

Test Report # 317347 D

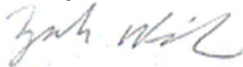
Equipment Under Test: KOLO Gen2 KOLO Gen2 WiFi Module

Requirement: FCC 1.1037, 2.1091, 2.1093, ISED Canada RSS-102 for a module

Test Date(s): October 12th, 2020

Prepared for: Georgia Pacific
Attn: Randall Duval
1915 Marathon Avenue
Neenah, WI 54956

Report Issued by: Zach Wilson, EMC Engineer

Signature: 

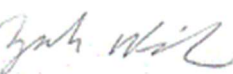
Date: 9/23/2021

Report Reviewed by: Adam Alger, Laboratory Manager

Signature: 

Date: 8/3/2021

Report Constructed by: Zach Wilson, EMC Engineer

Signature: 

Date: 7/29/2021

This test report may not be reproduced, except in full, without written approval of Laird Connectivity.

Company: Georgia Pacific	Page 1 of 19	Name: KOLO Gen2 WiFi Module
Report: TR319295 D		Model: ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Job: C-3397		Serial: Engineering Sample

CONTENTS

Contents.....	2
Laird Connectivity Test Services in Review	3
1 Test Report Summary	4
2 Client Information.....	5
2.1 Equipment Under Test (EUT) Information	5
2.2 Product Description	5
2.3 Modifications Incorporated for Compliance.....	6
2.4 Deviations and Exclusions from Test Specifications	6
2.5 Channels and Data Rates	6
2.6 Radio Programming	6
2.7 Antennas	6
2.8 Distance to End User.....	7
3 References	8
4 Uncertainty Summary	9
5 Test Data	10
5.1 Antenna Port Conducted Emissions.....	10
Data – 5 GHz WLAN.....	11
Data – 2.4 GHz WLAN.....	13
6 Exclusion Calculation.....	14
6.1 Highest Power Test Cases	14
6.2 FCC – 5 GHz WLAN	15
6.3 ISED Canada – 5 GHz WLAN	16
6.4 FCC – 2.4 GHz WLAN	17
6.5 ISED Canada - 2.4 GHz WLAN	18
7 Revision History	19

Laird Connectivity Test Services in Review

The Laird Connectivity laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:



A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted



Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers



Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

Company: Georgia Pacific	Page 3 of 19	Name: KOLO Gen2 WiFi Module
Report: TR3193295 D		Model: ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Job: C-3397		Serial: Engineering Sample

1 TEST REPORT SUMMARY

On **October 12th, 2020** the Equipment Under Test (EUT), **KOLO Gen2 WiFi Module**, as provided by **Georgia Pacific** was tested to the following requirements:

Requirement	Description	Specification	Method	Result
FCC Part 1.1307, 2.1091, 2.1093	RF Exposure and equipment authorization requirements	Reported	FCC KDB 447498	Reported
ISED Canada RSS-102	Radio Frequency Radiation Exposure Evaluation	Reported	RSS-102 Section 2.5.2	Reported

Notice:

The results relate only to the item tested and described in this report. Any modifications made to the equipment under test after the specified test date(s) may invalidate the data herein.

If the resulting measurement margin is seen to be within the uncertainty value, as listed in this report, the possibility exists that this unit may not meet the required limit specification if subsequently tested.

2 CLIENT INFORMATION

Company Name	Georgia Pacific
Contact Person	Randall Duval
Address	1915 Marathon Avenue Neenah, WI 54956

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	KOLO Gen2 WiFi Module
Model Number	ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Serial Number	Engineering Sample
FCC ID	2AALY-530GP
IC ID	21620-530GP

2.2 Product Description

The 530GP is a module consisting of the Texas Instruments CC3135 WLAN 2.4/5 GHz and the Laird BL654 BLE module. The radios are not capable of simultaneous transmission. Multiple antenna options and model variants are available and listed below. The device is powered by 3.3VDC. The antenna port was terminated at 50Ω for radiated testing. The chip antenna version was tested for radiated emissions with emissions being lower than those produced by the terminated method.

