



America

Verification Test Report

Module FCC ID: B4OEC86XFPX
Module IC: 21698-EC864FPA

FCC Rule Part: 15.247
ISED Canada's Radio Standards Specification: RSS-247

TÜV SÜD Report Number: RD72159794.202

Module Manufacturer: GT-Tronics
Module Model: EC864FPA

Host Manufacturer: ACCO Brands USA LLC
Host Model: Z-2500; Z-3500

Test Begin Date: June 11, 2020
Test End Date: July 20, 2020

Report Issue Date: August 28, 2020



A2LA Cert. No. 2955.18

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, ANSI, or any agency of the Federal Government.

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance of the GT-Tronics preapproved module when integrated into a host device as well as simultaneous transmissions of two radios with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-247 Certification.

1.2 Product Description

The Z-2500 and Z-3500 is a line of air purifiers which receive air quality data over-the-air from the SensorPod-M.

Technical Information:

Detail	BLE radio	802.11 radio
Chipset	Texas Instruments CC2640	ESP8266
Frequency Range	2402 – 2480MHz	2412 – 2462MHz
Number of Channels	39	11
Modulation Format	GFSK	802.11b/g/n(20MHz)
Data Rates	1Mbps	802.11b: 11/5.5/2/1Mbps 802.11g: 54/48/36/24/18/12/9/6Mbps 802.11n20:150/144.44/130/117/ 115.56/104/86.67/78/52/6.5Mbps
Operating Voltage	3.3Vdc	3.3Vdc
Antenna Type / Gain	PCB Antenna / -0.30dBi	PCB Antenna / 2dBi

Manufacturer Information:

ACCO Brands USA LLC
4 Corporate Drive
Lake Zurich, IL 60047

EUT Serial Numbers: T2/004

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

The EUT was configured with special firmware to control the 802.11 radio. The BLE radio was configured using a Texas Instruments DevPack.

The Z-2500 and Z-3500 are electrically identical and differ only in the scale of the enclosure. The Z-3500 was declared worst case and all testing was performed on that variant.

Resistors R5 and R6 were removed from the radio carrier board to ensure the 802.11 and BLE radios did not have a physical link.

The power levels for each of the radios were as follows:
BLE radio = 0dBm (Target Selection = CC2650EM-X4S)
802.11 radio = 0dBm attenuation (17-19dBm conducted)

The worst-case data rates from the original filing for the 802.11 radio were checked and documented in this report.

Simultaneous transmissions for the worst-case data rates of each of the available radios on the GT-Tronics and the integral 2.4GHz proprietary radio were evaluated and documented in this report.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

TÜV SÜD America Inc.
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 748-4615

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. (Durham) is accredited to ISO/IEC 17025 by A2LA accreditation program, and has been issued certificate number 2955.18 in recognition of this accreditation. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC and Innovation, Science and Economic Development (ISED) Canada.

FCC Designation Number: US1245
FCC Test Firm Registration Number: 238628
ISED Canada Company Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

