

Test Report # 319416 B

Equipment Under Test:	LC840PA
Requirement(s):	RSS 102, FCC 2.1091
Test Date(s):	May 3 rd -4 th , 2021
Prepared for:	Johnathan Kaye Laird Connectivity 50 S. Main Street, #1100 Akron, OH 44308

Report Issued by: Zach Wilson, EMC Engineer
 Signature: *Zach Wilson* Date: 12/20/2021

Report Reviewed by: Adam Alger, Laboratory Manager
 Signature: *Adam Alger* Date: 12/15/2021

Report Constructed by: Zach Wilson, EMC Engineer
 Signature: *Zach Wilson* Date: 5/19/2021

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Laird Connectivity Test Services in Review

The Laird Connectivity, Inc. 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

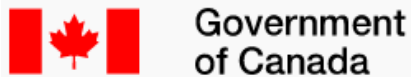
Scope of accreditation includes all test methods listed herein unless otherwise noted



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

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Report: TR319379 C		Model: LC840PA
Job: C-3380		Serial: Engineering Sample

1 TEST REPORT SUMMARY

During **May 3rd-4th, 2021** the Equipment Under Test (EUT), **LC840PA**, as provided by **Laird Connectivity** was tested to the following requirements of the **Federal Communications Commission** and **Innovation, Science and Economic Development Canada** :

Test Requirements	Description	Specification	Method	Compliant
RSS-102	Radio Frequency Exposure Compliance of Radiocommunication Apparatus	Reported	RSS-102 Section 2.5.1	Reported
FCC Part 1.1307, 2.1093	RF Exposure and equipment authorization requirements	Reported	FCC KDB 447498 D01	Reported

Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

Measurement Type	Rule
Emissions – Amplitude	N/A
Emissions – Frequency	N/A
Immunity	N/A

2 CLIENT INFORMATION

Company Name	Laird Connectivity
Contact Person	Johnathan Kaye
Address	50 S. Main Street, #1100 Akron, OH 44308

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	LC840PA
Model Number	LC840PA
Serial Number	Engineering Sample
FCC ID	SQG-LC840PA
IC ID	3147A-LC840PA

2.2 Product Description

Module based off the Laird BL654 PA Bluetooth v5 Power Amplified Module with an added 802.15.4 protocol. Only 802.15.4 radio is enabled in the firmware. The highest gain antenna used is 2 dBi.

2.3 Modifications Incorporated for Compliance

Duty cycle limited to 58.3% via firmware. The client understands the modifications.

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Radio Programming Information

EUT programmed using commands input into Tera Term v4.99. The radio manufacturer provided the commands to put the radio into the correct test modes.

2.6 Distance to User and Use Environment

Per customer, the radio will be greater than 55mm from the user's body/head. The EUT is a portable device used in an uncontrolled environment.

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3 REFERENCES

Publication	Edition	Date
CFR Title 47	-	2021
RSS-102	5	2015
FCC KDB 447498 D01	v06	2015

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 %

5 TEST DATA

5.1 802.15.4 Fundamental Emission

Operator	Jon Dilley	QA	Adam Alger
Temperature	22.0°C, 22.1°C	R.H. %	48.4%, 44.4%
Test Date	5/3/2021, 5/4/2021	Location	Conducted Bench
Requirement	FCC 15.247, RSS-247	Method	ANSI C63.10 §11.9.1.1

Test Parameters

Frequency	2405-2475 MHz
Method	Peak
EUT Power	4.5 VDC
EUT Mode	802.15.4 Transmit
Example Calculation	Conducted Power (e.i.r.p.) = Conducted Power (dBm) + Antenna Gain (dBi)

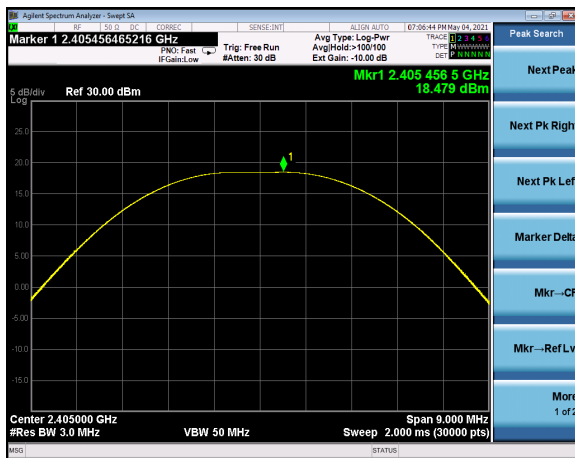
Instrumentation

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Cable	Gore	EKD01D01048.0	5546519	2/3/2021	2/3/2022	Active Verification
2	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	7/14/2020	7/14/2021	Active Calibration