Model Variants:

- HVIN ASM-0000001220:** This variant of the module has an onboard Wi-Fi chip antenna on the PCB of the daughter card. No external antenna is used on this variant.
- HVIN ASM-0000001303:** This variant of the module has an onboard Wi-Fi chip antenna on the PCB of the daughter card and is identical to ASM-0000001220 other than the FFC cable connector on the PCB at position J7 being mounted vertically. No external antenna is used on this variant.

- c. **HVIN ASM-0000000791:** This variant of the module has an external antenna connected to the Wi-Fi/BLE daughter card via u.FL connector on the daughter card. The antenna is mounted within the end device housing and is fully contained within the end device. The external antenna provides improved range for connectivity between the end device and the Wi-Fi access point.
- d. **HVIN ASM-0000001327:** This variant of the module has an external antenna connected to the Wi-Fi/BLE daughter card via u.FL connector on the daughter card and is identical to ASM-0000000791 other than the FFC cable connector on the PCB at position J7 being mounted vertically.

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Channels and Data Rates

Channels	Protocol	Data Rate
UNII-1: 36, 40, 44, 48 UNII 2A: 52, 56, 64 UNII 2C: 100, 116, 140 UNII 3: 149, 157, 165	802.11a 802.11n HT20	6Mbps, 54Mbps MCS0, MCS7

Channels	Protocol	Data Rate
1-11	802.11b	1 Mbps, 11 Mbps
1-11	802.11g	6 Mbps, 54 Mbps
1-11	802.11n HT20	MCS0, MCS7

2.6 Radio Programming

The WLAN radios were programmed using the Texas Instruments CC31XX/CC32XX Radio Tool v1.0.3.15.

2.7 Antennas

Radio	Antenna Type	Manufacturer	Model Number	Peak Gain (dBi)
WLAN 5	Chip	Yageo	ANT5320LL24R2455A	3.5
WLAN 5	Flexible (FlexPIFA)	Laird	001-0016	3.0
WLAN 2.4	Flexible (FlexPIFA)	Laird	001-0016	2.5
WLAN 2.4	Chip	Yageo	ANT5320LL24R2455A	2.2

Company: Georgia Pacific	Page 6 of 19	Name: KOLO Gen2 WiFi Module
Report: TR3193295 D		Model: ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Job: C-3397		Serial: Engineering Sample

2.8 Distance to End User

The 2.4 GHz and 5 GHz WLAN radios will be further than 20cm from the end user per the manufacturer.

Company: Georgia Pacific	Page 7 of 19	Name: KOLO Gen2 WiFi Module
Report: TR3193295 D		Model: ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Job: C-3397		Serial: Engineering Sample

3 REFERENCES

Publication	Edition	Date
CFR 47 Part 15	-	2021
ANSI C63.10	-	2013
RSS-247	2	2017
RSS GEN	5	2014
RSS-102	5	2015
CFR 47 Part 1 and 2	-	2021

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of $k = 2$.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty $\pm$
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

Parameter	ETSI U.C. $\pm$	U.C. $\pm$
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

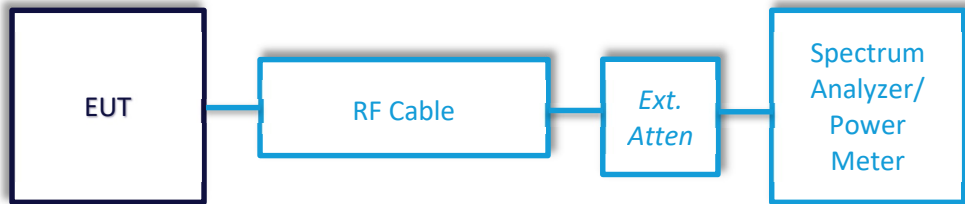
Company: Georgia Pacific	Page 9 of 19	Name: KOLO Gen2 WiFi Module
Report: TR3193295 D		Model: ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Job: C-3397		Serial: Engineering Sample