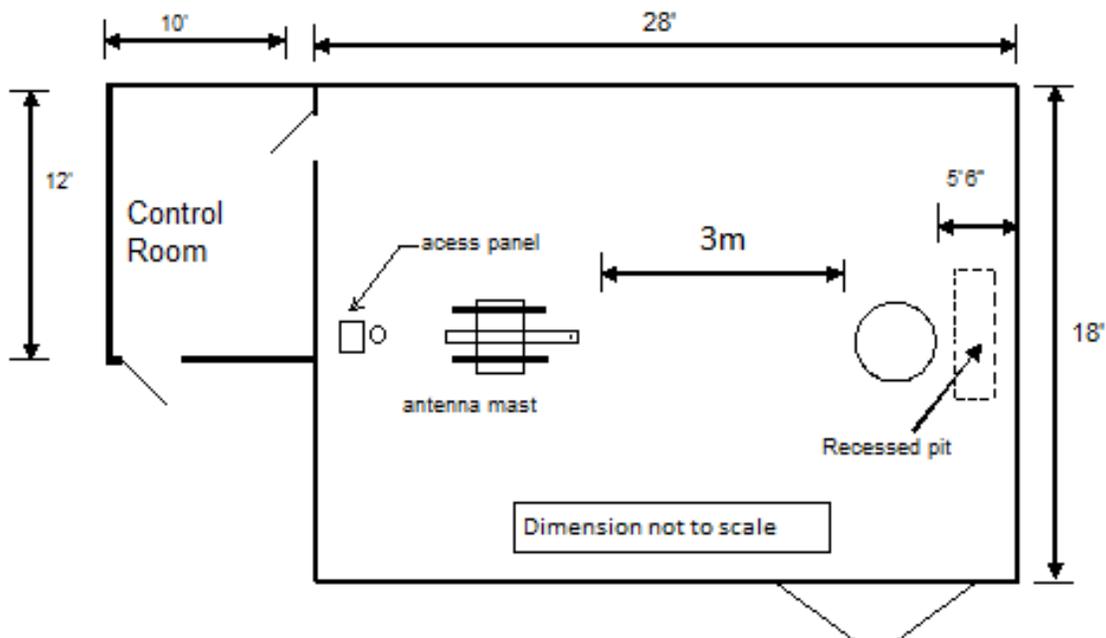


Figure 2.3-1: Semi-Anechoic Chamber Test Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2020
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020
- ❖ FCC 558074 D01 15.247 Meas Guidance v05r02 – Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules, April 2, 2019
- ❖ FCC KDB 996369 D04 Module Integration Guide v01 - Guidance for Host Product Manufacturers – February 2019
- ❖ ISED Canada Radio Standards Specification: RSS-247, Digital Transmission Systems (DTs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017
- ❖ ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1, March 2019

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
DEMC3002	Rohde & Schwarz	ESU40	Receiver	100346	1/22/2020	1/22/2021
DEMC3006	Rohde & Schwarz	TS-PR18	Amplifier	122006	1/23/2020	1/23/2021
DEMC3007	Rohde & Schwarz	TS-PR26	Amplifier	100051	1/23/2020	1/23/2021
DEMC3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
DEMC3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antenna	2013120203	4/8/2020	4/8/2021
DEMC3027	Micro-Tronics	BRM50702	2.4GHz Notch Filter	175	1/27/2020	1/27/2021
DEMC3032	Hasco, Inc.	HLL142-S1-S1-192/WA	Cable	3075	1/23/2020	1/23/2021
DEMC3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/27/2020	1/27/2021
DEMC3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/27/2020	1/27/2021
DEMC3055	Rohde & Schwarz	3005	Cable	3055	1/23/2020	1/23/2021
DEMC3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	1/22/2020	1/22/2021
DEMC3161	TESEQ	CBL-6112D	Antenna	51323	2/18/2020	2/18/2021
DEMC3179	Extech Instruments	SD700	Climate Monitoring Equipment	A.103595	6/2/2020	6/2/2021

NCR = No Calibration Required

DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.

Asset DEMC3002: Firmware Version: ESU40 is 4.73 SP4

Asset DEMC3012: Software Version: EMC32-B is 10.50.00

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	EUT	ACCO Brands USA, LLC	Z-2500; Z-3500	See Section 1.2

Notes:

