Engineering Test Report No. 2103660-04 Rev. B	
Report Date	February 10, 2022
Manufacturer Name	Enovation Controls LLC
Manufacturer Address	5311 South 122nd East Ave Tulsa, OK 74146
Product Name Part No.	Caribou Display, Model No. OD1025-01
Date Received	February 1, 2022
Test Dates	February 2, 2022 through February 4, 2022
Specifications	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247, FCC "Code of Federal Regulations", Title 47, Part 15, Subpart E, Section 407, and KDB 996369 ETSI EN 300 328 V2.2.2, ETSI EN 301 893 V2.1.1, ETSI EN 300 440 V2.1.1, and ETSI EG 203 367
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515
Signature	MARK E. LONGINOTTI
Tested by	Mark E. Longinotti
Signature	Raymond J Klouda
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894
PO Number	105460

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1. Report Revision History

Revision	Date	Description
–	24 FEB 2022	Initial Release of Engineering Test Report No. 2103660-04 Rev. B
A	17 MAR 2022 By Mark L.	– Engineering Test Report No. was changed from 2103660-04 to 2103660-04 Rev. A throughout the report – Product No. 78350859 was changed to Model No. 78350859 throughout the report
B	22 MAR 2022 By Mark L.	– Engineering Test Report No. was changed from 2103660-04 Rev. A to 2103660-04 Rev. B throughout the report. – Model No. 78350859 was changed to Model No. OD1025-01 throughout the report.

2. Introduction

This document presents the results of a series of intermodulation case spurious radiated emissions tests that were performed on one (1) Caribou Display (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was identified as follows:

The EUT is equipped with the following pre-certified radio modules:

- Texas Instruments WL18MODGI, FCC ID Z64-WL18DBMOD, IC ID 451I-WL18DBMOD, WiFi module operating in the 2.4GHz and 5GHz band
- Laird Connectivity BL850, FCC ID SQGBT850, IC ID 3147A-BT850, BLE module operating in the 2402MHz to 2480MHz band (3 each)

The EUT was identified as follows:

EUT #1	
Description	Caribou Display
Model No.	OD1025-01
Serial No.	FCC #3
Software/Firmware Version	Caribou Environmental Testing.pv2
Size of EUT	27 cm x 12.75 cm x 7.5 cm
Number of Interconnection Wires	1 each 1.7 meters long unshielded wiring harness
Type of Interconnection Wires	Harness has 19 wires
Highest Internal Frequency of the EUT	5.825GHz

3. Power Input

The EUT was powered by 12VDC from four wires of the wiring harness (two for (+) battery, two (-) battery, and 1 for ignition).

4. Grounding

The EUT was not connected to ground.

5. Support Equipment

For intermodulation case spurious radiated emissions tests, the 19-wire harness was used. The 14 wires that normally go to the load box were unterminated.

To control the Bluetooth transmitters, special test software was loaded on the EUT to program each of the Bluetooth transmitters to transmit constantly on a single frequency.

For WiFi transmitter testing, an HP laptop computer was connected to the EUT via a programming cable provided by Enovation Controls LLC personnel. The laptop computer used TI RTTE software, v2.0.0.55, to program the WiFi transmitter in the EUT.

6. Interconnect Cable

The EUT had 14 wires in the wire harness that were unterminated. The 5 power leads of the wiring harness were connected to a power supply.

7. Modifications Made to the EUT

No modifications were made to the EUT during the testing.

8. Modes of Operation

The EMC tests were performed with the EUT operating in one or more of the test modes described below.

See the specific test section for the applicable test modes.

8.1. Bluetooth Module 1, Transmit at 2402MHz, 3dBm output power, Bluetooth Module 2, Transmit at 2442MHz, 3dBm output power, Bluetooth Module 3, Transmit at 2480MHz, 3dBm output power, WiFi Transmit at 2412MHz, 802.11b, 1MBPS, 30dBm output power

This mode was achieved by powering up the EUT. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 1 and set it to transmit at 2402MHz, 3dBm output power. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 2 and set it to transmit at 2442MHz, 3dBm output power. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 3 and set it to transmit at 2480MHz, 3dBm output power. The HP laptop computer was connected to the EUT via a programming cable. The laptop computer was running TI RTTE software. The software was used to program the WiFi transmitter in the EUT to transmit at 2412MHz, 802.11b, 1MBPS data rate, 30dBm output power.

8.2. Bluetooth Module 1, Transmit at 2402MHz, 3dBm output power, Bluetooth Module 2, Transmit at 2442MHz, 3dBm output power, Bluetooth Module 3, Transmit at 2480MHz, 3dBm output power, WiFi Transmit at 2462MHz, 802.11b, 1MBPS, 30dBm output power

This mode was achieved by powering up the EUT. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 1 and set it to transmit at 2402MHz, 3dBm output power. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 2 and set it to transmit at 2442MHz, 3dBm output power. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 3 and set it to transmit at 2480MHz, 3dBm output power. The HP laptop computer was connected to the EUT via a programming cable. The laptop computer was running TI RTTE software. The software was used to program the WiFi transmitter in the EUT to transmit at 2462MHz, 802.11b, 1MBPS data rate, 30dBm output power.

8.3. Bluetooth Module 1, Transmit at 2402MHz, 3dBm output power, Bluetooth Module 2, Transmit at 2442MHz, 3dBm output power, Bluetooth Module 3, Transmit at 2480MHz, 3dBm output power, WiFi Transmit at 5180MHz, 802.11n, MCS0, 20MHz bandwidth, 30dBm output power

This mode was achieved by powering up the EUT. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 1 and set it to transmit at 2402MHz, 3dBm output power. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 2 and set it to transmit at 2442MHz, 3dBm output power. The touchscreen display on the front of the EUT was used to turn on Bluetooth module 3 and set it to transmit at 2480MHz, 3dBm output power. The HP laptop computer was connected to the EUT via a programming cable. The laptop computer was running TI RTTE software. The software was used to program the WiFi transmitter in the EUT to transmit at 5180MHz, 802.11n, MCS0, 20MHz bandwidth, 30dBm output power.

9. Test Specifications

The tests were performed to selected portions of, and in accordance with the following test specifications:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Chapter I, Subchapter A, Part 15, Subpart C, Section 15.247
- Federal Communications Commission "Code of Federal Regulations", Title 47, Chapter I, Subchapter A, Part 15, Subpart E, Section 407
- ANSI C63.10-2013, “American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices”

- 996369 D04 Module Integration Guide v02, October 13, 2020

- ETSI EN 300 328, V2.2.2, 2019, Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonized Standard for access to radio spectrum

- ETSI EN 301 893 V2.1.1, 2017, 5 GHz RLAN; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

- ETSI EN 300 440-1 V1.6.1, 2010, Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices; Radio equipment to be used in the 1 GHz to 40 GHz frequency range; Part 1: Technical characteristics and test methods

- ETSI EG 203 367, V1.1.1, 2016, Guide to the application of harmonized standards covering articles 3.1b and 3.2 of the Directive 2014/53/EU (RED) to multi-radio and combined radio and non-radio equipment

10. Test Plan

No test plan was provided. Instructions were provided by personnel from Enovation Controls LLC and used in conjunction with the, FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247, FCC "Code of Federal Regulations", Title 47, Part 15, Subpart E, Section 407, ETSI EN 300 328 V2.2.2, ETSI EN 301 893 V2.1.1, ETSI EN 300 440 V2.1.1, and ETSI EG 203 367, and KDC 996369 specifications.

