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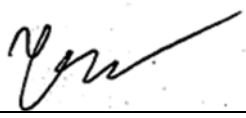

TEST REPORT

For

Minetec Pty Ltd

Unit 2, 29 Wellard Street,
Bibra Lake, WA, Australia, 6163

FCC ID: 2AVQP-M1010802
IC: 25823-M1010802

Report Type: Original Report	Product Type: Wireless Ranging and Data Transceiver Device
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Note: This test report is 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 report **must not** be used by the customer to claim product certification, approval, or endorsement by A2LA*, NIST, or any agency of the Federal Government.

* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" (Rev.2)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2005264-247	Original Report	2021-07-14
1	R2005264-247	Updated per 17065 TCB review comments	2021-10-27

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test report was prepared on behalf of *Minetec Pty Ltd.*, and their product model: M1010802, Caterpillar Part Number: 5908586, FCC ID: 2AVQP-M1010802, IC: 25823-M1010802, or the “EUT” as referred to in this report. The EUT is a Personal node which uses CSIRO’s Wireless Ad-hoc System for Positioning (WASP) including Time of Arrival (ToA) techniques using 5.8 GHz (for WASP) and 2.4 GHz (data communications) designed for harsh mining environment. The 2.4 GHz radio module has been pre-certified with FCC ID: 2AVQP-G2M5477, IC: 25823-G2M5477.

1.2 Mechanical Description of EUT

The EUT measures approximately 145 mm (L) x 75 mm (W) x 20 mm (H) and weighs approximately 556 g.

1.3 Objective

This report was prepared on behalf of *Minetec Pty Ltd.*, 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 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 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 v05r2: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

1.6 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 ° C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.7 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.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 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 17025:2005 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 17025:2005 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 - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
 - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
 - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
 - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
 - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
 - o 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:
 - o ENERGY STAR Recognized Test Laboratory – US EPA
 - o Telecommunications Certification Body (TCB) – US FCC;
 - o 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.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test software used was QCMBR provided by *Minetec Pty Ltd.*, the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
QPSK	5734.375	35
	5780.077	35
	5841.013	35

2.3 Duty Cycle Correction Factor

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

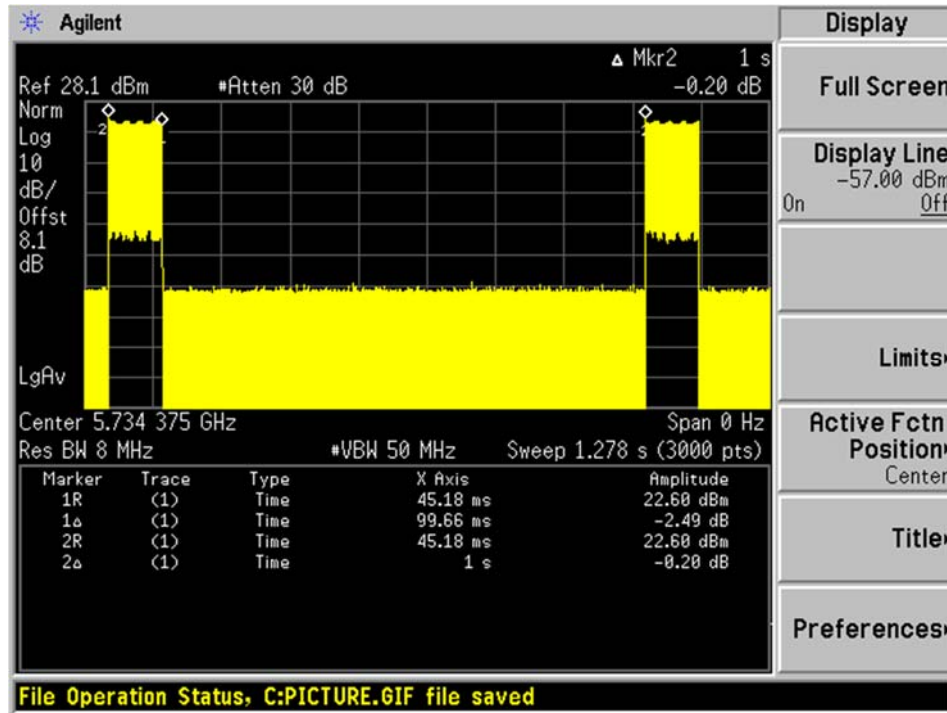
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized 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	Total On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
QPSK	99.66	1000	9.966	10

Duty Cycle = On Time (ms)/ Period (ms)

Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E7450

2.6 Remote Support Equipment

Manufacturer	Description	Model	S/N
Minetec	Vehicle PC	M1011057	1806-2592

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
RF Cable	< 1 m	EUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	N/A ¹
FCC §2.1093, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247 (d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9 and §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2 (1)	6 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4 (4)	Maximum Peak 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)	Power Spectral Density	Compliant

Note¹: the EUT is battery powered. Radio does not operate while charging.

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

This radio transmitter [enter the device's ISED certification number] 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

All antennas used are internal, and not accessible to the end users.

Manufacturer	Model Number	Frequency Range (MHz)	Antenna Type	Maximum Antenna Gain (dBi)
Minetec	-	5725-5850	Patch	7.1
Molex	47900011	2400-2483.5	Flexible PCB	2.6

5 FCC §2.1093, §15.247(i) & ISEDC RSS-102 – RF Exposure

5.1 Applicable Standards

According to FCC KDB 447498 D01 General RF Exposure Guidance v05r02 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:

$$\frac{[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}]}{\leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}}$$

- $f(\text{GHz})$ 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) $[\text{Power allowed at numeric threshold for 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) \cdot (f(\text{MHz})/150)] \text{ mW}$, at 100 MHz to 1500 MHz
- b) $[\text{Power allowed at numeric threshold for 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) \cdot 10] \text{ mW}$ 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 $[1 + \log(100/f(\text{MHz}))]$ 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 $\frac{1}{2}$ 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 IC RSS-102 Issue 5 §2.5.1,

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 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance

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

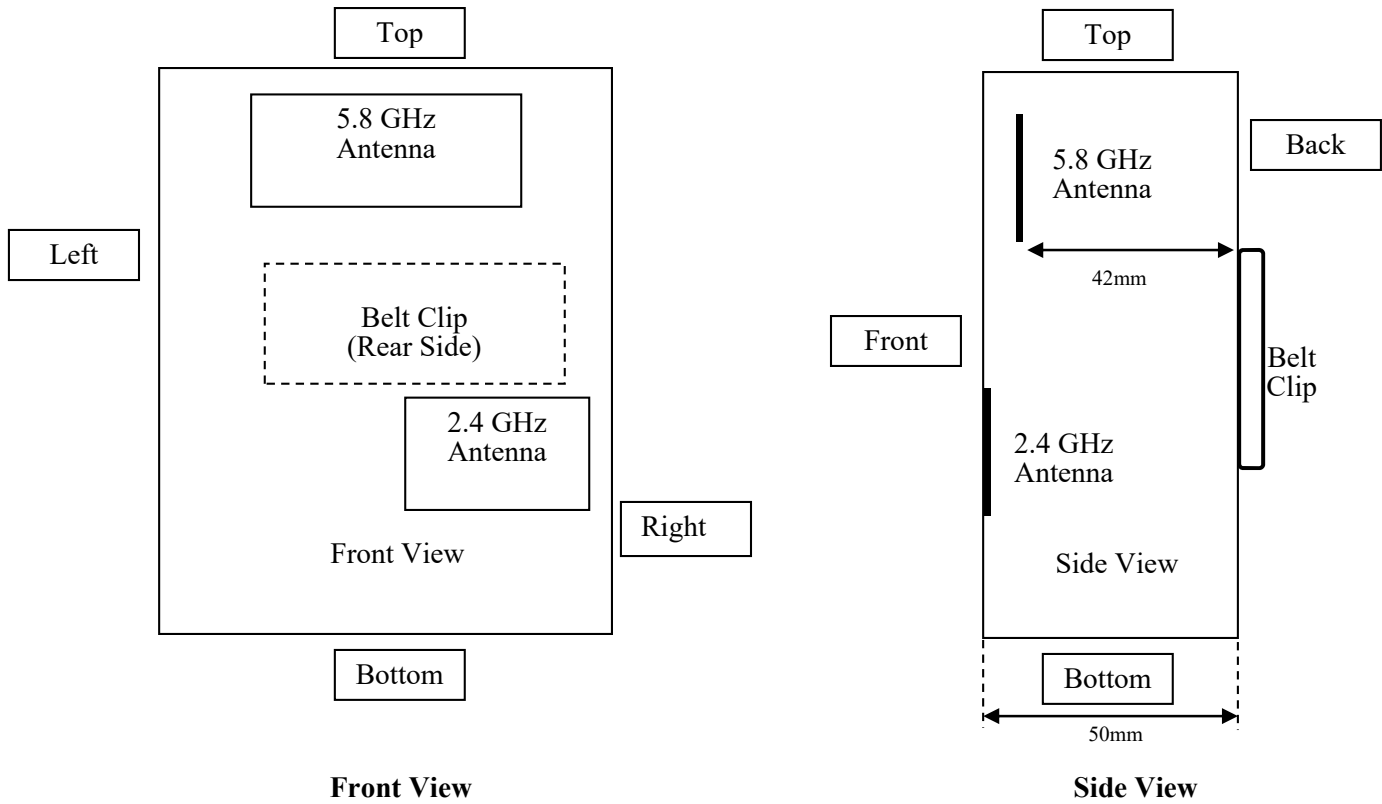
Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥ 50 mm
≤ 300	223	254	284	315	345
450	141	159	177	195	213
835	80	92	105	117	130
1900	99	153	225	316	431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

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required. For medical implants devices, the exemption limit for routine evaluation is set at 1 mW.

