FCC PART 15, SUBPART C
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Sindarin Inc.

431 Bryant Street
San Francisco, CA 94107, USA

FCC ID: 2BAHC-PT1
IC: 30424-PT1

Report Type:	**Product Type:**
Original Report	Page Turner

Prepared By:	Arturo Reyes Test Engineer
Report Number:	R2303303-247
Report Date:	2023-07-26
Reviewed By:	Christian McCaig RF Lead Engineer

Bay Area Compliance Laboratories Corp.
1274 Anvilwood Avenue,
Sunnyvale, CA 94089, USA
Tel: (408) 732-9162; Fax: (408) 732-9164

ACCREDITED
CERTIFICATE #3297.02

Note: This test report was prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This test report shall not be used by the customer to claim product certification, approval, or endorsement by A2LA or any agency of the United States Government or any foreign government.
* This test report may contain data and test methods that are not covered by BACL's scope of accreditation as of the test report date shown above. These items are marked within the test report text with an asterisk "*"

TABLE OF CONTENTS

1 General Description 5
1.1 Product Description for Equipment Under Test (EUT) 5
1.2 Objective 5
1.3 Related Submittal(s)/Grant(s) 6
1.4 Test Methodology 6
1.5 Measurement Uncertainty 6
1.6 Test Facility Registrations 6
1.7 Test Facility Accreditations 7
2 System Test Configuration 9
2.1 Justification 9
2.2 EUT Exercise Software 9
2.3 Duty Cycle Correction Factor 10
2.4 Equipment Modification 12
2.5 Local Support Equipment 12
2.6 Remote Support Equipment 12
2.7 Interface Ports and Cabling 12
3 Summary of Test Results 13
4 FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements 14
4.1 Applicable Standards 14
4.2 Antenna Description 14
5 FCC §15.247(i) §2.1093 & ISED RSS-102 - RF Exposure 15
5.1 Applicable Standards 15
5.2 RF exposure evaluation exemption for FCC 17
5.3 RF exposure evaluation exemption for IC 17
6 FCC §15.35(b), §15.205, §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10- Spurious Radiated Emissions 18
6.1 Applicable Standards 18
6.2 Test Setup 20
6.3 Test Procedure 20
6.4 Corrected Amplitude and Margin Calculation 20
6.5 Test Setup Block Diagram 21
6.6 Test Equipment List and Details 23
6.7 Test Environmental Conditions 24
6.8 Summary of Test Results 24
6.9 Radiated Emissions Test Results 25
7 FCC §15. 247(a) (2) & ISEDC RSS-247 §5.2, RSS-Gen §6.7 - Emission Bandwidth 29
7.1 Applicable Standards 29
7.2 Measurement Procedure 29
7.3 Test Setup Block Diagram 29
7.4 Test Equipment List and Details 29
7.5 Test Environmental Conditions 30
7.6 Test Results 30
8 FCC §15.247(b) (3) & ISEDC RSS-247 §5.4 - Maximum Output Power 34
8.1 Applicable Standards 34
8.2 Measurement Procedure 34
8.3 Test Setup Block Diagram 34
8.4 Test Equipment List and Details 34
8.5 Test Environmental Conditions 35
8.6 Test Results 35
9 FCC §15.247(d) & ISEDC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges 38
9.1 Applicable Standards 38
9.2 Measurement Procedure 38
9.3 Test Setup Block Diagram 38
9.4 Test Equipment List and Details 39

9.5 Test Environmental Conditions 39
9.6 Test Results 39
10 FCC §15.247(e) & ISEDC RSS-247 §5.2(2) – Peak Power Spectral Density 41
10.1 Applicable Standards 41
10.2 Measurement Procedure 41
10.3 Test Setup Block Diagram 41
10.4 Test Equipment List and Details 41
10.5 Test Environmental Conditions 42
10.6 Test Results 42
11 FCC §15.247(d) & ISEDC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals 45
11.1 Applicable Standards 45
11.2 Test Procedure 45
11.3 Test Setup Block Diagram 45
11.4 Test Equipment List and Details 46
11.5 Test Environmental Conditions 46
11.6 Test Results 46
12 Annex A (Normative) – EUT Test Setup Photographs 50
13 Annex B (Normative) – EUT External Photographs 51
14 Annex C (Normative) – EUT Internal Photographs 52
15 Annex D (Normative) - A2LA Electrical Testing Certificate 53

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2303303-247	Original Report	2023-07-26

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test was prepared on behalf of *Sindarin Inc.* and their product model: ED1-PT1, FCC ID: 2BAHC-PT1 IC: 30424-PT1, the "EUT" as referred to in this report. The EUT is a BLE device.

Model Number	ED1-PT1
Operating Frequency	2402MHz – 2480MHz
Modulation	GFSK (LE)
Channel Spacing	2 MHz
Omnidirectional Antenna Gain	0.50 dBi
RF Output Power	1.626 dBm

1.2 Objective

This report is prepared on behalf of *Sindarin Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules and ISEDC RSS-247 Issue 2, February 2017.

The objective was to determine compliance with FCC Part 15.247 and ISEDC RSS-247 for Antenna Requirement, RF Exposure, Emission Bandwidth, Radiated & Conducted Spurious Emissions, 100 kHz Band Edges, Maximum Output Power, and Peak Power Spectrum Density.

1.3 Related Submittal(s)/Grant(s)

N/A

1.4 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.5 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.6 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.7 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2017 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02)*****,** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2017 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2017 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISED) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v05r02.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

Radio	Frequency	Modulation	Power Setting
Bluetooth	2402	GFSK (LE)	2
	2442	GFSK (LE)	2
	2480	GFSK (LE)	2

Data Rates Tested:
GFSK (LE): LE1 (1 Mbps)

2.2 EUT Exercise Software

The test utility used was the “nRF Connect”, provided by *Nordic Semiconductor,* the software is compliant with the standard requirements being tested against.

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 DTS Meas Guidance v05r02 section 6.0:

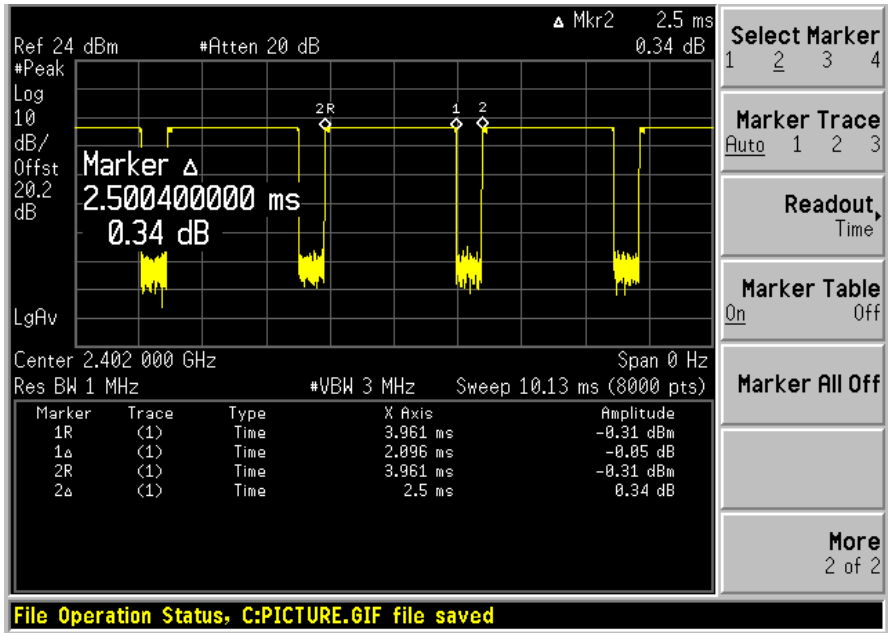
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data is being acquired (i.e., no transmitter off-time is to be considered).

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
BLE	2.096	2.5	83.9	0.76

Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plot.

BLE (GFSK)


Ref 24 dBm
#Atten 20 dB
Δ Mkr2 2.5 ms
0.34 dB
#Peak
Log
10
dB/
Offst
20.2
dB
Marker Δ
2.500400000 ms
0.34 dB
2R
1
2
LgAv
Center 2.402 000 GHz
Span 0 Hz
Res BW 1 MHz
#VBW 3 MHz
Sweep 10.13 ms (8000 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 3.961 ms -0.31 dBm
1Δ (1) Time 2.096 ms -0.05 dB
2R (1) Time 3.961 ms -0.31 dBm
2Δ (1) Time 2.5 ms 0.34 dB
Select Marker
1 2 3 4
Marker Trace
Auto 1 2 3
Readout
Time
Marker Table
On Off
Marker All Off
More
2 of 2
File Operation Status, C:PICTURE.GIF file saved

2.4 Equipment Modification

None.

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.6 Remote Support Equipment

Manufacturer	Description	Model
-	USB to RS232 FTDI Adapter	N/A

2.7 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
Jumper Wires (x3)	< 1	FTDI Adapter	EUT
Jumper Wires (x2)	< 1	Battery	EUT
Micro USB	< 1	FTDI Adapter	Laptop

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirements	Compliant
FCC §2.1093, §15.247(i) ISED RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Power Line Conducted Emissions	Compliant[1]
FCC §2.1053, §15.35(b), §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2 RSS-Gen §6.7	6 dB & 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4	Maximum Output Power	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) ISEDC RSS-247 §5.2(2)	Peak Power Spectral Density	Compliant
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant

Note[1]: N/A. Device is battery powered.

BACL is responsible for all the information provided in this report, except when information is provided by the customer as identified in this report. Information provided by the customer, e.g., antenna gain, can affect the validity of results.

4 FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements

4.1 Applicable Standards

According to FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotopically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For license-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

4.2 Antenna Description

External/Internal/ Integral	Part Number	Antenna Type	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Internal	2450AT18B100	SMT	2400-2500	0.50

Antenna gain was obtained from antenna specification "2450AT18B100_110518" issued by Johanson Technology Inc.

5 FCC §15.247(i) §2.1093 & ISED RSS-102 - RF Exposure

5.1 Applicable Standards

According to FCC KDB 447498 D01 General RF Exposure Guidance v06 Section 4.3.1, Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc.

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

   [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

   • f (GHz) is the RF channel transmit frequency in GHz
   • Power and distance are rounded to the nearest mW and mm before calculation
   • The result is rounded to one decimal place for comparison
   • 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

   The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

2) At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:

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

3) At frequencies below 100 MHz, the following may be considered for SAR test exclusion, and as illustrated in Appendix C:

   a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by [1 + log(100/f(MHz))] for test separation distances > 50 mm and < 200 mm
   b) The power threshold determined by the equation in a) for 50 mm and 100 MHz is multiplied by ½ for test separation distances ≤ 50 mm

c) SAR measurement procedures are not established below 100 MHz. When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any test results to be acceptable.