11. Deviation, Additions to, or Exclusions from Test Specifications

There were no deviations, additions to, or exclusions from the test specifications during this test series.

12. Laboratory Conditions

Ambient Parameters	Value
Temperature	21°C
Relative Humidity	23%
Atmospheric Pressure	1017mb

13. Summary

The following EMC tests were performed, and the results are shown below:

Test Description	Results
Intermodulation Case Spurious Radiated Emissions	Conforms

14. Test Method

The tests were performed using the referenced methods described in the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247, FCC "Code of Federal Regulations", Title 47, Part 15, Subpart E, Section 407, and KDB 996369 , ETSI EN 300 328 V2.2.2, ETSI EN 301 893 V2.1.1, ETSI EN 300 440 V2.1.1, and ETSI EG 203 367, ANSI C63.10-2014, ANSI C63.26-2015, and KDC 996369 specifications. The specific test sections and specification references are called out in the individual test sections.

15. Sample Calculations

For Powerline Conducted Emissions:

The resultant voltage level (VL) is a summation in decibels (dB) of the receiver meter reading (MTR) and the cable loss factor (CF).

Formula 1: VL (dBuV) = MTR (dBuV) + CF (dB).

For Radiated Emissions:

The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external preamplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

Formula 1: FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

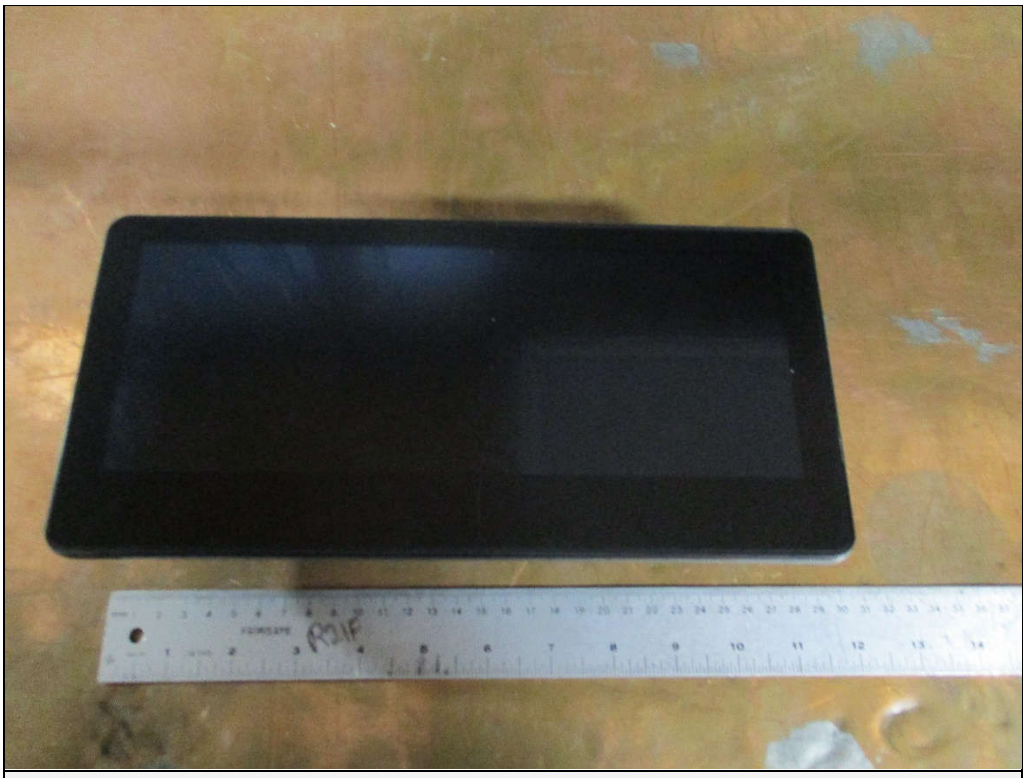
16. Statement of Conformity

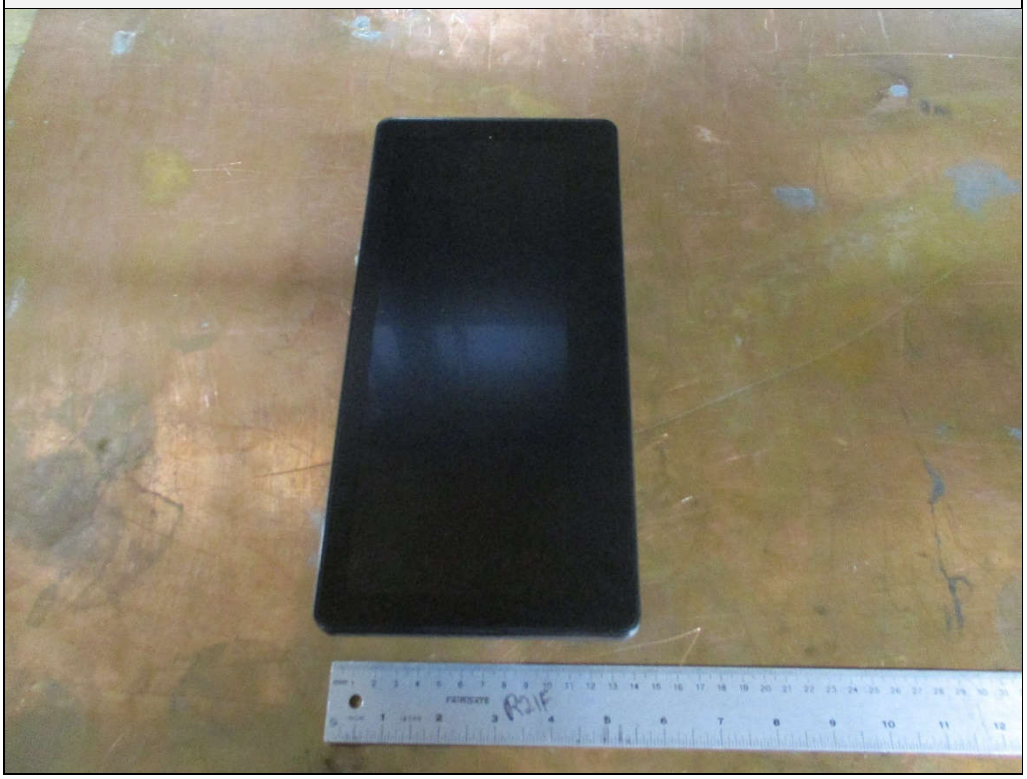
The Enovation Controls LLC, Caribou Display, Model No. OD1025-01, Serial No. FCC #3, did fully conform to the intermodulation case spurious radiated emissions requirements of FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247, FCC "Code of Federal Regulations", Title 47, Part 15, Subpart E, Section 407, and KDB 996369 , ETSI EN 300 328 V2.2.2, ETSI EN 301 893 V2.1.1, ETSI EN 300 440 V2.1.1, and ETSI EG 203 367, ANSI C63.10-2014, and KDB 996369.