The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

5.2 EUT Dimension and Antenna Location

EUT Mechanical Configuration



Note 1: the diagram above is only to show antenna location, and it doesn't represent the shape of the host device or the antenna. Please refer to the EUT photos exhibit for detailed information.

Body-Worn:

The device has a belt clip on the back of the enclosure, which enables body-worn operation. The belt clip is a permanent part of the enclosure. Therefore, only rear side of the EUT will be in close proximity with human body. Please refer to the EUT setup photographs for details.

5.3 FCC and IC SAR Exclusion Consideration

5.8 GHz DTS

Channel	Frequency (MHz)	Measured Conducted Output Power		Distance (mm)	Calculated Value	FCC 1-g SAR Threshold	SAR Exclusion (Yes/No)
		dBm	mW				
Low	5734.375	11.52	14.19	42	0.809	3	Yes
Middle	5780.077	11.08	12.82	42	0.734	3	Yes
High	5841.013	11.23	13.27	42	0.764	3	Yes

Channel	Frequency (MHz)	Measured Conducted Output Power		Max. Antenna Gain (dBi)	Max. e.i.r.p (mW)	Distance (mm)	IC 1-g SAR Limit * (mW)	SAR Exclusion (Yes/No)
		dBm	mW					
Low	5734.375	11.52	14.19	7.1	72.778	42	87.43	Yes
Middle	5780.077	11.08	12.82	7.1	65.766	42	85.74	Yes
High	5841.013	11.23	13.27	7.1	68.077	42	83.48	Yes

*40 mm distance and linear interpolation was applied for finding the exemption limit for the channel frequencies list above. The following equation was used to determine the exemption power level p_c at channel frequency f_c .

$$(f_1 - f_2) / (f_c - f_2) = (p_1 - p_2) / (p_c - p_2)$$

2.4 GHz Wi-Fi

Measured Average Power:

	Channel	Frequency (MHz)	Measured Average Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11b	Low	2412	17.76	2.6	20.36
	Middle	2437	17.48	2.6	20.08
	High	2462	17.69	2.6	20.29
802.11g	Low	2412	16.40	2.6	19
	Middle	2437	16.75	2.6	19.35
	High	2462	16.39	2.6	18.99

SAR Exemption Evaluation:

Channel	Frequency (MHz)	Measured Average Conducted Output Power		Distance (mm)	Calculated Value	FCC 1-g SAR Threshold	SAR Exclusion (Yes/No)
		dBm	mW				
Low	2412	17.76	59.70	50	1.85	3	Yes
Middle	2437	17.48	55.98	50	1.75	3	Yes
High	2462	17.69	58.75	50	1.84	3	Yes

Channel	Frequency (MHz)	Max. e.i.r.p. (dBm)	Max. e.i.r.p (mW)	Distance (mm)	IC 1-g SAR Limit * (mW)	SAR Exclusion (Yes/No)
Low	2412	20.36	108.64	50	309	Yes
Middle	2437	20.08	101.86	50	309	Yes
High	2462	20.29	106.91	50	309	Yes

*Threshold level at 2450 MHz was used.

5.4 Simultaneous Transmission SAR Exclusion Consideration

	Channel Frequency (MHz)	Measured Average Power (dBm)	Separation Distance (mm)	Estimated 1-g SAR (W/kg)
5.8 GHz DTS	5734.375	11.52	42	0.11
2.4 GHz Wi-Fi	2412	17.76	50	0.25

Estimated 1-g SAR value was calculated based on the following equation from FCC KDB 447498 D01 v06.

$$[(\text{max. Power of channel, including tune-up tolerance, mW}) / (\text{min. Test separation distance, mm})] [\sqrt{f_{(\text{GHz})}} / x] \text{ W/kg, } x = 7.5$$

$\text{SAR}_{5.8 \text{ GHz DTS}} + \text{SAR}_{2.4 \text{ GHz Wi-Fi}} = 0.11 + 0.25 = 0.36 \text{ W/kg} < 1.6$. Therefore, simultaneous transmission SAR is exempt.

6 FCC §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(d): 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) and RSS-Gen 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	16.42 – 16.423	960 – 1240	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5.35 – 5.46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 – 167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

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 ISEDC 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 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.

6.2 Test Setup

The radiated emissions tests were performed in the 5-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 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle 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 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter 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:

$$\text{RBW} = 100 \text{ kHz} / \text{VBW} = 300 \text{ kHz} / \text{Sweep} = \text{Auto}$$

Above 1000 MHz:

(1) Peak: $\text{RBW} = 1\text{MHz} / \text{VBW} = 1\text{MHz} / \text{Sweep} = \text{Auto}$

(2) Average: $\text{RBW} = 1\text{MHz} / \text{VBW} = 10\text{Hz} \text{ or } 1/\text{T} / \text{Sweep} = \text{Auto}$

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:

$$\text{CA} = \text{S.A. Reading} + \text{Correction Factor}$$

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:

$$\text{Correction Factor} = \text{AF} + \text{CL} + \text{Atten} - \text{Ga}$$

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

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:

$$CA = Ai + AF + CL + Atten - Ga$$

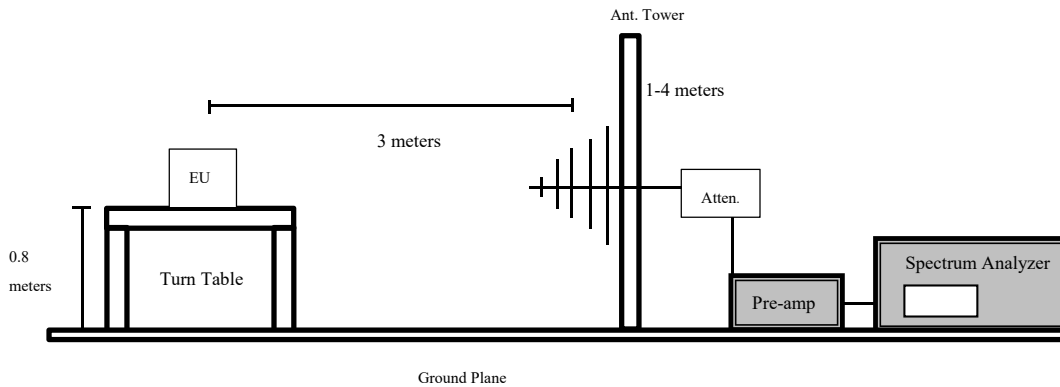
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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:

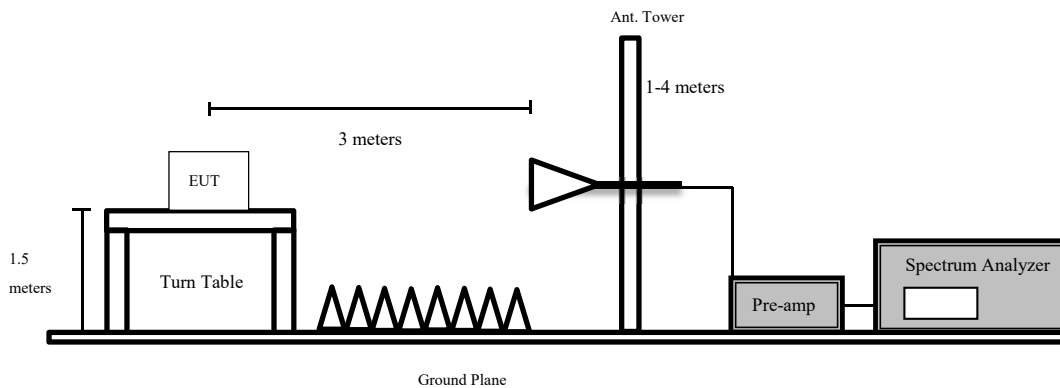
$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

