




# Test Report TR3664A BL654

<b>Equipment Under Test:</b>	BL654 - BLE
<b>Requirement(s):</b>	FCC 15.247 RSS-247
<b>Test Date(s):</b>	3/9/2023 – 3/20/2023
<b>Prepared for:</b>	Laird Connectivity Attn: Jonathan Kaye W66 N220 Commerce Ct. Cedarburg, WI 53012

<b>Report Issued by:</b> Anthony Smith, EMC Engineering Specialist	
Signature: 	Date: 02/29/2024
<b>Report Reviewed by:</b> Adam Alger, Laboratory Manager	
Signature: 	Date: 02/29/2024
<b>Report Constructed by:</b> Anthony Smith, EMC Engineering Specialist	
Signature: 	Date: 12/8/2023

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## 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.....	5
2.4 Deviations and Exclusions from Test Specifications .....	5
2.5 Additional Information.....	5
2.6 Additional Information.....	5
3 References .....	6
4 Uncertainty Summary .....	7
5 Test Data .....	8
5.1 Antenna Port Conducted Emissions.....	8
6 Revision History .....	27

## Laird Connectivity Test Services in Review

The Laird Connectivity LLC 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*



**Government  
of Canada**

### Innovation, Science and Economic Development Canada

*Accredited U.S. Identification Number: US0218*

*Recognition of two 3 meter Semi-Anechoic Chambers*

Company: Laird Connectivity	Page 3 of 27	Name: BL654
Report: TR3664A BL654		Model: BL654
Quote: NBO-12-2022-005678		Serial: Engineering Sample

## 1 TEST REPORT SUMMARY

During **March 9<sup>th</sup>, 2023 to March 20<sup>th</sup>, 2023** the Equipment Under Test (EUT), **BL654**, as provided by **Laird Connectivity** was tested to the following requirements:

### FCC 15.247 / RSS-247

Requirements	Description	Specification	Method	Compliant
FCC: 15.247 (b)(3) ISED: RSS-247 5.4 (d)	Maximum Conducted Output Power	<30 dBm	ANSI C63.10	Yes
FCC: 15.247 (d) ISED: RSS-GEN 8.10	Spurious Emissions in Restricted Frequency Bands	FCC 15.209 RSS-GEN8.9	ANSI C63.10	Yes

### 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	1 dB below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

## 2 CLIENT INFORMATION

<b>Company Name</b>	Laird Connectivity
<b>Contact Person</b>	Jonathan Kaye
<b>Address</b>	W66N220 Commerce Court Cedarburg, WI, 53012

### 2.1 Equipment Under Test (EUT) Information

*The following information has been supplied by the client*

<b>Product Name</b>	BL654
<b>Model Number</b>	BL654
<b>Serial Number</b>	Engineering Sample
<b>FCC ID</b>	SQGBL654
<b>IC ID</b>	3147A-BL654

### 2.2 Product Description

Bluetooth 5.0 BLE Data Module

### 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 Additional Information

nRF Connect for Desktop v4.0.0 – Direct Test Mode v2.0.4 used to program EUT. Bluetooth LE (Low Energy) 125k, 500k, 1M, 2M Data Rates. Channels tested: 37 (2402 MHz), 17 (2440 MHz), and 39 (2480 MHz). Dell Latitude 5480 Laptop used to program radio.

### 2.6 Additional Information

This testing is for a permissive change to add the iFlex-Pifa Antenna, with an antenna gain of 3.1 dBi, to the list of antennas usable by the BL654. EUT tested via Cabinet Radiation method.

Company: Laird Connectivity	Page 5 of 27	Name: BL654
Report: TR3664A BL654		Model: BL654
Quote: NBO-12-2022-005678		Serial: Engineering Sample

### 3 REFERENCES

Publication	Edition	Date	AMD 1
eCFR	-	2023	-
RSS-247	3	2023	-
RSS-GEN	5	2018	2019
ANSI C63.10	-	2013	-
KDB 178919 D01	6	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
CISPR 16-4-1
CISPR 16-4-2
CISPR 32
ANSI C63.23
A2LA P103
A2LA P103c
ETSI TR 100-028

Measurement Type	Configuration	Uncertainty ±
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

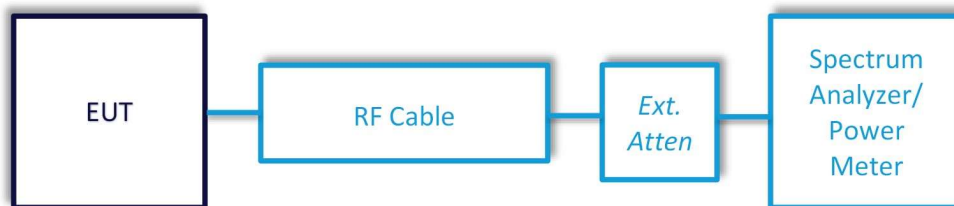
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	1x10 <sup>-7</sup>	0.55x10 <sup>-7</sup>
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

## 5 TEST DATA

### 5.1 Antenna Port Conducted Emissions

<b>Description of Measurement</b>	<p>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.</p> <p>The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.</p>
<b>Example Calculations</b>	<p>Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm)</p> <p>Margin (dB) = Limit (dBm) – Corrected Reading (dBm)</p>

#### Block Diagram





### 5.1.1 Antenna Port Conducted Emissions – RF Output Power

<b>Operator</b>	Anthony Smith	<b>QA</b>	Adam Alger
<b>Temperature</b>	20.7°C	<b>R.H. %</b>	29.4%
<b>Test Date</b>	3/9/2023	<b>Location</b>	Conducted RF Bench
<b>Requirement</b>	FCC 15.247 RSS-247	<b>Method</b>	ANSI C63.10

Limits: <30dBm

#### Test Parameters

<b>Frequency</b>	2400-2483.5 MHz	<b>Setup</b>	Conducted
<b>RBW</b>	3 MHz	<b>VBW</b>	50 MHz
<b>Detector(s)</b>	Peak	<b>Settings</b>	Trace Max Hold

#### Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960173	Cable	A.H. Systems, Inc.	SAC-26G-1	388	6/13/2023	6/12/2024	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/11/2023	4/11/2024	Active Calibration

#### EUT Parameters

<b>Input Power</b>	12VDC	<b>Mode</b>	BLE – 125k, 500k, 1M, 2M
<b>Frequency (MHz)</b>	2402, 2440, 2480	<b>Channel</b>	37, 17, 39
<b>Transmit Power Setting</b>	7		