17. Certification

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247, FCC "Code of Federal Regulations", Title 47, Part 15, Subpart E, Section 407, and KDB 996369 , ETSI EN 300 328 V2.2.2, ETSI EN 301 893 V2.1.1, ETSI EN 300 440 V2.1.1, and ETSI EG 203 367, ANSI C63.10-2014 test specifications. The data presented in this test report pertains to the EUT on the test date specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

18. Photographs of EUT





19. Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW14	PREAMPLIFIER	PLANAR	PE2-35-120-5R0-10-12-SFF	PL22671	1-20GHz	9/21/2021	9/21/2022
CDZ3	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
NSDS1	UNIVERSAL SPHERICAL DIPOLE SOURCE	AET	USDS-H	AET-1116		NOTE 1	
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	4/7/2020	4/7/2022
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	7/12/2021	7/12/2022
SMA4	POWER SUPPLY	MASTECH	HY3020EX	020177908	30 VOLT, 20AMP	NOTE 1	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XPQ6	FILTER	K&L MICROWAVE	11SH10-9000/U2000-O/O	2	5000-5800 MHZ	9/7/2021	9/7/2023
XPR0	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000	001	4.8-20GHZ	9/7/2021	9/7/2023

N/A: Not Applicable I/O: Initial Only CNR: Calibration Not Required
NOTE 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

20. Intermodulation Case Spurious Radiated Emissions

Manufacturer	Enovation Controls LLC
Model No.	OD1025-01
Model	Caribou Display
Serial No	FCC #3
Mode	Bluetooth Module 1, Transmit at 2402MHz, 3dBm output power, Bluetooth Module 2, Transmit at 2442MHz, 3dBm output power, Bluetooth Module 3, Transmit at 2480MHz, 3dBm output power, WiFi Transmit at 2412MHz, 802.11b, 1MBPS, 30dBm output power Bluetooth Module 1, Transmit at 2402MHz, 3dBm output power, Bluetooth Module 2, Transmit at 2442MHz, 3dBm output power, Bluetooth Module 3, Transmit at 2480MHz, 3dBm output power, WiFi Transmit at 2462MHz, 802.11b, 1MBPS, 30dBm output power Bluetooth Module 1, Transmit at 2402MHz, 3dBm output power, Bluetooth Module 2, Transmit at 2442MHz, 3dBm output power, Bluetooth Module 3, Transmit at 2480MHz, 3dBm output power, WiFi Transmit at 5180MHz, 802.11n, MCS0, 20MHz bandwidth, 30dBm output power

Information	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Semi-anechoic chamber
Type of Antennas Used	Below 1GHz: Bilog (or equivalent) Above 1GHz: Double-ridged waveguide (or equivalent)
Notes	The cables were manually maximized during the preliminary emissions sweeps. The cable arrangement which resulted in the worst-case emissions was utilized.

Measurement Uncertainty	
Measurement Type	Expanded Measurement Uncertainty
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2
Radiated disturbance (electric field strength on an open area test site or alternative test site) (18 GHz – 26.5 GHz)	3.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (26.5 GHz – 40 GHz)	3.4

FCC Requirements
Per KDB 996369, section 3.0, testing of the host product with all the transmitters installed is recommended, to verify that the host product meets all the applicable FCC rules. The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. 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. Attenuation below the general limits specified in §15.209(a) is not required. Per FCC 15.407(b)(1), for transmitters operating in the 5.15-5.25GHz band, all emissions outside of the 5.15-5.35GHz band shall not exceed an e.i.r.p. of -27dBm/MHz. Radiated emissions which fall in the restricted bands, as defined in FCC 15.205, Section (a), must comply with the radiated emission limits specified in FCC 15.209, Section (a).

ETSI Requirements

Per ETSI EG 203 367 section 6.2, in the case where a single EUT contains more than one transmitter operating at the same time, then a reassessment of the spurious emissions and consideration of potential effects of intermodulation should be performed. The assessment of the spurious emissions of the multi-radio equipment should be carried out as set out in the relevant radio harmonized standards applicable to each radio product. The applicable spurious emissions requirements and limits for multi-radio equipment are those specified in the relevant radio harmonized standards applicable to each radio product.

If the applicable harmonized radio standards contain different limits and measuring conditions, then the multi-radio equipment should be assessed to the harmonized radio standard that specifies the least stringent limits for the common part of the frequency measurement ranges, in those cases where more than one transmitter operates at the same time. To assess the remaining parts of the frequency measurement ranges, the limits from the relevant harmonized radio standard should be used.

Per section 4.3.1.10.3 of ETSI EN 300 328, the transmitter unwanted emissions in the spurious domain shall not exceed the following values:

Frequency Range	Maximum Power	Bandwidth
30MHz to 47MHz	-36dBm	100kHz
47MHz to 74MHz	-54dBm	100kHz
74MHz to 87.5MHz	-36dBm	100kHz
87.5MHz to 118MHz	-54dBm	100kHz
118MHz to 174MHz	-36dBm	100kHz
174MHz to 230MHz	-54dBm	100kHz
230MHz to 470MHz	-36dBm	100kHz
470MHz to 862MHz	-54dBm	100kHz
862MHz to 1GHz	-36dBm	100kHz
1GHz to 12.75GHz	-30dBm	1MHz

Per section 4.5.1.2 of ETSI EN 301 893, the transmitter unwanted emissions in the spurious domain shall not exceed the following values:

Frequency Range	Maximum Power	Bandwidth
30MHz to 47MHz	-36dBm	100kHz
47MHz to 74MHz	-54dBm	100kHz
74MHz to 87.5MHz	-36dBm	100kHz
87.5MHz to 118MHz	-54dBm	100kHz
118MHz to 174MHz	-36dBm	100kHz
174MHz to 230MHz	-54dBm	100kHz
230MHz to 470MHz	-36dBm	100kHz
470MHz to 862MHz	-54dBm	100kHz
862MHz to 1GHz	-36dBm	100kHz
1GHz to 5.15GHz	-30dBm	1MHz
5.35GHz to 5.47GHz	-30dBm	1MHz
5.725GHz to 26GHz	-30dBm	1MHz

Per section 7.3.6 of ETSI EN 300 440-1, the transmitter unwanted emissions in the spurious domain shall not exceed the following values:

Frequency Range	Maximum Power	Bandwidth
30MHz to 47MHz	-36dBm	100kHz
47MHz to 74MHz	-54dBm	100kHz
74MHz to 87.5MHz	-36dBm	100kHz

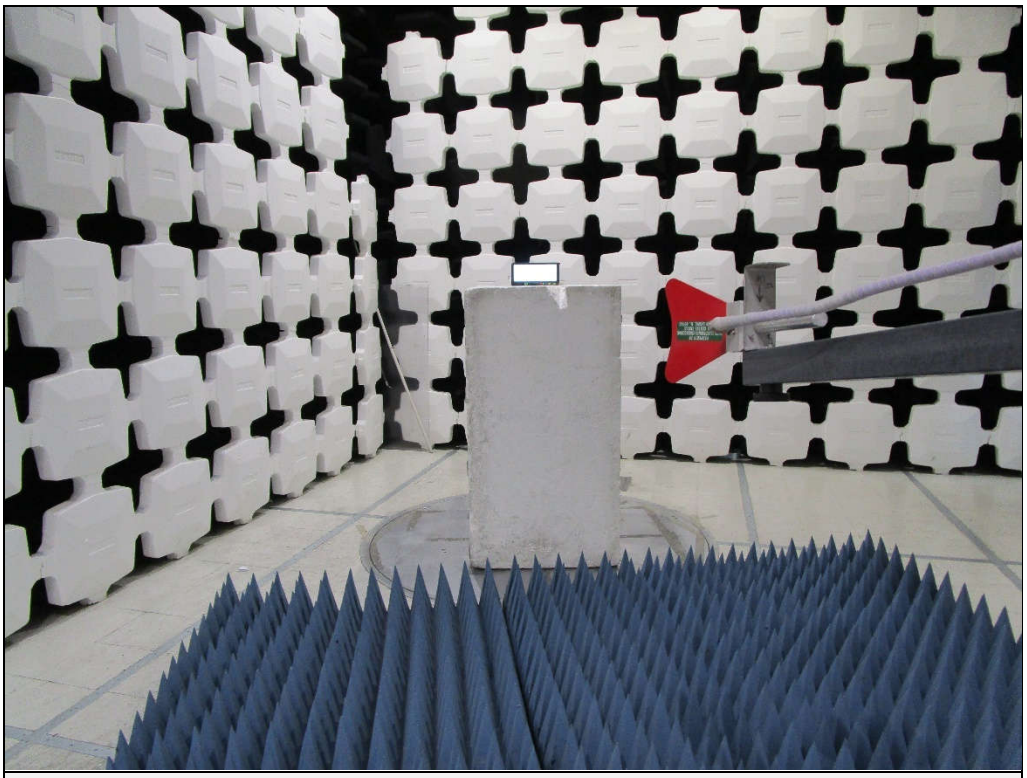
87.5MHz to 108MHz	-54dBm	100kHz
108MHz to 174MHz	-36dBm	100kHz
174MHz to 230MHz	-54dBm	100kHz
230MHz to 470MHz	-36dBm	100kHz
470MHz to 862MHz	-54dBm	100kHz
862MHz to 1GHz	-36dBm	100kHz
1GHz to 40GHz	-30dBm	1MHz