6.5 Test Setup Block Diagrams

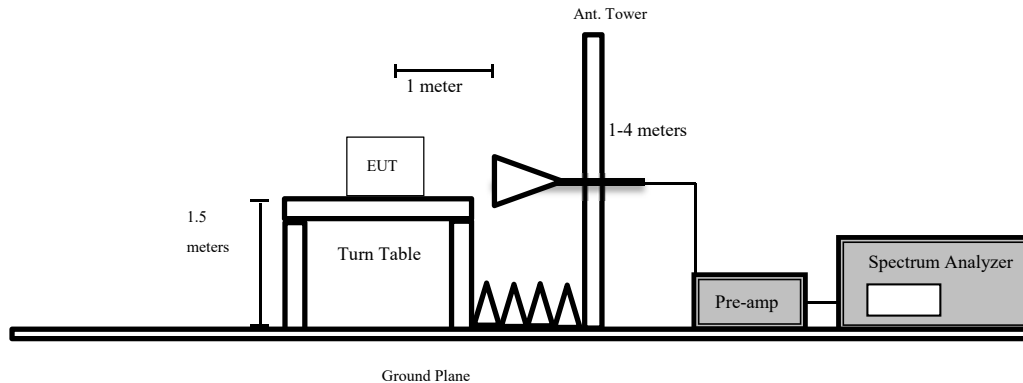
Test Setup for Below 1 GHz at 3 meters



Test Setup for Above 1 GHz at 3 meters



Test Setup for Above 1 GHz at 1 meter



6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
HP	Spectrum Analyzer	E4446A	US44300386	2019-08-24	18 months
Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2020-02-28	1 year
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2 years
IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs	KPS-1571AN-2400	DC 1922	2020-06-06	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950.03	100338	2020-03-17	18 months
MDP Digital	Times Microwave LMR 400 UltraFex Coaxial Cable 35'	LMR400UF	BACL1904161	2020-05-20	1 year
Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2019-11-20	2 years
HP	Pre Amplifier	8447D	2944A07030	2020-08-17	1 year
Agilent	Preamplifier	8449B	3147A00400	2020-02-27	1 year
BACL	5m3 Sensitivity Box	1	2	2020-10-27	1 year
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2020-02-05	2 years
Wisewave	Antenna, Horn	ARH-2823-02	10555-02	2020-02-05	2 years
-	RF cable	-	-	Each time ¹	N/A
-	Notch Filter	-	-	Each time ¹	N/A
AH Systems	Preamplifier	PAM 1840 VH	170	2020-11-09	1 year
Volteq	DC Power Supply	HY5003D	180100312	-	-

Note¹: 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".

6.7 Test Environmental Conditions

Temperature:	20-22 °C
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Allen Huang, 2020-12-30 to 2021-01-05 in 5m chamber 3.

6.8 Summary of Test Results

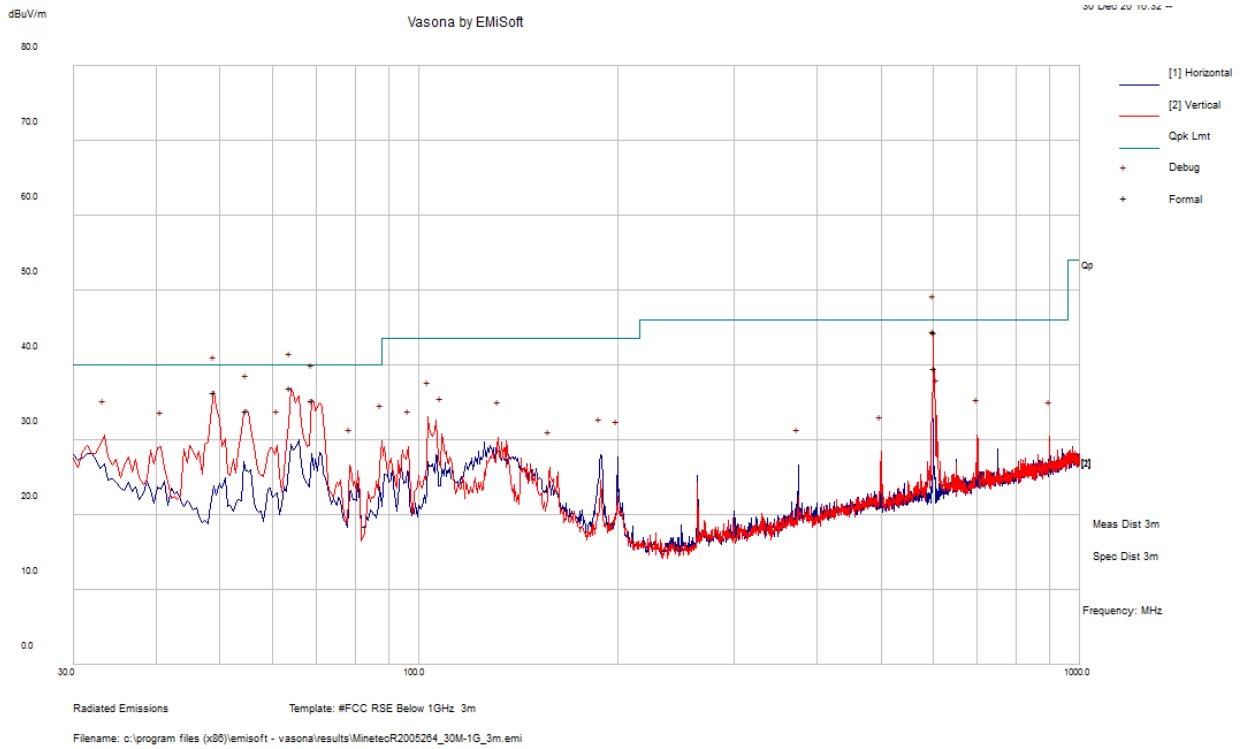
According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C and ISEDC RSS-247 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Mode, channel
-2.49	37425.95	Vertical	Low Channel (5734.375 MHz)

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

6.9 Radiated Emissions Test Results

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



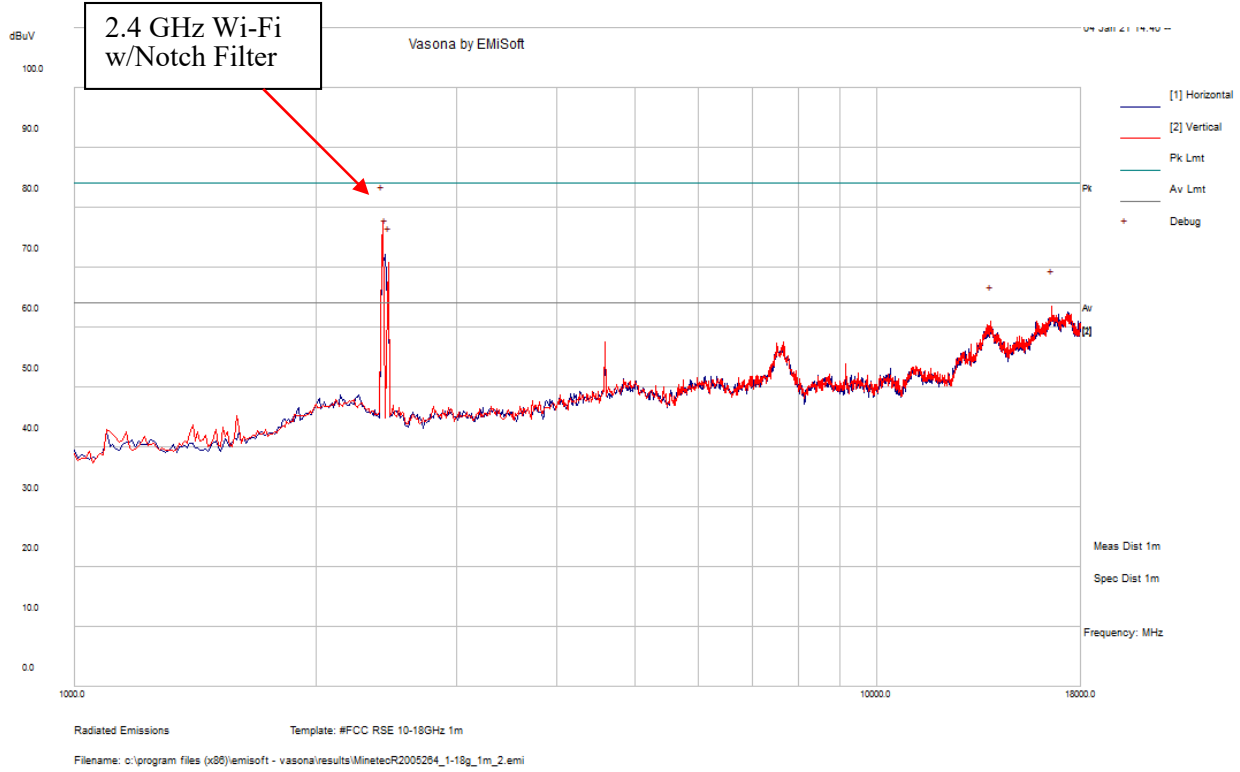
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
599.7188	47.19	-4.93	42.26	107	V	210	46	-3.74	QP
64.00775	45.25	-15.69	29.56	118	V	30	40	-10.44	QP
48.62875	33.58	-15.06	18.52	188	V	60	40	-21.48	QP
68.96625	46.42	-15.39	31.03	110	V	32	40	-8.97	QP
54.7635	37.56	-16.2	21.35	247	V	199	40	-18.65	QP
602.338	42.27	-4.79	37.48	101	V	177	46	-8.52	QP

