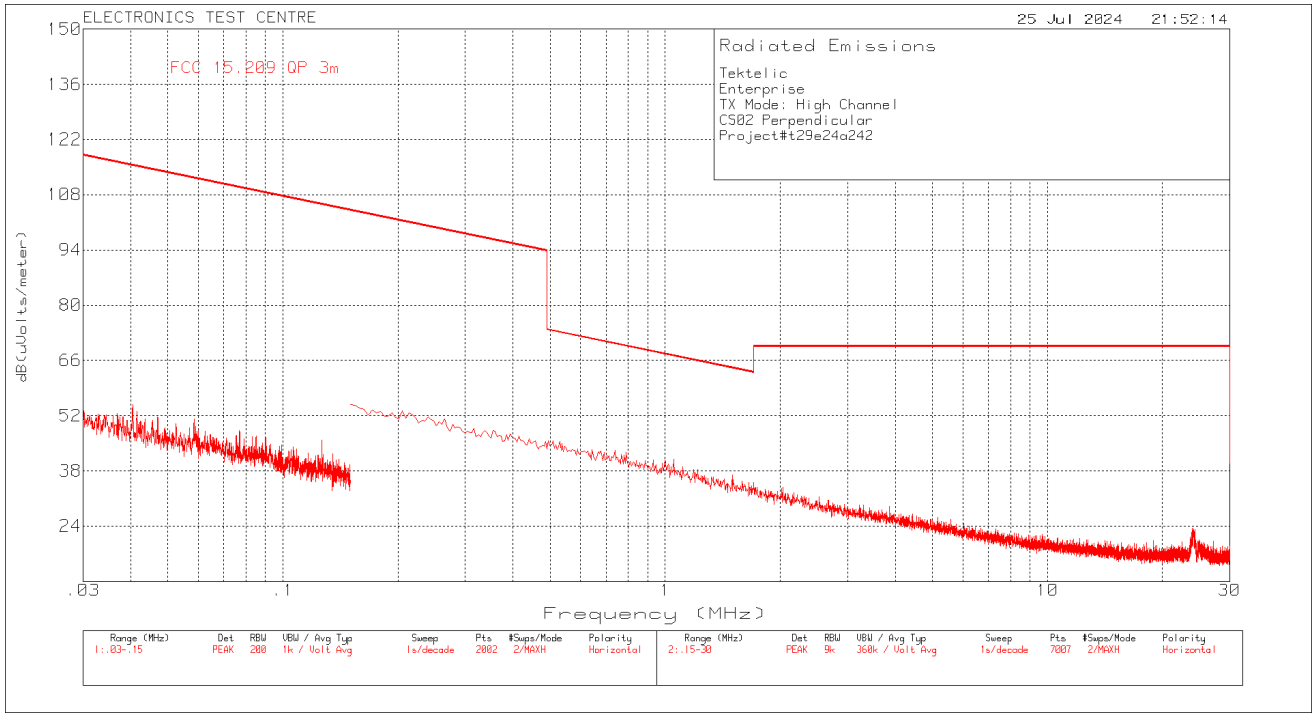
Freq. Marker	Freq. [MHz]	Raw reading [dBμv]	Det	Antenna Factor [dB/m]	Loss/ Gain [dB]	Corrected Reading [dBμv/m]	FCC 15.209 Limit [dBμv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	*613.9912	13.56	QP	23	6.5	43.06	46.02	-2.96	136	383	Horizontal
2	*609.9565	13.54	QP	22.9	6.5	42.94	46.02	-3.08	151	304	Vertical
1	*1593.3	28.9	AV	26.2	-34.3	20.8	54	-33.2	297	251	Horizontal
		50.81	PK	26.2	-34.3	42.71	74	-31.29	297	251	Horizontal
2	*1709.4	48.4	AV	27.1	-35.2	40.3	54	-13.7	46	226	Horizontal
		55.22	PK	27.1	-35.2	47.12	74	-26.88	46	226	Horizontal
3	*1564.3	44.1	AV	26.1	-33.6	36.6	54	-17.4	9	223	Vertical
		54.14	PK	26.1	-33.6	46.64	74	-27.36	9	223	Vertical
4	*1594.8	29.77	AV	26.2	-34.4	21.57	54	-32.43	82	220	Vertical
		55.62	PK	26.2	-34.4	47.42	74	-26.58	82	220	Vertical
5	*1709.5	49.89	AV	27.1	-35.2	41.79	54	-12.21	0	322	Vertical
		56.29	PK	27.1	-35.2	48.19	74	-25.81	0	322	Vertical
6	*4636.6	34.83	AV	32.7	-32.0	35.53	54	-18.47	4	386	Horizontal
		46.35	PK	32.7	-32.0	47.05	74	-26.95	4	386	Horizontal
7	*4637.0	42.53	AV	32.7	-32.0	43.23	54	-10.77	0	372	Vertical
		51.69	PK	32.7	-32.0	52.39	74	-21.61	0	372	Vertical

QP: Quasi-Peak Detector, PK: Peak Detector, AV: Average Detector
*** Spurious Emission in Restricted Band**

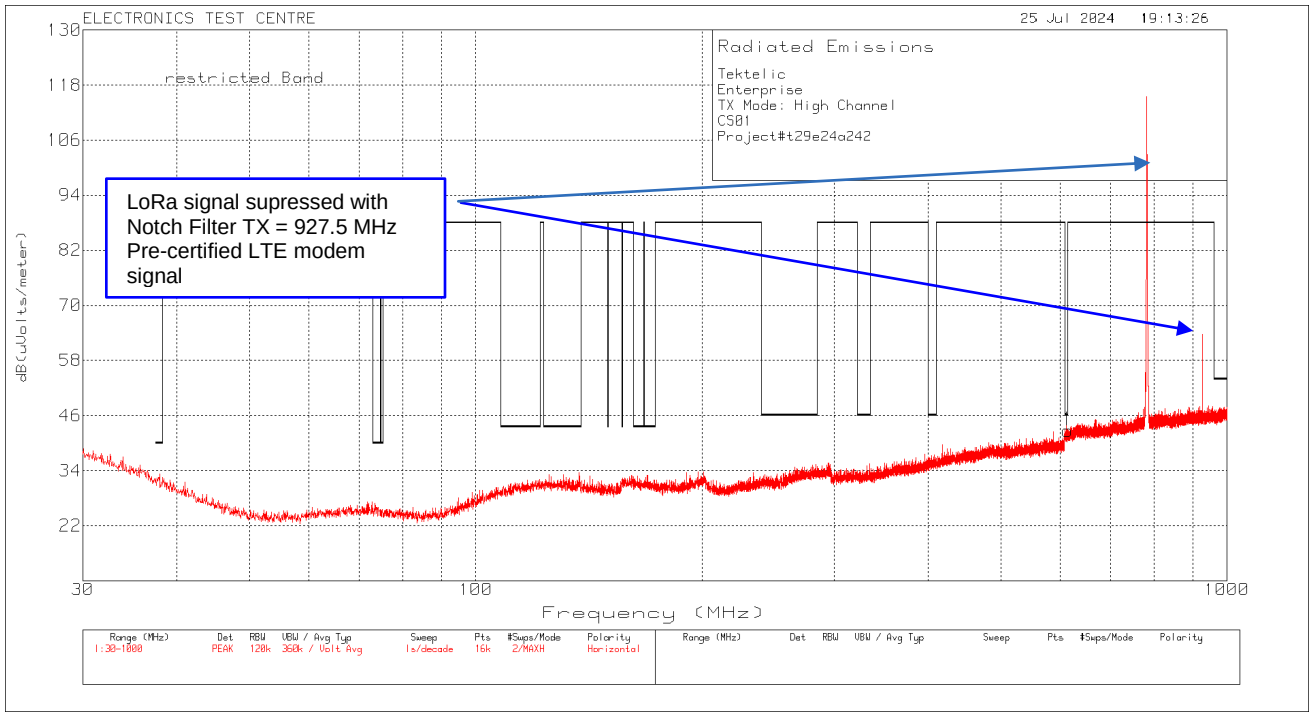
Plot of Radiated Emissions: Parallel



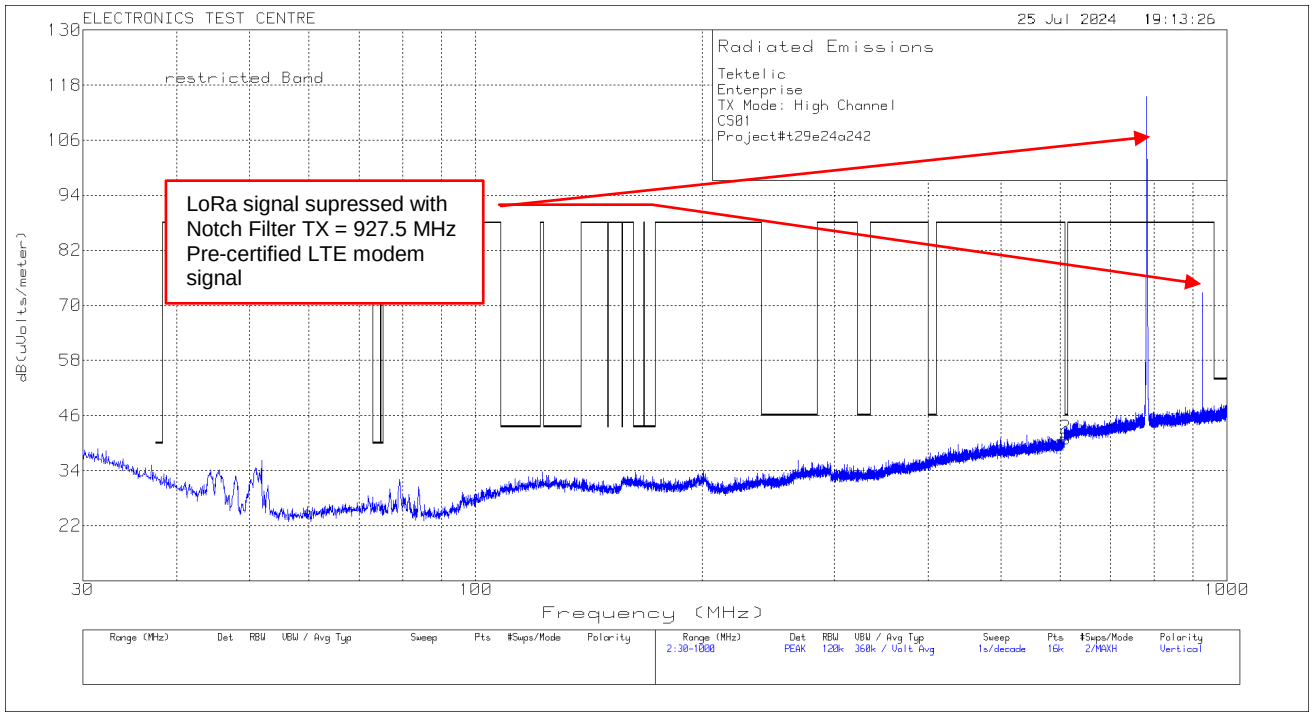
Plot of Radiated Emissions: Perpendicular



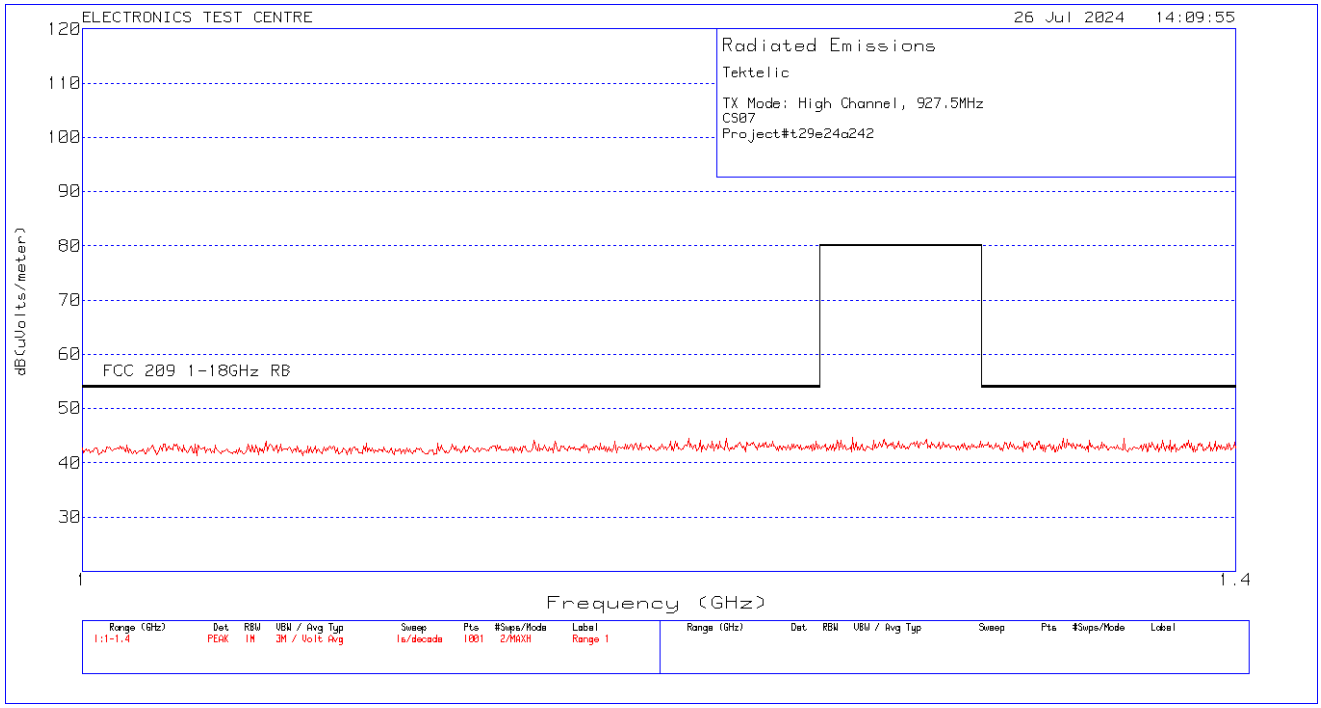
Plot of Radiated Emissions: Horizontal polarization