Procedures

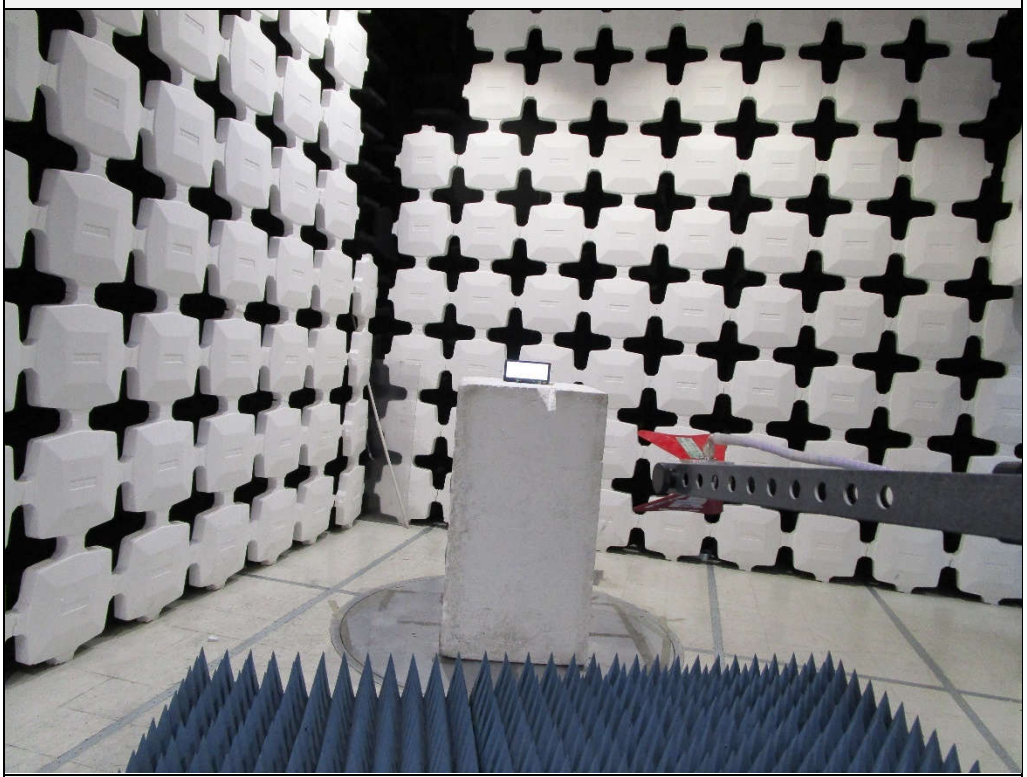
The frequency range from 1GHz to 18GHz was investigated using a peak detector function. If any intermodulation products were found during the preliminary radiated emissions sweeps, the emissions at that frequency were maximized using the following techniques:

i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

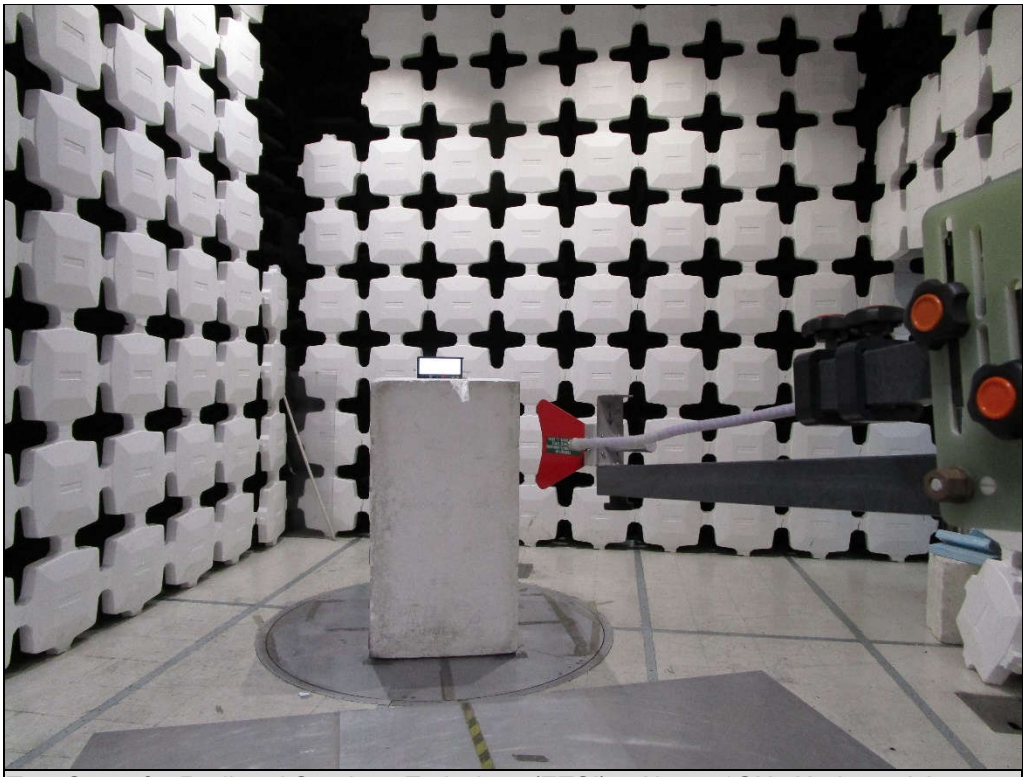
All measured intermodulation products must meet the least stringent emissions limits that are applicable to the EUT. If no intermodulation products are detected, the EUT is considered to have met the intermodulation case spurious radiated emissions requirements for all applicable standards.