2) 1-18 GHz Measurements at 1 Meter

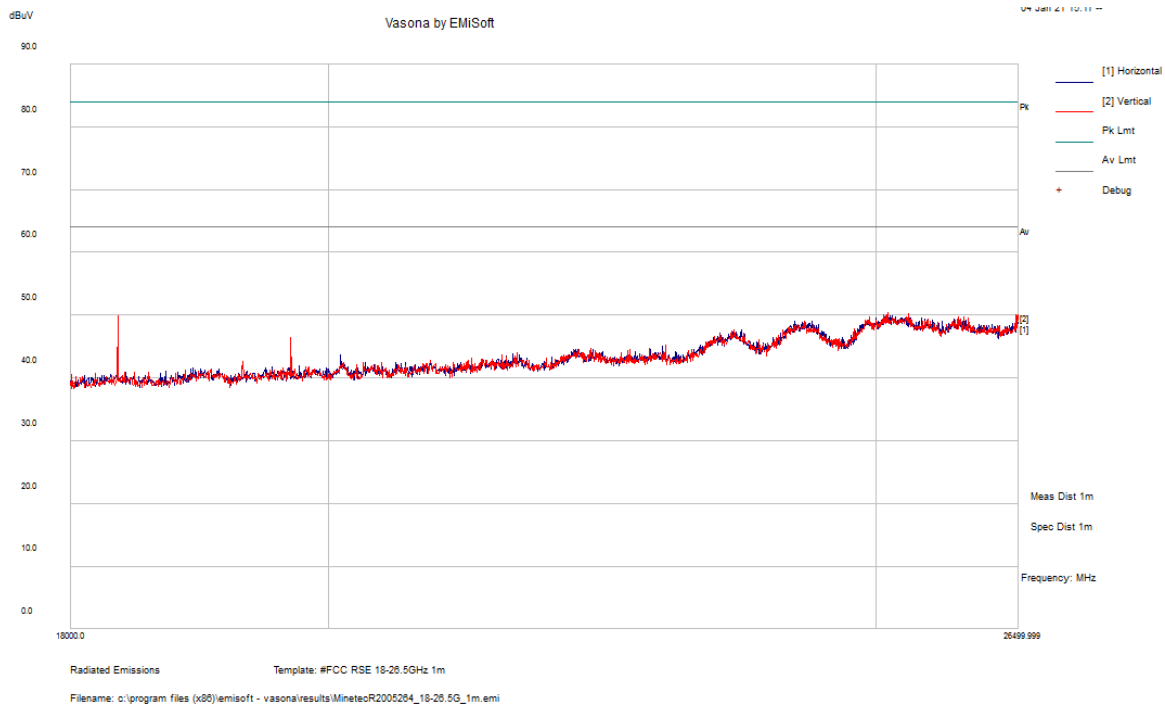
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel (5734.375 MHz)											
5734.375	55.840	15	150	H	35.4	8.473	-	99.713	-	-	Peak
5734.375	51.270	310	125	V	35.4	8.473	-	95.143	-	-	Peak
4587.5	52.190	15	150	H	34.6	7.302	35.63	58.46	84	-25.54	Peak
4587.5	52.770	310	175	V	34.6	7.302	35.63	59.04	84	-24.96	Peak
4587.5	47.962	15	150	H	34.6	7.302	35.63	54.23	64	-9.77	Ave
4587.5	50.412	310	175	V	34.6	7.302	35.63	56.68	64	-7.32	Ave
9175	48.640	35	175	H	37	11.59	36.03	61.20	84	-22.80	Peak
9175	46.230	55	145	V	37	11.59	36.03	58.79	84	-25.21	Peak
9175	43.694	35	175	H	37	11.59	36.03	56.25	64	-7.75	Ave
9175	39.675	55	145	V	37	11.59	36.03	52.24	64	-11.77	Ave
11468.75	45.840	15	140	H	38.7	13.053	34.47	63.12	84	-20.88	Peak
11468.75	45.040	320	150	V	38.7	13.053	34.47	62.32	84	-21.68	Peak
11468.75	35.934	15	140	H	38.7	13.053	34.47	53.22	64	-10.78	Ave
11468.75	35.195	320	150	V	38.7	13.053	34.47	52.48	64	-11.52	Ave
Middle Channel (5780.077 MHz)											
5780.077	54.84	20	150	H	35.4	8.473		98.713	-	-	Peak
5780.077	51.18	310	125	V	35.4	8.473		95.053	-	-	Peak
4624.1	51.52	10	165	H	34.6	7.302	35.57	57.852	84	-26.148	Peak
4624.1	54.23	335	180	V	34.6	7.302	35.57	60.562	84	-23.438	Peak
4624.1	48.057	10	165	H	34.6	7.302	35.57	54.389	64	-9.611	Ave
4624.1	51.884	335	180	V	34.6	7.302	35.57	58.216	64	-5.784	Ave
9248.2	47.21	40	150	H	37	11.59	36.03	59.77	84	-24.23	Peak
9248.2	45.88	315	120	V	37	11.59	36.03	58.44	84	-25.56	Peak
9248.2	42.235	40	150	H	37	11.59	36.03	54.795	64	-9.205	Ave
9248.2	40	315	120	V	37	11.59	36.03	52.56	64	-11.44	Ave
11560.15	44.98	15	110	H	38.9	13.053	34.47	62.463	84	-21.537	Peak
11560.15	44.30	320	150	V	38.9	13.053	34.47	61.783	84	-22.217	Peak
11560.15	34.451	15	110	H	38.9	13.053	34.47	51.9336	64	-12.066	Ave
11560.15	33.90	320	150	V	38.9	13.053	34.47	51.3876	64	-12.612	Ave

Frequency (MHz)	S.A. Reading (dB μ V)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB μ V/m)	FCC/ISED		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB μ V/m)	Margin (dB)	
High Channel (5841.013 MHz)											
5841.013	54.310	20	150	H	35.4	8.473	-	98.183	-	-	Peak
5841.013	51.450	310	125	V	35.4	8.473	-	95.323	-	-	Peak
4672.8	50.680	0	150	H	34.6	7.302	35.57	57.012	84	-26.988	Peak
4672.8	53.660	330	165	V	34.6	7.302	35.57	59.992	84	-24.008	Peak
4672.8	45.625	0	150	H	34.6	7.302	35.57	51.96	64	-12.04	Ave
4672.8	51.252	330	165	V	34.6	7.302	35.57	57.58	64	-6.42	Ave
9345.6	46.980	45	110	H	37	11.59	36.03	59.54	84	-24.46	Peak
9345.6	46.670	325	180	V	37	11.59	36.03	59.23	84	-24.77	Peak
9345.6	41.654	45	110	H	37	11.59	36.03	54.21	64	-9.79	Ave
9345.6	41.182	325	180	V	37	11.59	36.03	53.74	64	-10.26	Ave
11682.03	45.040	0	130	H	38.9	13.053	34.47	62.523	84	-21.48	Peak
11682.03	43.750	335	130	V	38.9	13.053	34.47	61.233	84	-22.77	Peak
11682.03	35.067	0	130	H	38.9	13.053	34.47	52.5496	64	-11.45	Ave
11682.03	34.21	335	130	V	38.9	13.053	34.47	51.6976	64	-12.30	Ave

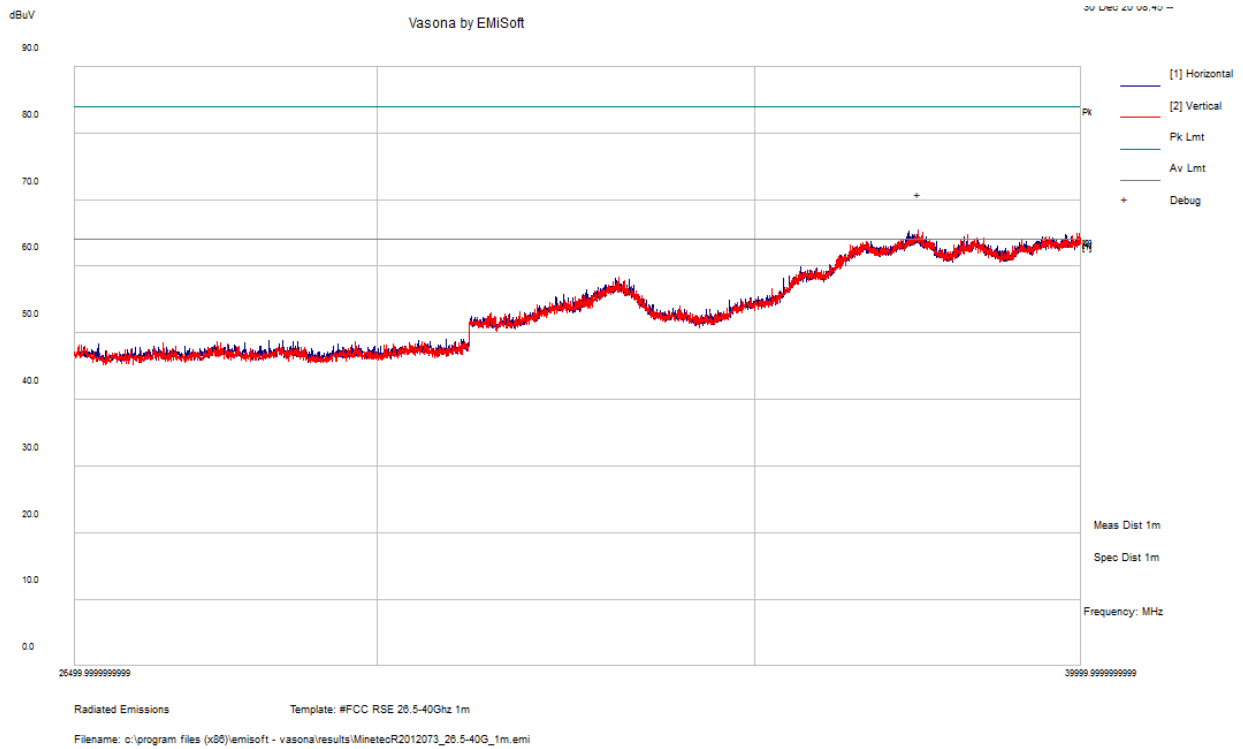
1 GHz – 18 GHz Low Channel (5734.375 MHz) Worst Case Scan at 1 Meter



