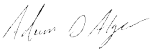
Test Report # TR3574D

Equipment Under Test:	BL654
Requirement(s):	FCC 1.1310 ISED RSS-102
Test Date(s):	4/17/2023
Prepared for:	Alcon Research LLC Attn: Hakan Gokdogan 20511 Lake Forest Drive Lake Forest, CA 92630

Report Issued by: Anthony Smith, EMC Engineering Specialist

Signature:  Date: 10/18/2023

Report Reviewed by: Adam Alger, Laboratory Manager

Signature:  Date: 7/14/2023

Report Constructed by: Anthony Smith, EMC Engineering Specialist

Signature:  Date: 7/14/2023

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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:

Certificate #1255.01

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

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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

1 TEST REPORT SUMMARY

During **April 17th, 2023** the Equipment Under Test (EUT), **BL654**, as provided by **Alcon Research LLC** was tested to the following requirements:

Portable Device

Requirements	Description	Method	Results
FCC: 1.1310	Radiofrequency Radiation Exposure Limits	Distance ≤ 5 mm 1g-SAR	Reported
IC: RSS-102	Radiofrequency Radiation Exposure Limits	Distance 15mm 1g-SAR	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	1 dB below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

2 CLIENT INFORMATION

Company Name	Alcon Research LLC
Contact Person	Hakan Gokdogan
Address	20511 Lake Forest Drive Lake Forest, CA 92630

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	BL654
Model Number	BL654
Serial Number	Engineering Sample
FCC ID	VMCBL654
IC ID	7345A-BL654

2.2 Product Description

The BL654 module is utilized for wireless transmission and reception in the 802.15.4 standard to establish communication with the Unity footswitch. No BLE to be used.

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

802.15.4 DTS Single Data Rate

Channels 1, 8, 15 operate at Power Setting +8

Channel 16 operates at Power Setting -8

2.6 Radio Programming

The 802.15.4 radio was programmed using the AlconTestTool software version 1.0.32.0.

2.7 Additional Information

Test Board Host Device has two radio modules with identical antenna design. Single antenna testing was performed on “Module 1”. Test Board Host Device tested referenced as “Telemetry” unit. The testing is for a permissive change to add an EPCOS B8328 bandpass filter into the antenna trace along with a Walsin RFDPA870900SBAB8G1 Dipole antenna, peak gain of 2dBi, via MMCX connector.

This is **Antenna Design 1** (of 2).

Max Output Power data from original filing report “FCC_TestRept – BL654_TR319220 B V2_C2PC”

3 REFERENCES

Publication	Edition	Date	AMD 1
FCC eCFR	-	2023	-
RSS-102	5	2015	2021
KDB 447498	-	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

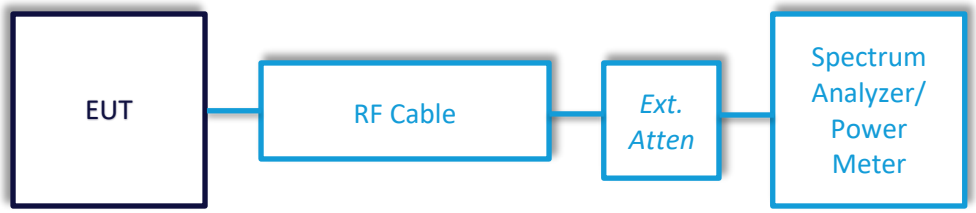
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %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

5 TEST DATA

5.1 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

Operator	Jon Dilley	QA	Shane Dock
Temperature	23.9 degrees Celsius	R.H. %	18.5% RH
Test Date	1/20/2020	Location	Conducted Bench
Requirement	FCC 15.247	Method	ANSI C63.10

Limits:

Pout: 30 dBm

Instrumentation

Laird

Date : 10-Aug-2020 Test : FCC Tx Job : C-3290

PE : Shane Dock Customer : Laird Connectivity Quote : 319220

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Cable	Gore	EKD01D01048.0	5546519	12/9/2019	1/9/2021	Active Calibration
2	EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	7/14/2020	7/14/2021	Active Calibration

EUT Parameters

Input Power	Battery Powered	Mode	Modulated Tx
Frequency	2400-2483.5 MHz	Channel	Low, Mid, High