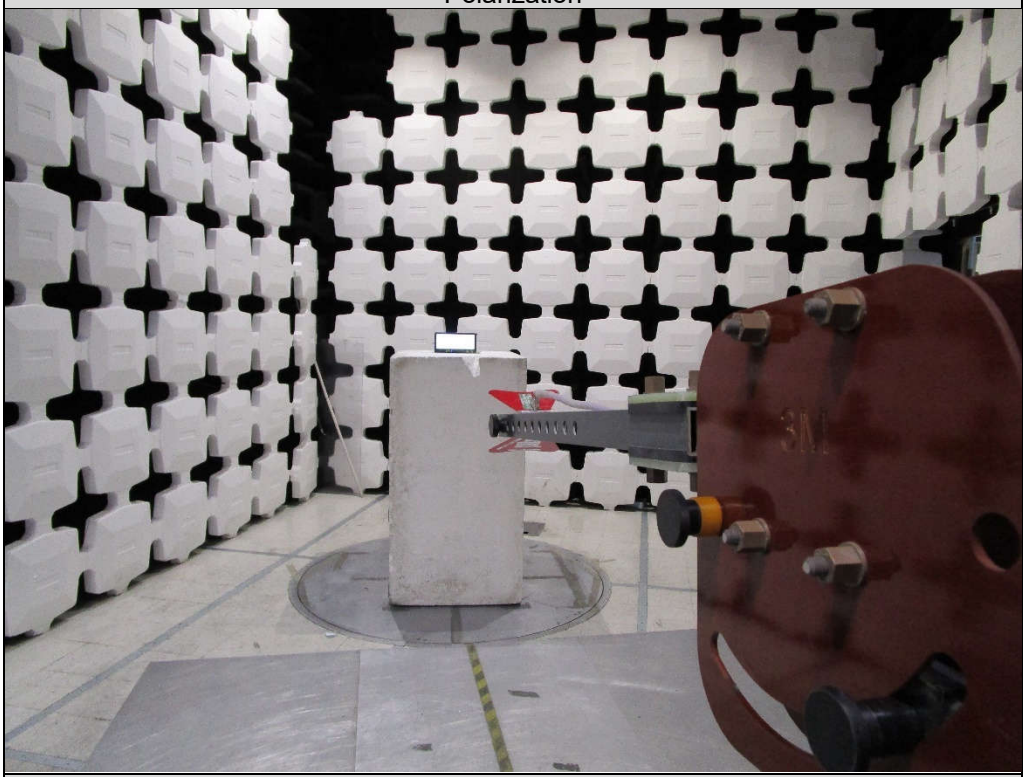
Test Setup for Spurious Emissions (FCC): 1GHz to 18GHz, Horizontal Polarization



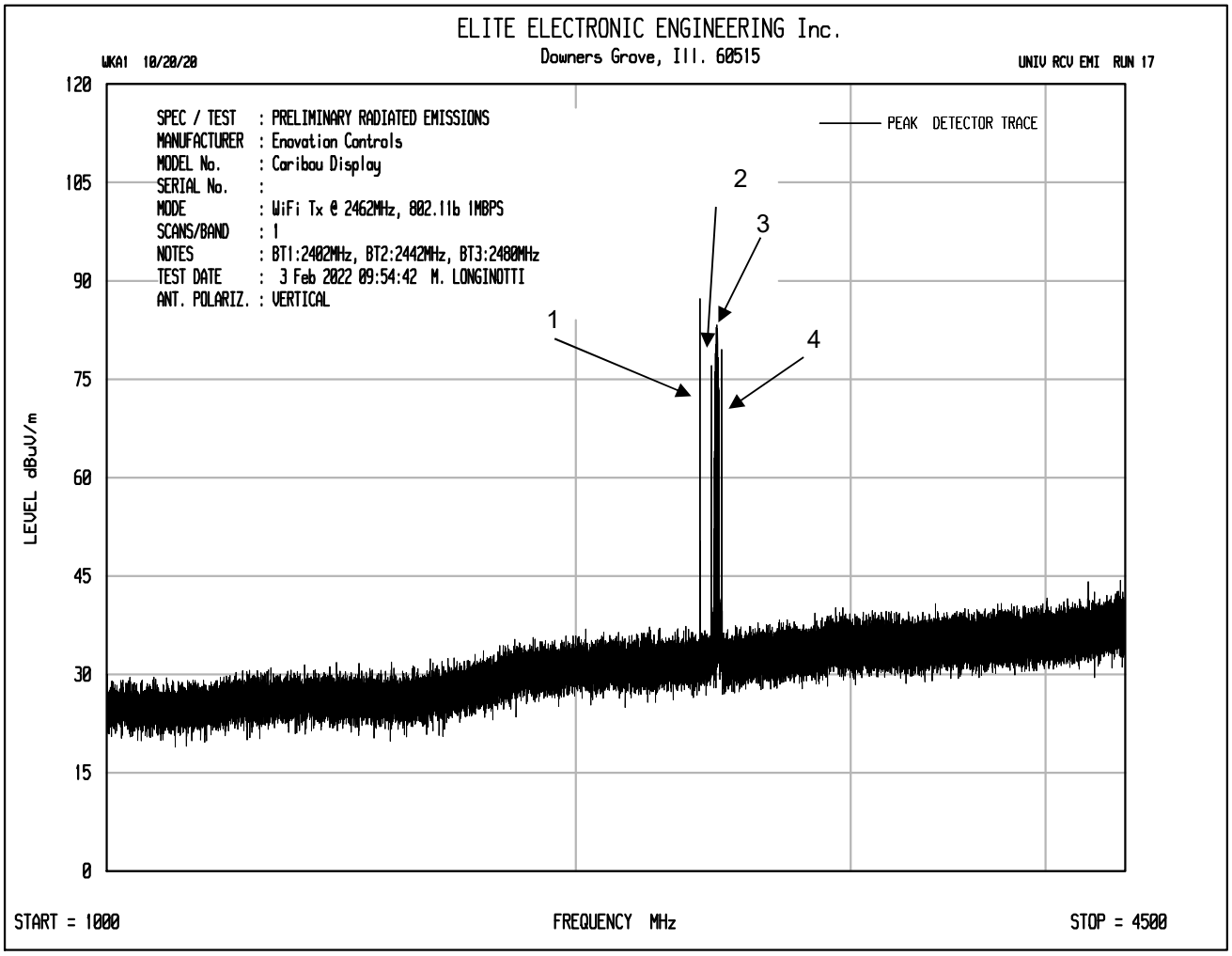
Test Setup for Spurious Emissions (FCC): 1GHz to 18GHz, Vertical Polarization