18 GHz – 26.5 GHz Low Channel (5734.375 MHz) Worst Case Scan at 1 Meter



26.5 GHz – 40 GHz Low Channel (5734.375 MHz) Worst Case GHz Scan 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
37425.95	55.12	17.26	72.38	180	V	292	84	-11.62	Peak
37425.95	44.25	17.26	61.51	180	V	292	64	-2.49	Average

7 FCC §15.247(a) (2) & ISEDC RSS-247 §5.2 -Emission Bandwidth

7.1 Applicable Standards

According to ECFR §15.247(a) (2) and ISEDC RSS-247 §5.2, systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 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 8.2: DTS bandwidth

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	N9010A	MY48030852	2020-02-21	1 year
-	RF cable	-	-	Each time ¹	N/A

Note¹: 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".

7.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

The testing was performed by Tri Pham on 2020-10-12 in RF site.

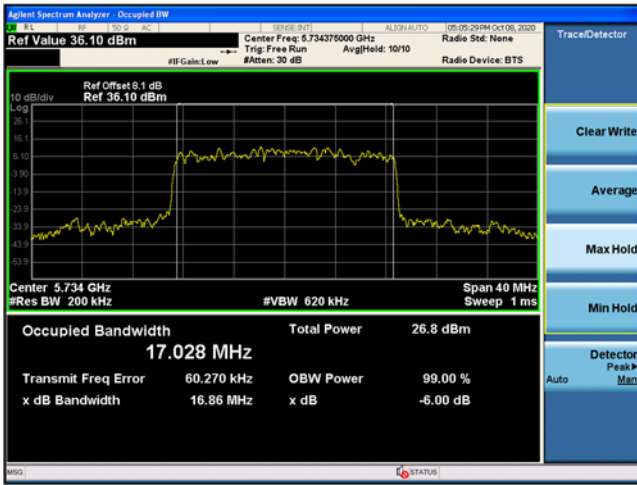
7.5 Test Results

Channel	Frequency (MHz)	99% OBW (kHz)	6 dB BW (kHz)	6 dB OBW limit (kHz)
Low	5734.375	17028	16840	≥500
Middle	5780.077	17076	16790	≥500
High	5841.013	17030	16820	≥500

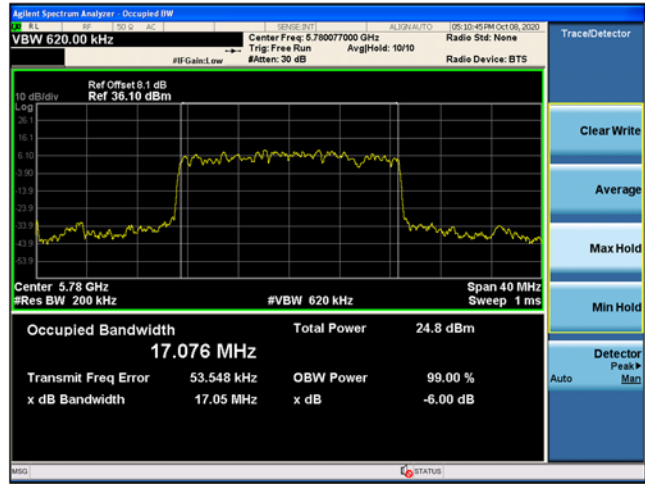
Please refer to the Plots below for test results from antenna port

99% OBW

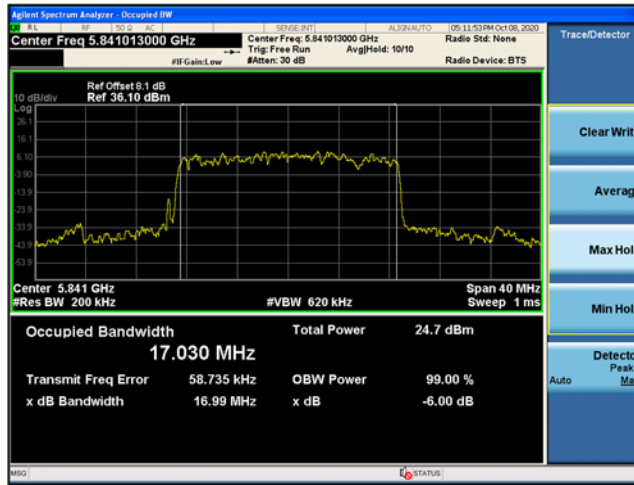
Low Channel 5734.375 MHz



Middle Channel 5780.077 MHz



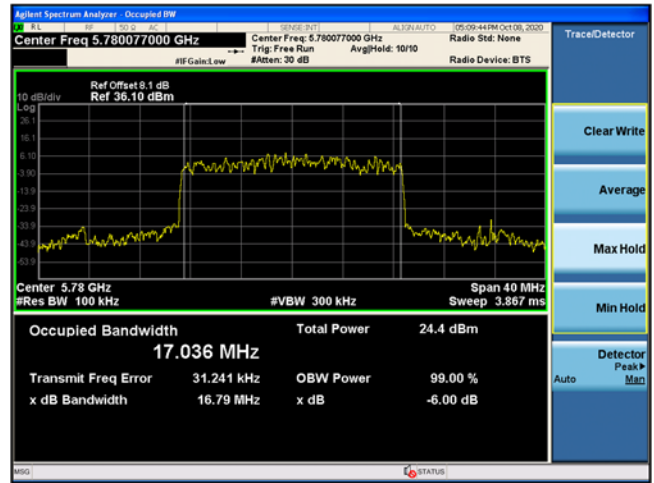
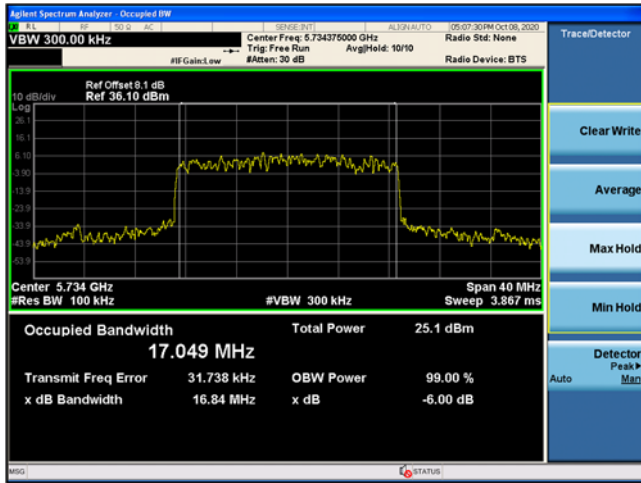
High Channel 5841.013 MHz



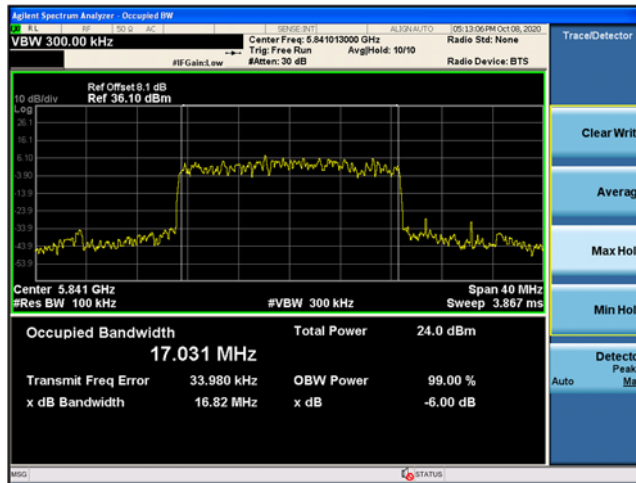
6 dB OBW

Low Channel 5734.375 MHz

Middle Channel 5780.077 MHz



High Channel 5841.013 MHz



8 FCC §15.247(b) (3) & ISEDC RSS-247 §5.4 (4) - Output Power Measurement

8.1 Applicable Standards

According to ECFR §15.247(b) (3) and ISEDC RSS-247 §5.4 (4) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 Watt.