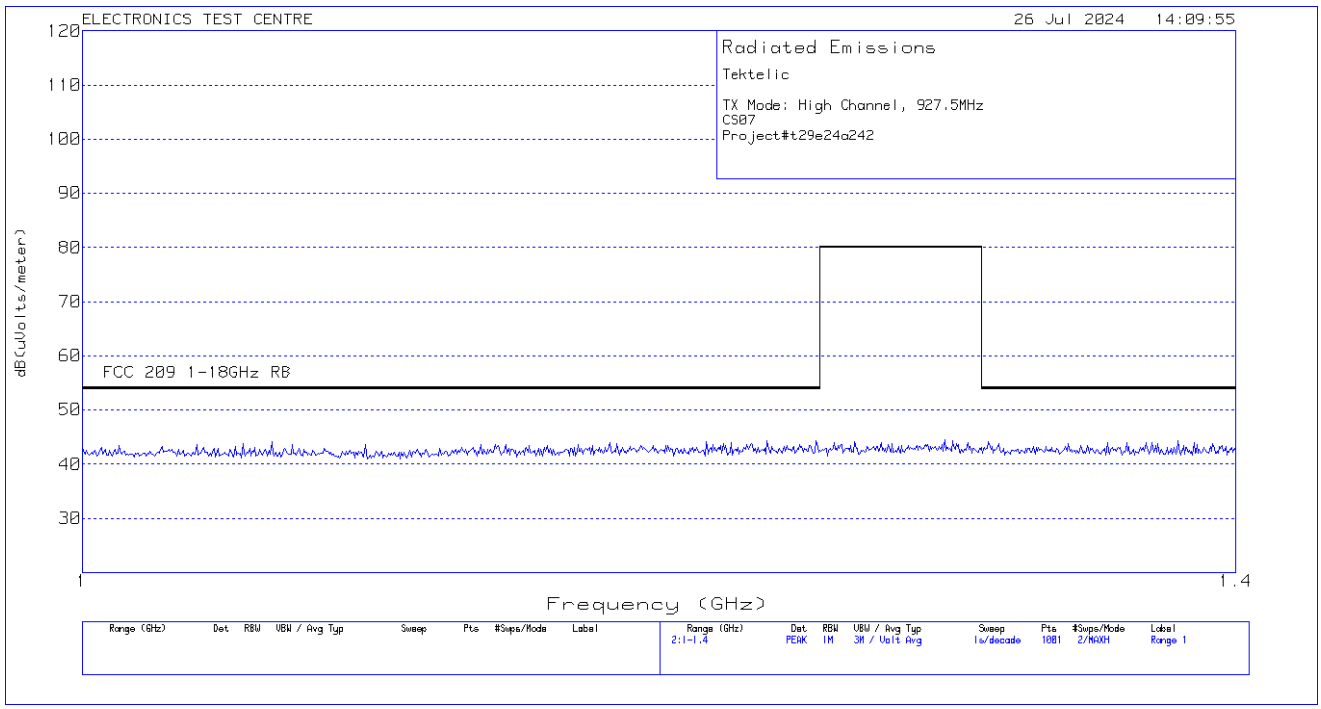
Plot of Radiated Emissions: Vertical polarization



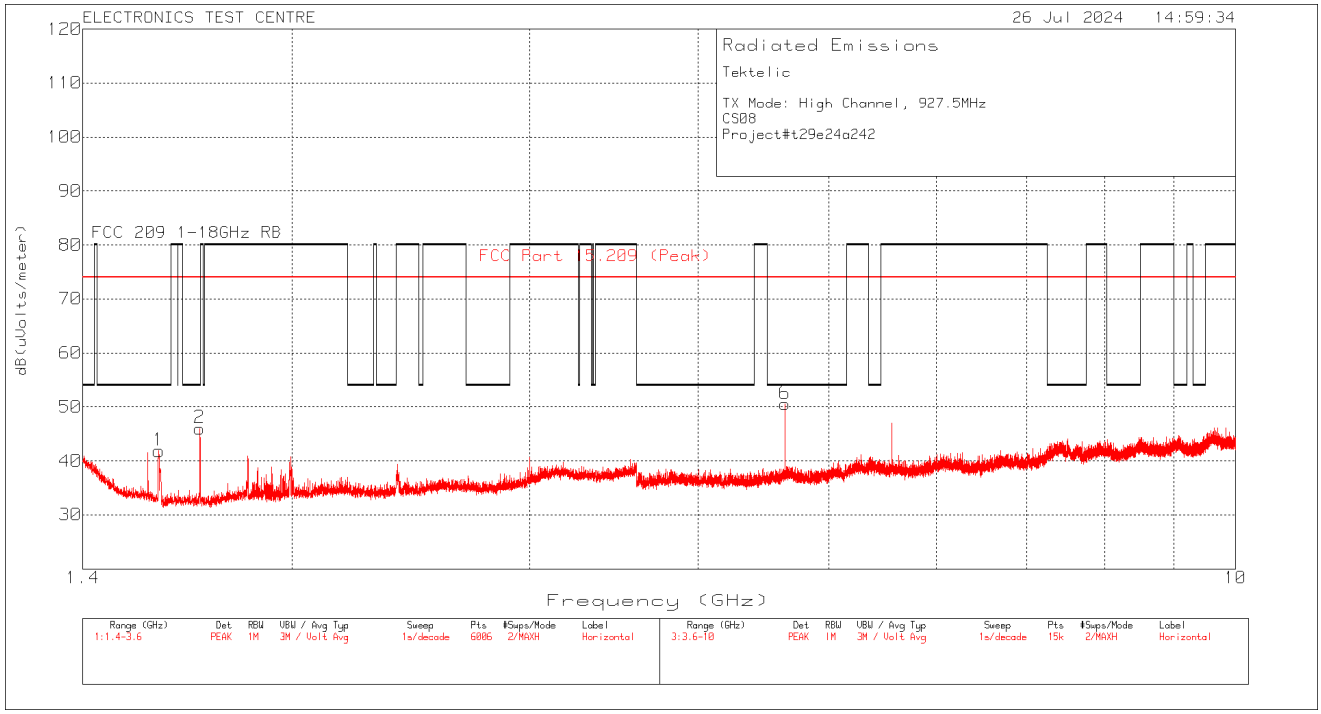
Plot of Radiated Emissions: Horizontal polarization



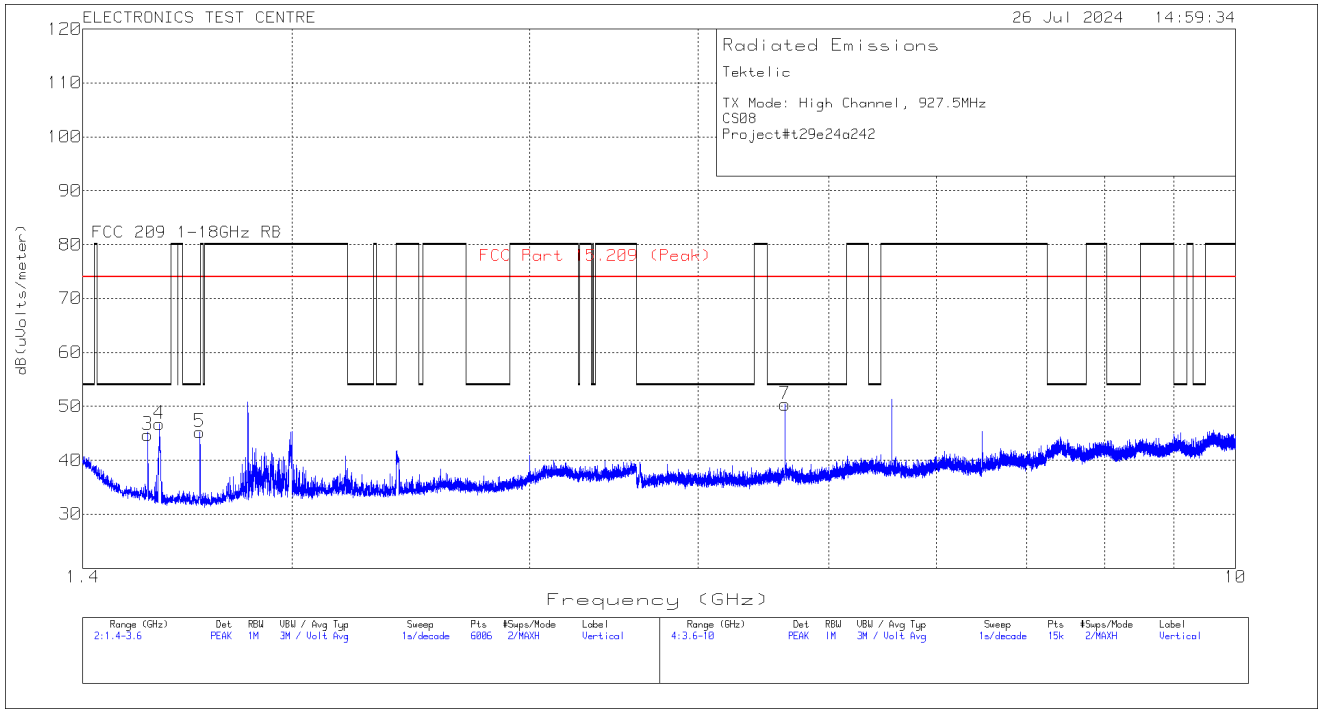
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



2.8.6 Radiated Emissions Data: Enterprise (Both LTE/LoRa transmitting simultaneously with internal antenna)

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 discreet 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 High band channel 927.5 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. [GHz]	Raw reading [dBµv]	Det	Antenna Factor [dB/m]	Loss/ Gain [dB]	Corrected Reading [dBµv/m]	FCC 15.209 Limit [dBµv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	1.8552	60.78	AV	27.4	-35	53.18	54	-0.82	4	137	Horizontal
		64.23	PK	27.4	-35	56.63	74	-17.37	4	137	Horizontal
2	5.5657	40.15	AV	34.1	-30.1	44.15	54	-9.85	0	266	Horizontal
		51.01	PK	34.1	-30.1	55.01	74	-18.99	0	266	Horizontal
3	1.8544	61.31	AV	27.4	-35	53.71	54	-0.29	41	120	Vertical
		66.08	PK	27.4	-35	58.48	74	-15.52	41	120	Vertical
4	*4.6382	33.54	AV	32.7	-32	34.24	54	-19.76	59	100	Vertical
		44.85	PK	32.7	-32	45.55	74	-28.45	59	100	Vertical
5	5.5658	39.49	AV	34.1	-30.1	43.49	54	-10.51	86	289	Vertical
		50.32	PK	34.1	-30.1	54.32	74	-19.68	86	289	Vertical

QP: Quasi-Peak Detector, PK: Peak Detector, AV: Average Detector
*** Spurious Emission in Restricted Band**