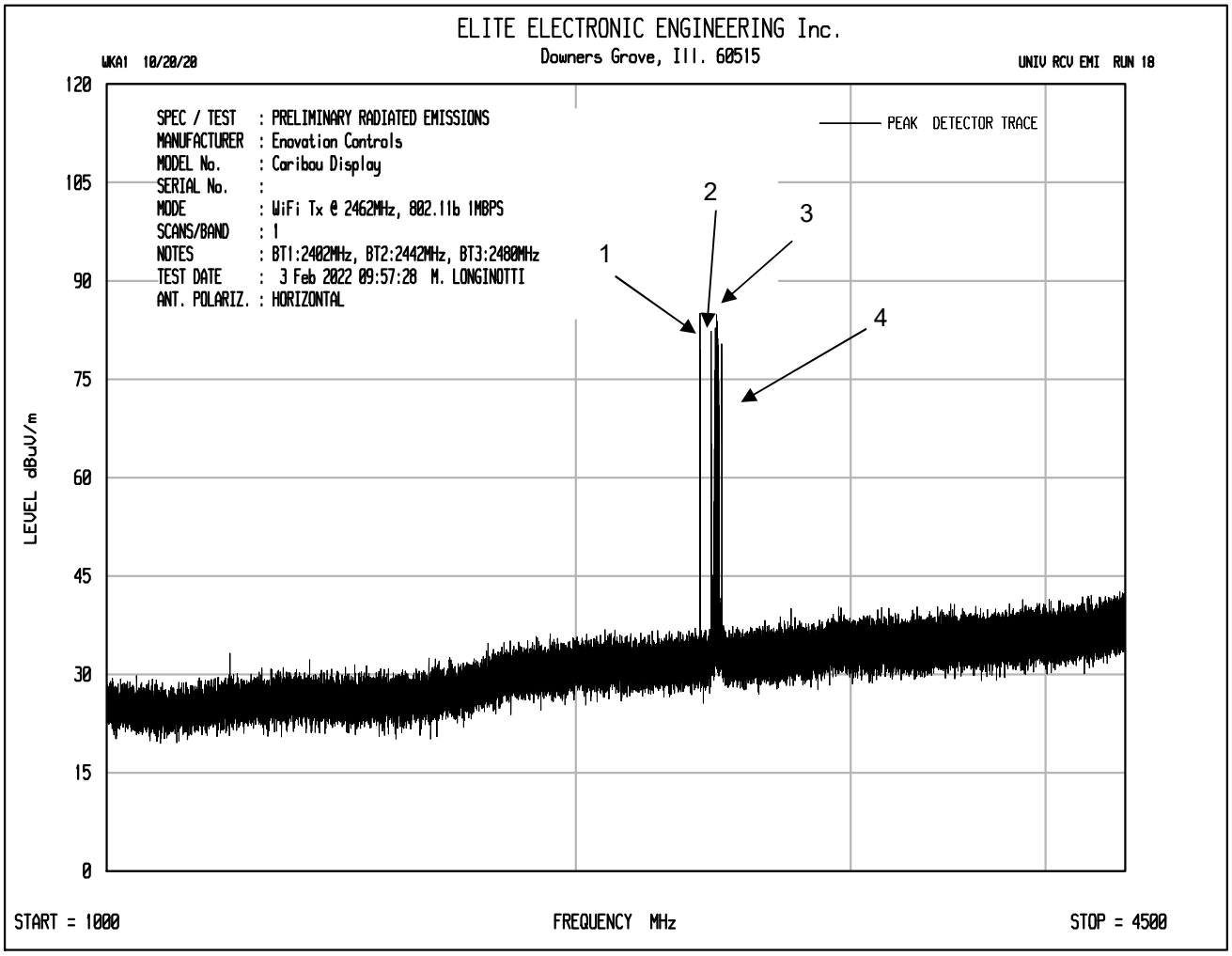
Test Setup for Radiated Spurious Emissions (ETSI) – Above 1GHz Horizontal Antenna Polarization



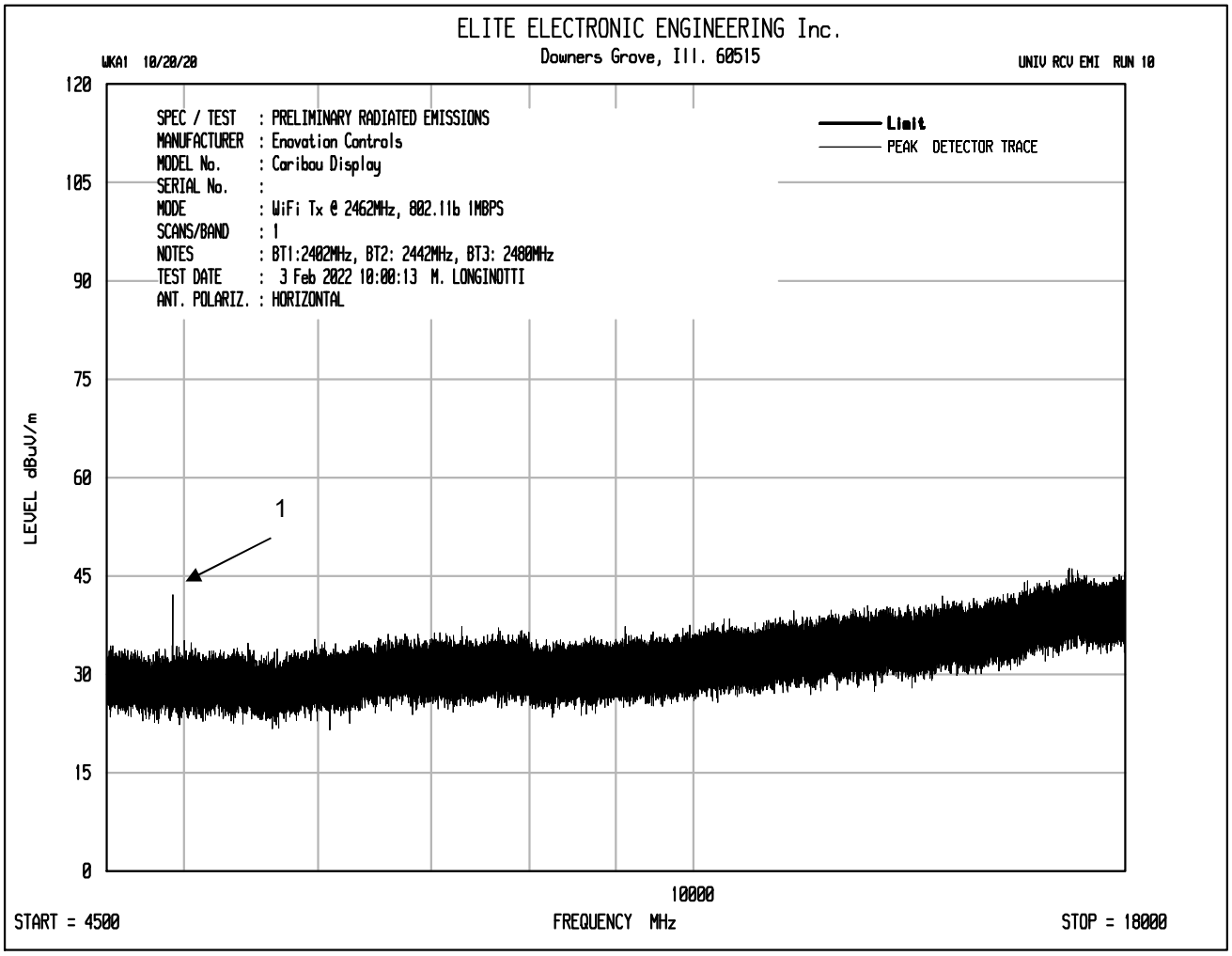
Test Setup for Radiated Spurious Emissions (ETSI) – Above 1GHz Vertical Antenna Polarization