8.2 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 8.3: DTS fundamental emission output power

Average power was measured using average power sensor. As requested by client, peak power was also measured using spectrum analyzer channel power function.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
ETS-LINDGREN	Power Sensor	7002-006	160097	2018-12-31	2.5 years
Agilent	Analyzer, Spectrum	N9010A	MY48030852	2020-02-21	1 year

Note¹: 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".

8.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Tri Pham on 2020-10-09 at RF site.

8.5 Test Result

Average Power

Channel	Frequency (MHz)	Measured Output Power (dBm)	Limit (dBm)
Low	5734.375	11.52	28.9
Middle	5780.077	11.08	28.9
High	5841.013	11.23	28.9

Note: According to ECFR §15.247(e) and ISEDC RSS-247 §5.4 f, since the antenna gain is 7.1 dBi, the new output power limit will be 28.9 dBm (reduced by the amount in dB that the gain exceeds 6dBi).

Note: Duty cycle was considered in the power meter reading.

Peak Power (Reference Only)

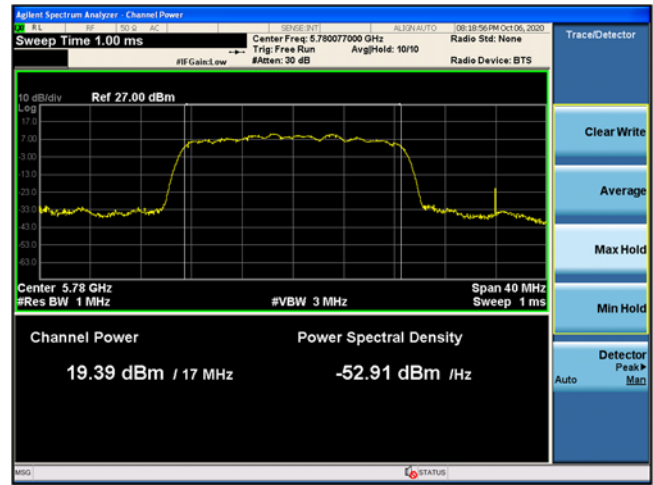
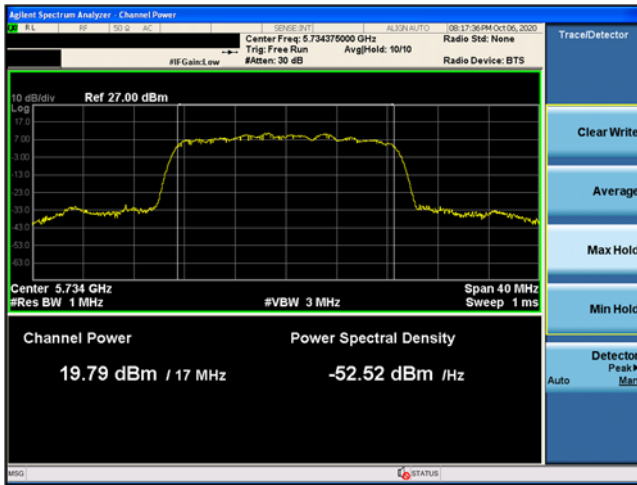
Channel	Frequency (MHz)	Conducted Maximum Power (dBm)	Limit (dBm)
Low	5734.375	19.79	28.9
Middle	5780.077	19.39	28.9
High	5841.013	19.39	28.9

Note: The Output power's results in the table above were tested using Peak Method. These results are for reference only.

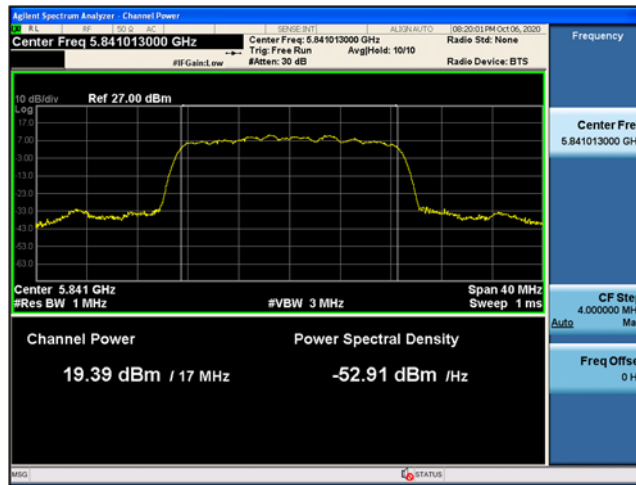
Peak Method (Reference Only)

Low Channel 5734.375 MHz

Middle Channel 5780.077 MHz



High Channel 5841.013 MHz



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

9.1 Applicable Standards

According to ECFR §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

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 13: Band-edge measurements

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	N9010A	MY48030852	2020-02-21	1 year
-	RF cable	-	-	Each time ¹	N/A

Note¹: 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".*

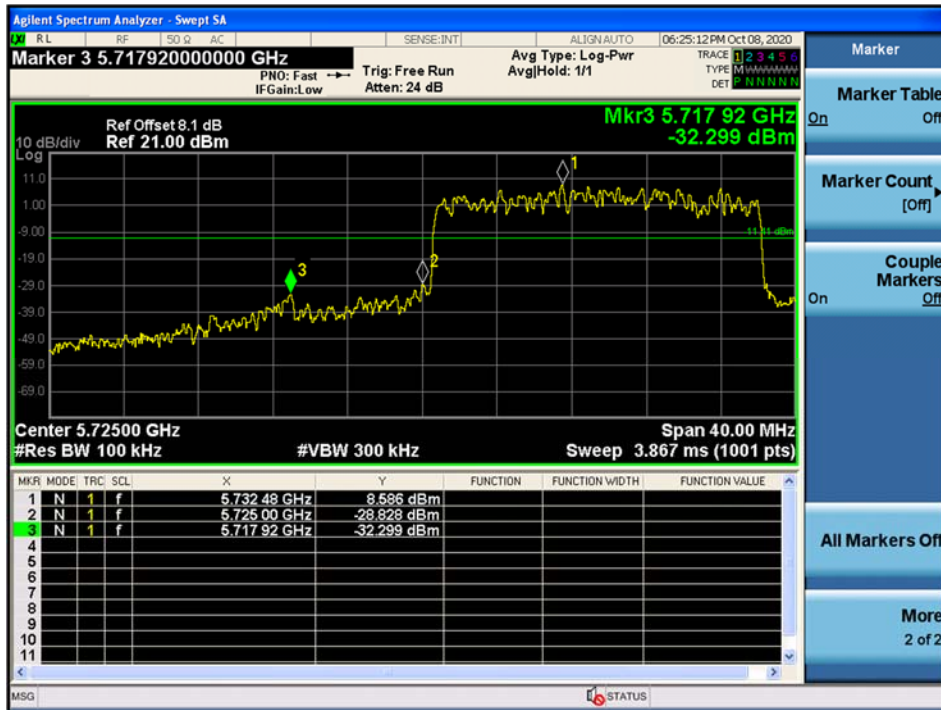
9.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

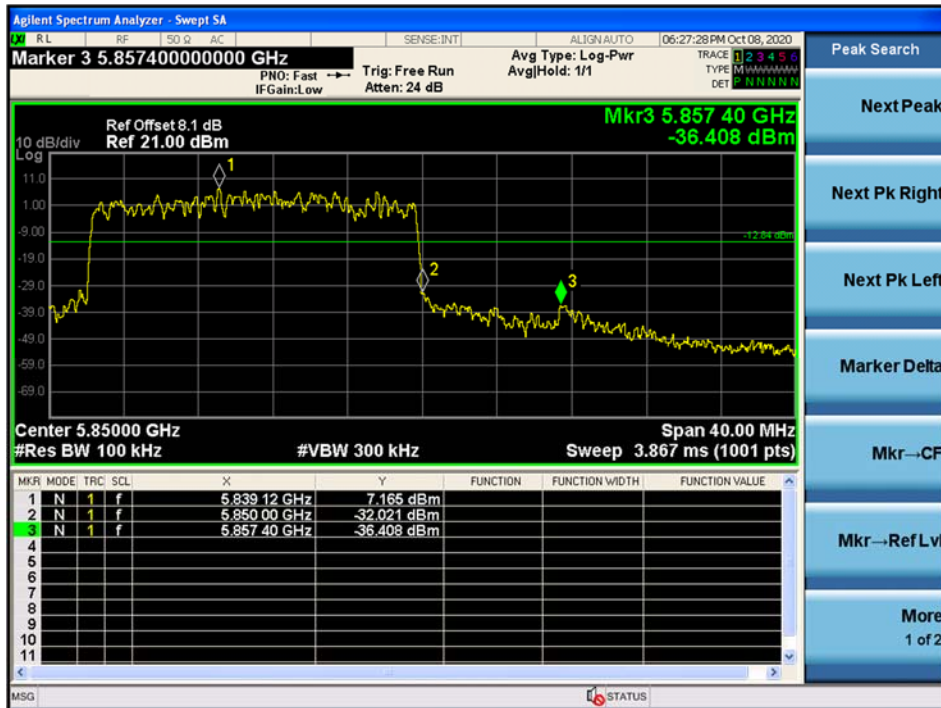
The testing was performed by Tri Pham on 2020-10-12 at RF site.