According to ISED RSS-102 Issue 5 Section 2.5.1 Exemption Limits for Routine Evaluation-SAR Evaluation:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in table below,

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	101	132	162	193
450	52	70	88	106	123
835	17	30	42	55	67
1900	7	10	18	34	60
2450	4	7	15	30	52
3500	2	6	16	32	55
5800	1	6	15	27	41

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	254	284	315	345
450	141	159	177	195	213
835	80	92	105	117	130
1900	99	153	225	316	431
2450	83	123	173	235	309
3500	86	124	170	225	290
5800	56	71	85	97	106

5.2 RF exposure evaluation exemption for FCC

The maximum power of channel, including tune-up tolerance is 2dBm(1.58mW). According to FCC KDB 447498,

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] [√f(GHz)] = (1.58 mW/5mm)* √2.480 = 0.50, which is less than 7.5. Therefore, FCC SAR testing is excluded.

5.3 RF exposure evaluation exemption for IC

2dBm + 0.5 dBi = 2.5 dBm(1.78mW) < (4mW*2.5) = 10mW

Therefore, RF exposure is not required.

6 FCC §15.35(b), §15.205, §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10- Spurious Radiated Emissions

6.1 Applicable Standards

As per FCC §15.35(b): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

As per FCC §15.209(a): 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 (micro volts/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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §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).

As per ISED RSS-Gen 8.9,

> Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (µv/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for license-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

As per ISED RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

6.2 Test Setup

The radiated emissions tests were performed in the 5-meter chamber and 10-meter chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C and ISEDC RSS-247.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundled when necessary.

6.3 Test Procedure

For the radiated emissions test, the EUT host and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meters, and the EUT was placed on a turntable, which was 0.8 meters and 1.5 meters above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz or 1/T / Sweep = Auto

6.4 Corrected Amplitude and Margin Calculation

For emissions below 1 GHz,

The Corrected Amplitude (CA) is calculated by adding the Correction Factor to the S.A. Reading. The basic equation is as follows:

CA = S.A. Reading + Correction Factor

For example, a corrected amplitude of 40.3 dBuV/m = S.A. Reading (32.5 dBuV) + Correction Factor (7.8 dB/m)

The Correction Factor is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) together. This calculation is done in the measurement software, and reported in the test result section. The basic equation is as follows:

Correction Factor = AF + CL + Atten – Ga

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude – Limit

For emission above 1 GHz,

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

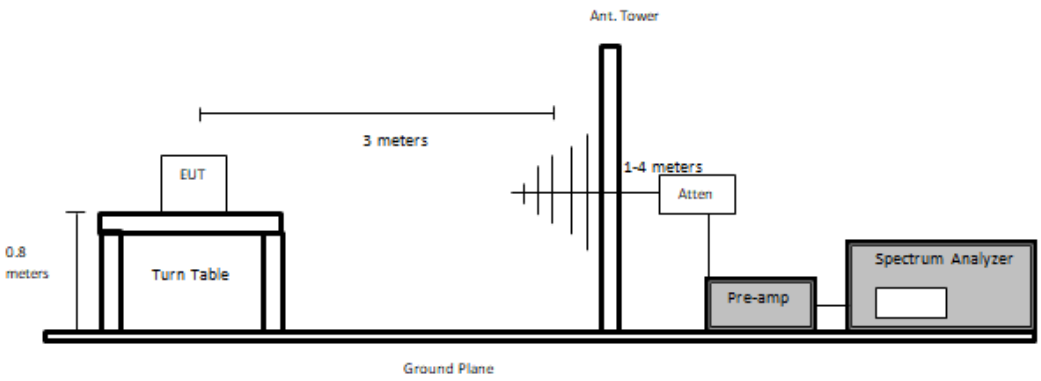
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude – Limit

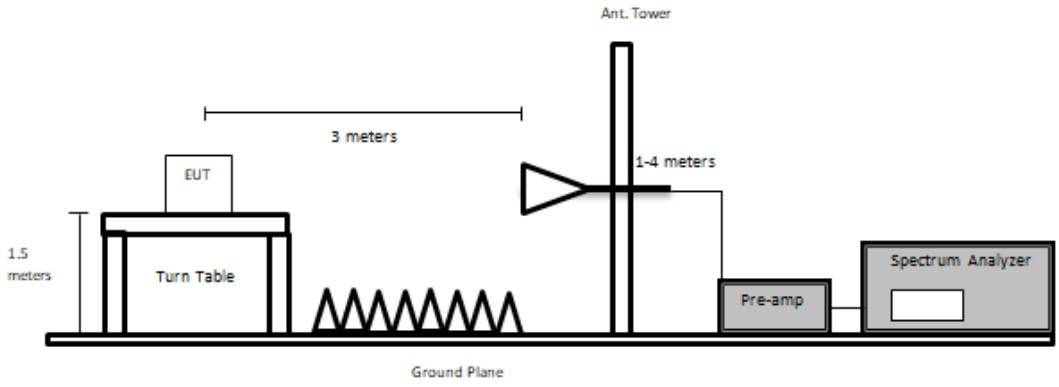
6.5 Test Setup Block Diagram

Below 1GHz:

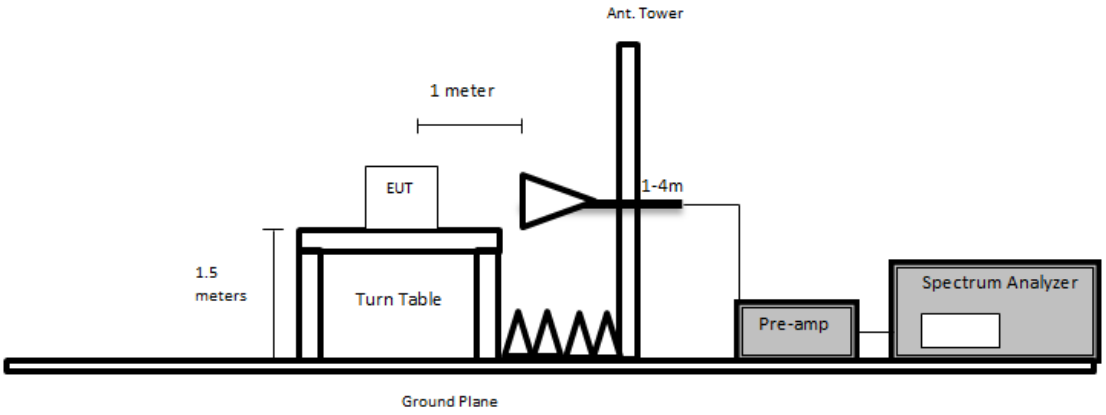


Above 1GHz:

At 3 meters:



At 1 meter:



6.6 Test Equipment List and Details

BACL No	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
124	Rhode & Schwarz	EMI Test Receiver	ESCI 1166.5950K 03	100044	2021-05-14	2 years
624	Agilent	Spectrum Analyzer	E4446A	MY48250 238	2022-08-01	1 year
655	Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2022-02-07	2 years
327	Sunol Sciences	Controller, System	SC110V	122303-1	N/A	N/A
316	Sonoma Instruments	Preamplifier 10 kHz - 2.5 GHz	317	260406	2023-04-12	6 months
658	HP/ Agilant	Pre Amplifier	8449B OPT HO2	3008A01 103	2022-07-22	1 year
827	AH Systems	Preamplifier	PAM 1840 VH	170	2022-11-01	1 year
91	Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2022-03-08	2 years
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2; 1504	2021-11-22	2 years
1192	ETS Lindgren	Horn Antenna	3117	00218973	2022-09-29	2 years
1186	Pasternack	Coaxial Cable, RG214	PE3062-1050CM	-	2023-04-14	6 months
1247	Uti flex	Micro - Coax	-	-	2022-07-22	1 year
1248	Pasternack	RG214 COAX Cable	PE3062	-	2023-04-14	6 months
1249	Time Microwave	LMR-400 Cable Dc-3 GHz	AE13684	2k80612-5 6fts	2023-04-14	6 months
1295	Carlisle	10m Ultra Low Loss Coaxial Cable	UFB142A-1-3937-200200	64639890 912-001	2023-05-04	6 months
1328	Centric RF	2.92mm short coaxial cable	C547-107-12B	CW10S3 4123	2022-12-09	6 months
1346	RFMW	2.92mm 10ft RF cable	KMSE-160SAW-240.0-KSME	-	2023-02-03	6 months
1354	RFMW	2.92mm 10ft RF Cable DC to 40 GHz	P1CA-29M29M-F150-120	-	2023-02-24	6 months
388	Micro Tronics	2.4~2.5 GHz Notch Filter	-	-	2023-03-02	1 year
672	Micro Tronics	2.4-2.6 GHz Notch Filter	BRM50701	160	2023-03-09	1 year
1245	-	6dB Attenuator	PE7390-6	01182018 A	2021-11-22	2 years
1246	HEWLET PACKARD	RF Limiter	11867A	01734	2023-04-13	1 year

Note[1]: cable and notch filters included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

6.7 Test Environmental Conditions

Temperature:	24° C
Relative Humidity:	45 %
Barometric Pressure:	101.1 kPa

The testing was performed by Arturo Reyes on 2023-05-04 and by Deepak Mishra from 2023-05-12 to 2023-05-14 in 5m chamber 3.

6.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.209, 15.247 and ISEDC RSS-247 standards' radiated emissions limits, and had the worst margin of:

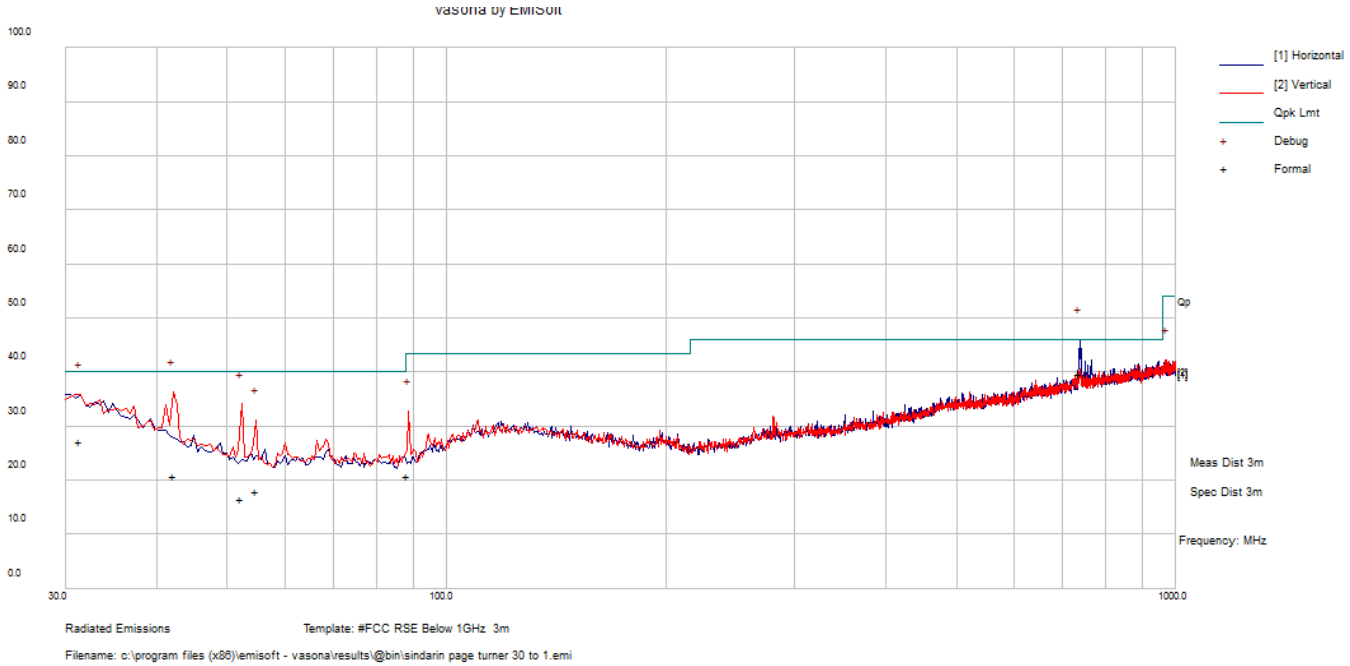
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Configuration**
-0.327	7326	Horizontal	GFSK (LE), 2442 MHz

Please refer to the following table and plots for specific test result details.