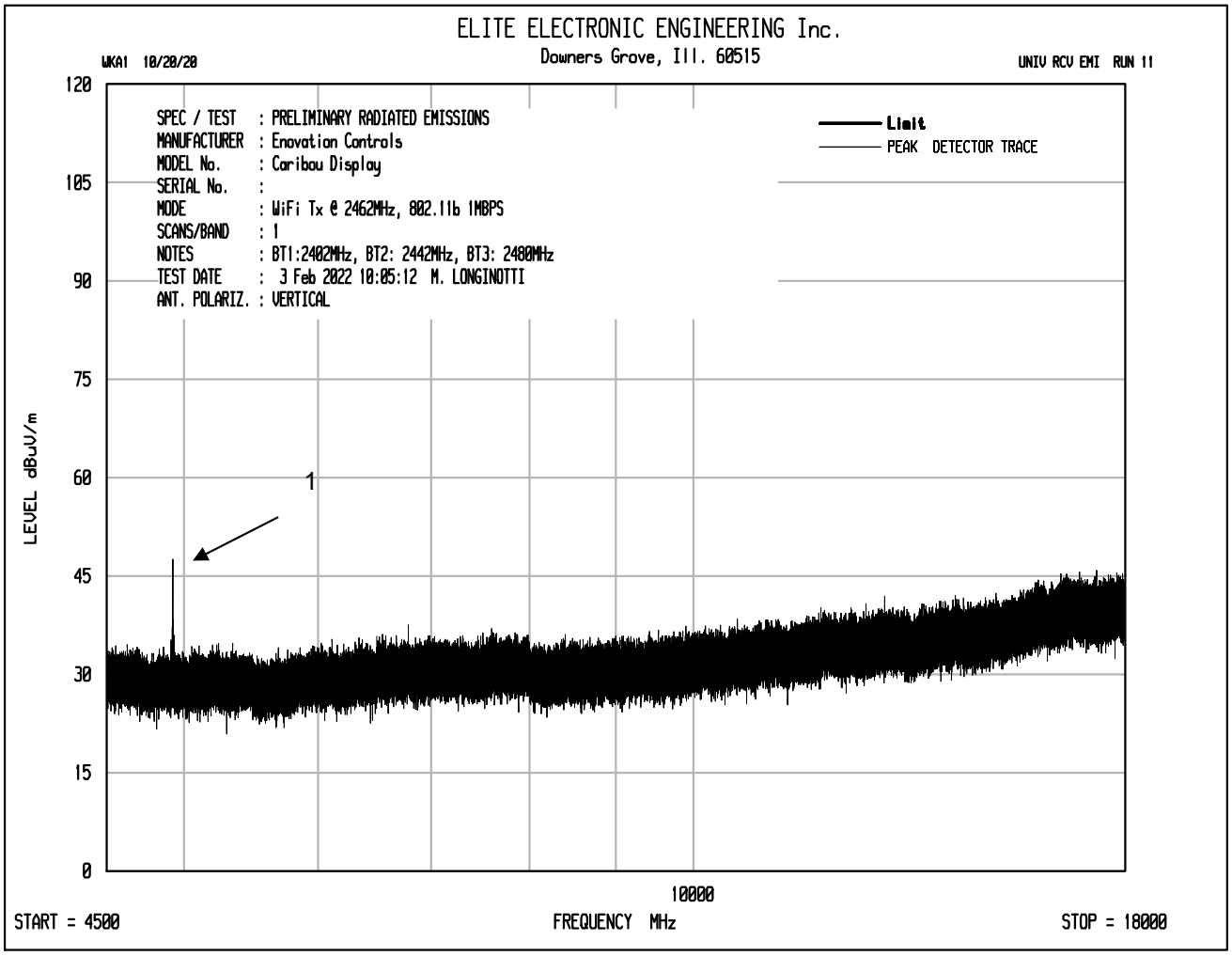
FCC 15.247
1: BLE Module 1, Transmit at 2402MHz
2: BLE Module 2, Transmit at 2442MHz
3: WiFi Module, Transmit at 2462MHz
4: BLE Module 3, Transmit at 2480MHz



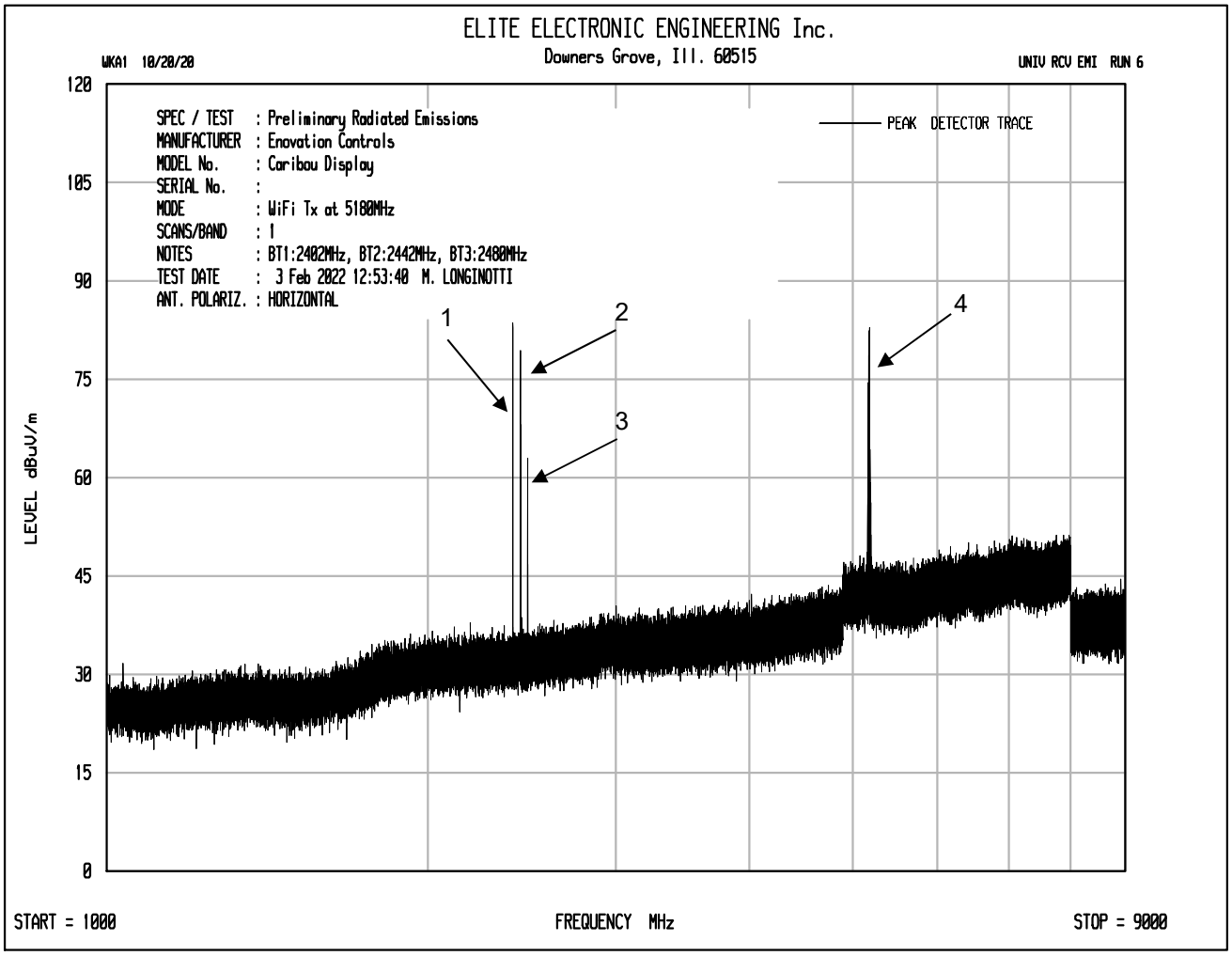
FCC 15.247
1: BLE Module 1, Transmit at 2402MHz
2: BLE Module 2, Transmit at 2442MHz
3: WiFi Module, Transmit at 2462MHz
4: BLE Module 3, Transmit at 2480MHz