9.5 Test Results

Low Channel 5734.375 MHz



High Channel 5841.013 MHz



10 FCC §15.247(e) & ISEDC RSS-247 §5.2(2) - 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: DTS maximum power spectral density level in the fundamental emission.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rhode & Schwarz	Signal Analyzer	FSV40	1321.3008K39-101203-UW	2019-08-06	18 months
Agilent	Analyzer, Spectrum	N9010A	MY48030852	2020-02-21	1 year

Note¹: 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".*

10.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

The testing was performed by Tri Pham on 2020-10-12 at RF site.

10.5 Test Results

Average PSD

Channel	Frequency (MHz)	Measured PSD (dBm/3 kHz)	Duty Cycle Correction Factor (dB)	Corrected PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
Low	5734.375	-16.72	10	-6.72	6.9
Middle	5780.077	-17.65	10	-7.65	6.9
High	5841.013	-17.12	10	-7.12	6.9

Note: According to ECFR §15.247(e) and ISEDC RSS-247 §5.4 f, since the antenna gain is 7.1 dBi, the new PSD limit will be 6.9 dBm/3 kHz (reduced by the amount in dB that the gain exceeds 6dBi).

Note: Add $[10 \log (1 / D)]$, where D is the duty cycle, to the measured power to compute the average power during the actual transmission times.

Peak PSD (Reference Only)

Channel	Frequency (MHz)	Conducted PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
Low	5734.375	1.316	6.9
Middle	5780.077	0.453	6.9
High	5841.013	0.560	6.9

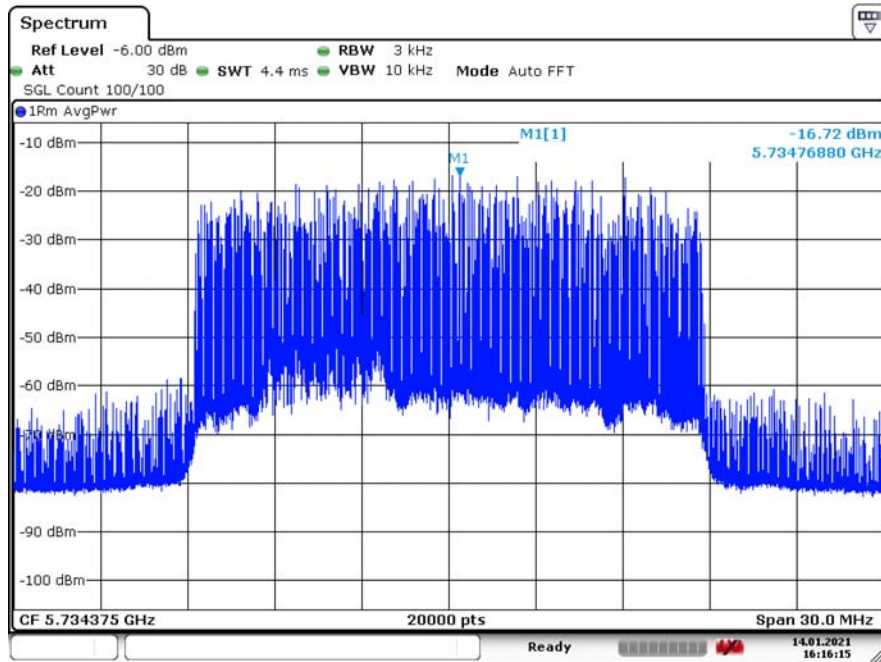
Note: According to ECFR §15.247(e) and ISEDC RSS-247 §5.4 f, since the antenna gain is 7.1 dBi, the new PSD limit will be 6.9 dBm/3 kHz.

Note: The PSD's results in the table above were tested using Peak detector based on client's request. This is for reference only.

Please refer to plots below for detailed test results

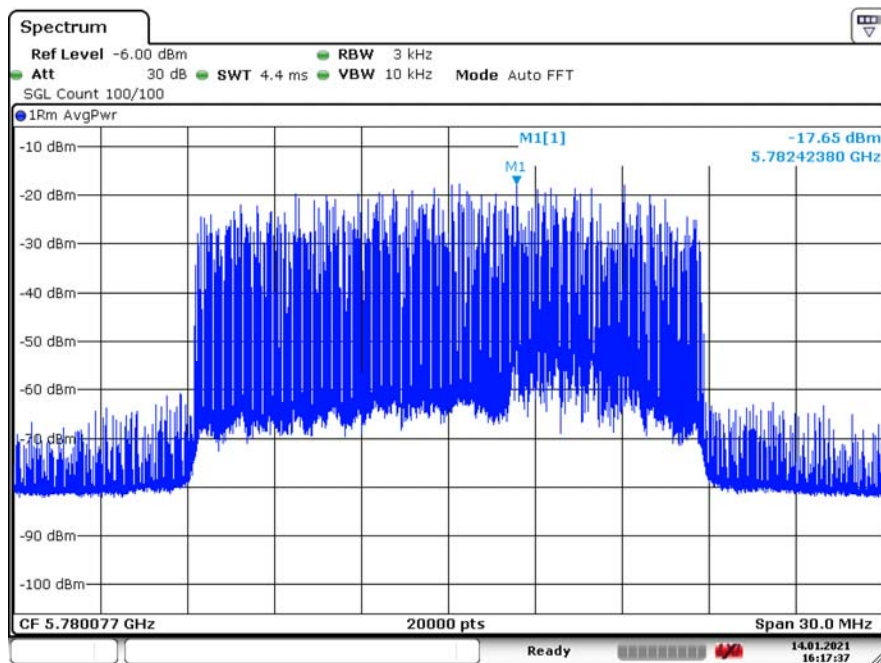
Average PSD

Low Channel 5734.375 MHz



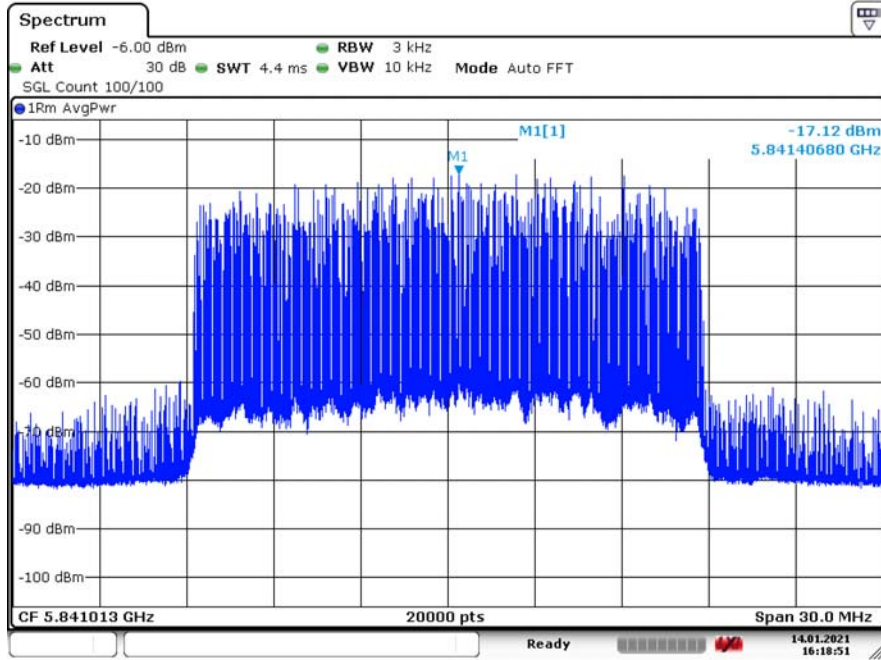
Date: 14.JAN.2021 16:16:15

Middle Channel 5780.077 MHz



Date: 14.JAN.2021 16:17:38

High Channel 5841.013

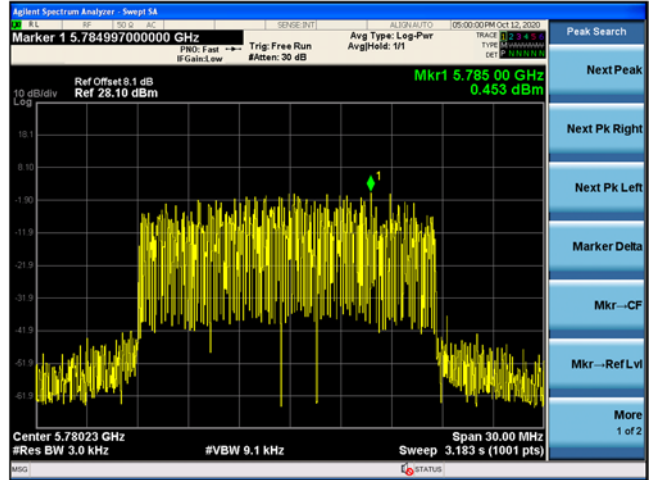
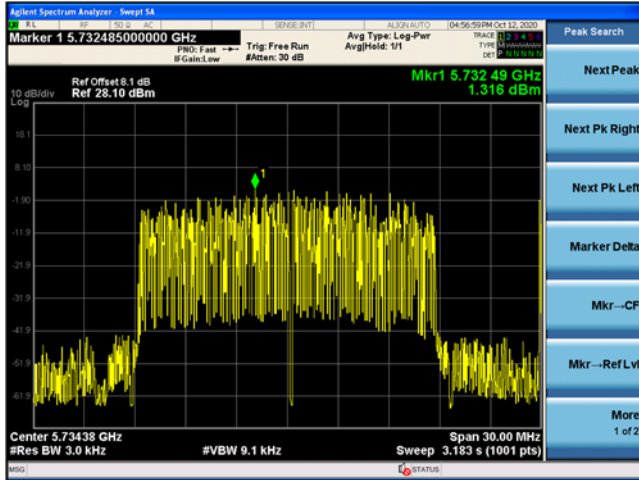