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

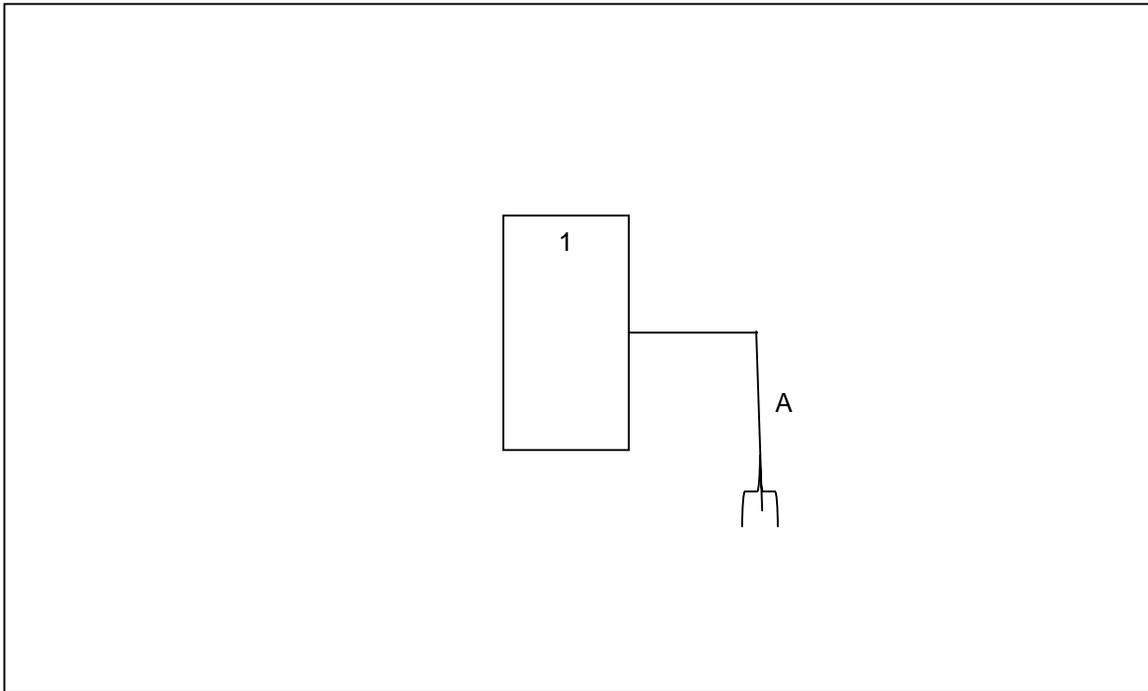


Figure 6-1: Test Setup Block Diagram

Table 6-1: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	AC Power Cable	1.9m	No	1 to AC

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: 15.203

The antenna is integral to the device and cannot be removed or replaced by the end user.

7.2 Emissions into Restricted Frequency Bands

7.2.1.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a RBW of 120 kHz and a VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

7.2.1.2 Duty Cycle Correction

The Duty Cycle Correction was not required.