6.9 Radiated Emissions Test Results

Note: Pre-scans were performed in order to investigate the x,y and z orientations of the EUT for radiated emissions testing. Worst case positioning of EUT determined can be seen in the test setup photos.
Note: EUT does not contain any metal materials that may affect emissions from the EUT. Thus, for radiated spurious emissions, testing is sufficient done without full enclosure attached as seen in test setup photos.
Note: Worst-case plots shown show spurious emissions for worst-case config: 2480MHz. Data for worst-emissions for all modulations and channels shown in"1 – 18 Spurious Emissions at 3 meters".

30 MHz – 1 GHz Worst Case, Measured at 3 meters

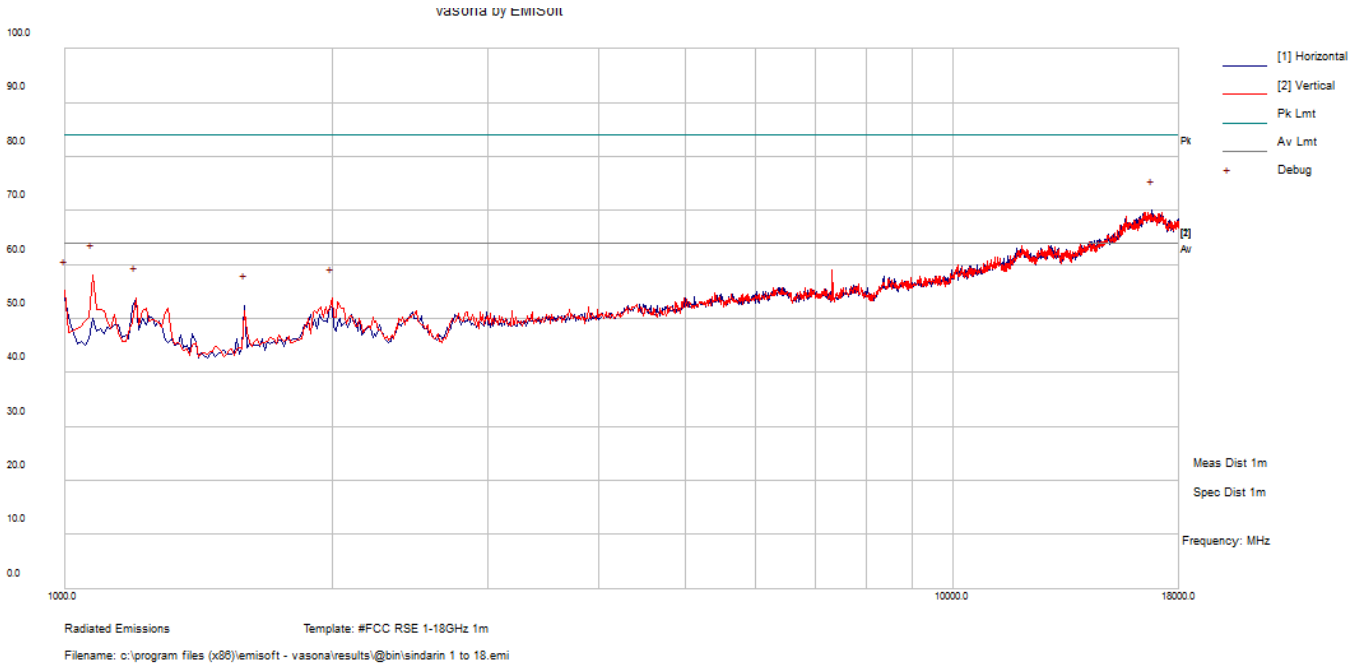


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV /m)	Margin (dB)	Comment
738.377	38	1.72	39.72	273	H	317	46	-6.29	QP
42.19225	29.89	-9.1	20.79	110	V	271	40	-19.22	QP
31.38325	29.2	-2.01	27.19	228	V	312	40	-12.81	QP
52.1695	29.81	-13.3	16.51	121	V	335	40	-23.49	QP
54.7955	31.65	-13.66	17.99	142	V	50	40	-22.02	QP
88.4535	33.82	-12.99	20.83	286	V	101	43.5	-22.67	QP

1 – 18 Spurious Emissions at 3 meter

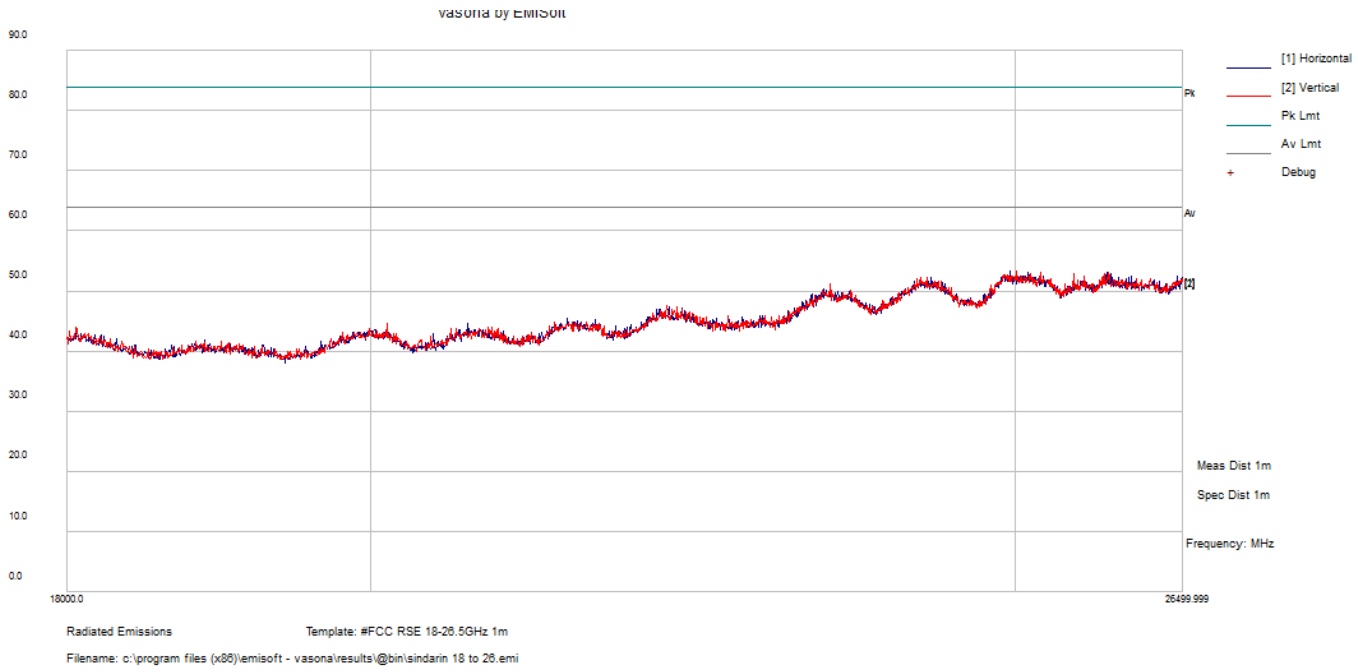
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Detector (Peak /Avg.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 2402 MHz											
2390	50.810	44	150	H	32.142	4.980	37.896	50.036	74	-23.964	Peak
2390	52.730	64	150	V	32.142	4.980	37.896	51.956	74	-22.044	Peak
2390	37.490	44	150	H	32.142	4.980	37.896	36.716	54	-17.284	Avg.
2390	38.640	64	150	V	32.142	4.980	37.896	37.866	54	-16.134	Avg.
4804	46.700	360	150	H	34.360	7.230	36.786	51.504	74	-22.496	Peak
4804	46.950	360	150	V	34.360	7.230	36.786	51.754	74	-22.246	Peak
4804	35.440	360	150	H	34.360	7.230	36.786	40.244	54	-13.756	Avg.
4804	35.550	360	150	V	34.360	7.230	36.786	40.354	54	-13.646	Avg.
7206	52.030	360	150	H	36.157	9.489	36.874	60.802	74	-13.198	Peak
7206	52.310	56	100	V	36.157	9.489	36.874	61.082	74	-12.918	Peak
7206	44.080	360	150	H	36.157	9.489	36.874	52.852	54	-1.148	Avg.
7206	44.400	56	100	V	36.157	9.489	36.874	53.172	54	-0.828	Avg.
Middle Channel: 2442 MHz											
4884	44.920	360	150	H	34.360	7.230	36.786	49.724	74	-24.276	Peak
4884	46.990	170	112	V	34.360	7.230	36.786	51.794	74	-22.206	Peak
4884	35.350	360	150	H	34.360	7.230	36.786	40.154	54	-13.846	Ave
4884	36.500	170	112	V	34.360	7.230	36.786	41.304	54	-12.696	Ave
7326	53.240	26	150	H	36.157	8.870	36.874	61.393	74	-12.607	Peak
7326	51.060	60	110	V	36.157	8.870	36.874	59.213	74	-14.787	Peak
7326	45.520	26	150	H	36.157	8.870	36.874	53.673	54	-0.327	Ave
7326	42.410	60	110	V	36.157	8.870	36.874	50.563	54	-3.437	Ave
High Channel: 2480 MHz											
2483.5	55.640	154	152	H	32.672	5.080	37.913	55.479	74	-18.521	Peak
2483.5	59.390	151	142	V	32.672	5.080	37.913	59.229	74	-14.771	Peak
2483.5	39.300	154	152	H	32.672	5.080	37.913	39.139	54	-14.861	Ave
2483.5	41.150	151	142	V	32.672	5.080	37.913	40.989	54	-13.011	Ave
4960	46.580	331	160	H	34.360	7.230	36.786	51.384	74	-22.616	Peak
4960	46.640	125	166	V	34.360	7.230	36.786	51.444	74	-22.556	Peak
4960	36.270	331	160	H	34.360	7.230	36.786	41.074	54	-12.926	Ave
4960	36.180	125	166	V	34.360	7.230	36.786	40.984	54	-13.016	Ave
7440	52.190	24	140	H	36.157	9.560	36.874	61.033	74	-12.967	Peak
7440	52.120	54	100	V	36.157	9.560	36.874	60.963	74	-13.037	Peak
7440	44.730	24	140	H	36.157	9.560	36.874	53.573	54	-0.427	Ave
7440	44.110	54	100	V	36.157	9.560	36.874	52.953	54	-1.047	Ave

1 – 18 Worst Case Spurious Emissions at 1 meter



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
16786.928	46.64	20.65	67.29	209	H	49	84	-16.71	Peak
16786.928	36.12	20.65	56.77	209	H	49	64	-7.23	Avg.