Date: 14.JAN.2021 16:18:52

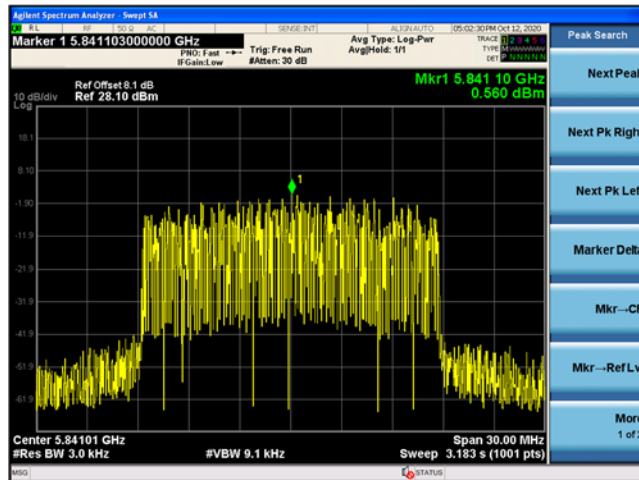
Peak PSD (Reference Only)

Low Channel 5734.375 MHz

Middle Channel 5780.077 MHz



High Channel 5841.013 MHz



11 FCC §15.247(d) & ISEDC RSS-247 §5.5, RSS-GEN §8.9 - Spurious Emissions at Antenna Terminals

11.1 Applicable Standards

For ECFR §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 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.

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 Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2019-09-24	18 months
-	RF cable	-	-	Each time ¹	N/A

Note¹: 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".*

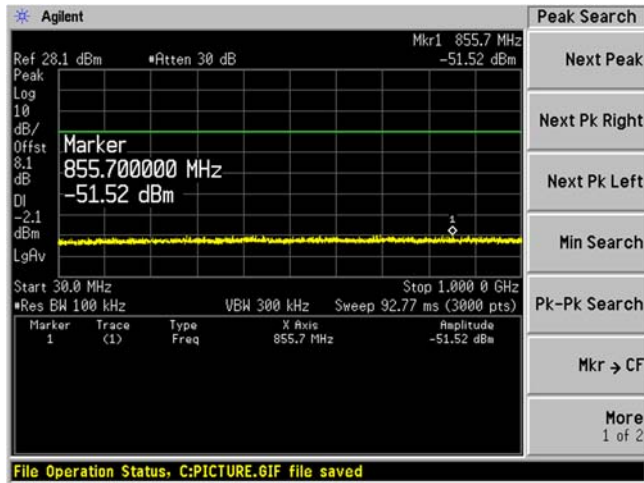
11.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

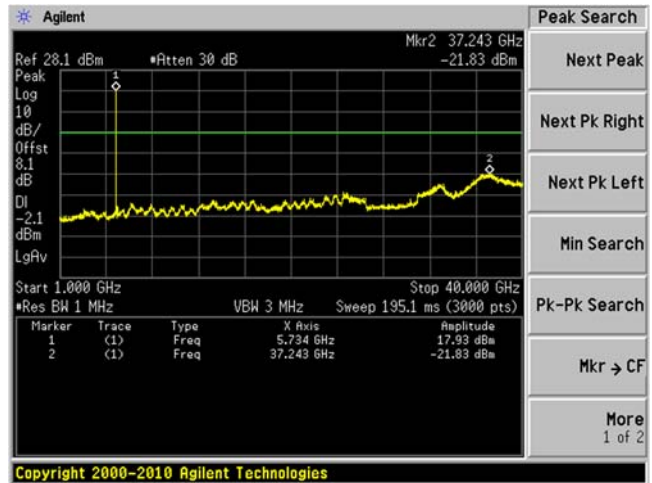
The testing was performed by Tri Pham on 2020-10-12 at RF site.

11.5 Test Results

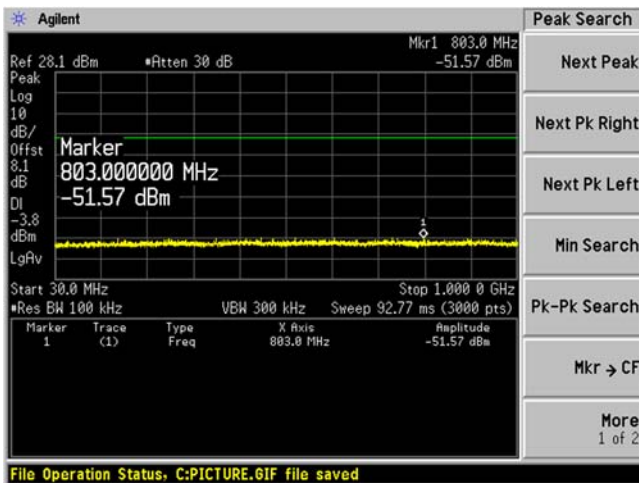
Low Channel 30 MHz – 1 GHz



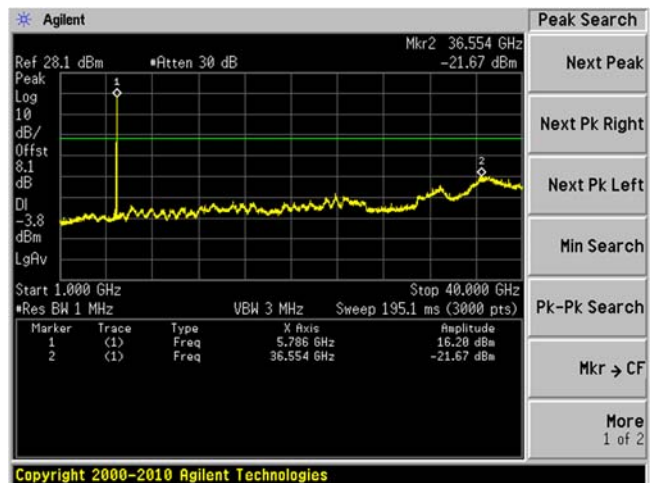
Low Channel 1 GHz – 40 GHz



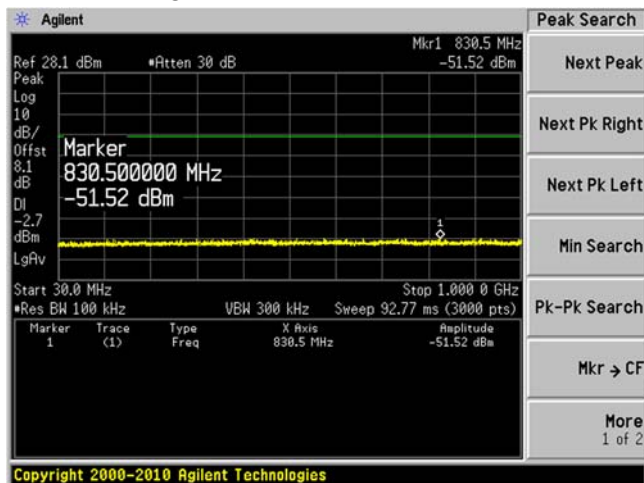
Middle Channel 30 MHz – 1 GHz



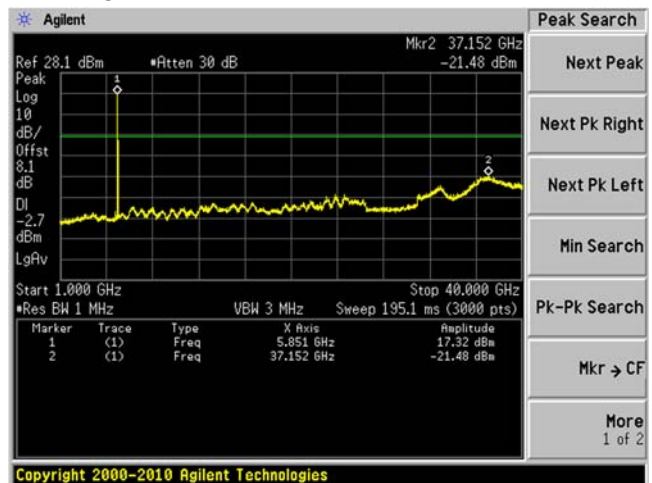
Middle Channel 1 GHz – 40 GHz



High Channel 30 MHz – 1 GHz



High Channel 1 GHz – 40 GHz



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 10th day of March 2021.

A blue ink signature of Trace McInturf.

Trace McInturf, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2022

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 ---