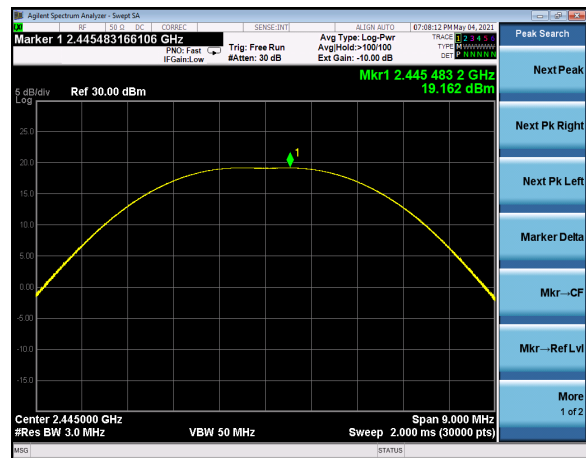
Data Table

Channel	Power Setting	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
11	neg4dBm	18.5	2.0	20.5
19	neg4dBm	19.2	2.0	21.2
25	neg4dBm	19.3	2.0	21.3

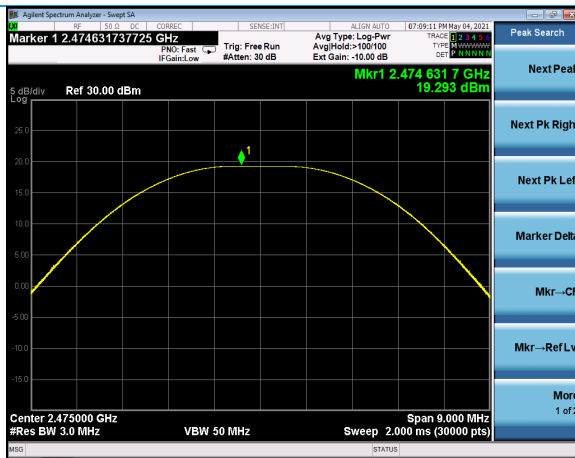
Plots



Output Power, Channel 11, neg4dBm



Output Power, Channel 19, neg4dBm



Output Power, Channel 25, neg4dBm

6 EXCLUSION CALCULATION

6.1 Technical Brief

FCC Worst Case: **19.3 dBm** (Pout) + **1 dB** (Tune-Up Tolerance) = **20.3 dBm = 107.2 mW**

ISED Worst Case: **19.3 dBm** (Pout) + **2 dB** (Maximum Antenna Gain) + **1 dB** (Tune-Up Tolerance) = **22.3 dBm = 169.8 mW = 170 mW**

Test Separation Distance: **55mm or greater**

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6.2 FCC – SAR Test Exclusion Calculation

From KDB 447498 D01 Section 4.3.1:

$$P_{\max} = 107 \text{ mW}$$

$$f_{(\text{GHz})} = 2.45$$

$$D_{\min} = 55 \text{ mm}$$

Power allowed at numeric threshold in step a: 96 mW

b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following (also illustrated in Appendix B):³²

- 1) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm) · (f_(MHz)/150)]} mW, for 100 MHz to 1500 MHz
- 2) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm) · 10]} mW, for > 1500 MHz and ≤ 6 GHz

Power threshold from step b: [96 mW + ((55-50) * 10)] = **146 mW**

CONFORMANCE STATEMENT

Routine SAR testing per FCC is **excluded** when the EUT is used at a **distance of 55mm or greater** from the end user.

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6.3 ISED

EIRP CALCULATION = OP + ANTENNA GAIN + TUNE UP TOLERANCE

19.3 dBm + 2.0 dBi = 22.3 dBm = **170 mW**

Table 1: SAR evaluation — Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

CONFORMANCE STATEMENT

Routine SAR testing per ISED is **excluded** as 170 mW is less than 173 mW when the EUT is at a **distance of 40mm or greater** from the end user.

7 REVISION HISTORY

Version	Date	Notes	Person
0	5/19/2021	Initial Draft	Zach Wilson
1	6/20/2021	Revised per internal review	Zach Wilson
2	12/15/2021	Revised per TCB review	Zach Wilson
3	12/20/2021	Revised per TCB review	Zach Wilson

END OF REPORT