



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

ETC Report #: t29e21a157_FCC Release1

Report date: July 15, 2021

Test Dates: March 05, 2021, April 12, 23,24 and 26, 2021

EMC testing of the Tektelic Communication Inc. Kona Enterprise Gateway 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: 2ALEPT0007323

Tested by: Imran Akram, Janet Mijares, Brandon Vanhee

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 <u>marc.rousseau@mpbc.ca</u> QA Manager Electronics Test Centre (Airdrie)

Page 1 of 40

REVISION RECORD

ISSUE	DATE	AUTHOR	REVISIONS
DRAFT 1	2021-04-29	I. Akram	Initial draft submitted for review.
Release1	2021-07-25	I. Akram	Sign off

TABLE OF CONTENTS

1.0	INTF	RODUCTION	5
	1.1	Scope	5
	1.2	Applicant	5
	1.3	Test Sample Description	5
	1.4	General Test Conditions and Assumptions	5
	1.5	Scope of Testing	
		1.5.1 Test Methodology1.5.2 Variations in Test Methodology	
		1.5.2 Valiations in rest Methodology 1.5.3 Test Sample Verification, Configuration & Modifications	6
		1.5.4 Uncertainty of Measurement:	
2.0	TES	T CONCLUSION	7
	2.1	AC Power Line Conducted Emissions 2.1.1 Test Guidance: ANSI C63.4-2014, Clause 7.3.1 & ANSI C63.10: 2013 2.1.2 Deviations From The Standard: 2.1.3 Test Equipment 2.1.4 Test Sample Verification, Configuration & Modifications 2.1.5 Conducted Emissions Data:	8 8 8 9
	2.2	Channel Occupied Bandwidth	e v05r02/ 12 12 12 12 13
	2.3	 Maximum conducted (average) output power (DTS Mode)	9 v05r02/ 15 15 16 16 16
	2.4	Power Spectral Density2.4.1Test Guidance: FCC KDB 558074 D01 15.247 Measurement Guidanceclause 11.10 of ANSI C63.10	9 v05r02/ Sub 19 19 19 19 20
	2.5	 Band Edge Attenuation (DTS Mode) 2.5.1 Test Guidance: ANSI C63.10-2013 Clause 11.11, 11.13.2 / FCC KDB 5 15.247 Measurement Guidance v05r02 Clause 8.7 2.5.2 Deviations From The Standard: 2.5.3 Test Equipment. 2.5.4 Test Sample Verification, Configuration & Modifications 2.5.5 Band Edge Data (DTS MODE) 	558074 D01 22 22 23 23

	2.6	Conducted Spurious Emissions in non-restricted frequency bands252.6.1Test Guidance: ANSI C63.10-2013, Clause 11.11, FCC KDB 558074 D01Measurement Guidance v05r02 Clause 8.5252.6.2Deviations From The Standard:2.6.3Test Equipment.2.6.4Test Sample Verification, Configuration & Modifications2.6.5Conducted Spurious Emissions Data: LoRa	15.247 5 5 5 5 5
	2.7	EUT Positioning Assessment	9
	2.8	Radiated Spurious Emissions in restricted frequency bands (Co-Location)2.8.1Test Guidance: ANSI C63.10-2013, Clause 11.12 / KDB 558074 D01 15.24Measurement Guidance v05r02 Clause 8.6	47 0 1 1 1
	2.9	RF Exposure	8
3.0	TEST	FACILITY 39	9
	3.1	Location	9
	3.2	Grounding Plan	9
	3.3	Power Supply	9
Append	lix A (V	Worse Emission test Setup Block Diagram)40	0
End of	Docum	nent 40	0

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. Kona Enterprise Gateway 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.:

Produc	Product Name:		*Kona Enterprise Gateway
	Frequency Band		902 – 928 MHz
	Type of Modulatio	n	Chirp Spread Spectrum
	BW / Frequency Range		DTS 500kHz, 923 - 928 MHz
	Associated	Internal	SRF2I019 (flexiiANT), Polarization Linear, PK Gain=1.9dBi
LoRa Radio		External	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
	Detachable/Non Detachable		Detachable (Professional Installation)
Model# / Serial#			T0007242 / 2101K0001
Power	supply:		POE

* Contain Pre-certified LTE Module

<u>Note:</u> All three channels of LoRa Radio for T0007242 with highest gain external antenna were evaluated. Worse Channel was selected for detail analysis for radiated emission.

1.4 General Test Conditions and Assumptions

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.

The environmental conditions are recorded during each test and are reported in the relevant sections of this document.

1.5 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.

1.5.1 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.

1.5.2 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.

1.5.3 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.

1.5.4 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document "Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002." as based on the "ISO Guide to the Expression of Uncertainty in Measurement, 1995."

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)	±4.6 dB
Radiated Emissions Level (1 GHz – 26.5 GHz)	±5.31 dB
Conducted Emissions Level (150 KHz – 30 MHz)	±2.7 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 = (923 – 928) MHz 500 KHz DTS Mode Max. Conducted Tx Power =27.28dBm (0.535)Watt								
2.1	AC Conducted Emissions (Tx)	15.207	Kona Enterprise Gateway	none	see § 2.1	Compliant			
2.2	Occupied Bandwidth	15.247(a)(1) 15.247(2)(2)	Kona Enterprise Gateway	none	see § 2.2	Compliant			
2.3	Max Average Output Power Conducted	15.247(b)	Kona Enterprise Gateway	none	see § 2.3	Compliant			
2.4	Power Spectral Density	15.247(e) 15.247(f)	Kona Enterprise Gateway	none	see § 2.4	Compliant			
2.5	Band Edge	15.247(d)	Kona Enterprise Gateway	none	see § 2.5	Compliant			
2.6	Conducted Spurious Emission in Non-Restricted Band	15.247(d)	Kona Enterprise Gateway	none	see § 2.6	Compliant			
2.7	EUT Position	ANSI C63.4	Kona Enterprise Gateway	none	see § 2.7	n/a			
2.8	Radiated Spurious Emission in Restricted Band (Tx Mode)	15.205, 15.209 15.247(d)	Kona Enterprise Gateway	none	see § 2.8	Compliant			
2.9	RF Exposure	15.247(i)	Kona Enterprise Gateway	none	see § 2.9	Compliant			

Refer to the test data for applicable test conditions.