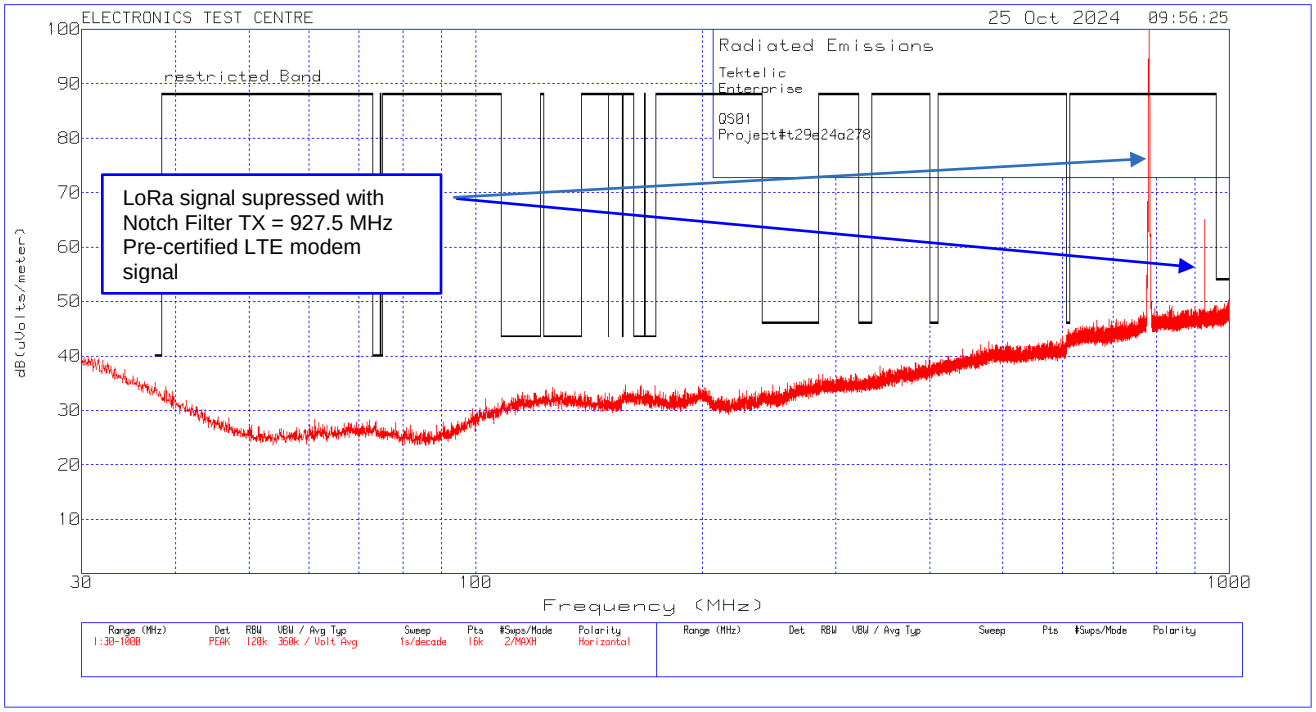
Plot of Radiated Emissions: Parallel

Emission is more than 20 dB below the limit

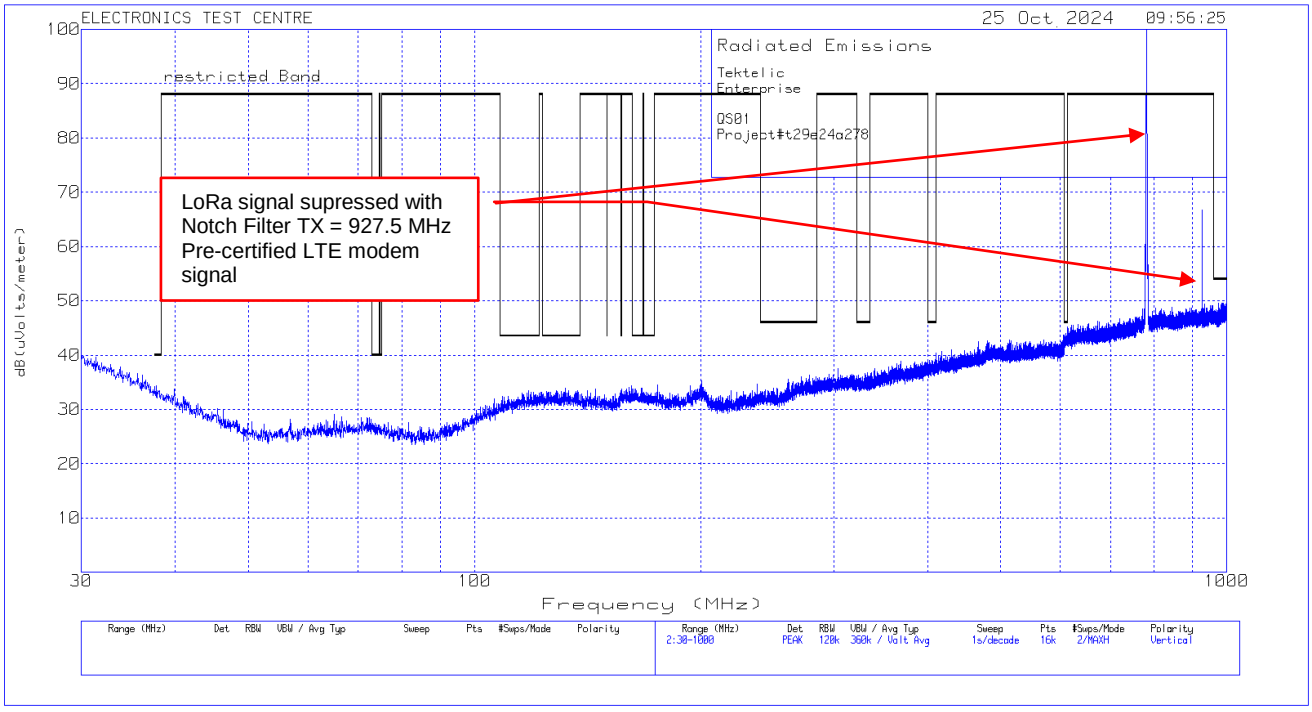
Plot of Radiated Emissions: Perpendicular

Emission is more than 20 dB below the limit

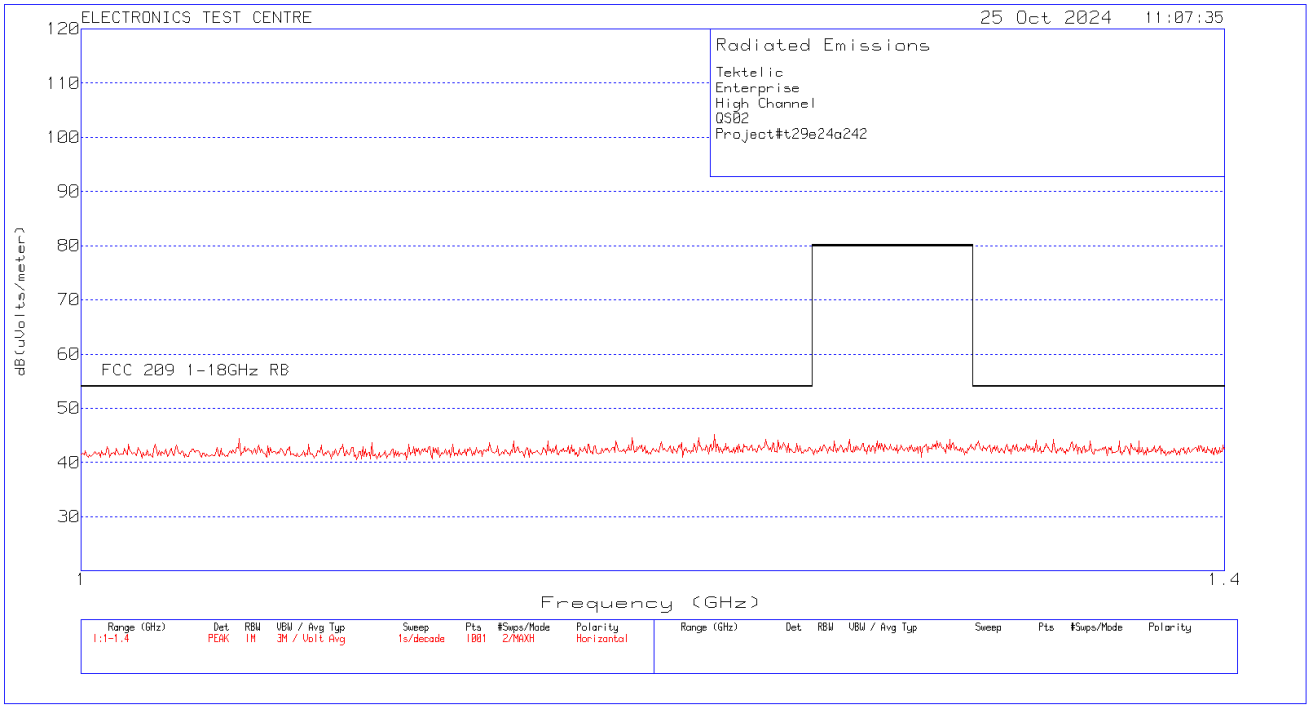
Plot of Radiated Emissions: Horizontal polarization



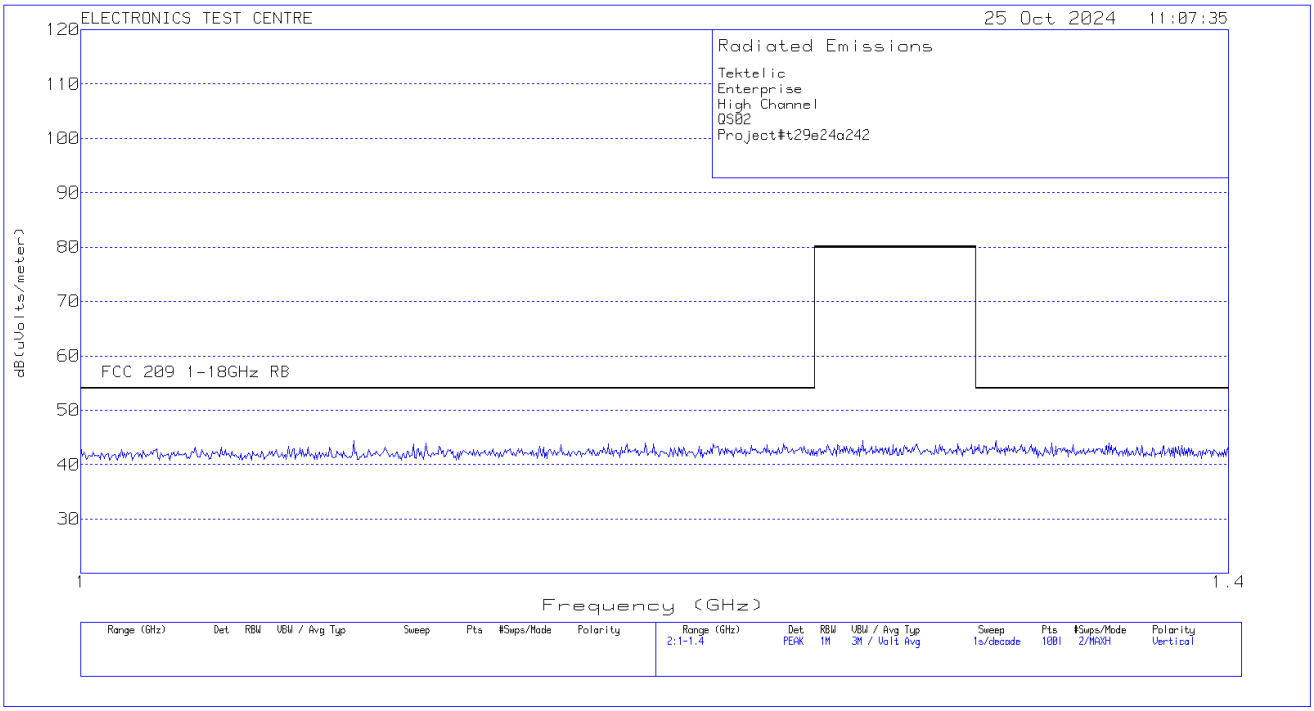
Plot of Radiated Emissions: Vertical polarization



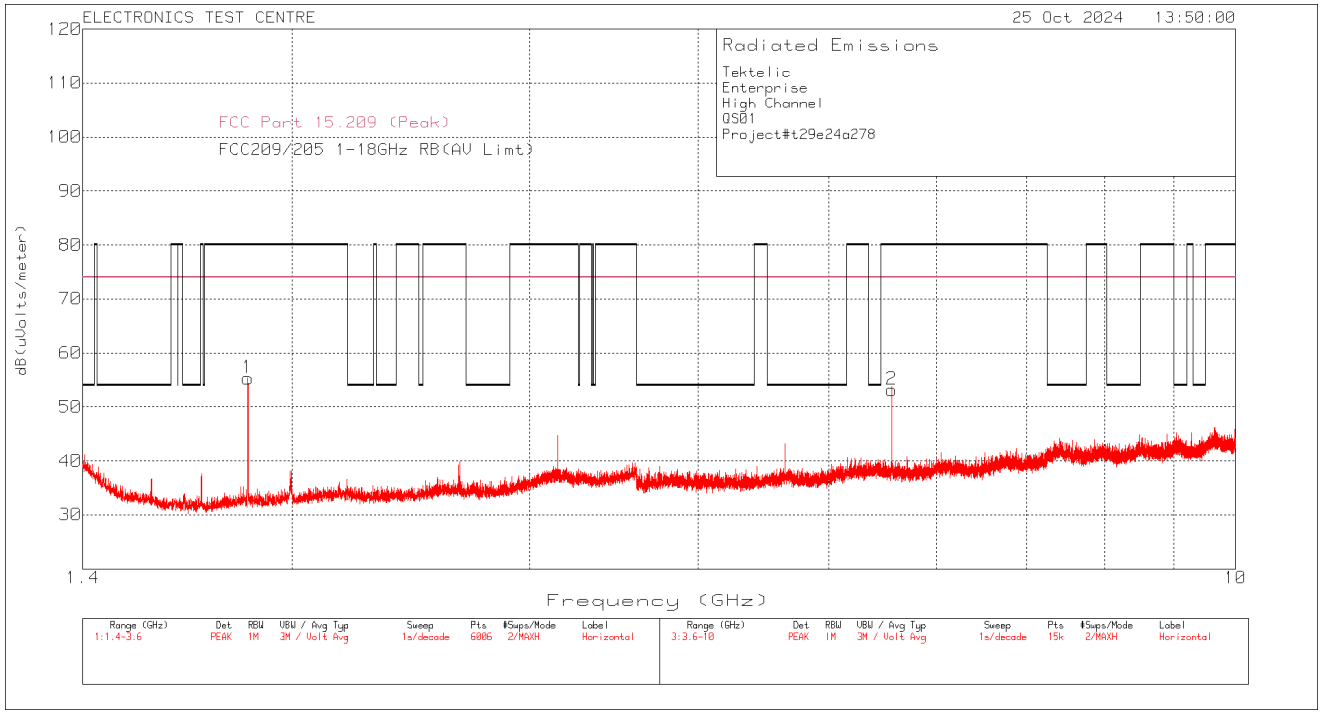
Plot of Radiated Emissions: Horizontal polarization



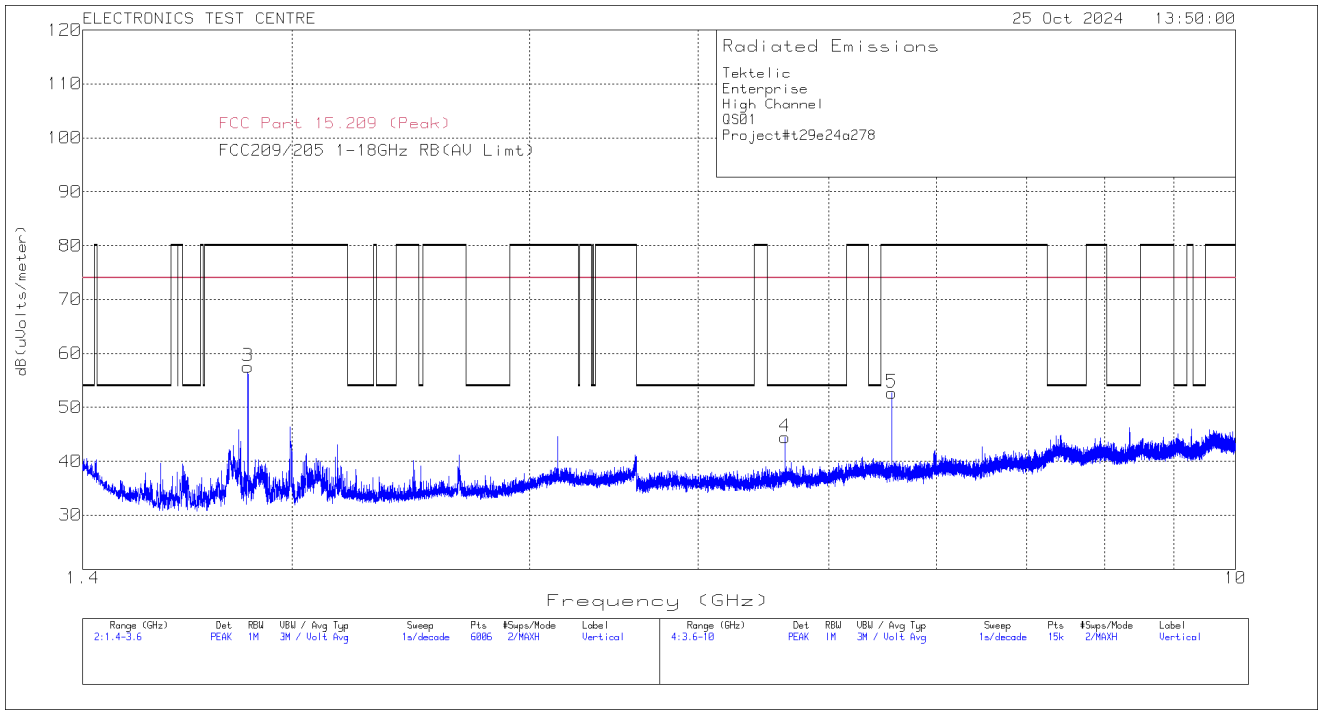
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



2.8.7 Radiated Emissions Data: Photon Variant (Both LTE/LoRa transmitting simultaneously)

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 discreet 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 914.2 MHz was selected as the worst-case condition for detailed examination.
- In Transmit mode, the EUT was assessed up to 10 GHz.