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



5.1.1 Antenna Port Conducted Emissions

Data – 5 GHz WLAN

Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Corrected Conducted Output Power (dBm)
802.11a	6Mbps	36	4.1	5.4	9.5
802.11a	6Mbps	40	5.9	5.4	11.3
802.11a	6Mbps	44	6.0	5.4	11.4
802.11a	6Mbps	48	5.6	5.4	11.0
802.11a	6Mbps	52	6.3	5.4	11.7
802.11a	6Mbps	56	6.5	5.4	11.9
802.11a	6Mbps	64	6.4	5.4	11.8
802.11a	6Mbps	100	6.2	5.4	11.6
802.11a	6Mbps	116	8.3	5.4	13.7
802.11a	6Mbps	140	3.4	5.4	8.8
802.11a	6Mbps	149	7.6	5.4	13.0
802.11a	6Mbps	157	8.6	5.4	14.0
802.11a	6Mbps	165	6.4	5.4	11.8

Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Corrected Conducted Output Power (dBm)
802.11a	54Mbps	36	-4.2	12.5	8.3
802.11a	54Mbps	40	-3.6	12.5	8.9
802.11a	54Mbps	44	-3.3	12.5	9.2
802.11a	54Mbps	48	-4.2	12.5	8.3
802.11a	54Mbps	52	-2.8	12.5	9.7
802.11a	54Mbps	56	-3.2	12.5	9.3
802.11a	54Mbps	64	-1.2	12.5	11.3
802.11a	54Mbps	100	-1.1	12.5	11.4
802.11a	54Mbps	116	-1.7	12.5	10.8
802.11a	54Mbps	140	-3.3	12.5	9.2
802.11a	54Mbps	149	-1.5	12.5	11.0
802.11a	54Mbps	157	-0.7	12.5	11.8
802.11a	54Mbps	165	-1.5	12.5	11.0

Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Corrected Conducted Output Power (dBm)
802.11n	MCS0	36	4.2	5.4	9.6
802.11n	MCS0	40	5.9	5.4	11.3
802.11n	MCS0	44	6.1	5.4	11.5
802.11n	MCS0	48	5.4	5.4	10.8
802.11n	MCS0	52	6.4	5.4	11.8
802.11n	MCS0	56	6.9	5.4	12.3
802.11n	MCS0	64	6.6	5.4	12.0
802.11n	MCS0	100	5.9	5.4	11.3
802.11n	MCS0	116	8.4	5.4	13.8
802.11n	MCS0	140	3.3	5.4	8.7
802.11n	MCS0	149	7.8	5.4	13.2
802.11n	MCS0	157	8.6	5.4	14.0
802.11n	MCS0	165	6.3	5.4	11.7

Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Corrected Conducted Output Power (dBm)
802.11n	MCS7	36	-4.1	11.2	7.1
802.11n	MCS7	40	-3.3	11.2	7.9
802.11n	MCS7	44	-3.2	11.2	8.0
802.11n	MCS7	48	-3.6	11.2	7.6
802.11n	MCS7	52	-2.9	11.2	8.3
802.11n	MCS7	56	-2.5	11.2	8.7
802.11n	MCS7	64	-1.0	11.2	10.2
802.11n	MCS7	100	-0.7	11.2	10.5
802.11n	MCS7	116	-1.0	11.2	10.2
802.11n	MCS7	140	-2.1	11.2	9.1
802.11n	MCS7	149	-1.3	11.2	9.9
802.11n	MCS7	157	-0.9	11.2	10.3
802.11n	MCS7	165	-1.5	11.2	9.7

Data – 2.4 GHz WLAN

Protocol	Data Rate	Channel	Measured Output Power (dBm)	Duty Cycle Correction Factor (dB)	Corrected Conducted Output Power (dBm)
802.11b	1Mbps	1	13.1	1.7	14.8
802.11b	1Mbps	6	13.2	1.7	14.9
802.11b	1Mbps	11	13.9	1.7	15.6
802.11b	11Mbps	1	11.6	3.2	14.8
802.11b	11Mbps	6	11.9	3.2	15.1
802.11b	11Mbps	11	12.0	3.2	15.2
802.11g	6Mbps	1	4.7	5.4	10.1
802.11g	6Mbps	6	9.4	5.4	14.8
802.11g	6Mbps	11	4.8	5.4	10.2
802.11g	54Mbps	1	-2.2	12.7	10.5
802.11g	54Mbps	6	-1.8	12.7	10.9
802.11g	54Mbps	11	-2.1	12.7	10.6
802.11n	MCS0	1	4.9	5.5	10.4
802.11n	MCS0	6	8.3	5.5	13.8
802.11n	MCS0	11	4.9	5.5	10.4
802.11n	MCS7	1	-2.5	11.0	8.5
802.11n	MCS7	6	-2.2	11.0	8.8
802.11n	MCS7	11	-2.2	11.0	8.8