2.1 AC Power Line Conducted Emissions

Test Lab: Electronics Test Centre, Airdrie

Test Personnel: Janet Mijares

EUT: Kona Enterprise Gateway Standard: FCC Part 15.207

Date: 2021-04-20 (21.0°C,17.2 % RH)

Basic Standard: ANSI C63.10: 2013

EUT status: Compliant

Comments: Test is performed at AC port of POE adaptor. Although manufacture is not providing the POE adaptor.

Specification: Part15-207

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)			
0.15 – 0.5	66 – 56	56 – 46			
0.5 – 5	56	46			
5 – 30	60	50			
Criteria. The conducted emissions produced by a device shall not exceed the limits on encoified					

Criteria: The conducted emissions produced by a device shall not exceed the limits as specified.

2.1.1 Test Guidance: ANSI C63.4-2014, Clause 7.3.1 & ANSI C63.10: 2013

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.

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:

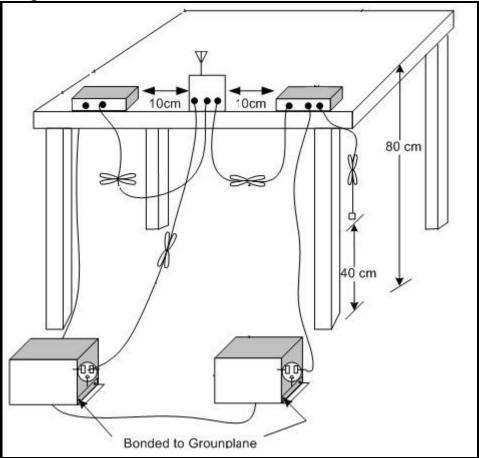
Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy- mm-dd)	Cal. Due (yyyy- mm-dd)
EMC Software	UL	Ver. 9.5	ETC-SW- EMC 2.1	N/A	N/A
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2020-05-27	2021-05-27
LISN	Com-Power	LI-215A	6180	2020-06-30	2022-06-30
Temp/RH logger	Extech	42270	5892	2021-04-06	2022-04-06

2.1.4 Test Sample Verification, Configuration & Modifications

The EUT was set to selected channels with test-specific software. The output was modulated as in normal operation. Configuration in Tx mode. Test was performed at AC port of POE adaptor model# PD-9501GO-ET/AC Manufacture Microsemi Corp.

The EUT met the requirements without modification.

Test setup diagram:



2.1.5 Conducted Emissions Data:

The EUT was evaluated in all transmit mode. No mode of transmission showed emission worst then another. The plots are from the DTS mode using mid-channel.

Freq. Marker	Freq. (MHz)	Raw reading(dΒμν)	Det.	LISN Factor (dB/m)	Cable Loss (dB)	Corrected Reading (dBµV)	FCC 15.207 Limit (dBµV)	Delta (dB)	L/N
1	0.197	18.12	AV	0	.1	18.22	53.73	-35.51	Line
2	0.155	30.71	AV	.1	.2	31.01	55.7	-24.69	Neutral

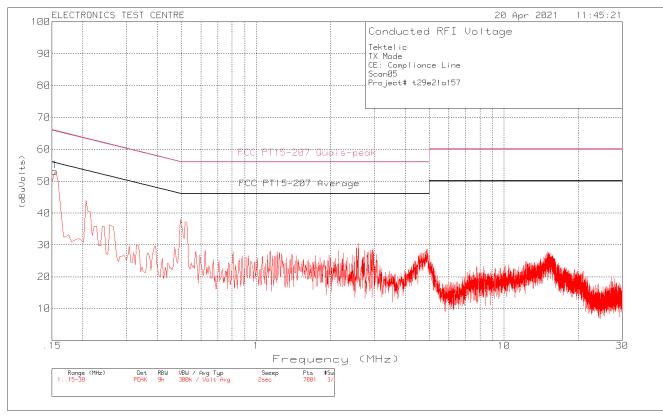
AV = Average Detector

Raw Reading in dBµV + LISN Factor dB + Gain/Loss Factor in dB = Corrected Field Strength in dbµV.

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

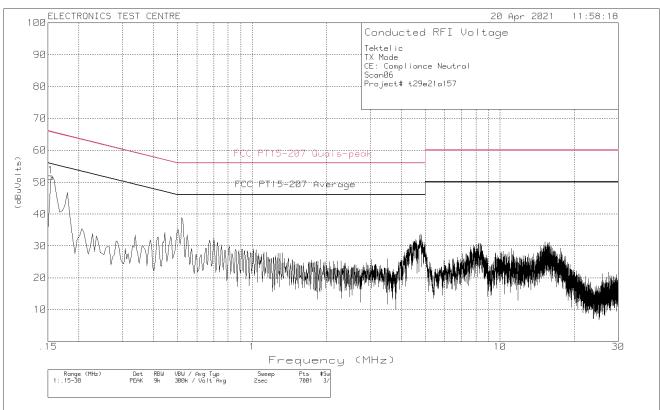
Negative values for Delta indicate compliance.

The Ground Bond was measured and found to be 1.25 m Ω .



Plot of Conducted Emissions: Line

Plot of Conducted Emissions: Neutral



2.2 Channel Occupied Bandwidth

Test Lab: Electronics Test Centre, Airdrie	EUT: Kona Enterprise Gateway
Test Personnel: Imran Akram	Standard: FCC PART 15.247
Date: 2021-03-05 (21.0°C,17.2 % 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 Clause 8.2 / 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 s	Use the following spectrum analyzer settings: DTS 6 dB BW					
Span	between two times and five times the channel center frequency OBW					
RBW	100 KHz					
VBW	Set the VBW \geq [3 x RBW].					
Sweep	Auto Couple					
Detector function	peak					
Trace mode	max hold					
Allow the trace to stabilize. The automatic bandwidth measurement capability of an						
instrument employ	red 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)
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2020-05-27	2021-05-27
Temp/Humidity	Extech	42270	5892	2020-04-07	2021-04-07
Attenuator	FairView Microwave	SA18N5WA-10	6886	2021-02-01	2022-02-01
DC Blocker	MCL	BLK-89-S+	-	2021-02-01	2022-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2021-02-01	2022-02-01