18 – 26.5 GHz Worst Case, Measured at 1 meter



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
24924.249	38.7	14.8	53.5	101	V	7	64	-10.5	Peak

Note: Worst case peak emission was compared to average limit to show compliance.

7 FCC §15. 247(a) (2) & ISEDC RSS-247 §5.2, RSS-Gen §6.7 - Emission Bandwidth

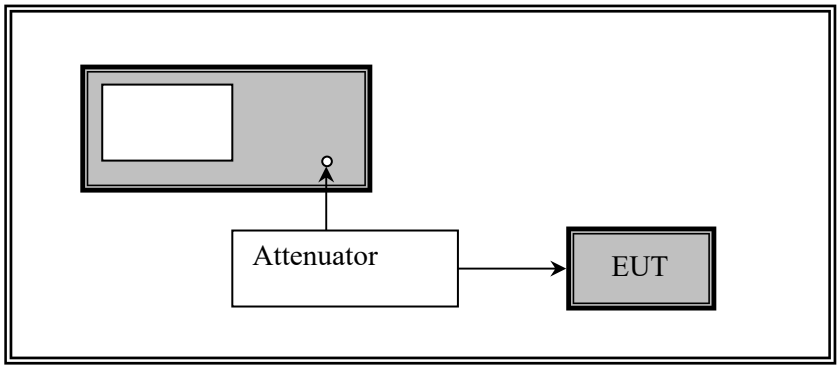
7.1 Applicable Standards

According to FCC §15.247(a) (2) and ISEDC RSS-247 §5.2: the minimum 6 dB bandwidth shall be 500 kHz.

7.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth.

7.3 Test Setup Block Diagram



7.4 Test Equipment List and Details

BACL No	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
-	-	10dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
424	Agilent	Spectrum Analyzer	E4440A	US45303 156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

7.5 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	51.3%
ATM Pressure:	101.1 kPa

Testing was performed by Christian Schwarz from 2023-05-08 to 2023-05-18 at the RF site.

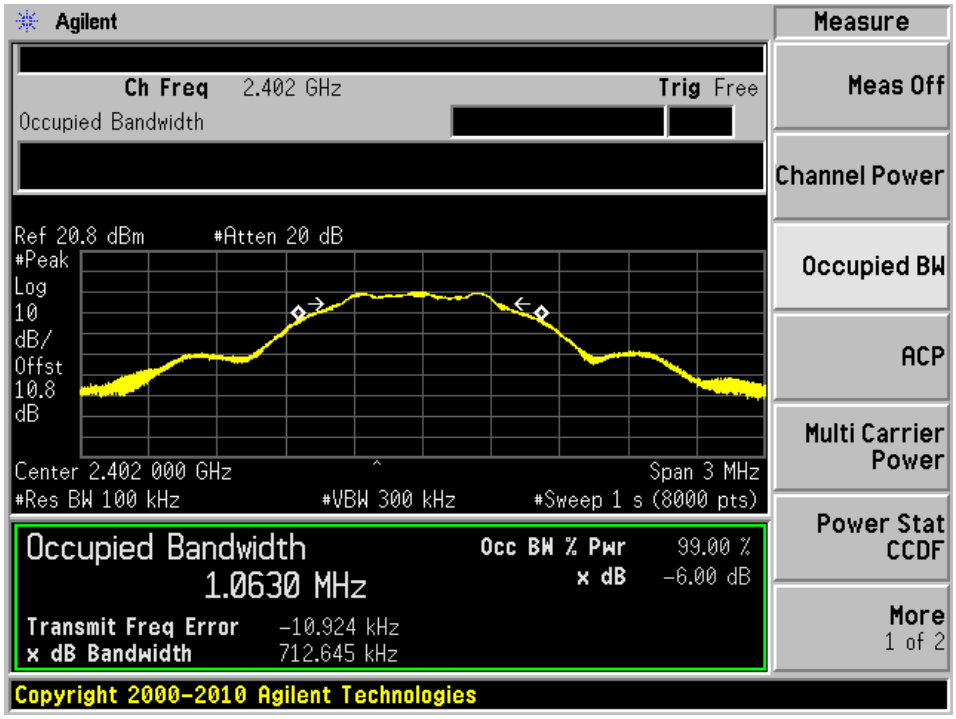
7.6 Test Results

Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	6 dB OBW Limit (kHz)	Result
GFSK (LE)					
Low	2402	0.713	1.0405	≥ 500	Pass
Middle	2442	0.699	1.0442	≥ 500	Pass
High	2480	0.705	1.0505	≥ 500	Pass

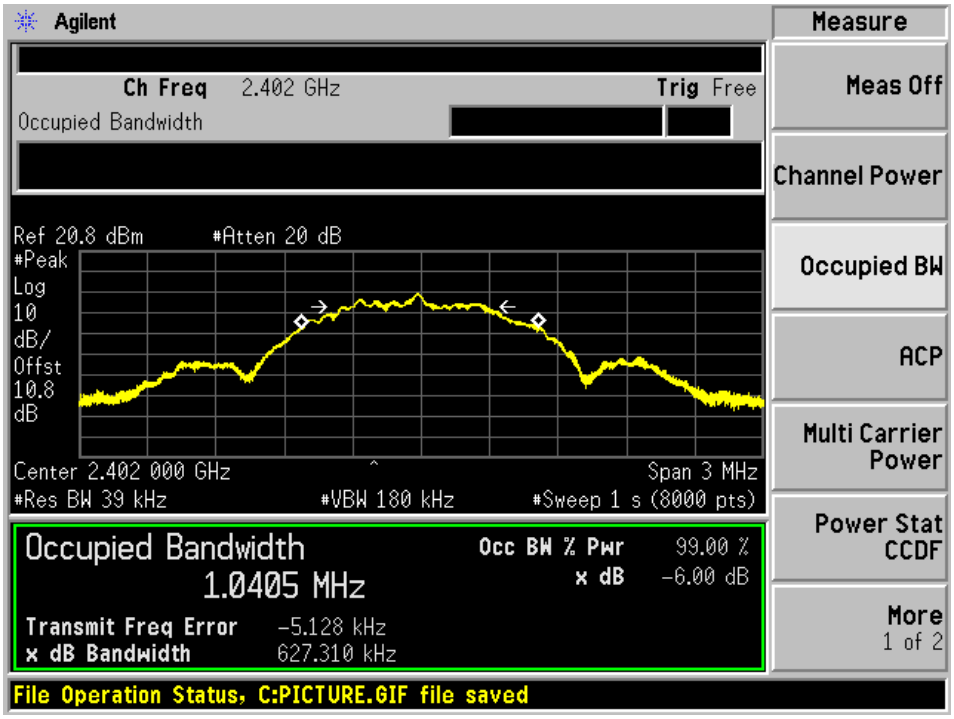
Please refer to the following plots for detailed test results:

GFSK (LE)

Low Channel 6 dB OBW

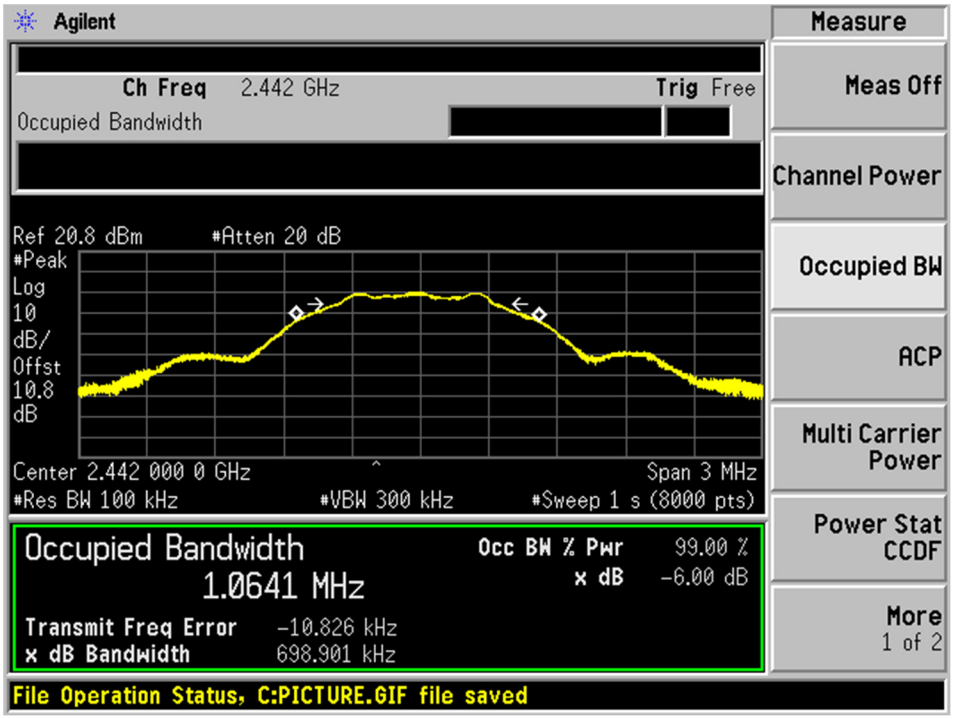


Low Channel 99% OBW

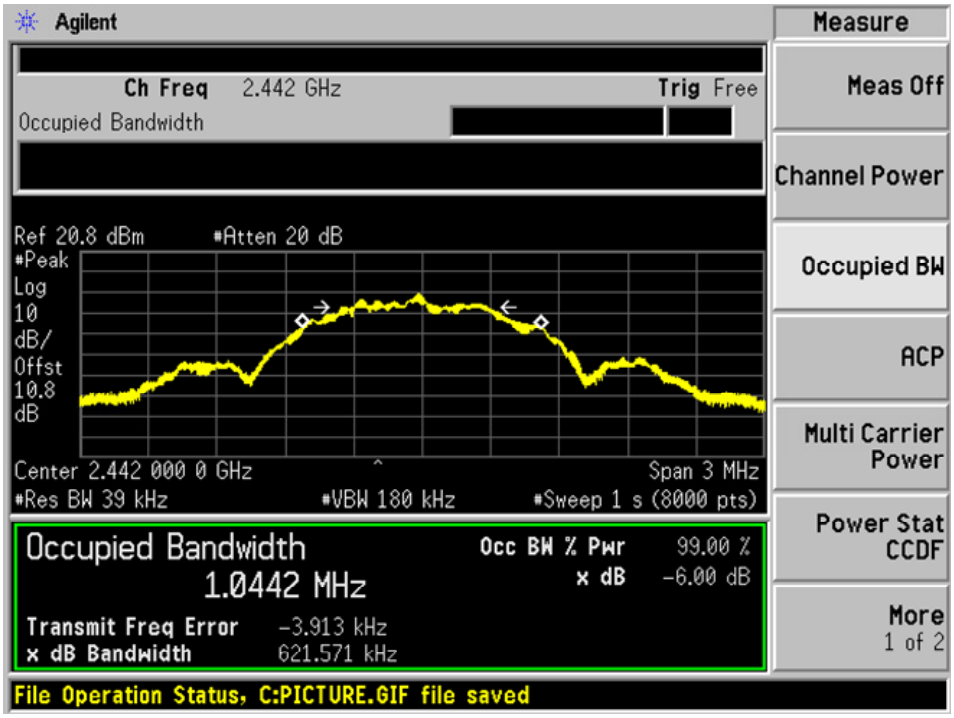


GFSK (LE)