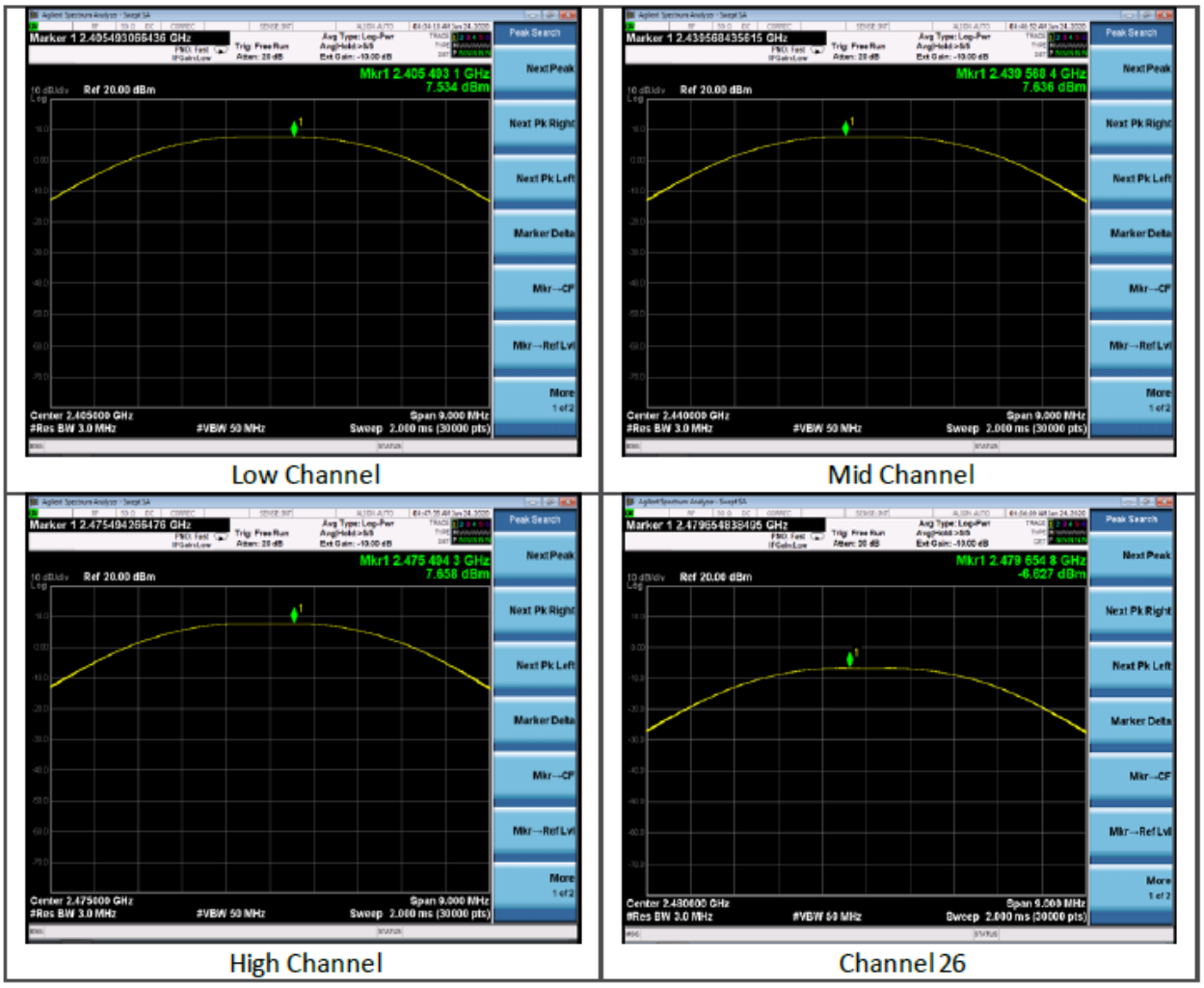
Data

Table – Output Power

Channel	Power Setting (dBm)	Pout Measured (dBm)
11	8	7.5
11	-40	-35.9
18	8	7.6
18	-40	-35.9
25	8	7.7
25	-40	-35.9
26	-8	-6.6
26	-40	-36.1

Worst Case Plots – 8 dBm

Conducted Output Power



6 EXCLUSION CALCULATION

6.1 FCC

Max Power of Channel = 7.7 dBm
Tune Up Tolerance = 2.0 dB
Total Channel Power = 9.7 dBm = 9.3 mW
Distance: ≤5 mm

SAR Test Exclusion Calculation

(9.3mW/5mm) x (√2.475) ≤ 3.0
1.86 x 1.573 ≤ 3.0
2.9 ≤ 3.0

Result:
The EUT is excluded from routine SAR testing as 2.9 is less than 3.0.

6.2 Industry Canada

Max Power of Channel = 7.7 dBm

Tune Up Tolerance = 2.0 dB

Peak Antenna Gain = 2.0 dBi

Total Channel Power = 11.7 dBm = 14.8 mW

Distance: 15 mm

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

Result:

The EUT is excluded from routine SAR testing at 15 mm as 14.8 mW is less than 15.0 mW.

7 REVISION HISTORY

Version	Date	Notes	Person
1	7/13/2023	Initial Draft	Anthony Smith
2	7/14/2023	Revised Draft	Anthony Smith
3	10/18/2023	TCB Response	Anthony Smith

END OF REPORT