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:

Test Sample: Kona Enterprise Gateway

FCC ID: 2ALEPT0007323

EUT	Attenuator	Spectrum Analyzer

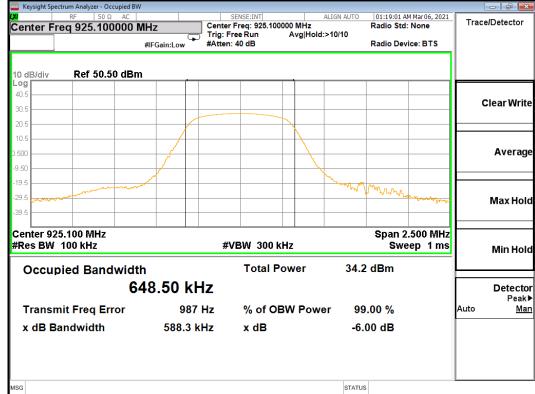
2.2.5 Channel Occupied Bandwidth Data: (LoRa)

Channel	Freq. [MHz]	6 dB OBW [kHz]	99% OBW [KHz]	Limit 6 dB OBW
Low	923.3	594.0	651.02	≥ 500 KHz
Mid	925.1	588.3	648.50	≥ 500 KHz
High	927.5	581.3	645.27	≥ 500 KHz

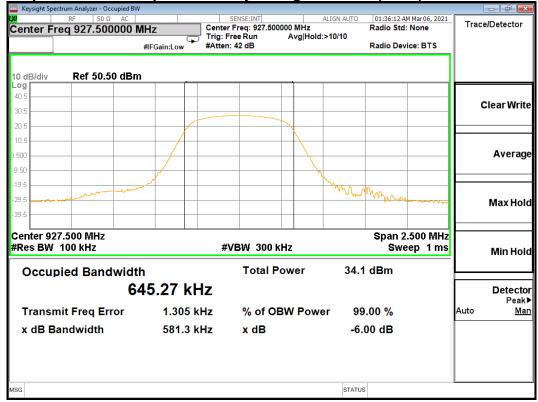
Screen Captures from the spectrum analyzer: Low Channel (LoRa)

	trum Analyzer - Occupied					1			
🕅 Ref Value	RF2 50 Ω AC		SENSE:IN	23.300000 MHz	ALIGN AUTO	12:41:19 AM	1 Mar 06, 2021 None	Trac	e/Detector
		#IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Hold	:>10/10	Radio Devi	ice: BTS		
		an Guineon							
10 dB/div	Ref 50.50 dl	Bm							
40.5									
30.5								(Clear Write
20.5									
10.5									
D.500		/							Average
-9.50									
-19.5		-			- And and a start				
-29.5 Jaro	American					Man	Naghrer and		Max Hold
-39.5									
Center 923	3.300 MHz					Span 2	.500 MHz	├ ──	
#Res BW	100 kHz		#VBW 3	300 kHz		Swe	ep 1 ms		Min Hold
Occup	ied Bandwi	dth	Tot	al Power	35.0	dBm			
Cooup		651.02 k	47						Detector
									Peak▶
Transm	it Freq Error	1.425	kHz %o	of OBW Powe	er 99.	.00 %		Auto	<u>Man</u>
x dB Ba	andwidth	594.0	kHz xd	в	-6.0	0 dB			
MSG					STATUS				





Screen captures from the spectrum analyzer High Channel (LoRa)



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

Test Lab: Electronics Test Centre, Airdrie	EUT: Kona Enterprise Gateway
Test Personnel: Imran Akram	Standard: FCC PART 15.247
Date: 2021-03-05 (21.0°C,17.2 % 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 Clause 8.3.2 / 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.

Outpu	ut 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)
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2020-05-27	2021-05-27
Temp/Humidity	Extech	42270	5892	2020-04-07	2021-04-07
Attenuator	FairView Microwave	SA18N5WA-10	6886	2021-02-01	2022-02-01
DC Blocker	MCL	BLK-89-S+	-	2021-02-01	2022-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2021-02-01	2022-02-01

2.3.4 Test Sample Verification, Configuration & Modifications

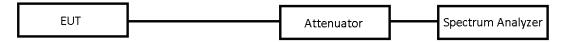
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

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)

Channel	Freq. [MHz]	Out Put Power (dBm)	Out Put Power Limit (dBm)	Margin (dB)
Low	923.3	27.28	30	2.72
Mid	925.1	26.41	30	3.59
High	927.5	25.25	30	4.75

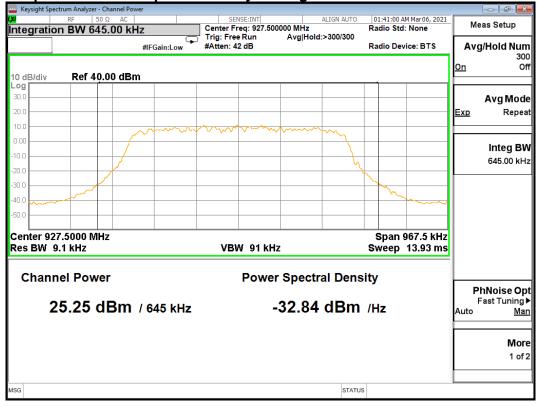
Screen Captures from the spectrum analyzer Low Channel



Screen Captures from the spectrum analyzer: MID Channel



Screen Captures from the spectrum analyzer: High Channel



2.4 **Power Spectral Density**

Test Lab: Electronics Test Centre, Airdrie	EUT: Kona Enterprise Gateway
Test Personnel: Imran Akram	Standard: FCC PART 15.247
Date: 2021-03-05 (21.0°C,17.2 % 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 Clause 8.4 / 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 s	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 amplitude level.	stabilize. Use the peak marker function to determine the maximum

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

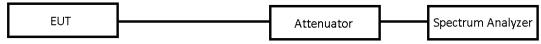
Testing was performed with this equipment:

Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2020-05-27	2021-05-27
Temp/Humidity	Extech	42270	5892	2020-04-07	2021-04-07
Attenuator	FairView Microwave	SA18N5WA-10	6886	2021-02-01	2022-02-01
DC Blocker	MCL	BLK-89-S+	-	2021-02-01	2022-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2021-02-01	2022-02-01