6 EXCLUSION CALCULATION

6.1 Highest Power Test Cases

5 GHz WLAN: 14.0 dBm at 5320 MHz (Tune up Tolerance = +/- 2 dB)

2.4 GHz WLAN: 15.6 dBm at 2450 MHz (Tune up Tolerance = +/- 2 dB)

Antenna Gain: 2.5 dBi @ 2.4 GHz, 3.5 dBi @ 5 GHz

Company: Georgia Pacific	Page 14 of 19	Name: KOLO Gen2 WiFi Module
Report: TR3193295 D		Model: ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Job: C-3397		Serial: Engineering Sample

6.2 FCC – 5 GHz WLAN

Worst Case Scenario: 14.0 dBm at 5320 MHz

Tune-Up Tolerance: 2.0 dB

Total Power: 16.3 dBm = 42.7 mW

Peak Antenna Gain: 3.5 dBi

Prediction of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density

P = power input to the antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	16.30 (dBm)
Maximum peak output power at antenna input terminal:	42.658 (mW)
Antenna gain(typical):	3.5 (dBi)
Numeric Antenna Gain:	2.239 (numeric)
Prediction distance:	20 (cm)
Prediction frequency:	5320 (MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0 (mW/cm ²)
Power density at prediction frequency:	0.018999 (mW/cm ²)

Result

The EUT's 5GHz WLAN radio complies with the FCC MPE limits at a 20cm separation distance as the power density of **0.018999 mW/cm²** is lower than the MPE limit of **1.0 mW/cm²**.

6.3 ISED Canada – 5 GHz WLAN

Per Section 2.5.2:

Maximum EIRP Limit = $(f(\text{MHz})^{0.6834}) * 1.31 * 10^{-2} \text{ W} = 4.6 \text{ W}$

Result

The EUT's 5GHz WLAN radio meets ISED's MPE Exemption limit at 20 cm as the maximum **95.5 mW EIRP** is less than **4.6 W**.

Company: Georgia Pacific	Page 16 of 19	Name: KOLO Gen2 WiFi Module
Report: TR3193295 D		Model: ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Job: C-3397		Serial: Engineering Sample

6.4 FCC – 2.4 GHz WLAN

Worst Case Scenario: 15.6 dBm at 2450 MHz

Tune-Up Tolerance: 2.0 dB

Total Power: 17.6 dBm = 57.5 mW

Peak Antenna Gain: 2.5 dBi

Prediction of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density

P = power input to the antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	17.60 (dBm)
Maximum peak output power at antenna input terminal:	57.544 (mW)
Antenna gain(typical):	3.5 (dBi)
Numeric Antenna Gain:	2.500 (numeric)
Prediction distance:	20 (cm)
Prediction frequency:	2450 (MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1.0 (mW/cm ²)
Power density at prediction frequency:	0.028620 (mW/cm ²)

Result

The EUT's 2.4GHz WLAN radio complies with the FCC MPE limits at a 20cm separation distance as the power density of **0.02862 mW/cm²** is lower than the MPE limit of **1.0 mW/cm²**.

6.5 ISED Canada - 2.4 GHz WLAN

Per Section 2.5.2:

Maximum EIRP Limit = $(f(\text{MHz})^{0.6834}) * 1.31 * 10^{-2} \text{ W} = 2.7 \text{ W}$

Result

The EUT's 2.4 GHz WLAN radio meets ISED's MPE Exemption limit at 20 cm as the maximum **102.3 mW EIRP** is less than **2.7 W**.

Company: Georgia Pacific	Page 18 of 19	Name: KOLO Gen2 WiFi Module
Report: TR3193295 D		Model: ASM-0000001220, ASM-0000001303, ASM-0000000791, ASM-0000001327
Job: C-3397		Serial: Engineering Sample

7 REVISION HISTORY

Version	Date	Notes	Person
0	7/29/2021	Initial Draft	Zach Wilson
1	9/23/2021	Revised per TCB review	Zach Wilson

END OF REPORT