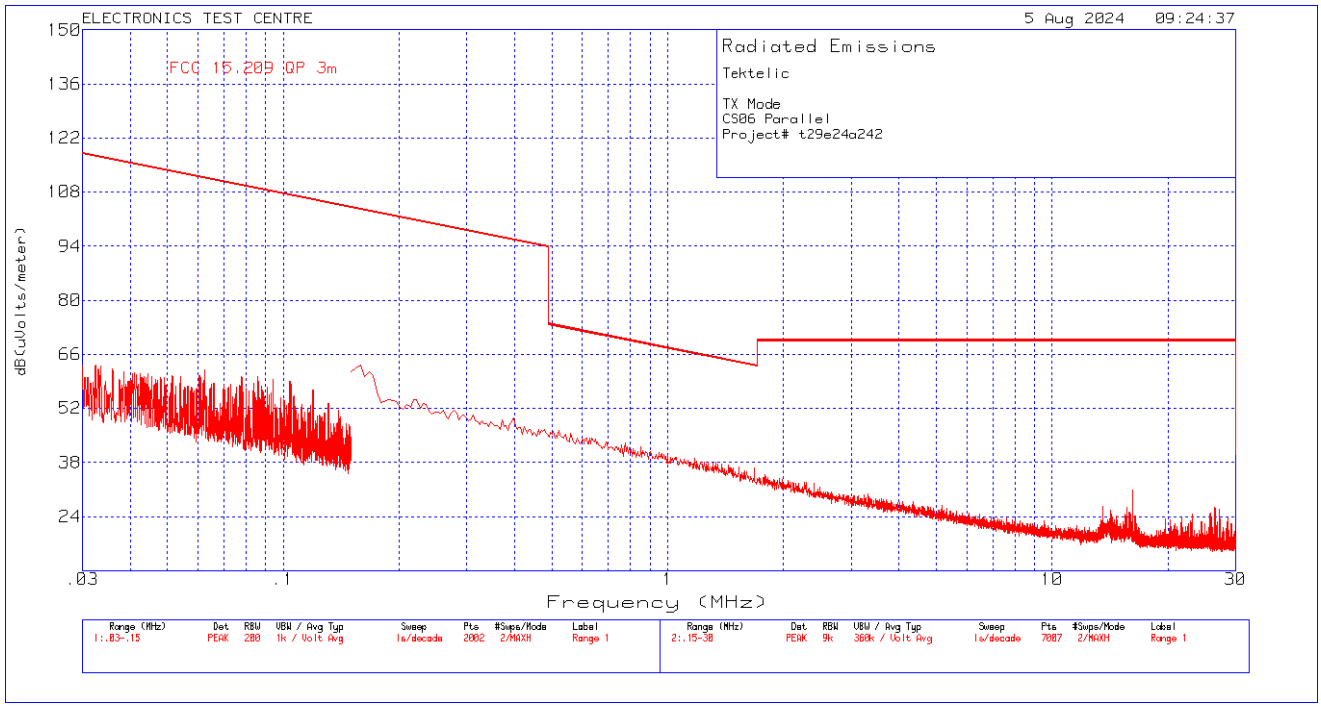
Negative values for Delta indicate compliance.

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	26.6107	35.03	QP	8.7	1.4	45.13	69.56	-24.43	157	109	Perpendicular
1	*1564	33.03	Av	26.1	-33.6	25.53	54	-28.47	192	163	Horizontal
		44.39	Pk			36.89	73.98	-37.09			
2	*2346.3	31.16	Av	28.4	-34.3	25.26	54	-28.74	185	268	Horizontal
		43.41	Pk			37.51	73.98	-36.47			
3	*1564.1	36.13	Av	26.1	-33.6	28.63	54	-25.37	183	247	Vertical
		45.85	Pk			38.35	73.98	-35.63			
4	*1696.2	40.11	Av	27.1	-35.2	32.01	54	-21.99	210	100	Vertical
		49.65	Pk			41.55	73.98	-32.43			
5	*2345.2	27.72	Av	28.4	-34.3	21.82	54	-32.18	28	103	Vertical
		40.64	Pk			34.74	73.98	-39.24			
6	*3910.6	35.11	Av	32.5	-32.7	34.91	54	-19.09	270	139	Horizontal
		45.7	Pk			45.5	73.98	-28.48			

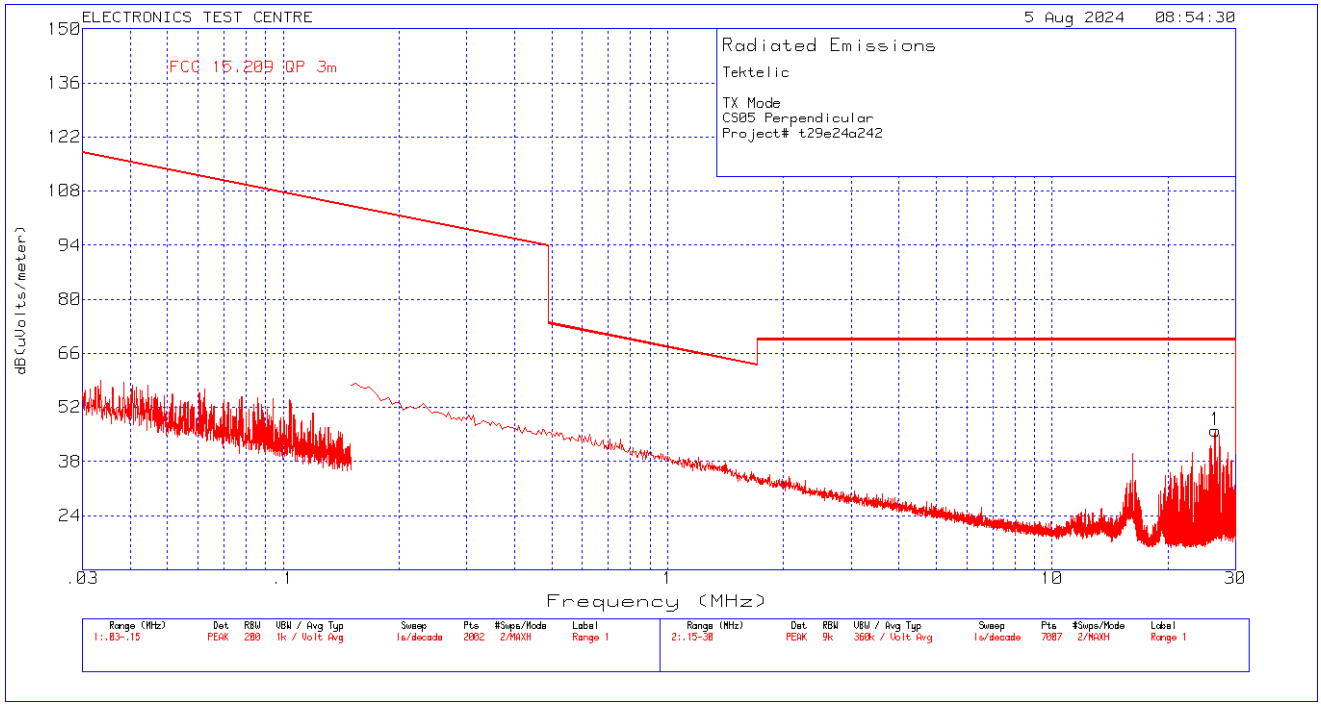
QP: Quasi-Peak Detector, PK: Peak Detector, AV: Average Detector

*** Spurious Emission in Restricted Band**

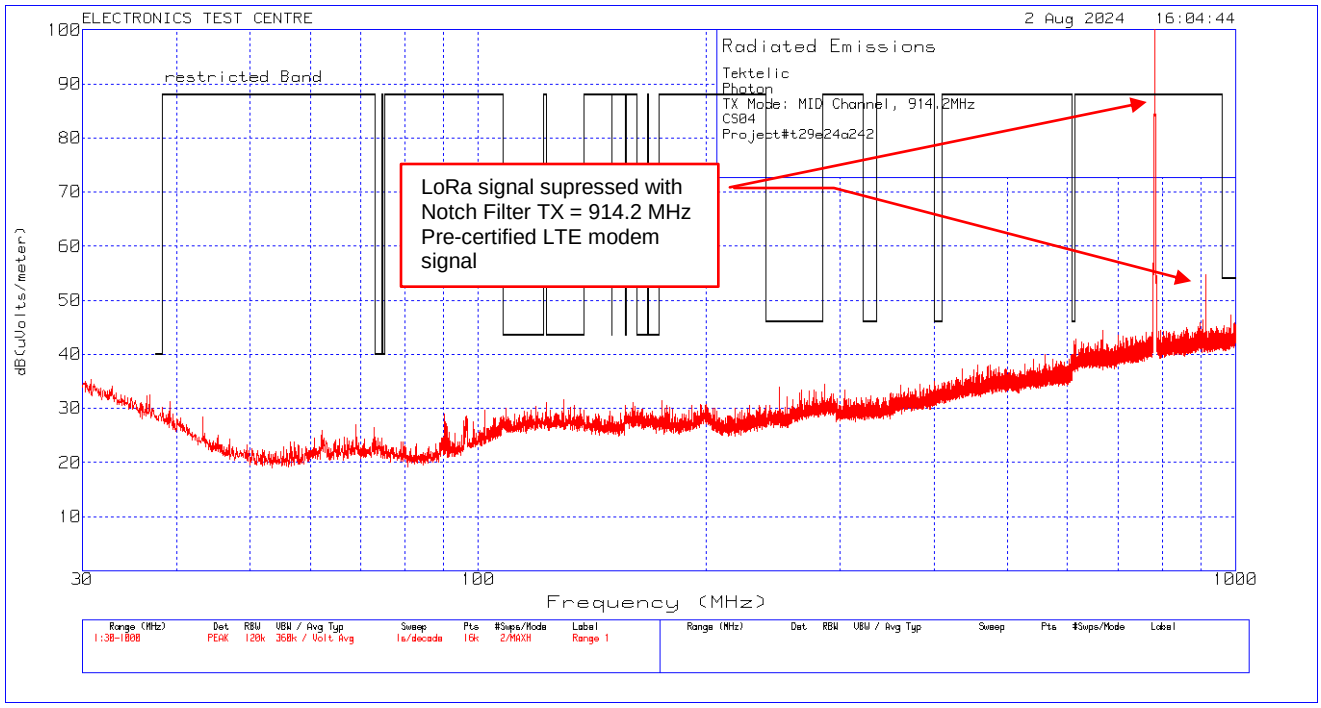
Plot of Radiated Emissions: Parallel



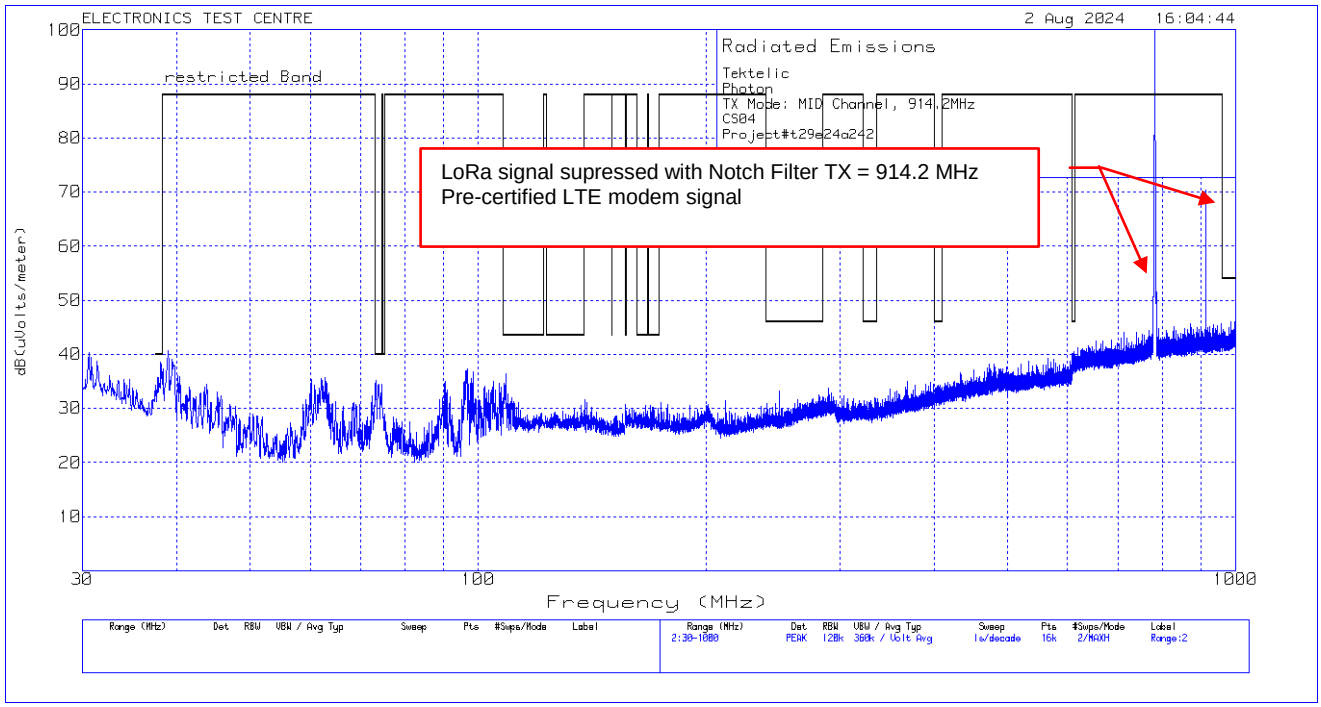
Plot of Radiated Emissions: Perpendicular