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	923.3	7.849	8
Mid	925.1	6.549	8
High	927.5	6.338	8

Screen Capture from Spectrum Analyzer: LOW Channel



Test Sample: Kona Enterprise Gateway FCC ID: 2ALEPT0007323

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

Next Pk Right Next Pk Le			1						Analyzer - Sw	-	ysight	- Key
Ref Offset 10.5 dB Mkr1 925.101 MHz Next Pea 0.6 6.549 dBm 6.549 dBm Next Pk Rigt 0.6 1 1 1 1 Next Pk Rigt 0.5 1 1 1 1 1 Next Pk Le 0.5 1 1 1 1 1 1 Next Pk Le 0.5 1 1 1 1 1 1 Next Pk Le 0.5 1 1 1 1 1 1 Next Pk Le 0.5 1 1 1 1 1 1 Next Pk Rigt 0.5 1 1 1 1 1	Peak Search	E 1 2 3 4 5 6	TRAC	pe:RMS				0000 MHz			ker	a Aarl
Next Pk Right Next Pk Right Next Pk Right Next Pk Right Next Pk Le Next Pk Le <t< th=""><th>Next Pea</th><th>01 MHz</th><th>[.]1 925.1</th><th></th><th>, (19)</th><th></th><th></th><th>IFG</th><th></th><th></th><th>B/di\</th><th></th></t<>	Next Pea	01 MHz	[.] 1 925.1		, (19)			IFG			B/di\	
Next Pk Le Marker Del Ma	Next Pk Rig				and the state of the office of the state of	1	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				⊢	-0g 20.5 10.5
19:5 1	Next Pk Le	[).500 -9.50 -19.5
Res BW 3.0 kHz #VBW 10 kHz* Sweep 136.1 ms (1001 pts) Image: Mode tric scile X Y Image: Mode tric scile X Image: Mode tric scile Y Image: Image: Mode tric scile Y Image: I	Marker De	mont	Marked Marke								~	-29.5 -39.5 -49.5 -59.5
1 N 1 f 925.101 MHz 6.549 dBm 2 3 4 5 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 1 <td>Mkr→</td> <td>1001 pts)</td> <td>36.1 ms (</td> <td>-</td> <td>UNCTION</td> <td>0 kHz*</td> <td>#VBW</td> <td>×</td> <td></td> <td>N 3.0 I</td> <td>s Bl</td> <td>#Re</td>	Mkr→	1001 pts)	36.1 ms (-	UNCTION	0 kHz*	#VBW	×		N 3.0 I	s Bl	#Re
7 8 8 9 9 0 1 0 1 0 7 1	Mkr→RefL	E				6.549 dBm	I MHz					1 2 3 4 5
m • • • • • • • • • • • • • • • • • • •												7
		•				III						•

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

Keysight Spectrum Analyzer - Swept SA				
RF 50 Ω AC arker 1 927.501000000		ALIGN AUTO Avg Type: RMS	01:43:51 AM Mar 06, 2021 TRACE 1 2 3 4 5 6 TYPE A WWWW	Peak Search
Ref Offset 10.5 dB	PNO: Wide Trig: Free Run IFGain:Low #Atten: 42 dB	Avg Hold:>300/300	1 927.501 MHz 6.338 dBm	NextPeal
21.5	1			Next Pk Righ
1.50 3.50 18.5	have a second			Next Pk Le
28.5 38.5 48.5 58.5			and the second s	Marker Delt
enter 927.5000 MHz Res BW 3.0 kHz IRR MODE TRC SCL X	#VBW 10 kHz*	Sweep 13	Span 1.000 MHz 6.1 ms (1001 pts)	Mkr→C
1 1 2 - 3 - 4 - 5 -				Mkr→RefL
6 7 8 9 0				Mo 1 of
G	m	STATUS	•	

2.5 Band Edge Attenuation (DTS Mode)

Test Lab: Electronics Test Centre, Airdrie	EUT: Kona Enterprise Gateway
Test Personnel: Imran Akram	Standard: FCC PART 15.247
Date: 2021-03-05 (21.0°C,17.2 % 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 §15.209(a) (see §15.205(c)).

2.5.1 Test Guidance: ANSI C63.10-2013 Clause 11.11, 11.13.2, 6.10.4, 6.10.6 / 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 \geq [3 x RBW].			
Sweep	Auto Couple			
Detector function	Peak			
Trace mode	Max Hold.			
Allow the trace to amplitude level.	stabilize. Use the peak marker function to determine the maximum			

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:

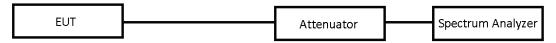
Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2020-05-27	2021-05-27
Temp/Humidity	Extech	42270	5892	2020-04-07	2021-04-07
Attenuator	FairView Microwave	SA18N5WA-10	6886	2021-02-01	2022-02-01
DC Blocker	MCL	BLK-89-S+	-	2021-02-01	2022-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2021-02-01	2022-02-01

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	923.3	58.915 dBc	30 dBc
Channels	927.5	47.223 dBc	30 dBc

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

К	eysight S	pectrur	n Analyz	er - Swep	ot SA											
w Ma	r ker :		F2 1.95	50 Ω 0000	AC	MHz			NSE:INT		Type:	LIGN AUTO Log-Pwr	TRA	M Mar 06, 202 CE 1 2 3 4 5	6	Trace/Detector
		P	of Offe	set 10.	5 48		:Fast ⊂⊾ n:Low	Trig: Fre #Atten: 4		Avg	Hold:>	-300/300 Mkr2	ء 901.95		Z	Select Trace
	B/div			.50 d									-30.5	62 dBn	n	
Log 30.8 20.8	5															Clear Write
10.8 0.500 -9.50 -19.6														DL1 -3.00 dB		Trace Average
-19.6 -29.6 -39.6 -49.6	5		2	- <u>n</u> [hit]n	مىيى يەرىپى مەربىيە مەربىيە مەربىيە		unent for the the	᠂᠇᠆ᠼᡀᡘᡃᠰᢛᢦᠴᢪᡨᠬᡟᡟᢑ	ar Maran	-palaene-An	พระศาสตรท	ሉጣይ- _ፈ ቸርመለበተቀሻች አ	- Albert - and - and			Max Hold
#Re	rt 90 es BV	V 10	0 kHz	2	×		#VBW	7 300 kHz Y		UNCTION		weep 2	.333 ms	23.80 MH (1001 pts ION VALUE	z 5)	Min Hold
1 2 3 4 5 6	N N	1 1	f			300 2 M 950 0 M		28.353 d -30.562 d							=	View Blank Trace On
7 8 9 10 11															-	More 1 of 3
•								m						F.		
MSG												STATUS	6			