Middle Channel 6 dB OBW

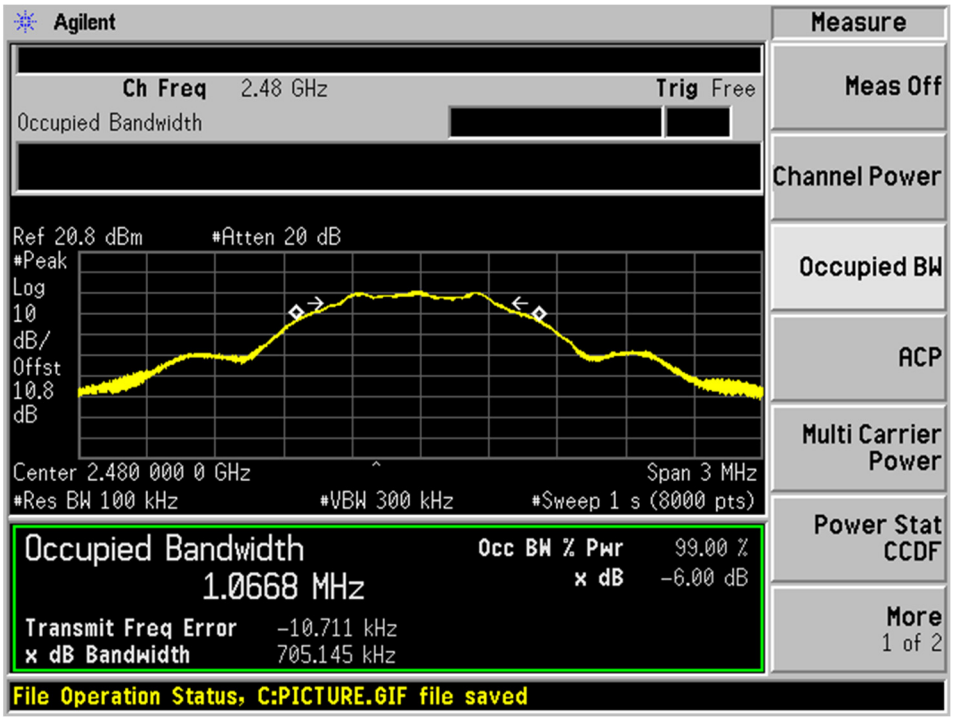


Middle Channel 99% OBW

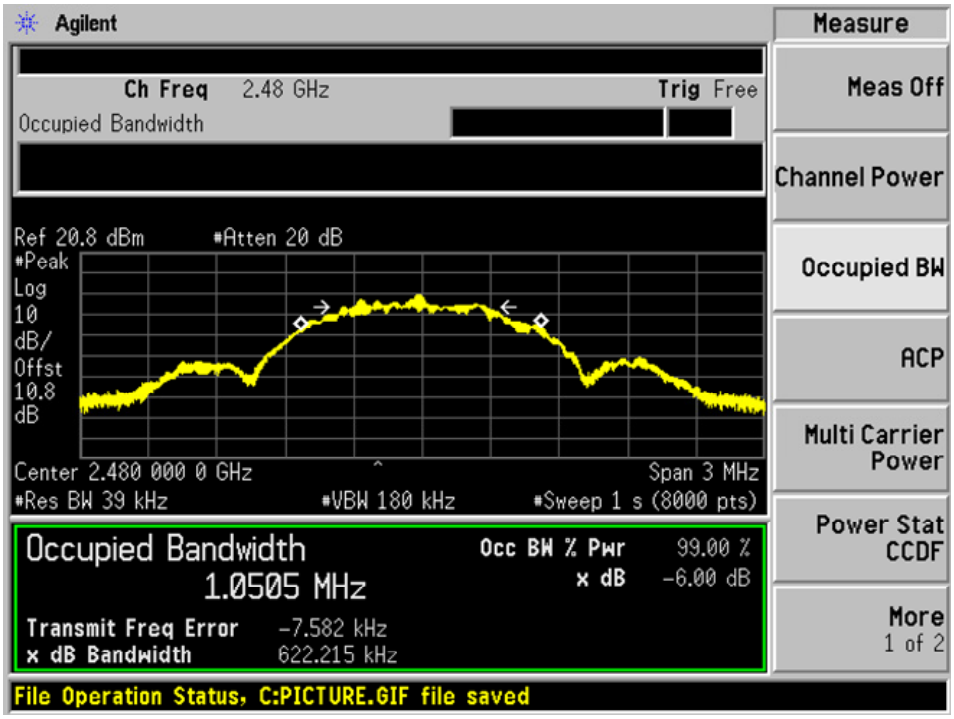


GFSK (LE)

High Channel 6 dB OBW



High Channel 99% OBW



8 FCC §15.247(b) (3) & ISEDC RSS-247 §5.4 - Maximum Output Power

8.1 Applicable Standards

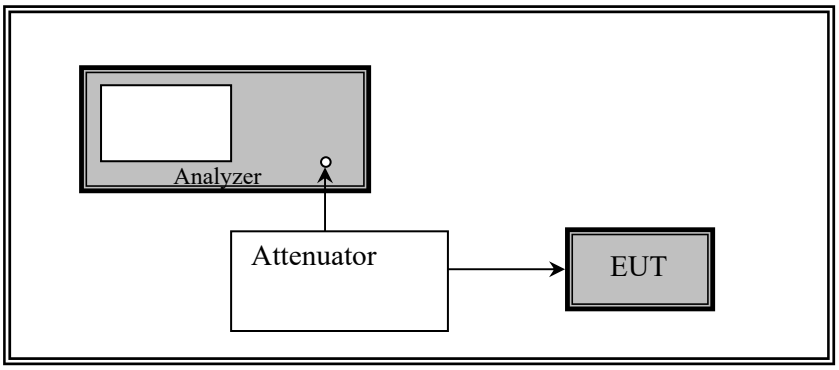
According to FCC §15.247(b) (3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to RSS-247 §5.4: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

8.2 Measurement Procedure

The measurements are based on ANSI C63.10-2013, Section 11.9.1.1.

8.3 Test Setup Block Diagram



8.4 Test Equipment List and Details

BACL No	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
-	-	10dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
424	Agilent	Spectrum Analyzer	E4440A	US45303 156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

8.5 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	51.3%
ATM Pressure:	101.1 kPa

Testing was performed by Christian Schwarz from 2023-05-08 to 2023-05-18 at the RF site.

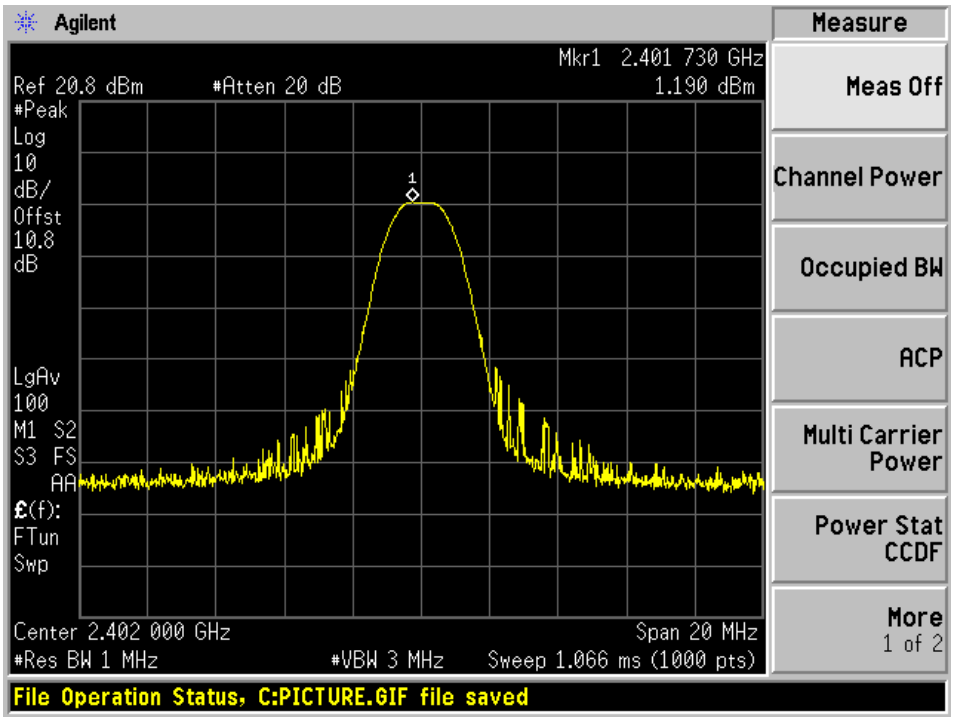
8.6 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Output Power Limit (dBm)	Result
GFSK (LE)				
Low	2402	1.190	30	Pass
Middle	2442	1.198	30	Pass
High	2480	1.626	30	Pass

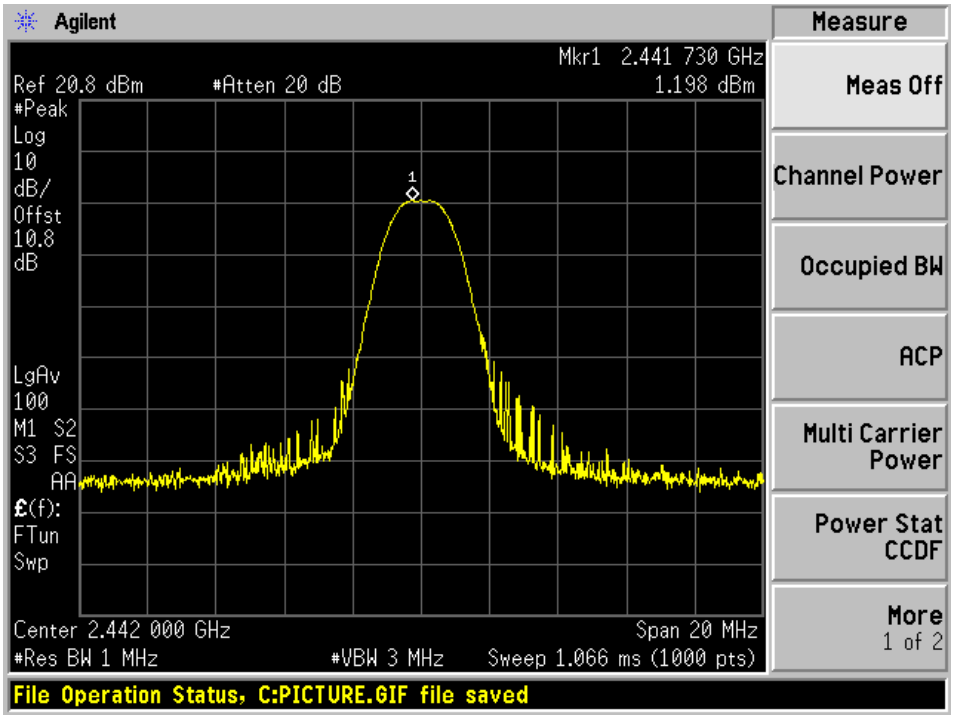
Please refer to the following plots for detailed test results