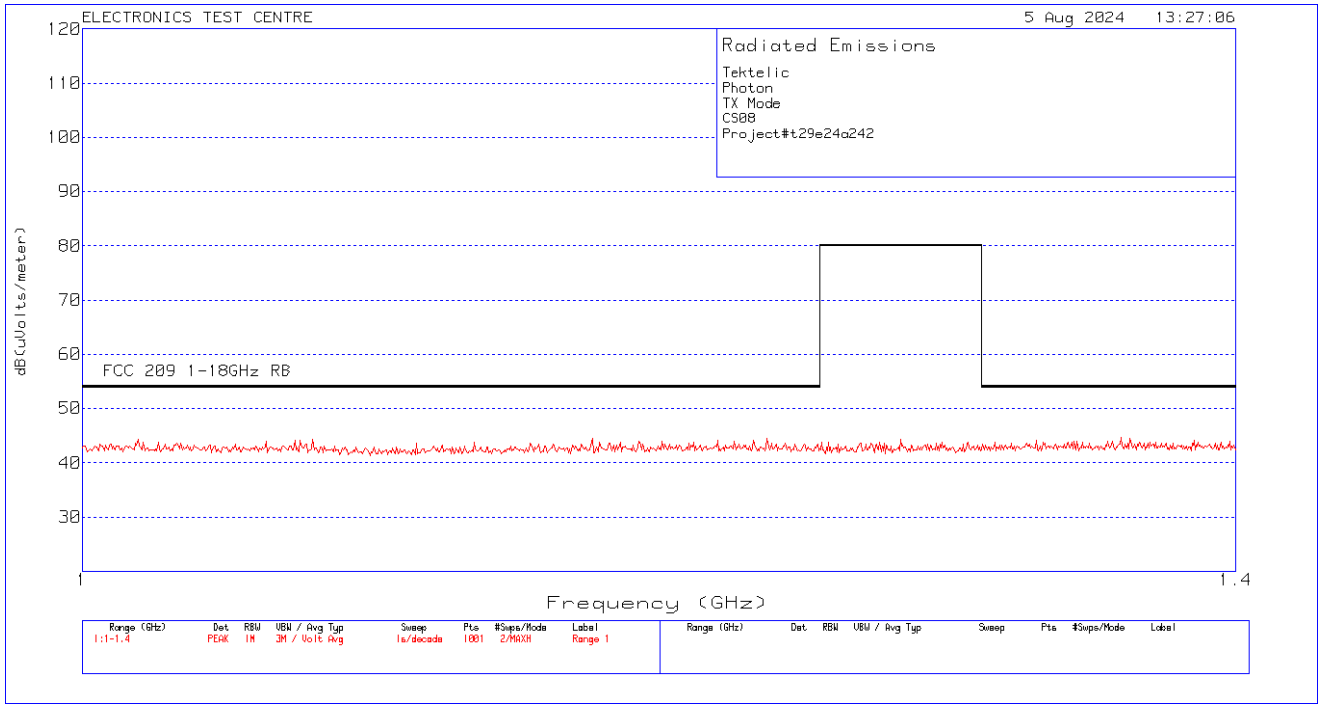
Plot of Radiated Emissions: Horizontal polarization



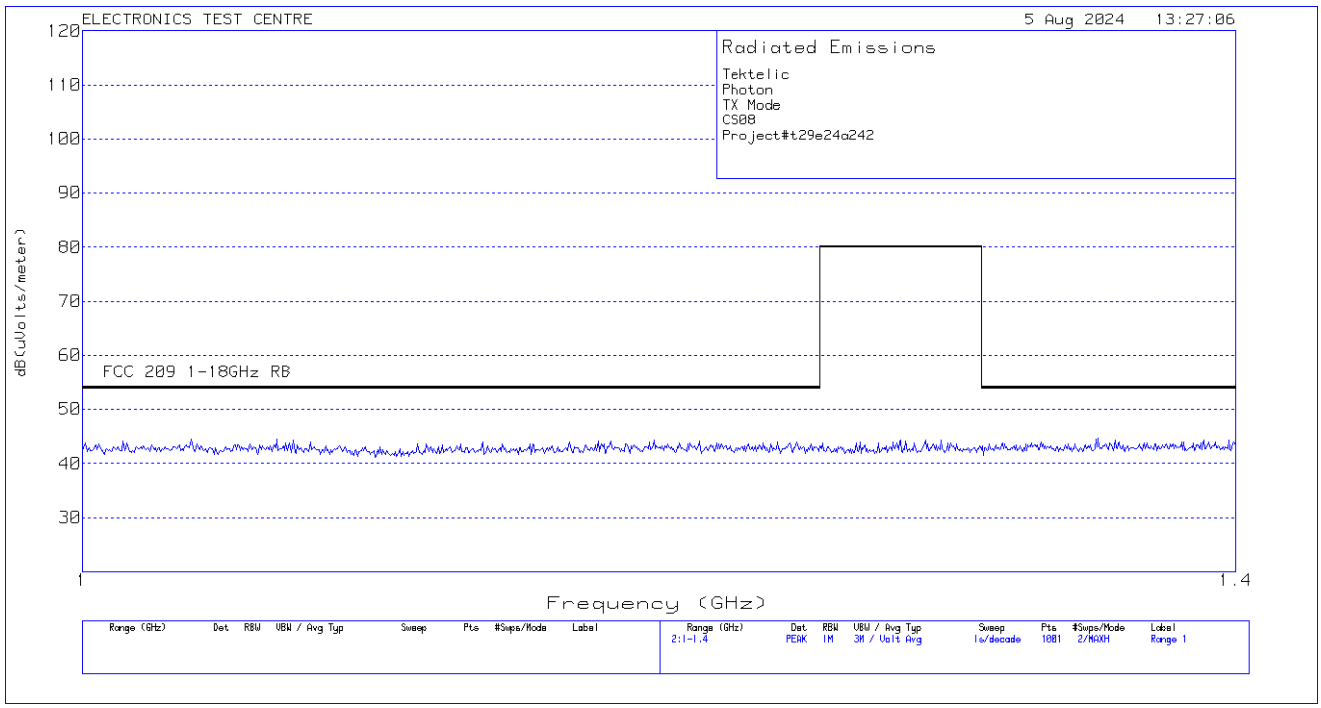
Plot of Radiated Emissions: Vertical polarization



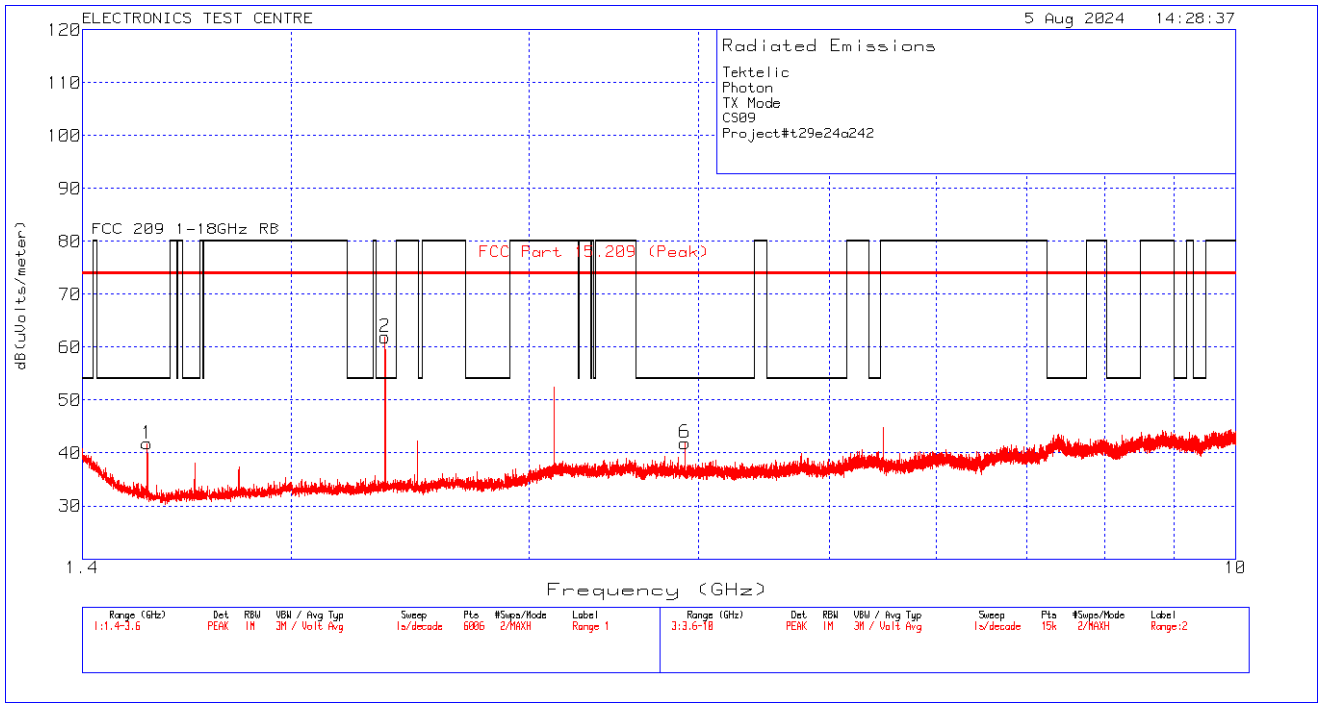
Plot of Radiated Emissions: Horizontal polarization



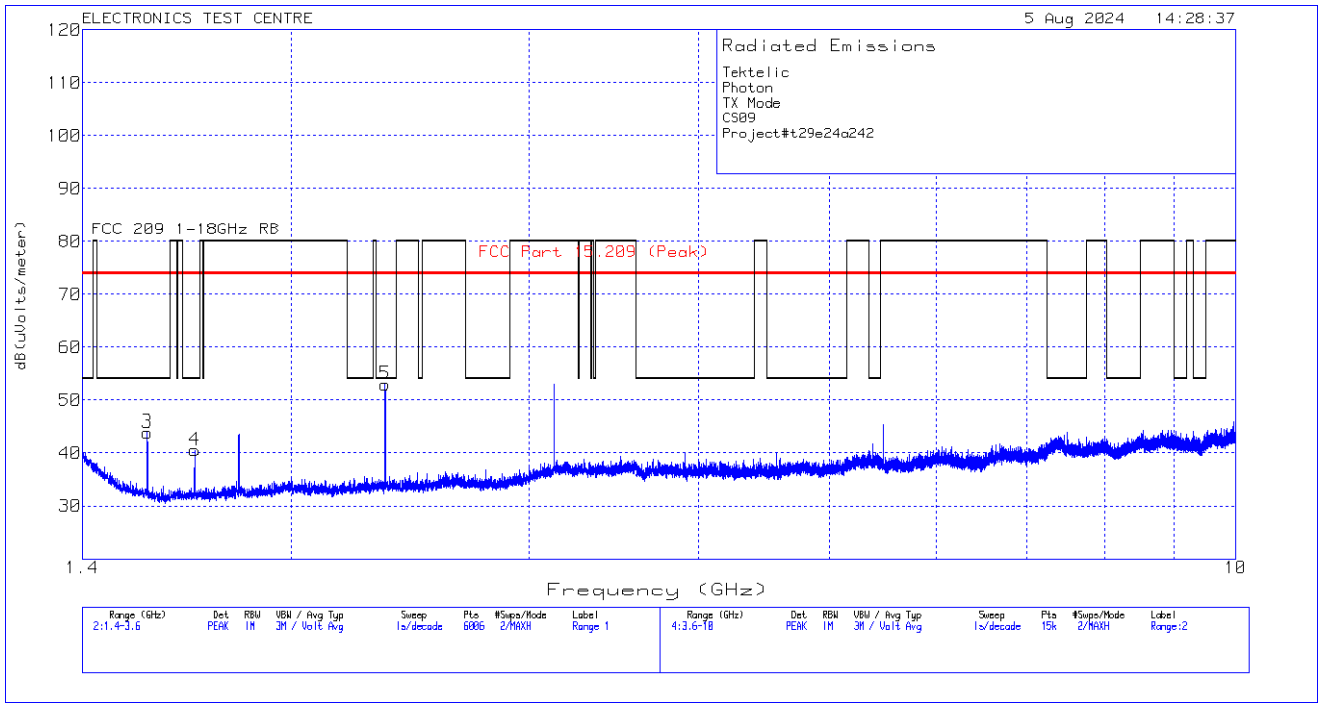
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



2.9 Radiated Emissions (RX Mode)

Test Lab: Electronics Test Centre, Airdrie	**EUT: Kona Enterprise Gateway** **Kona Photon Gateway**
Test Personnel: Janet Mijares	**Standard: FCC Part 15.109**
Date: 2024/07/26-30 (23.8° C, 39.7% RH) **2024/08/02 (23.0° C, 33.8% RH)**	**Basic Standard: ANSI C63.4: 2014**
	Class: A

EUT status: Compliant

Frequency (MHz)	FCC Part 15.109 Class A Limit (3m)
30 – 88	49.54 (dBµV/m)
88 – 216	53.98 (dBµV/m)
216 – 960	56.90 (dBµV/m)
Above 960	60.0 (dBµV/m)

Criteria: The radiated emissions produced by a device, measured at a distance of 3 meters, shall not exceed the limits as specified.