7.2.1.3 Measurement Results

Performed by: Chris Gormley

Table 7.5.2.3-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Turntable Position (o)	Antenna Height (cm)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg					pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
BLE – 1Mbps High Channel												
2483.5	48.20	31.60	H	220	100	-3.16	45.04	28.44	74.0	54.0	28.96	25.56
4960	46.80	40.20	H	126	100	3.81	50.61	44.01	74.0	54.0	23.39	9.99
4960	46.50	39.90	V	213	100	3.81	50.31	43.71	74.0	54.0	23.69	10.29
7440	39.10	26.50	H	207	100	8.93	48.03	35.43	74.0	54.0	25.97	18.57
7440	38.80	25.70	V	0	100	8.93	47.73	34.63	74.0	54.0	26.27	19.37
12400	36.40	22.50	H	0	100	12.32	48.72	34.82	74.0	54.0	25.28	19.18
12400	35.80	22.60	V	0	100	12.32	48.12	34.92	74.0	54.0	25.88	19.08
19840	38.90	25.90	H	0	150	9.35	48.25	35.25	74.0	54.0	25.75	18.75
19840	37.80	25.90	V	0	150	9.35	47.15	35.25	74.0	54.0	26.85	18.75
22320	36.70	25.00	H	0	150	11.87	48.57	36.87	74.0	54.0	25.43	17.13
22320	37.10	25.00	V	0	150	11.87	48.97	36.87	74.0	54.0	25.03	17.13
802.11b – 1Mbps High Channel												
2380	49.80	43.90	H	210	100	-2.99	46.81	40.91	74.0	54.0	27.19	13.09
2483.5	50.51	43.9	H	210	100	-3.16	47.35	40.74	74.0	54.0	26.65	13.26
4924	56.90	49.10	H	127	223	3.79	60.69	52.89	74.0	54.0	13.31	1.11
4924	56.20	44.10	V	228	206	3.79	59.99	47.89	74.0	54.0	14.01	6.11
7386	45.60	36.30	H	257	165	8.69	54.29	44.99	74.0	54.0	19.71	9.01
7386	44.10	33.90	V	326	100	8.69	52.79	42.59	74.0	54.0	21.21	11.41
12310	36.50	23.00	H	0	100	12.65	49.15	35.65	74.0	54.0	24.85	18.35
12310	36.80	23.00	V	0	100	12.65	49.45	35.65	74.0	54.0	24.55	18.35
19696	39.40	26.80	H	0	150	9.27	48.67	36.07	74.0	54.0	25.33	17.93
19696	39.10	26.80	V	0	150	9.27	48.37	36.07	74.0	54.0	25.63	17.93
22158	37.40	25.00	H	0	150	11.70	49.10	36.70	74.0	54.0	24.90	17.30
22158	37.50	24.90	V	0	150	11.70	49.20	36.60	74.0	54.0	24.80	17.40
802.11n20 – MSC0 High Channel												
2380	57.30	35.40	H	210	100	-2.99	54.31	32.41	74.0	54.0	19.69	21.59
2483.5	76.90	52.30	H	184	153	-3.16	73.74	49.14	74.0	54.0	0.26	4.86
4924	52.60	32.30	H	99	100	3.79	56.39	36.09	74.0	54.0	17.61	17.91
4924	51.30	29.20	V	239	100	3.79	55.09	32.99	74.0	54.0	18.91	21.01
7386	47.10	30.30	H	130	156	8.69	55.79	38.99	74.0	54.0	18.21	15.01
7386	45.00	28.90	V	0	100	8.69	53.69	37.59	74.0	54.0	20.31	16.41
12310	36.40	22.90	H	0	100	12.65	49.05	35.55	74.0	54.0	24.95	18.45
12310	36.30	23.00	V	0	100	12.65	48.95	35.65	74.0	54.0	25.05	18.35
19696	40.00	26.70	H	0	150	9.27	49.27	35.97	74.0	54.0	24.73	18.03
19696	39.40	26.70	V	0	150	9.27	48.67	35.97	74.0	54.0	25.33	18.03
22158	37.20	24.90	H	0	150	11.70	48.90	36.60	74.0	54.0	25.10	17.40
22158	37.70	25.00	V	0	150	11.70	49.40	36.70	74.0	54.0	24.60	17.30

Table 7.5.2.3-2: Simultaneous Transmissions – Integral 2.4GHz proprietary and GT-Tronics BLE

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Turntable Position (o)	Antenna Height (cm)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg					pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Integral BLE – Low Channel, GT-Tronics BLE – High Channel												
2246	38.70	24.60	H	0	100	-2.78	35.92	21.82	74.0	54.0	38.08	32.18
2324	38.10	24.60	H	0	100	-2.90	35.20	21.70	74.0	54.0	38.80	32.30
2714	37.80	24.50	H	0	100	-2.50	35.30	22.00	74.0	54.0	38.70	32.00
2792	38.40	24.40	H	0	100	-2.25	36.15	22.15	74.0	54.0	37.85	31.85

Table 7.5.2.3-3: Simultaneous Transmissions – Integral 2.4GHz proprietary and GT-Tronics WiFi

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Turntable Position (o)	Antenna Height (cm)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg					pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Integral BLE – Low Channel, GT-Tronics WiFi – Channel 11												
2222	47.80	24.80	H	190	100	-2.74	45.06	22.06	74.0	54.0	28.94	31.94
2282	64.10	26.00	H	223	100	-2.84	61.26	23.16	74.0	54.0	12.74	30.84
2342	69.80	28.00	H	231	100	-2.93	66.87	25.07	74.0	54.0	7.13	28.93
2702	39.20	25.20	H	191	100	-2.54	36.66	22.66	74.0	54.0	37.34	31.34