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

01:56:26 AM Marolo, 2021 Peak Search TRACE 1 2 3 4 5 6 TYPE MWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWW	ALIGN AUTO Avg Type: Log-Pwr Avg Hold:>10/10 Mkr3	Trig: Free Run #Atten: 42 dB	50 Ω AC .272654531 MHz PNO: Wide IFGain:Low	r⊧ arker 3 928.
928.272 7 MHz -22.271 dBm	-			
Next Pk Righ			Offset 10.5 dB f 40.50 dBm	dB/div Ref
				og 30.5 ↓ 1 20.5 ↓
DL1 -6.00 dBm Next Pk Le			\wedge^2 3	9.5
Marker De	how we have the second second	te bothe marked and a second	who have and have an	9.5
Stop 930.000 MHz 333 ms (5000 pts) Mkr→0	Sweep 1	300 kHz	kHz #VI	tart 927.500 M Res BW 100 H
Mkr→RefL		26.275 dBm -20.947 dBm -22.271 dBm	927.574 5 MHz 928.050 0 MHz 928.272 7 MHz	1 N 1 f 2 N 1 f 3 N 1 f 4 5 6
Ma 1 o				7 8 9 0 1
•	STATU	m		G

2.6 Conducted Spurious Emissions in non-restricted frequency bands

EUT: Kona Enterprise Gateway
Standard: FCC PART 15.247
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 6.7, 7.8.8 / 11.11.1(b) and 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 \geq 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)
EMI receiver	Agilent	N9038A (FW A.25.05)	6130	2020-05-27	2021-05-27
Temp/Humidity	Extech	42270	5892	2020-04-07	2021-04-07
Attenuator	FairView Microwave	SA18N5WA-10	6886	2021-02-01	2022-02-01
DC Blocker	MCL	BLK-89-S+	-	2021-02-01	2022-02-01
CE Cable (50cm length)	Huber+Suhner	Enviroflex 400	-	2021-02-01	2022-02-01

2.6.4 Test Sample Verification, Configuration & Modifications

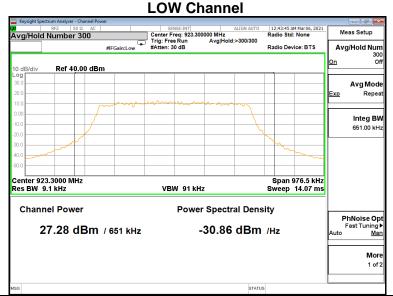
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

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

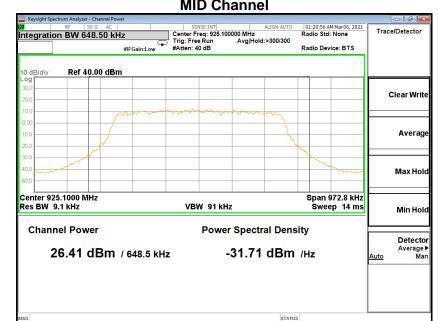
Test setup diagram for Conducted Spurious Emissions testing:

EUT	Attenuator	Spectrum Analyzer
-----	------------	-------------------

2.6.5 Conducted Spurious Emissions Data: LoRa

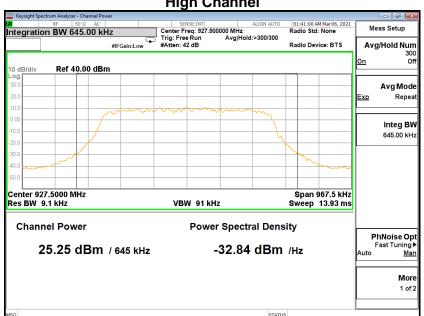


wy Keysight Spectrum Analyzer - Swept SA			📃 🔤 Keysight Spectrum Analyzer - Swept SA			- 8 -
	ALIGN AUTO 01:02:43 AM Mar 06, 2021 Type: Log-Pwr TRACE 1 2 3 4 5 6 Hold:>10/10 TYPE M WWWW	Trace/Detector	Marker 2 2.6877266572	38 GHz	ALIGN AUTO 01:04:28 AM Mar06, 2021 Avg Type: Log-Pwr TRACE 1 2 3 4 5 6 Avg Hold:>10/10 Type M	Peak Search
PNO: Fast 🖵 Trig: Free Run Avg H IFGain:Low #Atten: 40 dB	DET P NNNN	Select Trace		PNO: Fast 🕌 Trig: Free Run IFGain:Low #Atten: 40 dB	DET P N N N N	Next Peak
Ref Offset 10.5 dB 10 dB/div Ref 30.50 dBm	Mkr1 73.6 kHz -33.428 dBm	1	Ref Offset 11.5 d 10 dB/div Ref 41.50 dBn		Mkr2 2.687 7 GHz -34.669 dBm	Hexti cuk
20.5		Clear Write	31.5 21.5			Next Pk Right
0.500	0L1-3.00 vBm		11.5			
-9.50		Trace Average	-8.50		DL1-2.00 dBm	Next Pk Left
-29.5			-18.5	▲2		
-49.5	in gradie and in this second methods are seen as a second more that with	Max Hold	-38.5			Marker Delta
-59.5			-48.5			
Start 30 kHz #Res BW 10 kHz #VBW 300 kHz	Stop 30.00 MHz Sweep 279.2 ms (99700 pts)		Start 30 MHz #Res BW 100 kHz	#VBW 300 kHz	Stop 10.000 GHz Sweep 957.1 ms (99700 pts)	Mkr→CF
MKR MODE TRC SCL X Y FUNCTION 1 N 1 f 73.6 kHz -33.428 dBm	FUNCTION WIDTH FUNCTION VALUE		MKR MODE TRC SCL 1 N 1 f	923.3 MHz 29.088 dBm	CTION FUNCTION WIDTH FUNCTION VALUE	
2 3 4 5 6	E	View Blank Trace On	2 N 1 f 3 4 5	2.687 7 GHz -34.669 dBm	E	Mkr→RefLvl
5 8 9		More	9			More
10 11 • • • • • •		1 of 3	10	III		1 of 2
MSG	STATUS 🦺 DC Coupled		MSG		STATUS	