2.9.1 Test Guidance:

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 scan is performed at discreet increments of turntable azimuth and stepped antenna height, with peak detector and Max Hold function 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.

After the pre-scan is completed, the frequencies of interest 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. This may produce a different reading than the pre scan trace. 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.

2.9.2 Deviations From The Standard:

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

2.9.3 Test Equipment

Testing was performed with the following equipment:

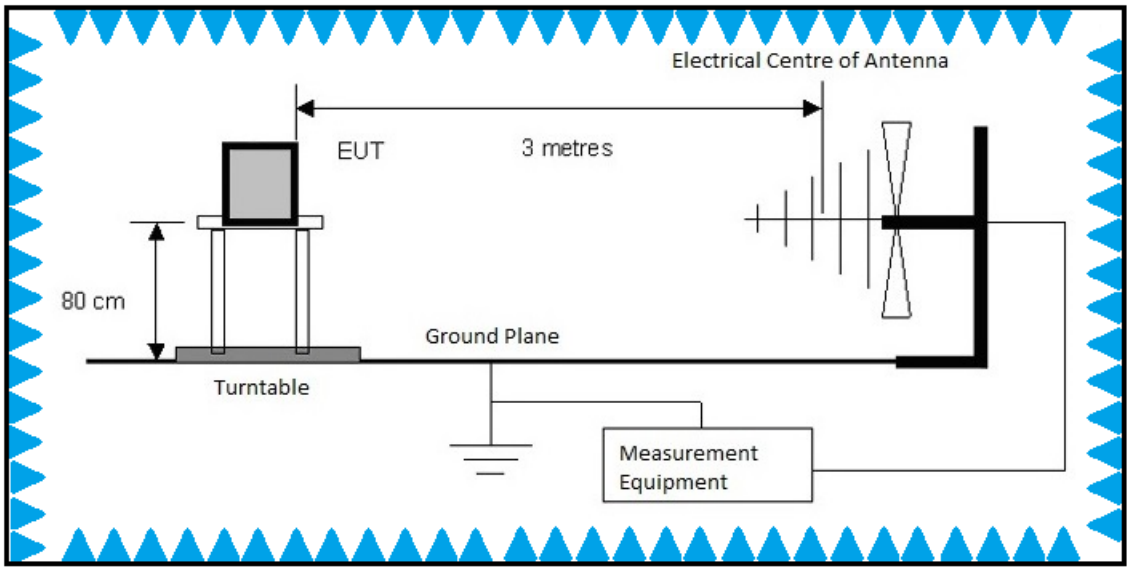
Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
EMC Software	UL	Ver. 9.5	SWE021	N/A	
EMI receiver	Agilent	N9038A (FW A.22.08)	6906	2024-01-02	2025-01-02
Biconilog Antenna (30 – 1000 MHz)	AR	JB1	6905	2023-11-29	2025-11-29
DRG Horn (1000 – 18000 MHz)	EMCO	3115	19357	2022-10-05	2025-10-05
Humidity/Temp Logger	Extech Ins. Corp.	42270	5892	2024-04-08	2025-04-08
Pre-Amplifier (30 – 1400 MHz)	HP	8447D	9291	2024-01-23	2025-01-23
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800-21-5P	4354	2024-01-23	2025-01-23
RE Cable below 1GHz	Insulated Wire Inc.	KPS-1501A-3600-KPA-01102006	4419	2024-01-23	2025-01-23
Re Cable Above 1 GHz	A.H. System Inc.	SAC-26G-8.23	6187	2024-01-23	2025-01-23

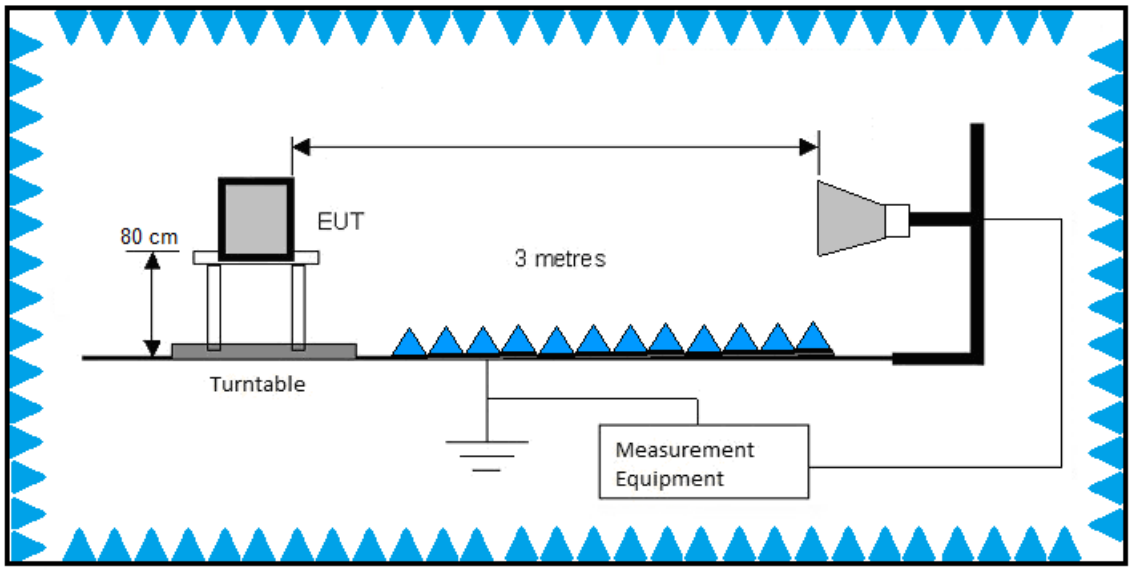
2.9.4 Test Sample Verification, Configuration & Modifications

To cover the unintentional radiated emission. The EUT was configured in receive mode. Unit was placed at the center of turntable in semi-anechoic chamber 80cm above the ground plane and at a distance of 3m from the test receive antenna.

The EUT met the requirements without modification. EUTs were powered with POE and internal battery for Enterprise and Photon respectively.

EUT RX configuration Block Diagram for Radiated Emissions testing:




80 cm
EUT
3 metres
Turntable
Measurement
Equipment

2.9.5 Radiated Emissions Data: Kona Enterprise Gateway

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.

Freq. Marker	Freq. [MHz]	Raw reading [dBµv]	Det	Antenna Factor [dB/m]	Pre amp Gain [dB]	Corrected Reading [dBµv/m]	FCC 15.109 Class A Limit [dBµv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	43.06	34.45	QP	15.4	-24.7	25.15	49.54	-24.39	115	100	Vertical
2	48.02	41.62	QP	12.4	-24.6	29.42	49.54	-20.12	274	100	Vertical
3	72.01	38.59	QP	12.3	-24.2	26.69	49.54	-22.85	98	223	Vertical
4	81.41	32.89	QP	11.6	-24.0	20.49	49.54	-29.05	98	177	Vertical
1	1599.6	28.79	AV	26.2	-34.6	20.39	59.5	-39.11	61	369	Horizontal
2	1197.4	30.94	AV	25.0	-35.2	20.74	59.5	-38.76	273	255	Vertical
3	1593.3	31.22	AV	26.2	-34.6	22.82	59.5	-36.68	172	193	Vertical

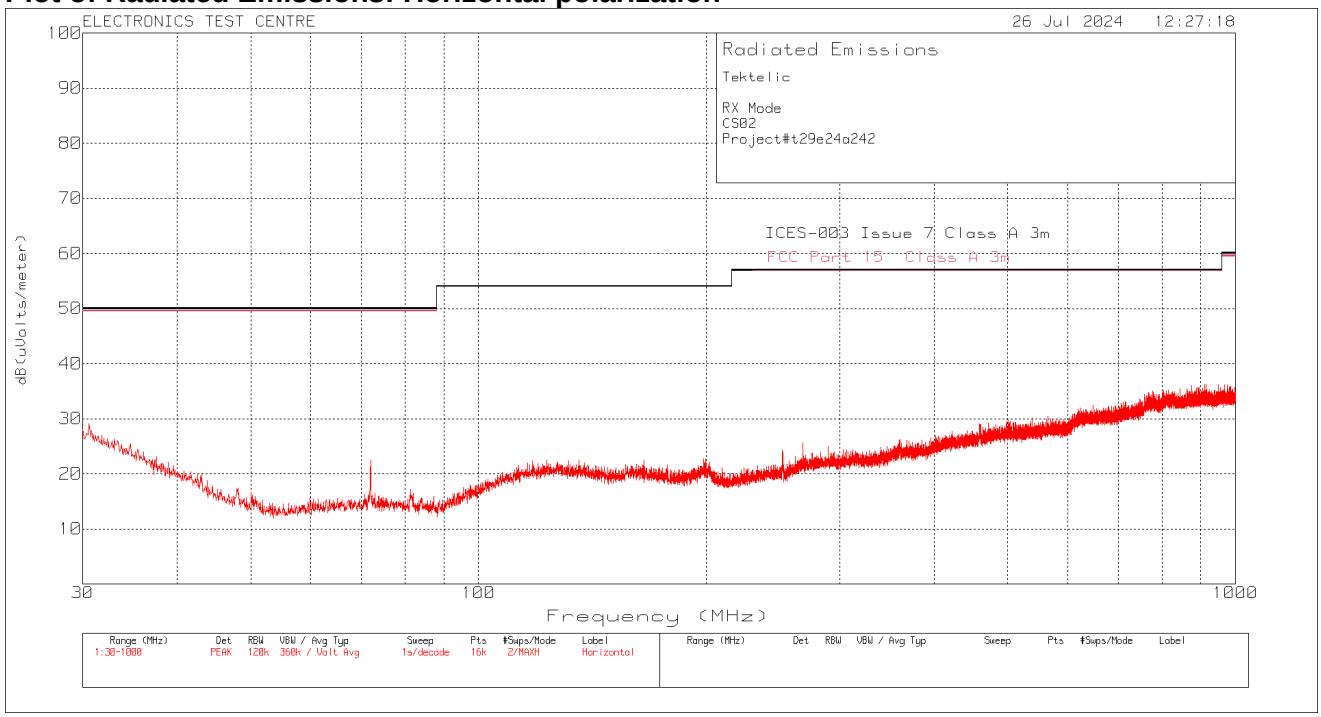
Meter Reading in dBµV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbµV/m.

Notes:

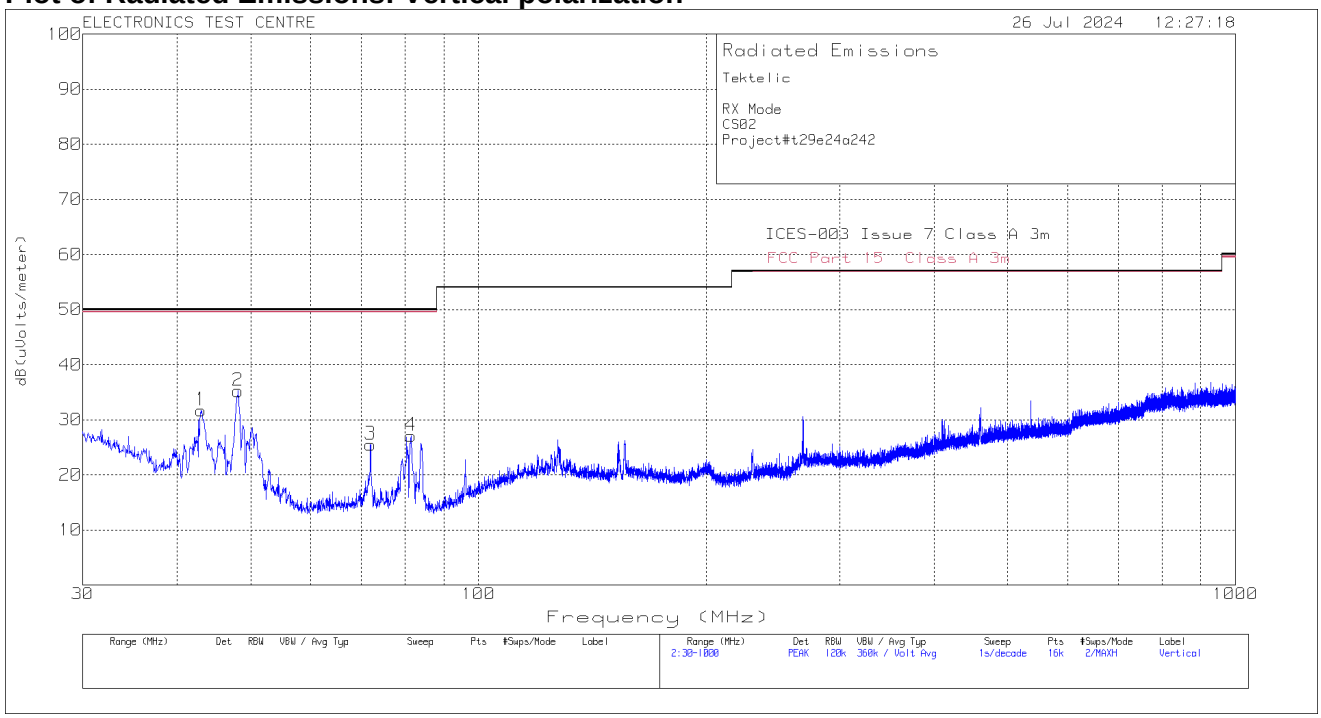
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet 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 the EUT was assessed up to 6.0 GHz.