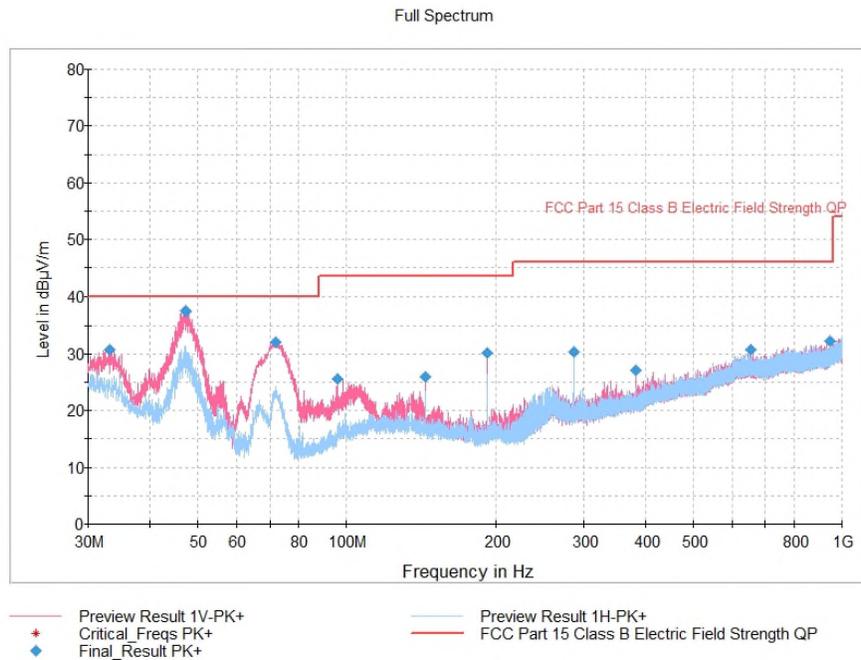


Figure 7.5.2.3-1: BLE - 30MHz-1GHz

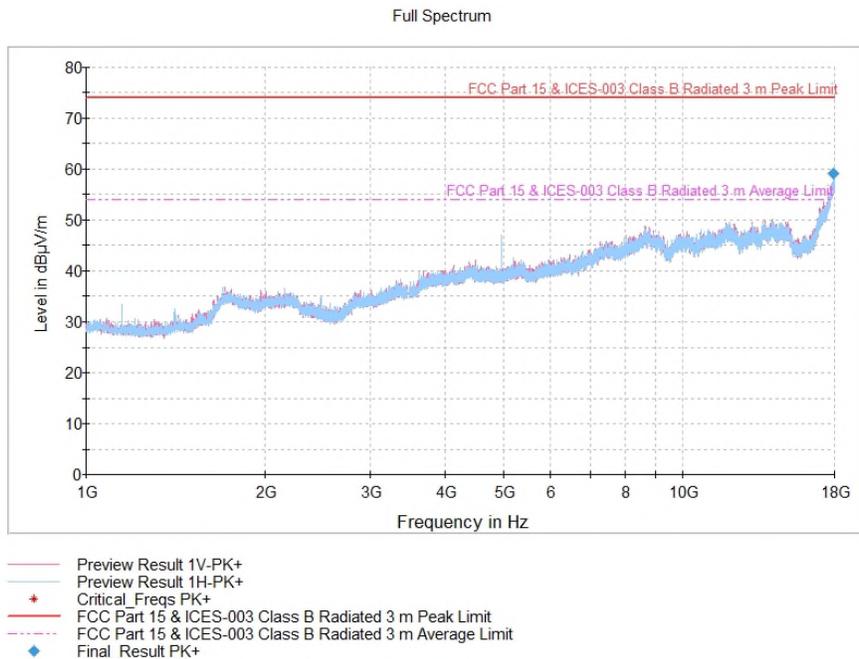
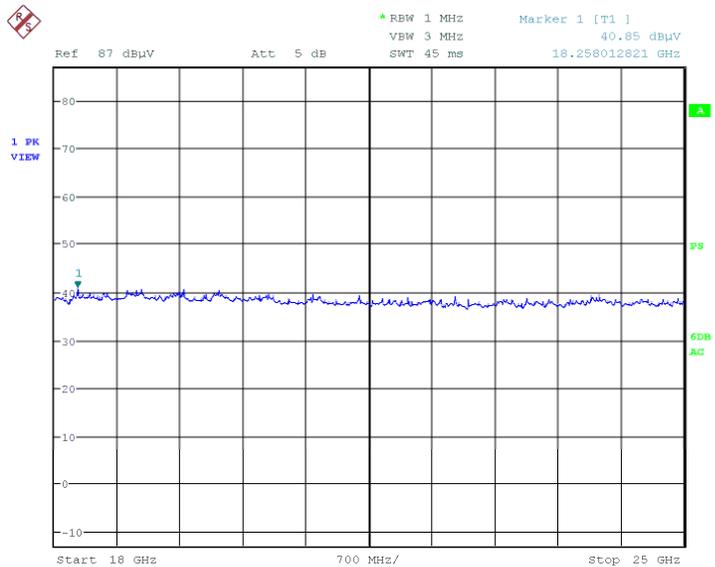