Marker 1 100 dB/div Sense:INT ALIGN AUTO [01:29:12 MM Mar66, 2021] Peak Search Marker 1 Display Line 1 Sense:INT ALIGN AUTO [01:29:12 MM Mar66, 2021] Display Line 1 ALIGN AUTO [01:29:12 MM Mar66, 2021] Display Line 1 ALIGN AUTO [01:29:12 MM Mar66, 2021] Display Line 1 ALIGN AUTO [01:29:12 MM Mar66, 2021] Display Line 1 ALIGN AUTO [01:29:12 MM Mar66, 2021] Display Line 1 ALIGN AUTO [01:29:12 MM Mar66, 2021] Display Line 1 AUG Type: Log-Pwr Arg Type: Log-Pwr </th <th>olay otation> Title></th>	olay otation> Title>
Marker 1 107.322600 kHz Arg Type: Log-Pwr ArgHold:>10/10 Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Display Line 1 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Marker 1 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Marker 1 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Marker 1 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Marker 1 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Marker 2 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Marker 2 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Marker 2 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Marker 2 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Trace[]: 3:3:5 6 Display Line 1 -4.00 dBm Arg Type: Log-Pwr ArgHold:>10/10 Marker 2 -4.00 dBm	otation►
Marker 1 107.322000 KHZ Trig: Free Run IFGain:Low Trig: Free Run #Atten: 42 dB Trig: Free Run #Atten: 42 dB Avgilhoid:>10/10 Trig: Free Run #Atten: 42 dB Avgilhoid:>10/10 Ref Offset 11.5 dB Mkr1 107.32 kHz -30.623 dBm Next Peak Ref Offset 11.5 dB Mkr2 2.647 224 7 GHz -31.830 dBm Anite 10 dB/div Ref 31.50 dBm -31.830 dBm -31.830 dBm -31.830 dBm	otation►
Ref Offset 11.5 dB Mkr1 107.32 kHz -30.623 dBm Next Peak Ref Offset 11.5 dB Mkr2 2.647 2247 GHz -31.830 dBm And -31.830 dBm 21.5	
Ref Offset 11.5 dB IMKLT 107.32 KHZ Ref Offset 11.5 dB IMKLT 22.047 224 7 GHZ 10 dB/div Ref 31.50 dBm -30.623 dBm 10 dB/div Ref 41.50 dBm -31.830 dBm 21.5 Image: State Stat	
Ref Onset 115 db -30.623 dBm -30.623 dBm -30.623 dBm -31.830 dBm -31.830 dBm 21.5 - <t< td=""><td>Title►</td></t<>	Title►
	Title►
Next Pk Right	Title►
Next Pk Right	Title►
11.5	
8.50 1.50 1.50 1.50 0.00 dbm	Graticule
	Off
-28.5	
	olay Line
	4.00 dBm Off
	011
Start 30 MHz Stop 30.00 MHz Stop 10.000 GHz Start 30 MHz Stop 10.000 GHz	
#Res BW 10 kHz #VBW 300 kHz Sweep 280.0 ms (100001 pts) Mkr→CF #Res BW 100 kHz #VBW 300 kHz Sweep 953.3 ms (100001 pts) Displ	yLines▶
MRR MODE TRC SCL X Y FUNCTION FUNCTION MOTH FUNCTION VALUE A	
1 N 1 f 925/106 6 MHz 28.604 dBm 2 1 N 1 f 925/106 6 MHz 28.604 dBm	
	System
	Display► ettings
	stangs
NSG STATUS	

MID Channel



High Channel

MSG			STATUS			
Keysight Spectrum Analyzer - Swept SA			Keysight Spectrum Analyzer - Swept SA			
Marker 1 71.966393 kHz Avg Type: Log		Trace/Detector	RF 50 Ω AC Arker 2 2.834860100000 GHz		ALIGN AUTO 01:52:24 AM Mar 06, 2021 Type: Log-Pwr TRACE 1 2.3 4 5 6 told:>10/10 TYPE M WWWW	Peak Search
PNO: Fast Trig: Free Run Avg Hold:>10/ IFGain:Low #Atten: 42 dB	DET P NNNN	Select Trace	PNO: Fas IFGain:Lo		DET P NNNN	NextPeak
Ref Offset 10.5 dB 10 dB/div Ref 31.50 dBm	Mkr1 72 kHz -31.012 dBm	1	Ref Offset 11.5 dB 0 dB/div Ref 41.50 dBm		Mkr2 2.834 860 1 GHz -32.853 dBm	Nextreak
21.5		Clear Write	31.5			Next Pk Right
11.5	DL1 -5.00 dBm		21.5			
-8.50		Trace Average	1.50		DL1 -5.00 dBm	Next Pk Left
-18.5			18.5			
-38.5		Max Hold				Marker Delta
140.5 Performance of the second state of the s	n still se i la de statem serai la instance () i se perta se site a stra la ins		48.5			
Start 30 kHz #VBW 10 kHz Swe	Stop 30.00 MHz ep 361.6 ms (5000 pts)		Start 30 MHz #Res BW 100 kHz #	/BW 300 kHz	Stop 10.000 GHz Sweep 953.3 ms (100001 pts)	Mkr→CF
MKR MODE TRC SCL X Y FUNCTION FUNCTION	N WIDTH FUNCTION VALUE		MKR MODE TRC SCL X		FUNCTION WIDTH FUNCTION VALUE	
1 N 1 f 72 kHz -31.012 dBm 2 3 4 5 6	E	View Blank Trace On	1 N 1 f 927.574 5 MHz 2 N 1 f 2.834 860 1 GHz 3 4 5 5	27.355 dBm -32.853 dBm	E	Mkr→RefLvl
7 8 9 10 11		More 1 of 3	7 8 9 10			More 1 of 2
•	•			m	•	
MSG STATUS DC Coupled MSG STATUS						

2.7 EUT Positioning Assessment

Test Lab: Electronics Test Centre, Airdrie	EUT: Kona Enterprise Gateway					
Test Personnel:	Standard: FCC PART 15.247					
Date:	Basic Standard: ANSI C63.4-2014					
n/a						
Comments: EUT be in fixed position in final installation.						