GFSK (LE)

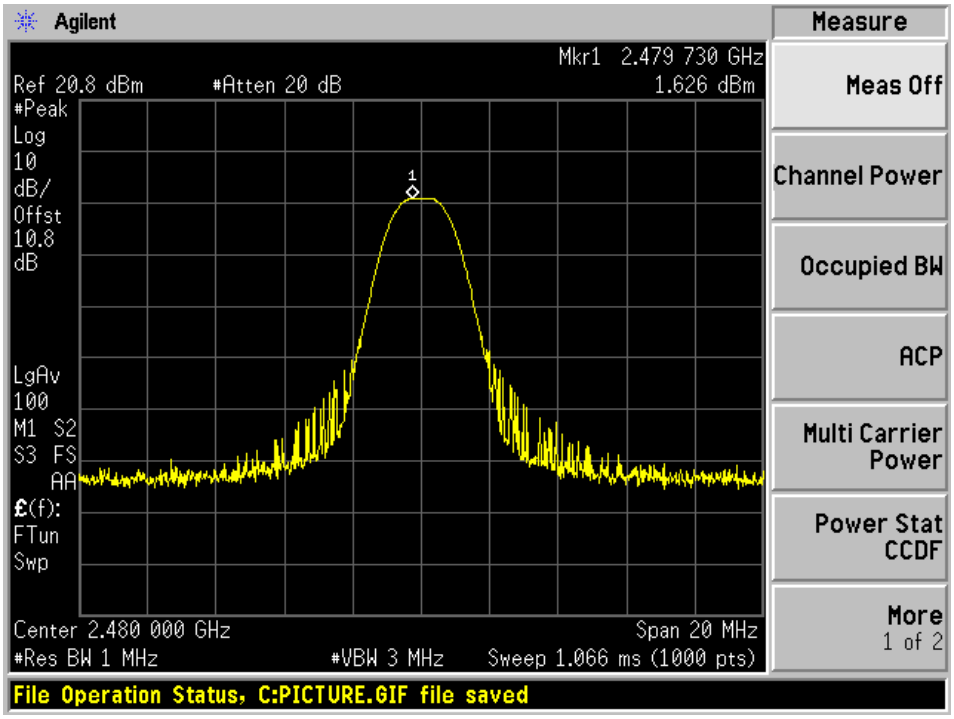
Low Channel: 2402 MHz



Middle Channel: 2442 MHz



High Channel: 2480 MHz



9 FCC §15.247(d) & ISEDC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges

9.1 Applicable Standards

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

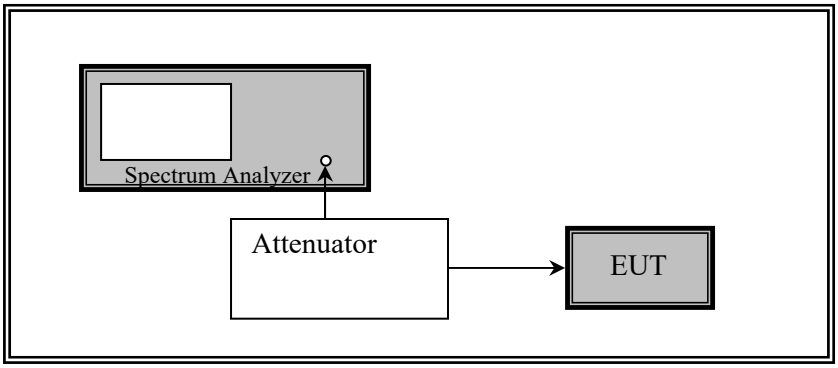
According to ISEDC RSS-247 §5.5.In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

9.2 Measurement Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW = 100 kHz
VBW = 300 kHz
Sweep = coupled
Detector function = peak
Trace = max hold

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

BACL No	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
-	-	10dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
424	Agilent	Spectrum Analyzer	E4440A	US45303 156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

9.5 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	51.3%
ATM Pressure:	101.1 kPa

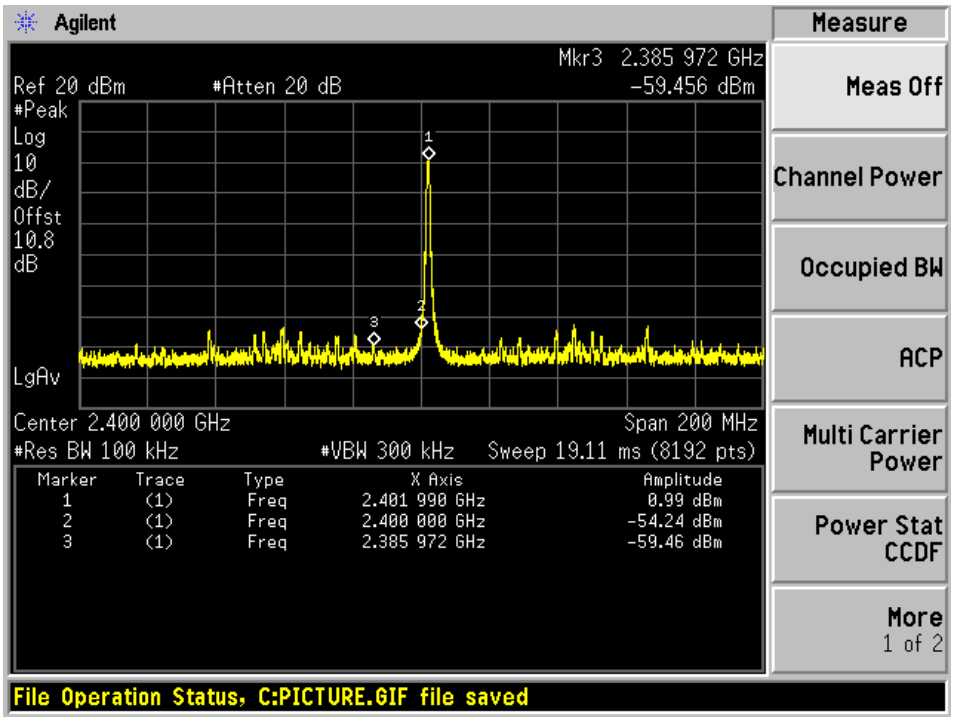
Testing was performed by Christian Schwarz from 2023-05-08 to 2023-05-18 at the RF site.

9.6 Test Results

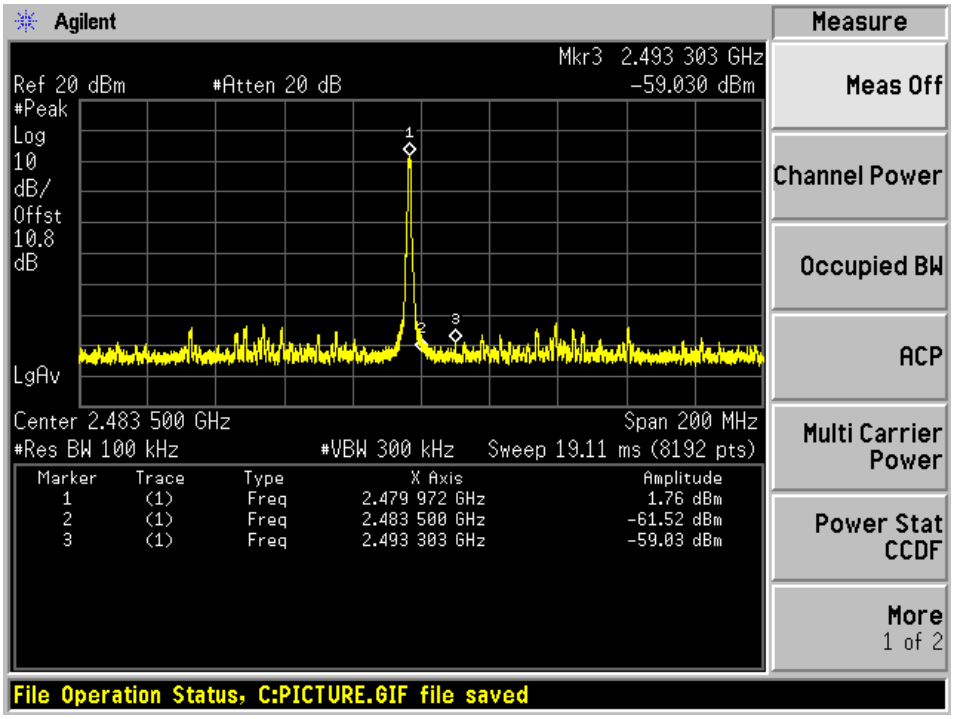
Please refer to the following plots for detailed test results

GFSK (LE)

Low Channel



High Channel



10 FCC §15.247(e) & ISEDC RSS-247 §5.2(2) – Peak Power Spectral Density

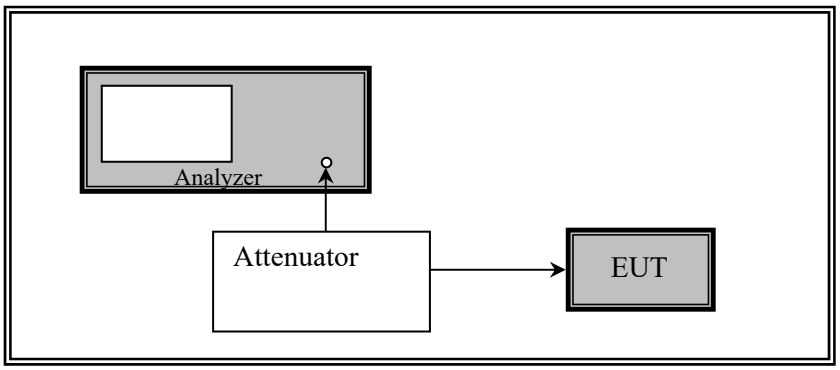
10.1 Applicable Standards

According to ECFR §15.247(e) and RSS-247 §5.2 (2) , 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.

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8.4: Maximum power spectral density level in the fundamental emission.

10.3 Test Setup Block Diagram



10.4 Test Equipment List and Details

BACL No	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
-	-	10dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
424	Agilent	Spectrum Analyzer	E4440A	US45303 156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

10.5 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	51.3%
ATM Pressure:	101.1 kPa

Testing was performed by Christian Schwarz from 2023-05-08 to 2023-05-18 at the RF site.