Figure 7.5.2.3-2: BLE - 1-18GHz



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Figure 7.5.2.3-3: BLE - 18-25GHz

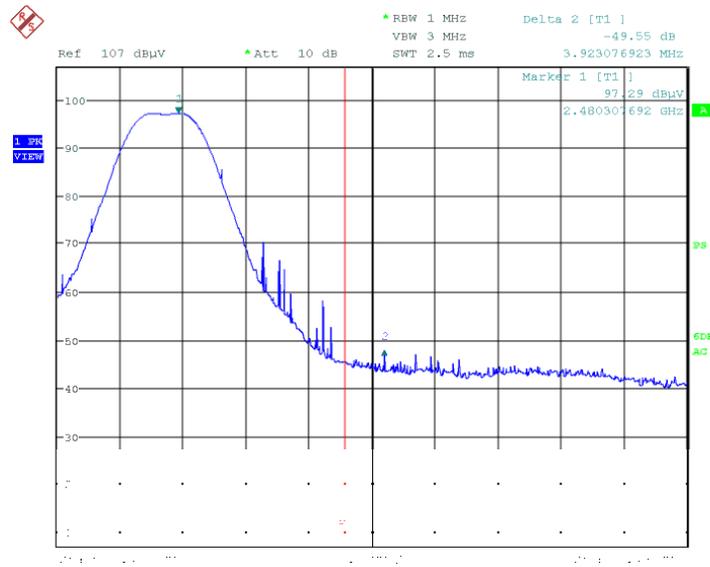
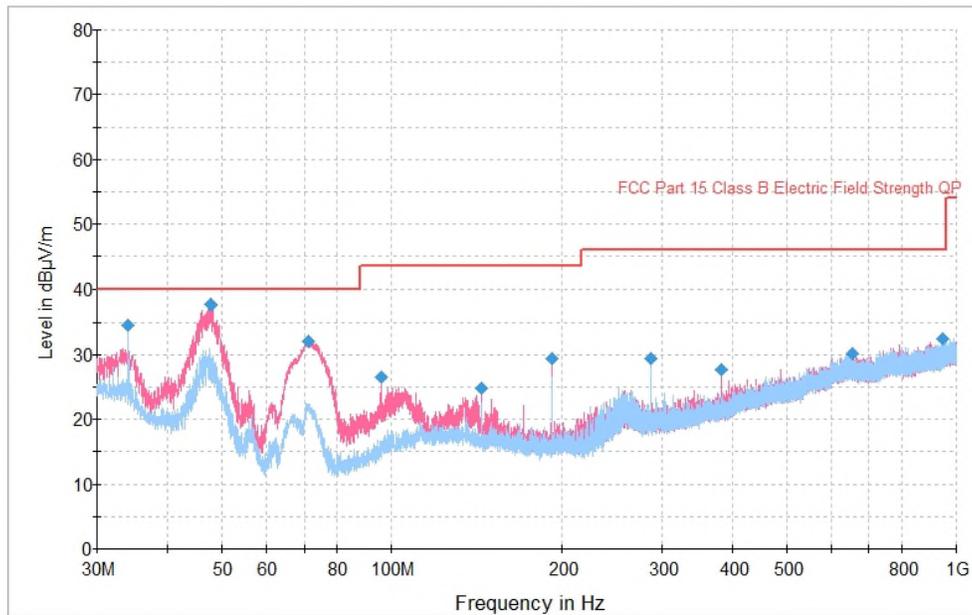