QP: Quasi-peak detector; Av: Average detector

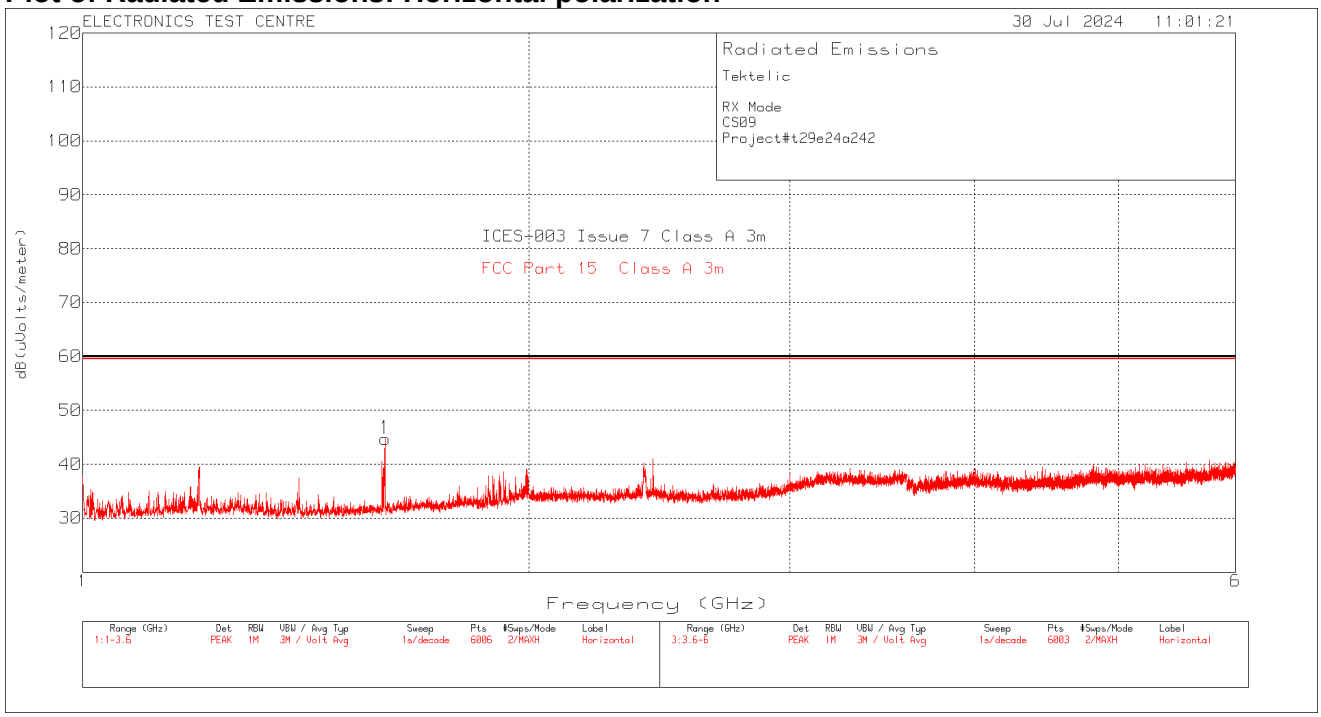
Plot of Radiated Emissions: Horizontal polarization



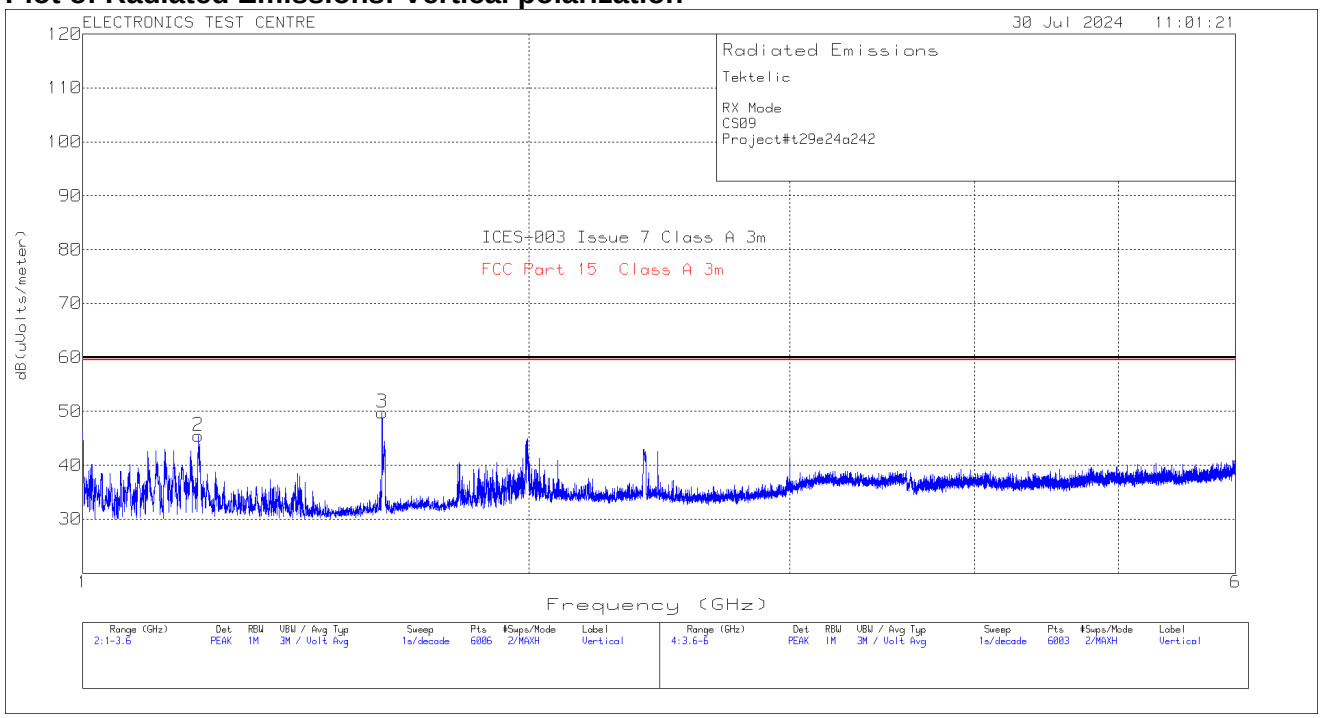
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



2.9.6 Radiated Emissions Data: Kona Photon Gateway Variant

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.

Freq. Marker	Freq. [MHz]	Raw reading [dBµv]	Det	Antenna Factor [dB/m]	Pre amp Gain [dB]	Corrected Reading [dBµv/m]	FCC 15.109 Class A Limit [dBµv/m]	Delta [dB]	Azimuth [Deg]	Height [cm]	Polarization
1	30.6355	37.81	QP	24.8	-25	37.61	49.54	-11.93	167	100	Vertical
2	38.9585	44.46	QP	18.5	-24.8	38.16	49.54	-11.38	195	100	Vertical
3	73.9392	51.1	QP	12.2	-24.2	39.1	49.54	-10.44	164	234	Vertical

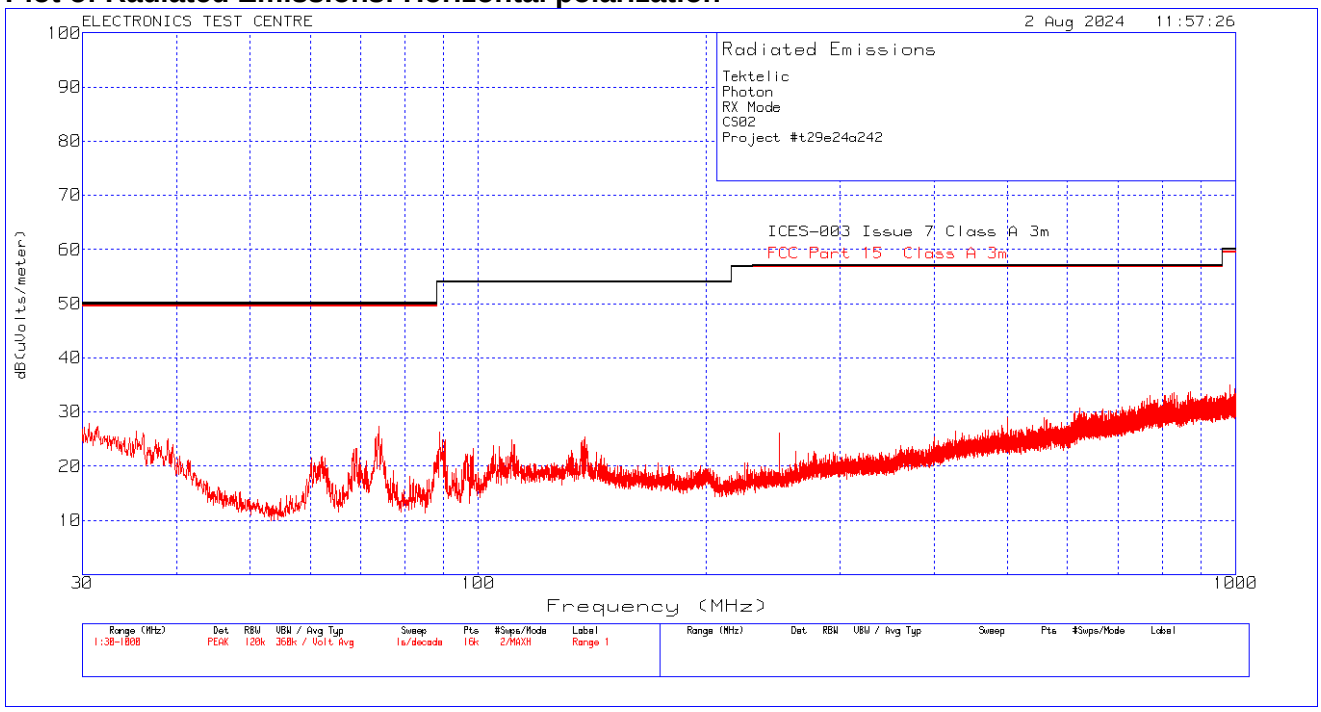
Meter Reading in dBµV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbµV/m.

Notes:

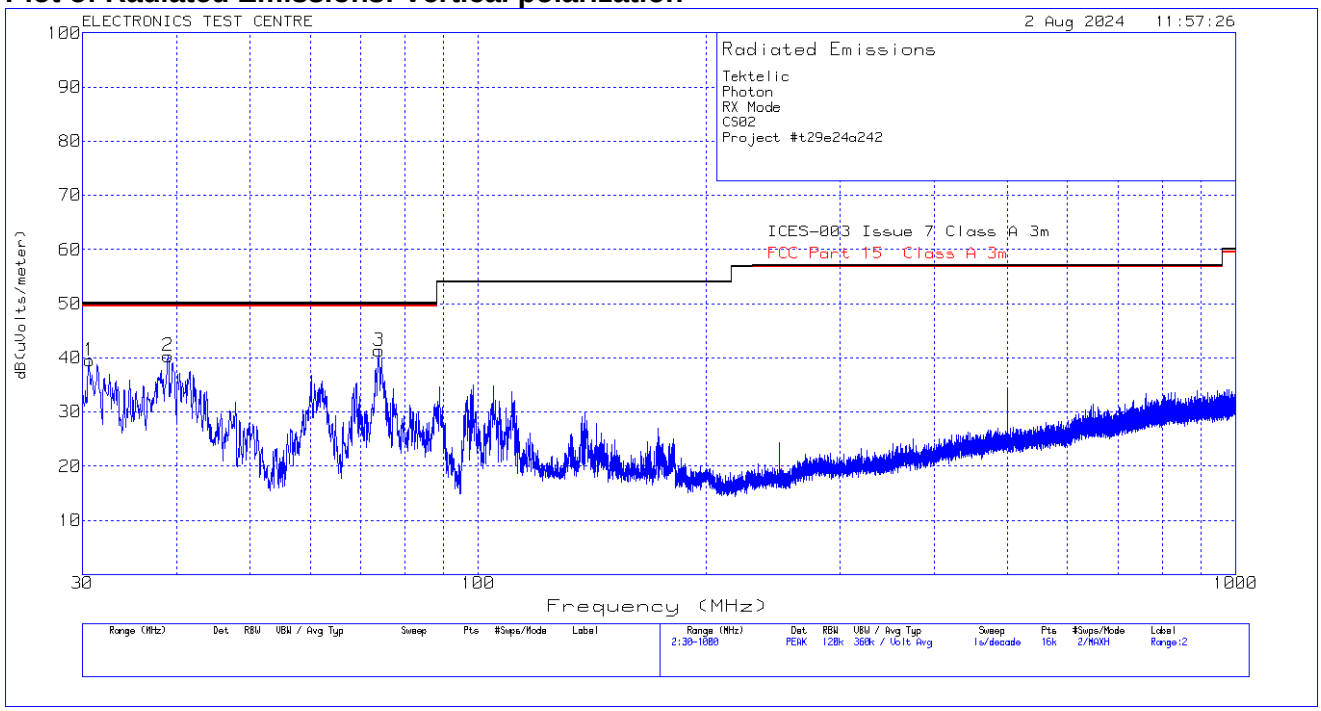
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet 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 the EUT was assessed up to 6.0 GHz.