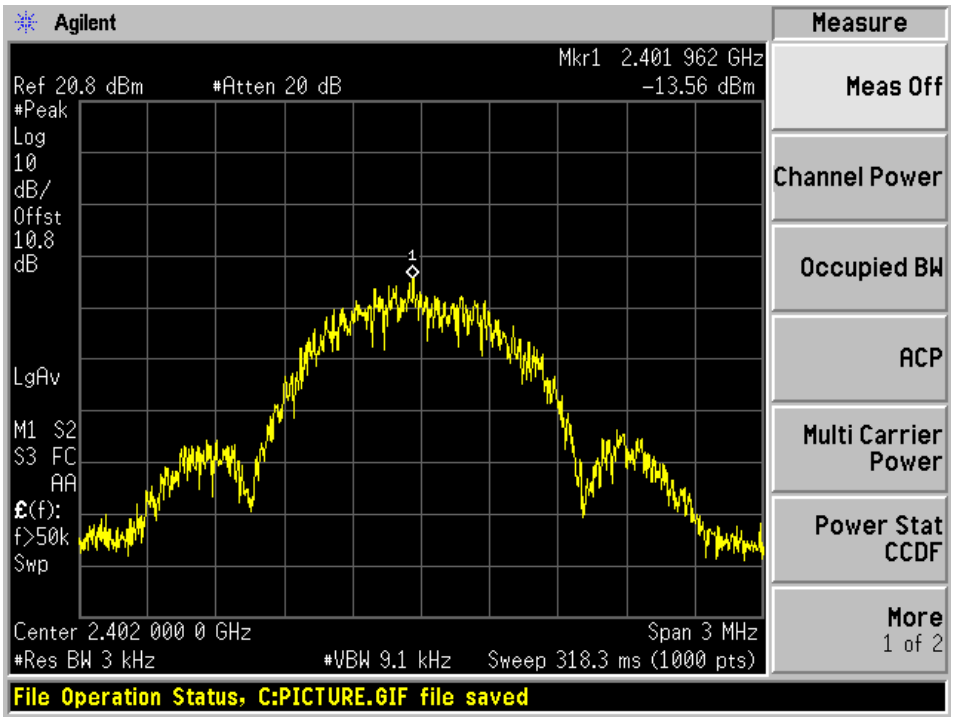
10.6 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
GFSK (LE)			
Low	2402	-13.56	<8
Middle	2442	-13.70	<8
High	2480	-13.40	<8

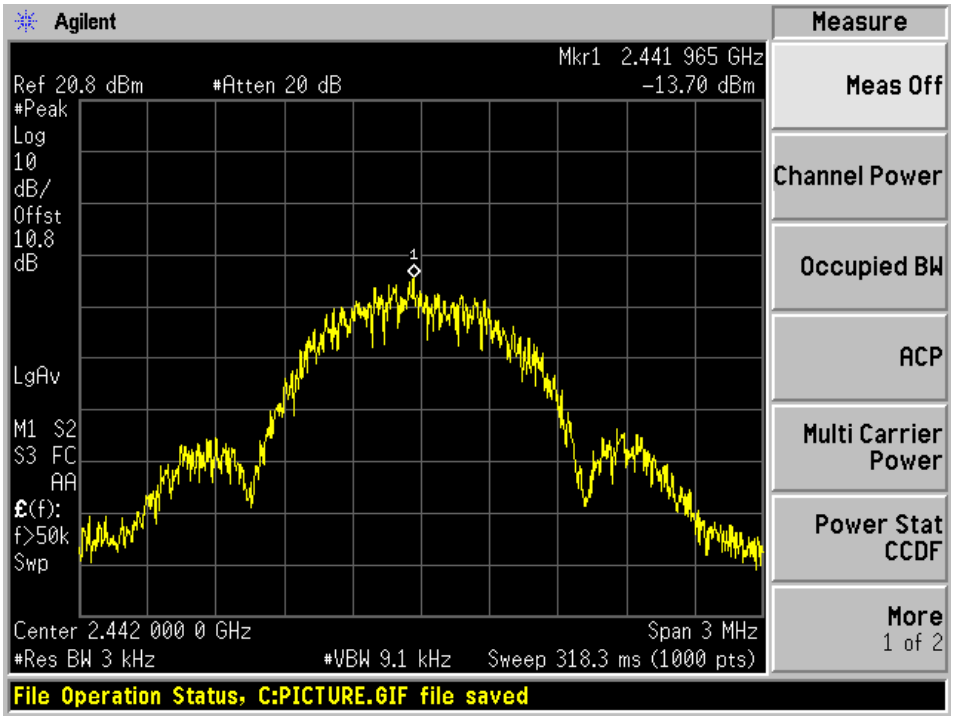
Please refer to the following plots for detailed test results

GFSK (LE)

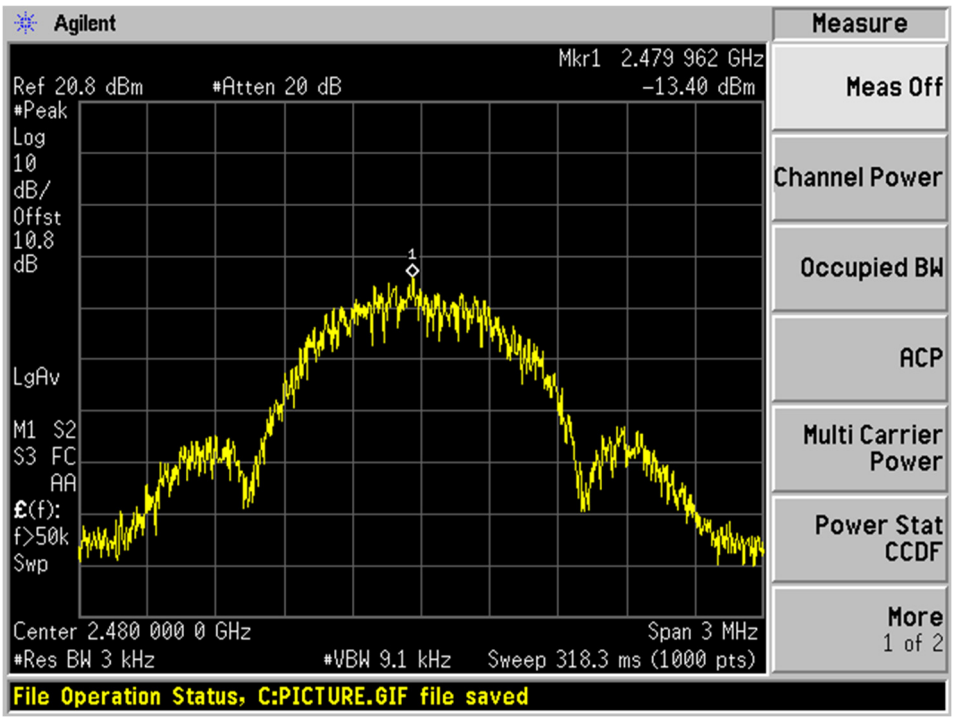
Low Channel: 2402 MHz



Middle Channel: 2442 MHz



High Channel: 2480 MHz



11 FCC §15.247(d) & ISEDC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals

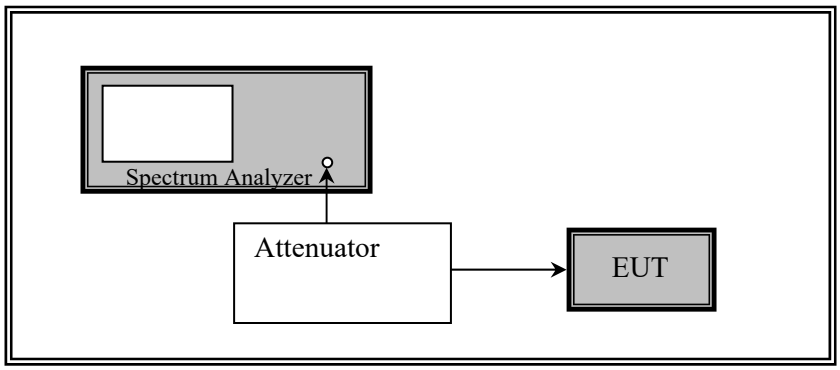
11.1 Applicable Standards

For FCC §15.247(d) and ISEDC RSS-247 §5.5, 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)).

11.2 Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

11.3 Test Setup Block Diagram



11.4 Test Equipment List and Details

BACL No	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
-	-	10dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
424	Agilent	Spectrum Analyzer	E4440A	US45303 156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

11.5 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	51.3%
ATM Pressure:	101.1 kPa

Testing was performed by Christian Schwarz from 2023-05-08 to 2023-05-18 at the RF site.

11.6 Test Results

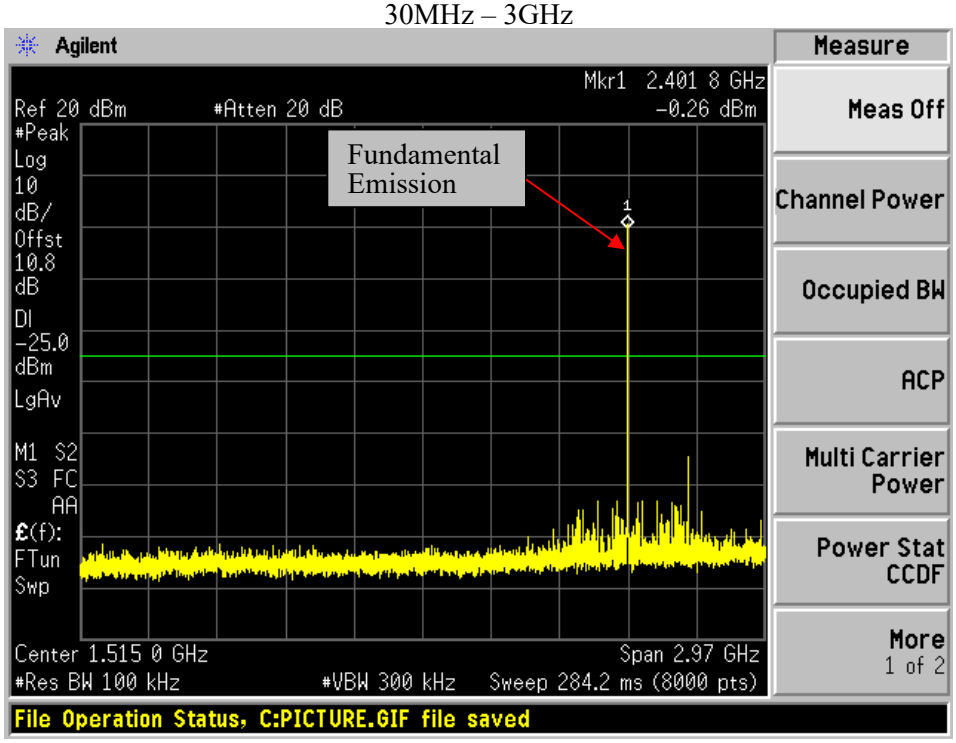
Please refer to following plots.

Note: due to trace stabilization, some plots show limit line greater than the required 20dBc. However, compliance is shown as all emissions displayed in plots are clearly below >20dBc.