Figure 7.5.2.3-4: BLE - High Channel Band Edge

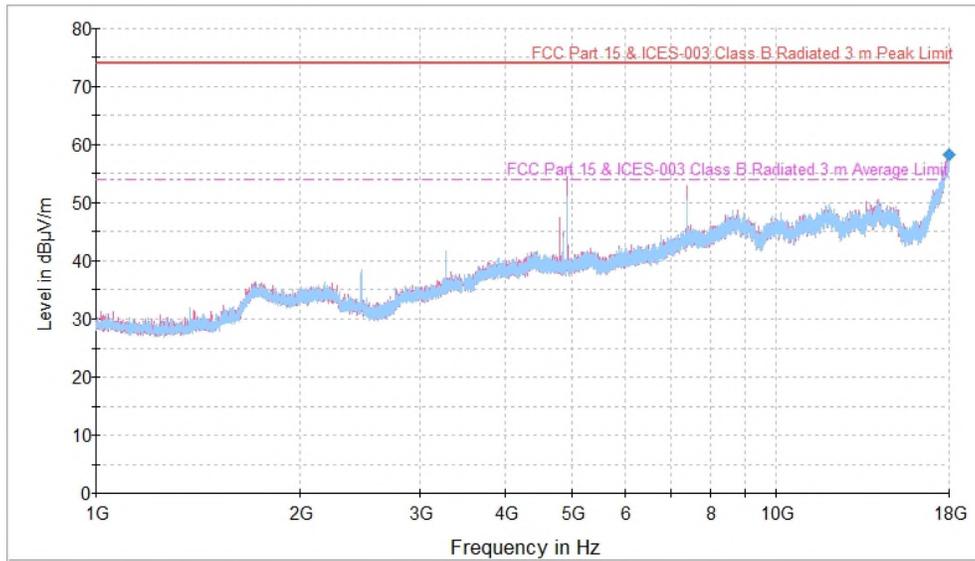
Full Spectrum



- Preview Result 1V-PK+
- Critical_Freqs PK+
- Final_Result PK+
- Preview Result 1H-PK+
- FCC Part 15 Class B Electric Field Strength QP

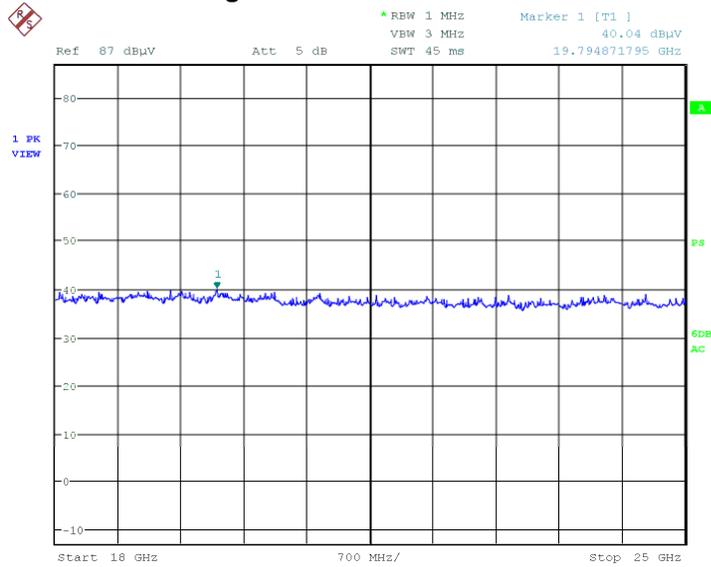
Figure 7.5.2.3-5: 802.11 - 30MHz-1GHz

Full Spectrum



- Preview Result 1V-PK+
- Preview Result 1H-PK+
- * Critical Freqs PK+
- FCC Part 15 & ICES-003 Class B Radiated 3 m Peak Limit
- - - FCC Part 15 & ICES-003 Class B Radiated 3 m Average Limit
- ◆ Final_Result PK+

Figure 7.5.2.3-6: 802.11 - 1-18GHz



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Figure 7.5.2.3-7: 802.11 - 18-25GHz