QP: Quasi-peak detector

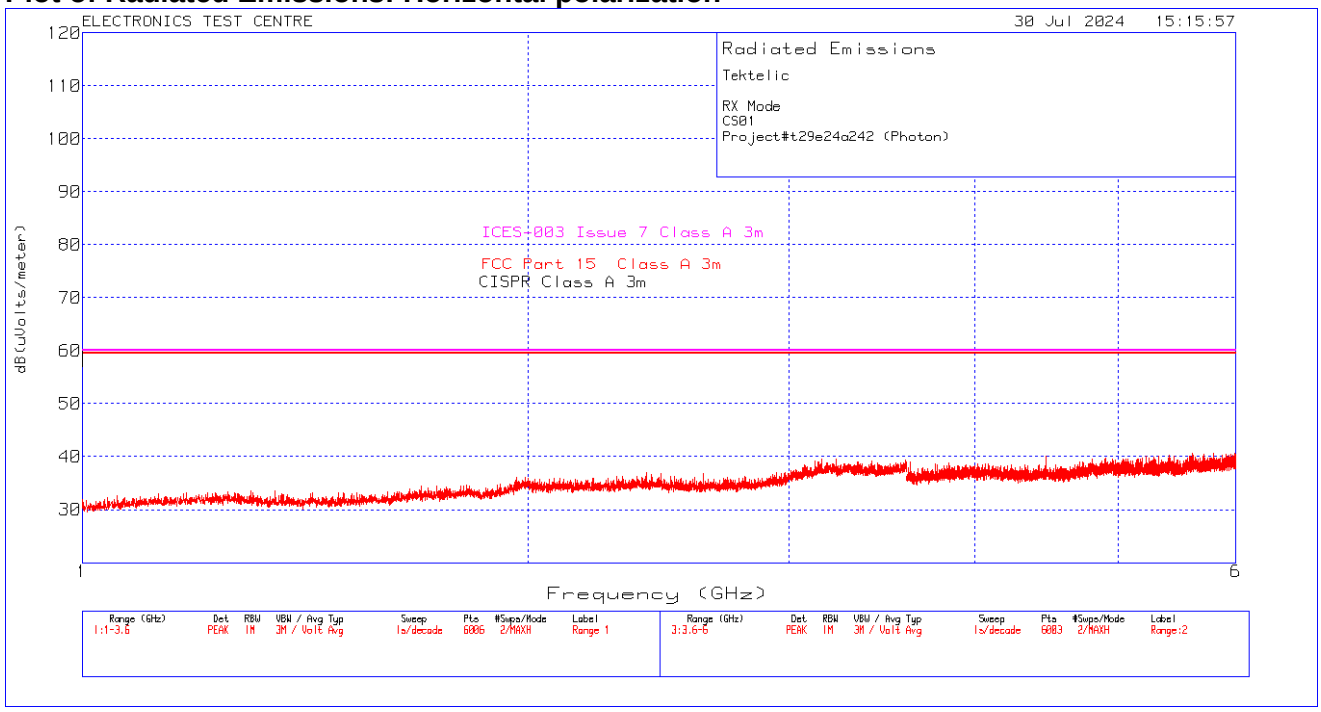
Plot of Radiated Emissions: Horizontal polarization



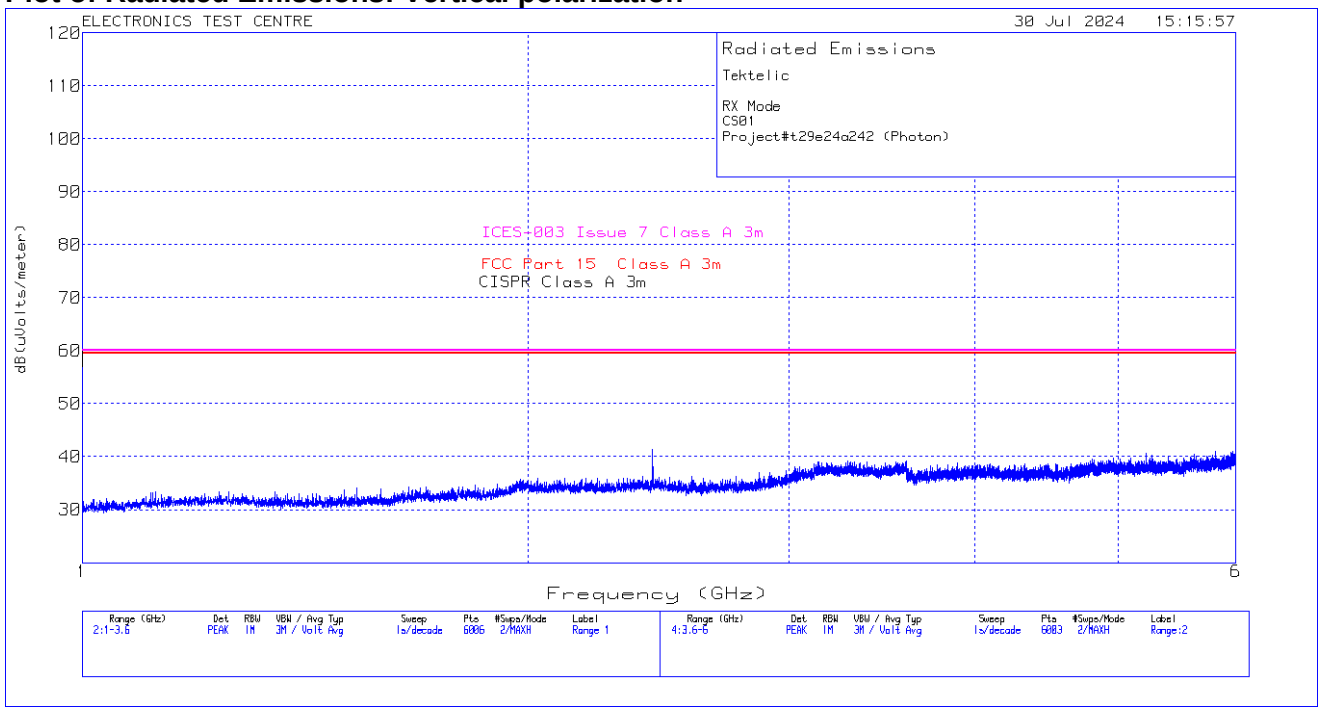
Plot of Radiated Emissions: Vertical polarization



Plot of Radiated Emissions: Horizontal polarization



Plot of Radiated Emissions: Vertical polarization



2.10 RF Exposure

Test Lab: Electronics Test Centre, Airdrie	**EUT: Kona Enterprise Gateway** **Kona Photon Gateway**
Test Personnel:	
Date:	**Standard: FCC PART 15.247**

EUT status: Exempt from SAR Evaluation

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

3.0 TEST FACILITY

3.1 Location

The Kona Enterprise Gateway & Kona Photon Gateway was tested 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

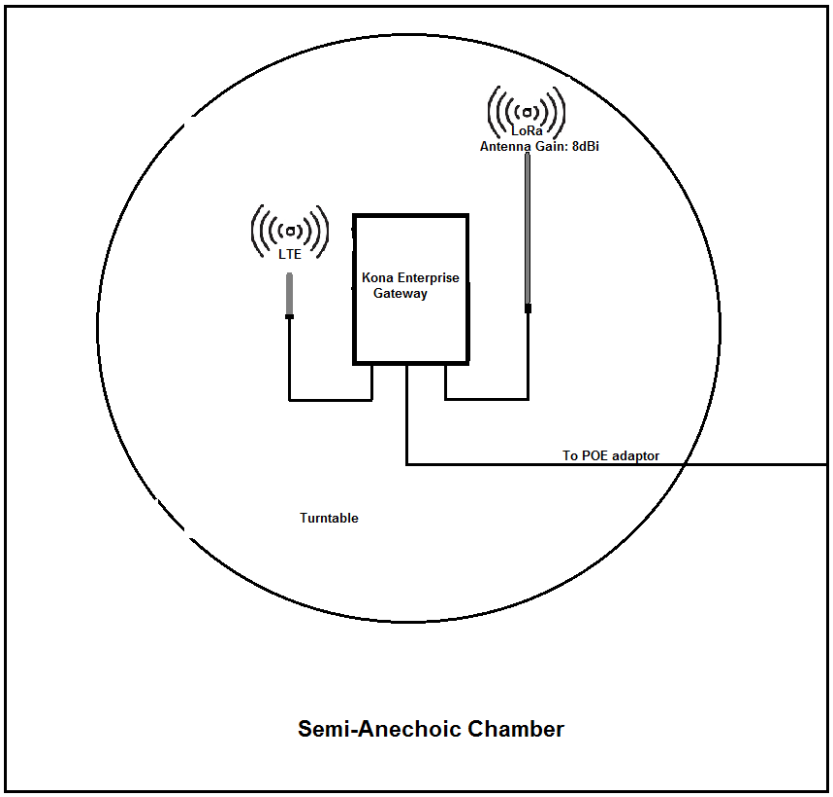
The Kona Enterprise Gateway was placed at the center of the test chamber turntable 80-cm high below 1GHz and at 1.5m high above 1 GHz for transmits mode and 80cm high for RX mode from ground reference plane. The Kona Enterprise Gateway & Kona Photon Gateway earth ground is connected to GRP.

3.3 Power Supply

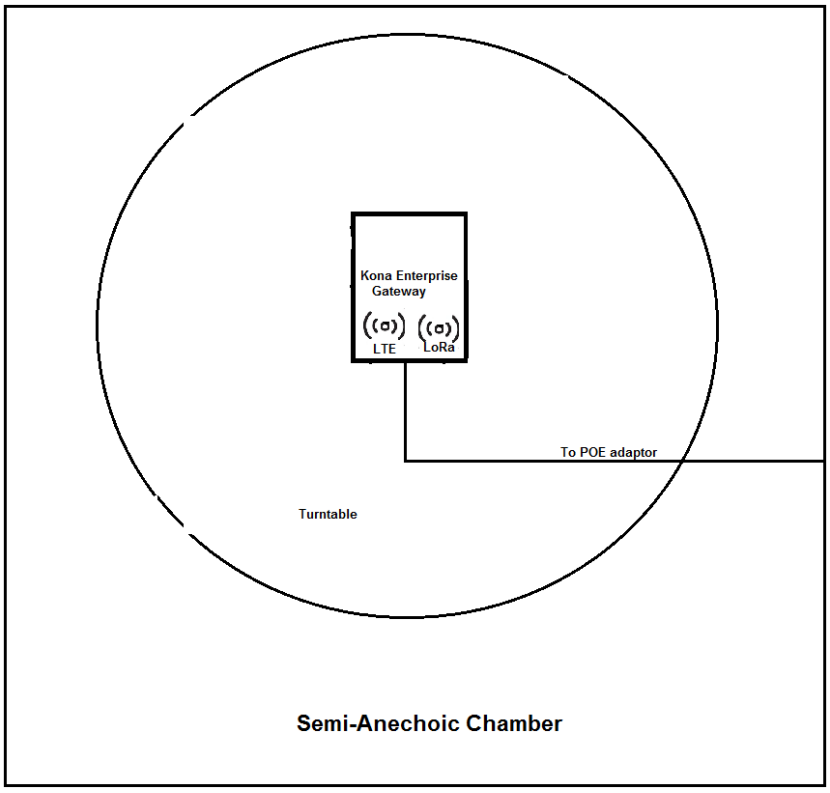
Power supplied via POE for Kona Enterprise Gateway and Kona Photon Gateway is powered via internal battery.

Appendix A – Test Setup Block Diagram

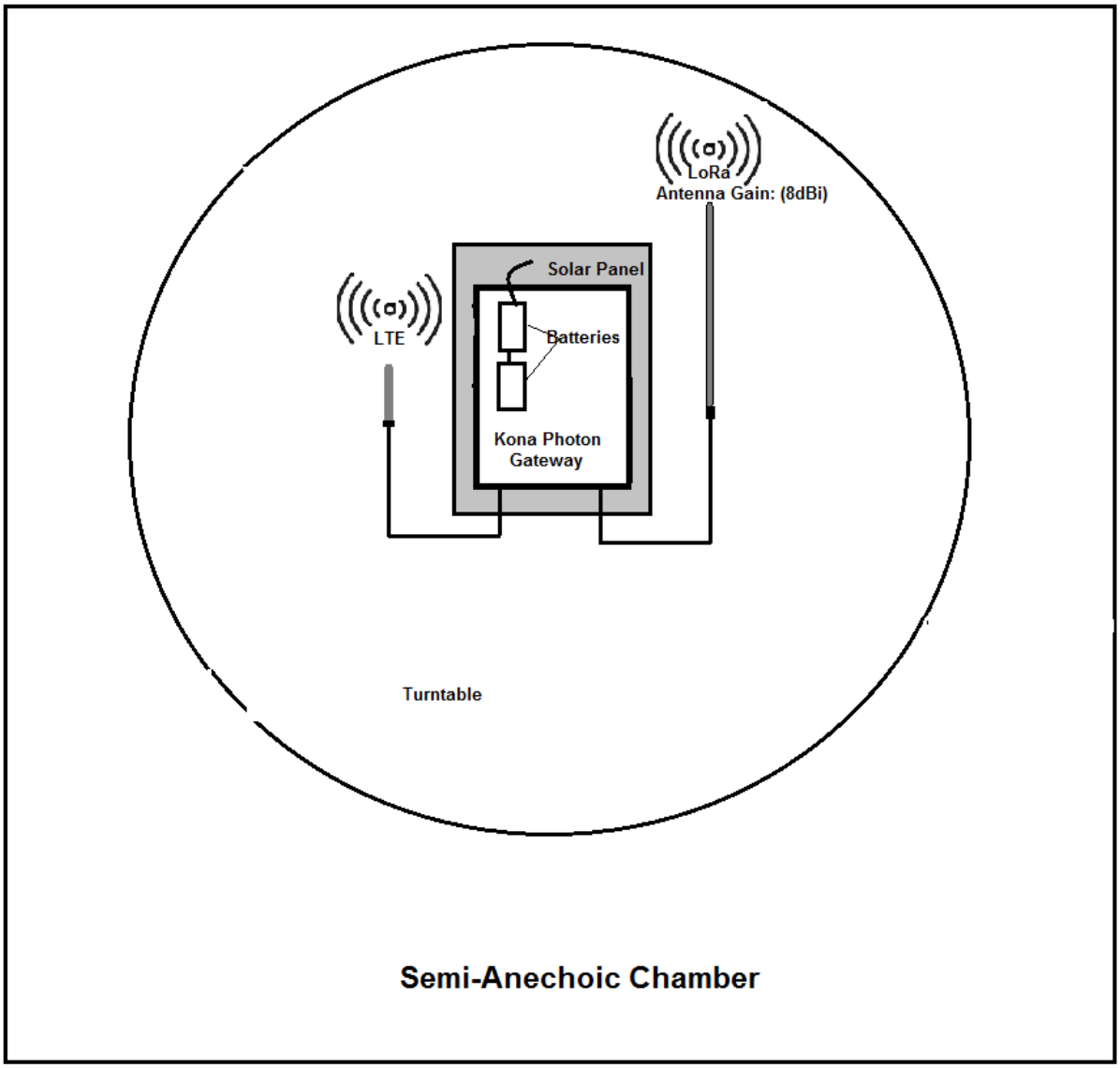
TX MODE with External Antenna



TX MODE with Internal Antenna



TX Mode with External Antenna



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