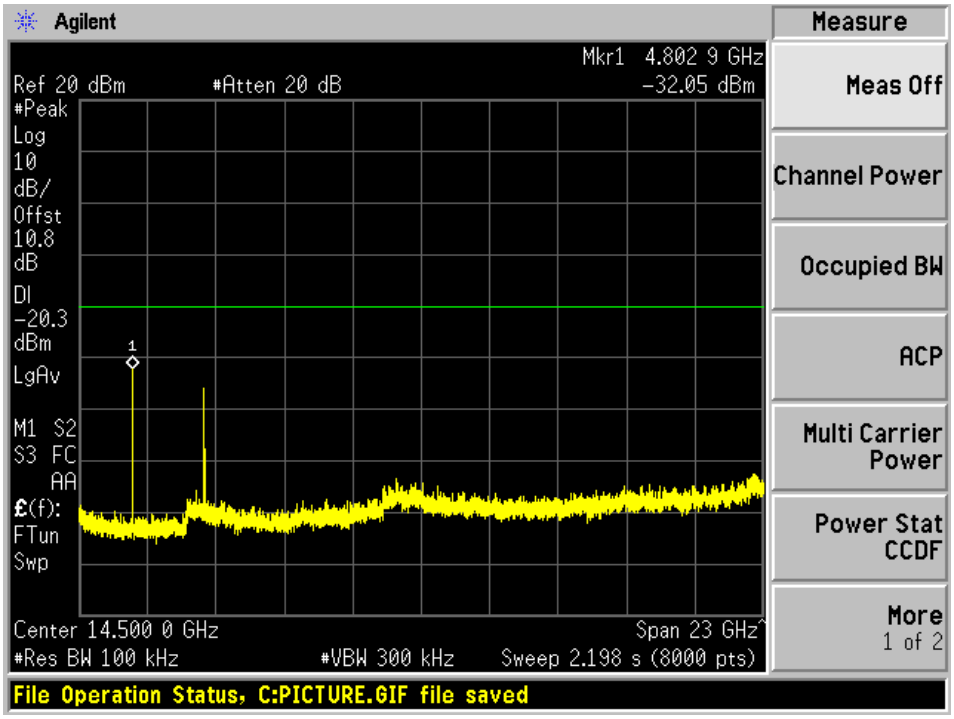
GFSK (LE)

Low Channel 2402MHz

30MHz – 3GHz

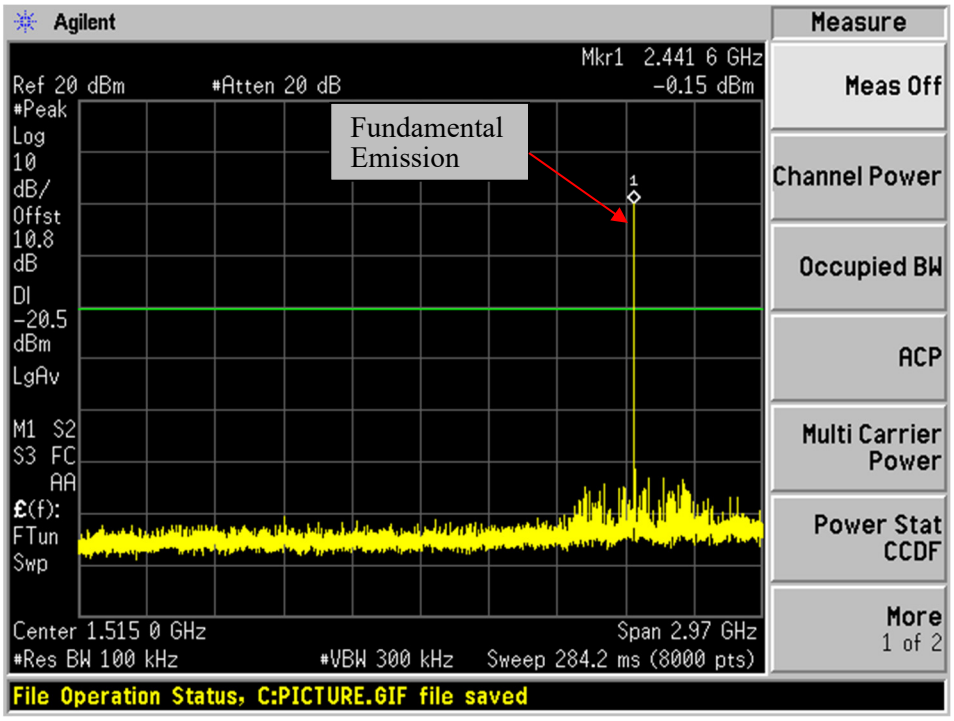


3GHz – 26GHz

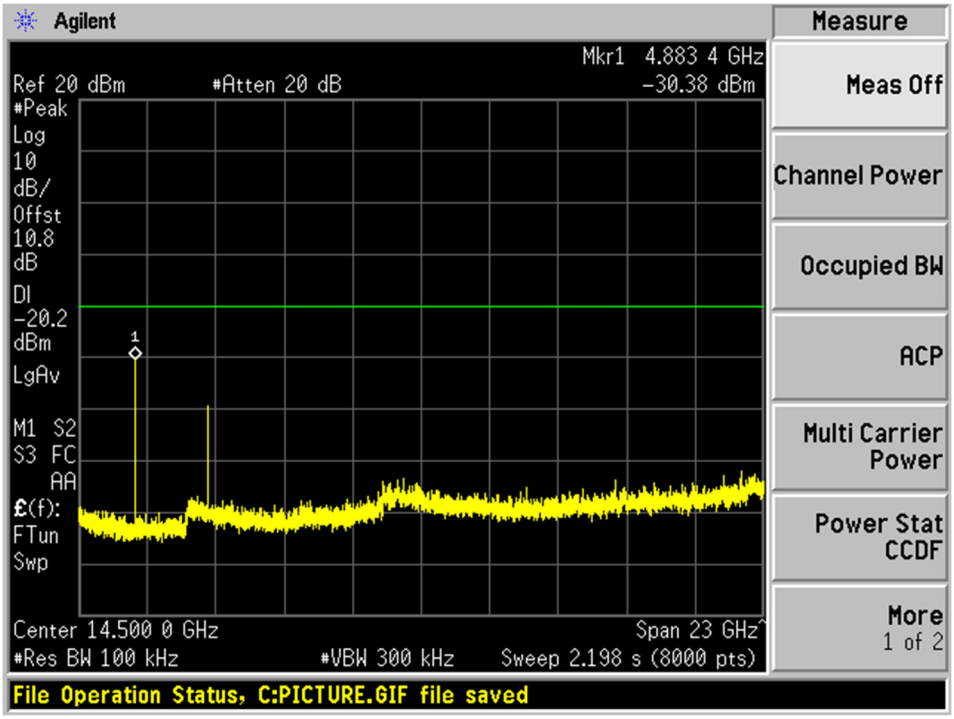


Middle Channel 2442MHz

30MHz – 3GHz

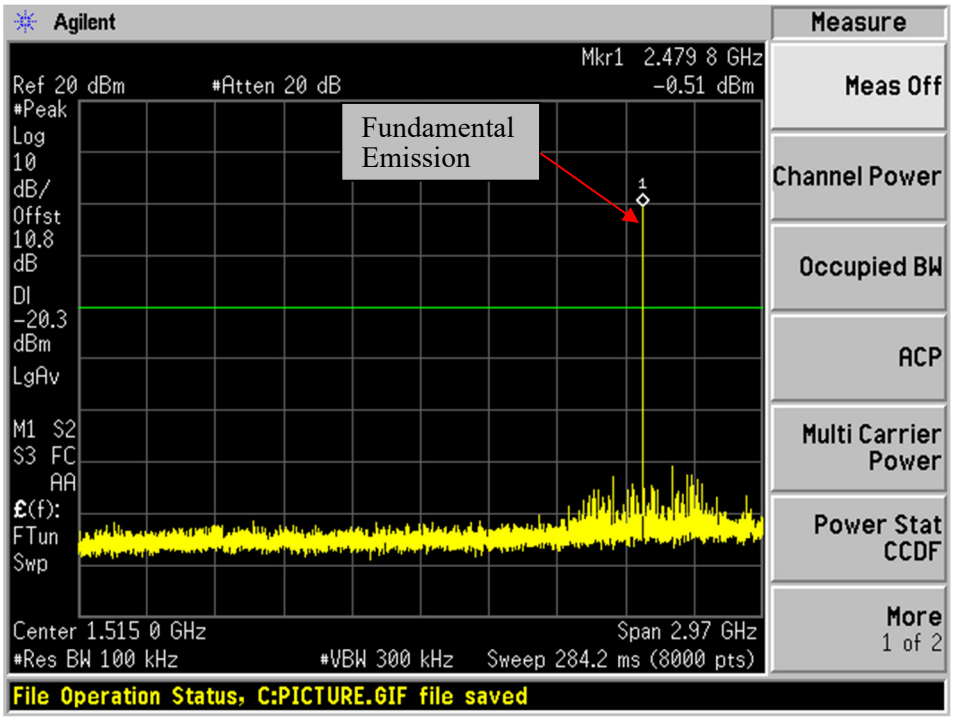


3GHz – 26GHz

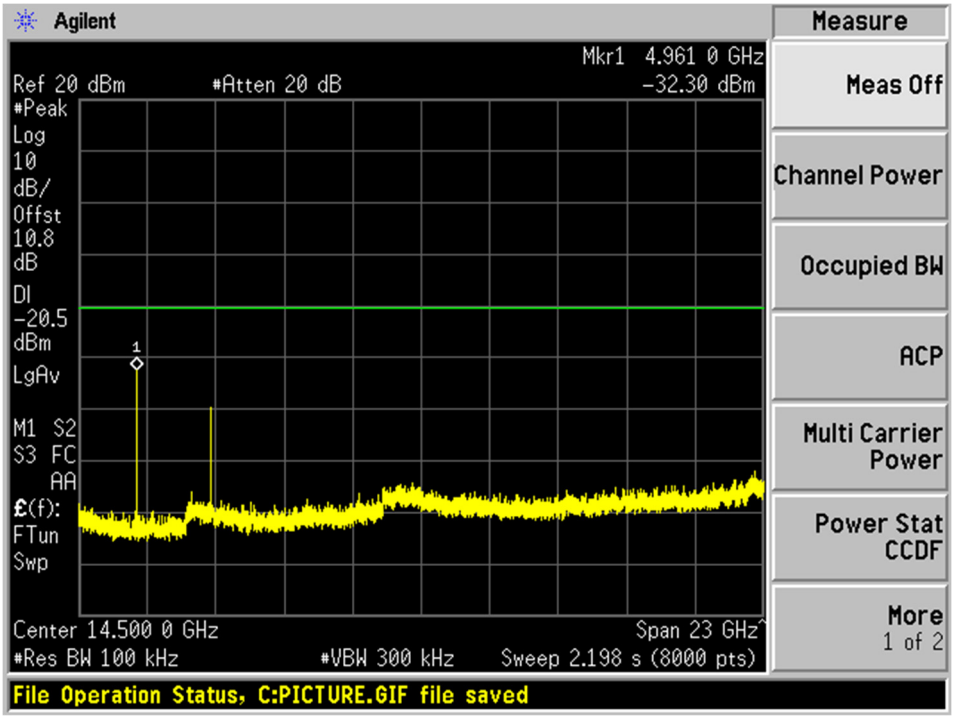


High Channel 2402MHz

30MHz – 3GHz



3GHz – 26GHz



12 Annex A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

13 Annex B (Normative) – EUT External Photographs

Please refer to the attachment

14 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment

15 Annex D (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA *R222 - Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 21st day of December 2022.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2024

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

--- END OF REPORT ---