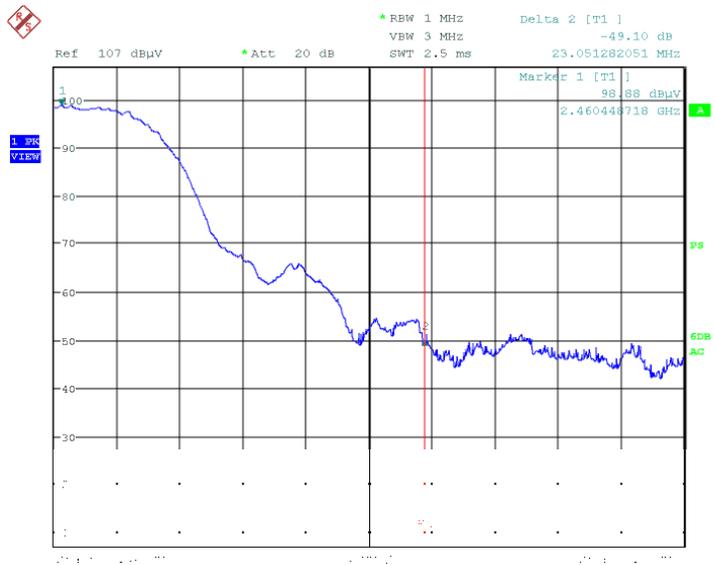


Figure 7.5.2.3-8: 802.11b – High Channel Band Edge

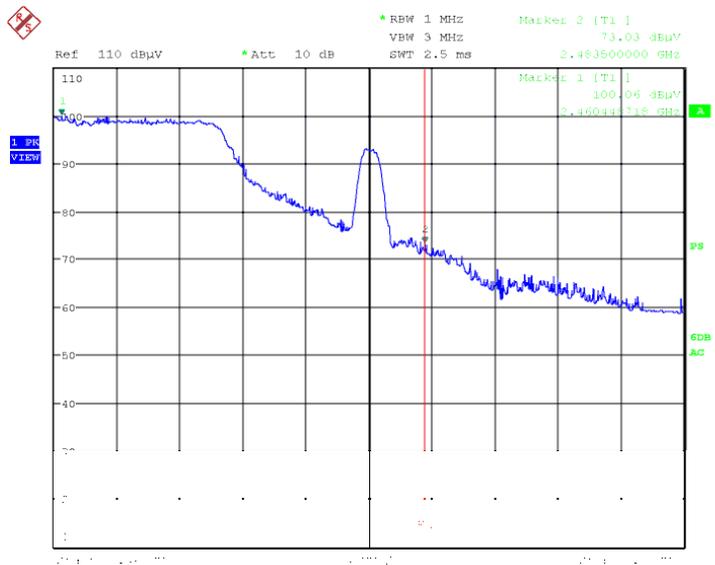


Figure 7.5.2.3-9: 802.11n – High Channel Band Edge

7.2.1.4 Sample Calculation:

$$R_C = R_U + CF_T$$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: PeakCorrected Level: $48.20 + -3.16 = 45.04\text{dBuV/m}$ Margin: $74\text{dBuV/m} - 45.04\text{dBuV/m} = 28.96\text{dB}$ **Example Calculation: Average**Corrected Level: $31.60 + -3.16 = 28.44\text{dBuV}$ Margin: $54\text{dBuV} - 28.44\text{dBuV} = 25.56\text{dB}$

8 MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) $k = 1.96$ which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	$\pm 0.004\%$
RF Conducted Output Power	$\pm 0.689 \text{ dB}$
Power Spectral Density	$\pm 0.5 \text{ dB}$
Antenna Port Conducted Emissions	$\pm 2.717 \text{ dB}$
Radiated Emissions	$\pm 5.877 \text{ dB}$
Temperature	$\pm 0.860 \text{ }^\circ\text{C}$
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	± 2.85

9 CONCLUSION

In the opinion of TÜV SÜD America Inc. the Z-2500; Z-3500, manufactured by ACCO Brands USA LLC meets the requirements of FCC Part 15 subpart C and ISED Canada Radio Standards Specification: RSS-247 for the tests documented herein.

END REPORT