2.8 Radiated Spurious Emissions in restricted frequency bands (Co-Location)

Test Lab: Electronics Test Centre, Airdrie

Date: 2021-04-12/23/24/26 (20.4°C,19.6% RH)

EUT: Kona Enterprise Gateway

Standard: FCC PART 15.247

Test Personnel: Janeth Mijares, Brandon Vanhee

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, 6.0 / 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:

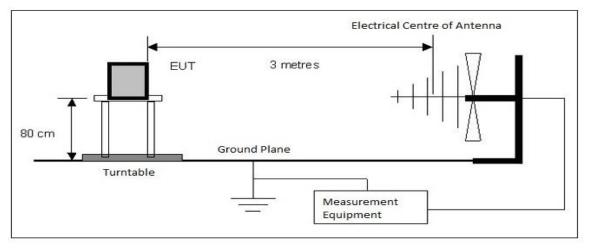
Equipment	Manufacturer	Model #	Asset #	Cal. Date (yyyy-mm-dd)	Cal. Due (yyyy-mm-dd)	
EMC Software	UL	Ver. 9.5	ETC-SW-EMC 2.1	N/A		
EMI receiver	EMI receiver Agilent		6130	2020-05-27	2021-05-27	
Loop Antenna	EMCO	6502	10868	2021-04-15	2021-04-15	
Biconilog Antenna	AR	JB1	6905	2019-10-14	2021-10-14	
DRG Horn	EMCO	3115	19357	2020-09-29	2022-09-29	
Humidity/Temp Logger	Extech Ins. Corp.	42270	5892	2021-04-06	2022-04-06	
Low Noise Amplifier (1 – 18 GHz)	MITEQ	JS43-01001800- 21-5P	4354	2021-02-01	2022-02-03	
Pre-Amplifier (30 – 1400 MHz)	HP	8447D	9291	2021-02-01	2022-02-03	
RE Cable below Insulated Wire 1GHz Inc.		KPS-1501A- 3600-KPA- 01102006	4419	2021-02-01	2022-02-03	
Re Cable Above 1 GHz	A.H. System Inc.	SAC-26G-8.23	6187	2021-02-01	2022-02-03	
High Pass Filter	K&L	4DH21	-	2021-02-01	2022-02-03	

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. During spurious emission both LTE pre-certified module and LoRa transmitting simultaneously.

The EUT met the requirements without modification.





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

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	<u>960 - 1240</u>	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 $dB_{\mu}V$ + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in $db_{\mu}V/m$.

Delta = Field Strength - Limit

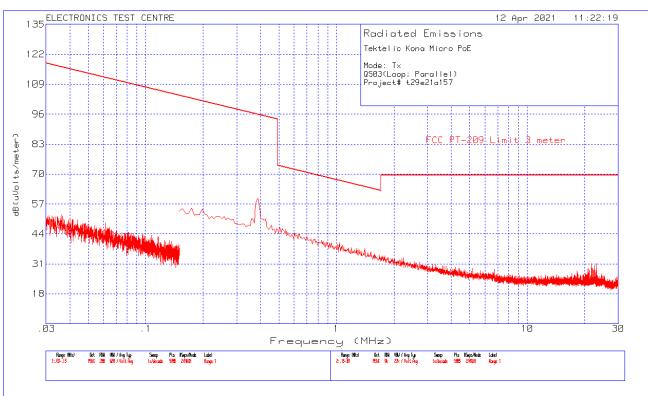
- **Notes:** When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
 - Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. 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 LOW band channel 923.3 MHz was selected as the worst-case condition for detailed examination.

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	*37.54	16.67	QP	19.5	1.7	37.87	40.01	-2.14	57	124	Vertical
2	*108.80	15.6	QP	16.6	2.7	34.9	43.52	-8.62	212	104	Vertical
3	*249.99	18.37	QP	15.5	4.1	37.97	46.02	-8.05	97	109	Vertical
1	1846.6	56.31	РК	28	-34.6	49.71	74	-24.29	137	158	Vertical
1	1846.6	52.31	AV	28	-34.6	45.71	54	-8.29	137	158	Vertical
2	9561.3	47.71	РК	37.7	-26.1	59.31	74	-14.69	314	262	Horizontal
2	9561.3	39.74	AV	37.7	-26.1	51.34	54	-2.66	314	262	Horizontal
3	9561.3	47.82	РК	37.7	-26.1	59.42	74	-14.58	330	124	Vertical
3	9561.3	39.7	AV	37.7	-26.1	51.38	54	-2.62	330	124	Vertical

- In Transmit mode, the EUT was assessed up to 10.0 GHz.

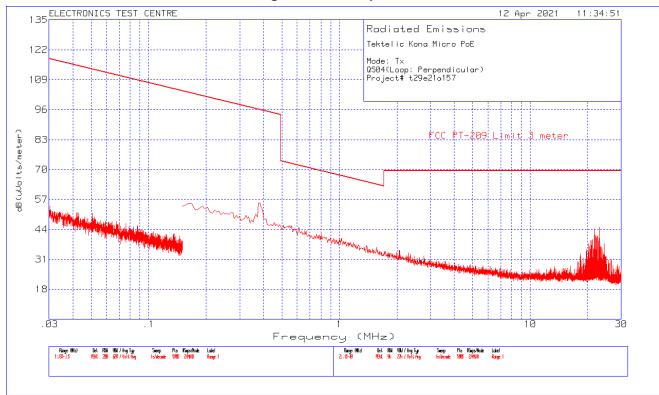
Negative values for Delta indicate compliance.

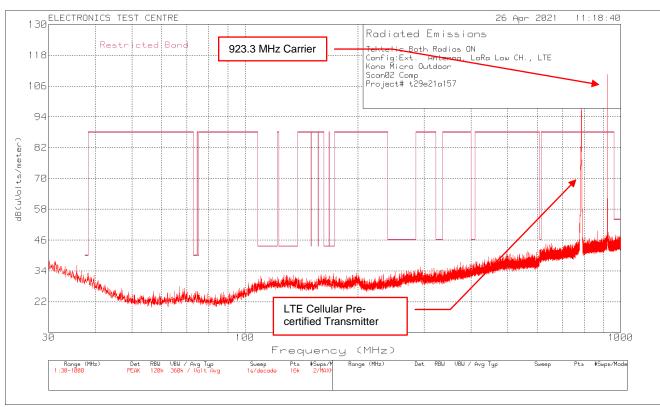
QP: Quasi Peak Detector * Restricted Band (RB) Non Restricted Band (NRB)



Plot of Radiated Emissions: Measuring Antenna Parallel

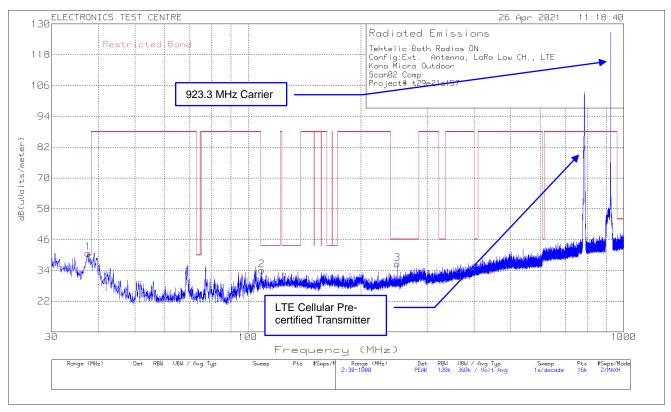
Plot of Radiated Emissions: Measuring Antenna Perpendicular



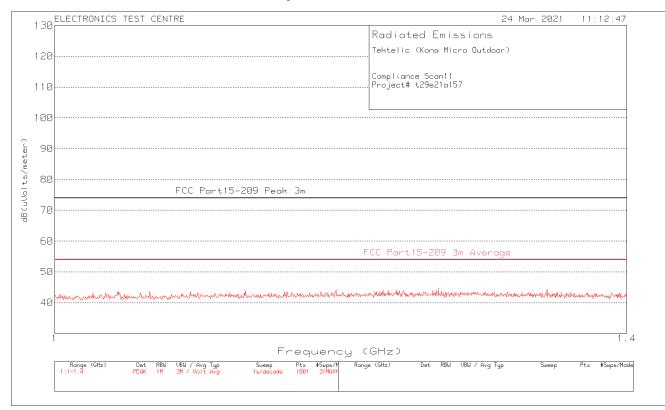


Plot of Radiated Emissions: Horizontal polarization

Plot of Radiated Emissions: Vertical polarization

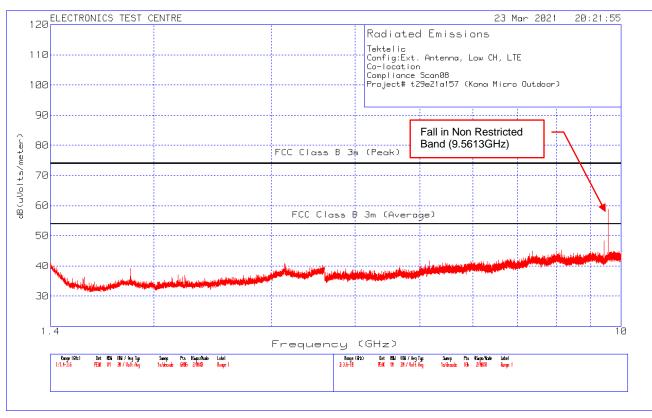


Plot of Radiated Emissions: Horizontal polarization



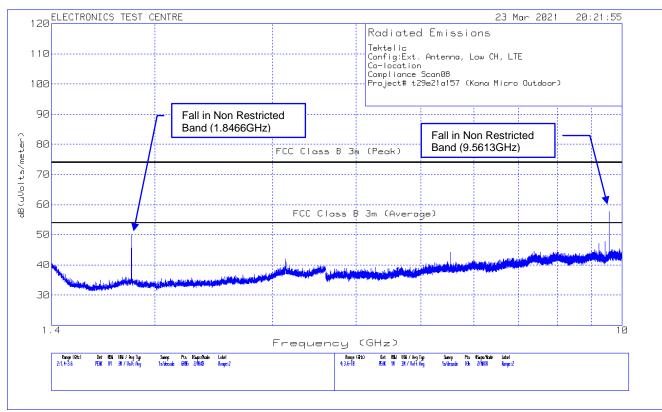
Plot of Radiated Emissions: Vertical polarization





Plot of Radiated Emissions: Horizontal polarization

Plot of Radiated Emissions: Vertical polarization



2.9 RF Exposure

Test Lab: Electronics Test Centre, Airdrie

Test Personnel:

Date:

EUT: Kona Enterprise Gateway Standard: FCC PART 15.247

EUT status: Complaint

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

3.0 TEST FACILITY

3.1 Location

The Kona Enterprise Gateway 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.

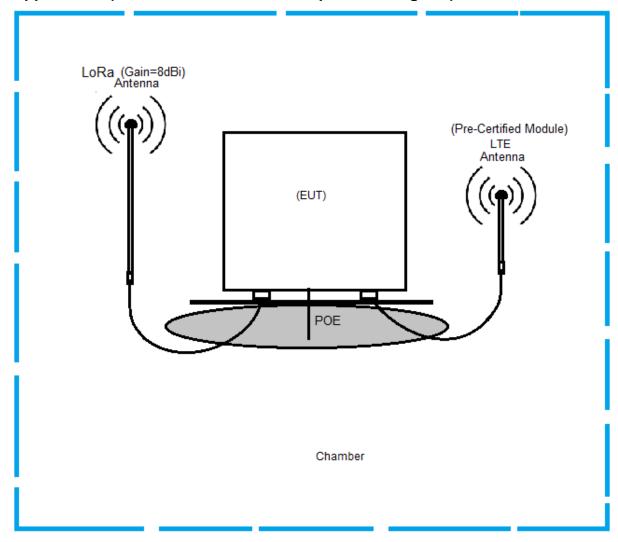
3.2 Grounding Plan

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

3.3 Power Supply

All EUT power was supplied via Power over Ethernet (POE).

Appendix A (Worse Emission test Setup Block Diagram)



End of Document