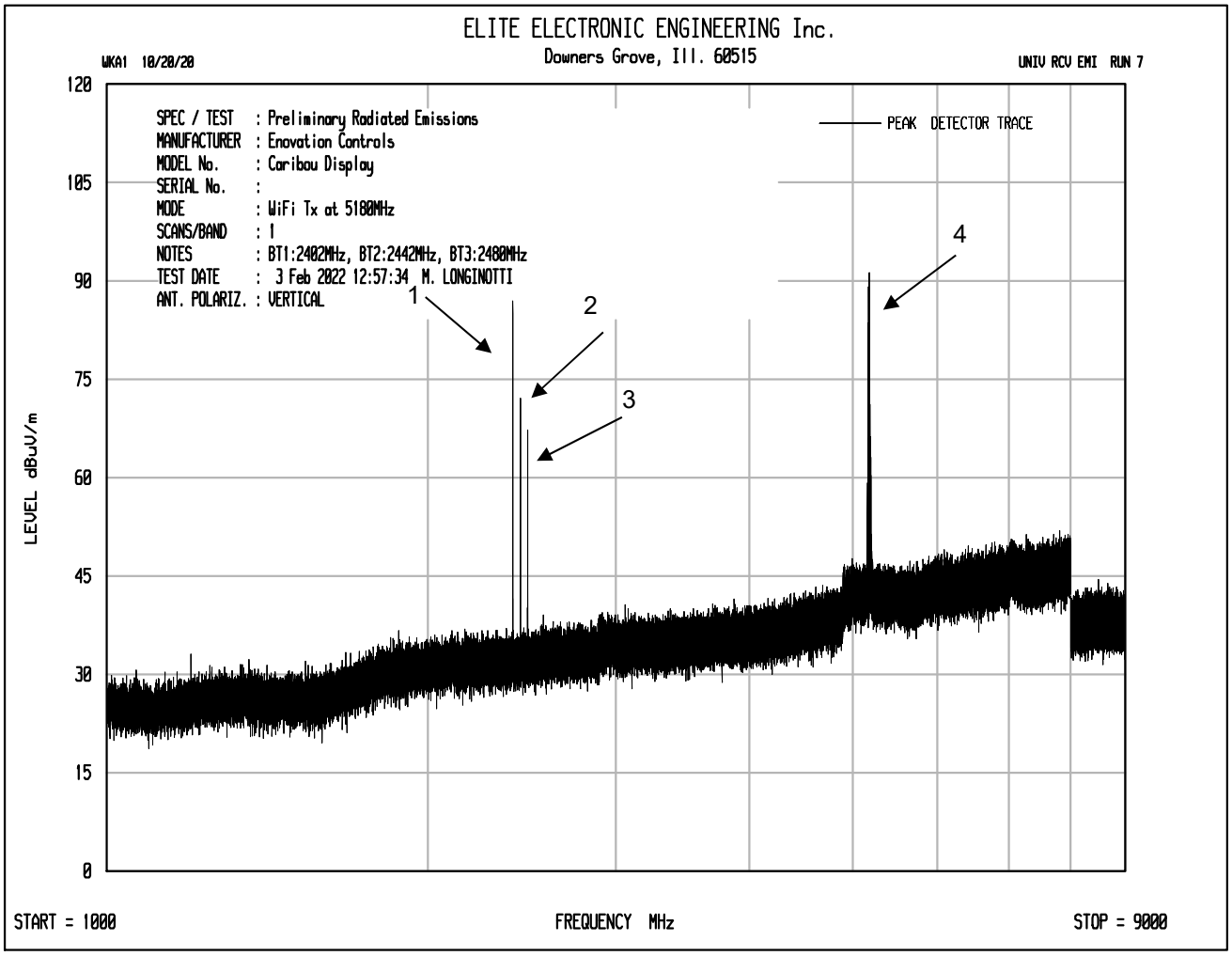
FCC 15.247
1 – 4924MHz (2nd harmonic of 2462MHz)



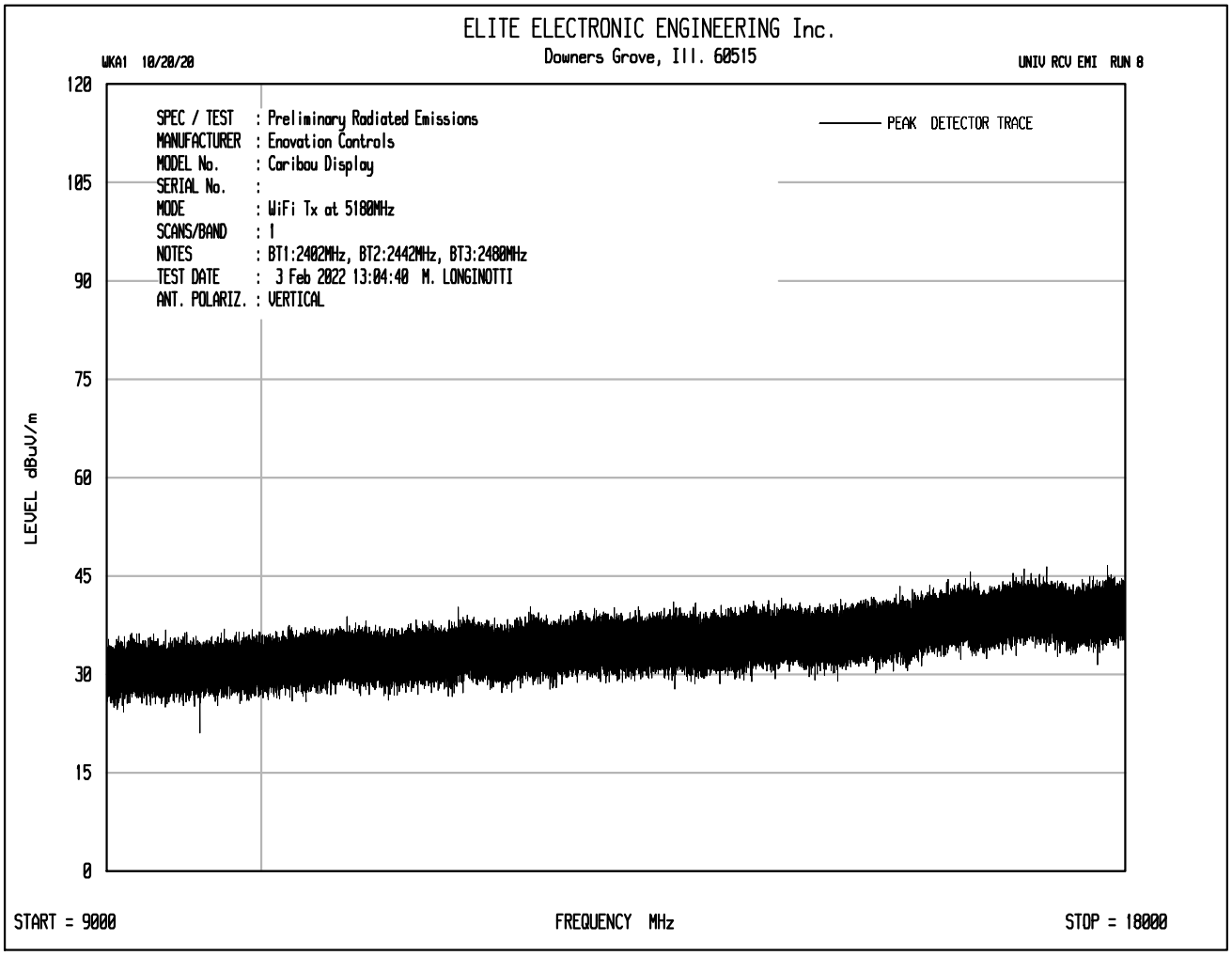
FCC 15.247
1 – 4924MHz (2nd harmonic of 2462MHz)



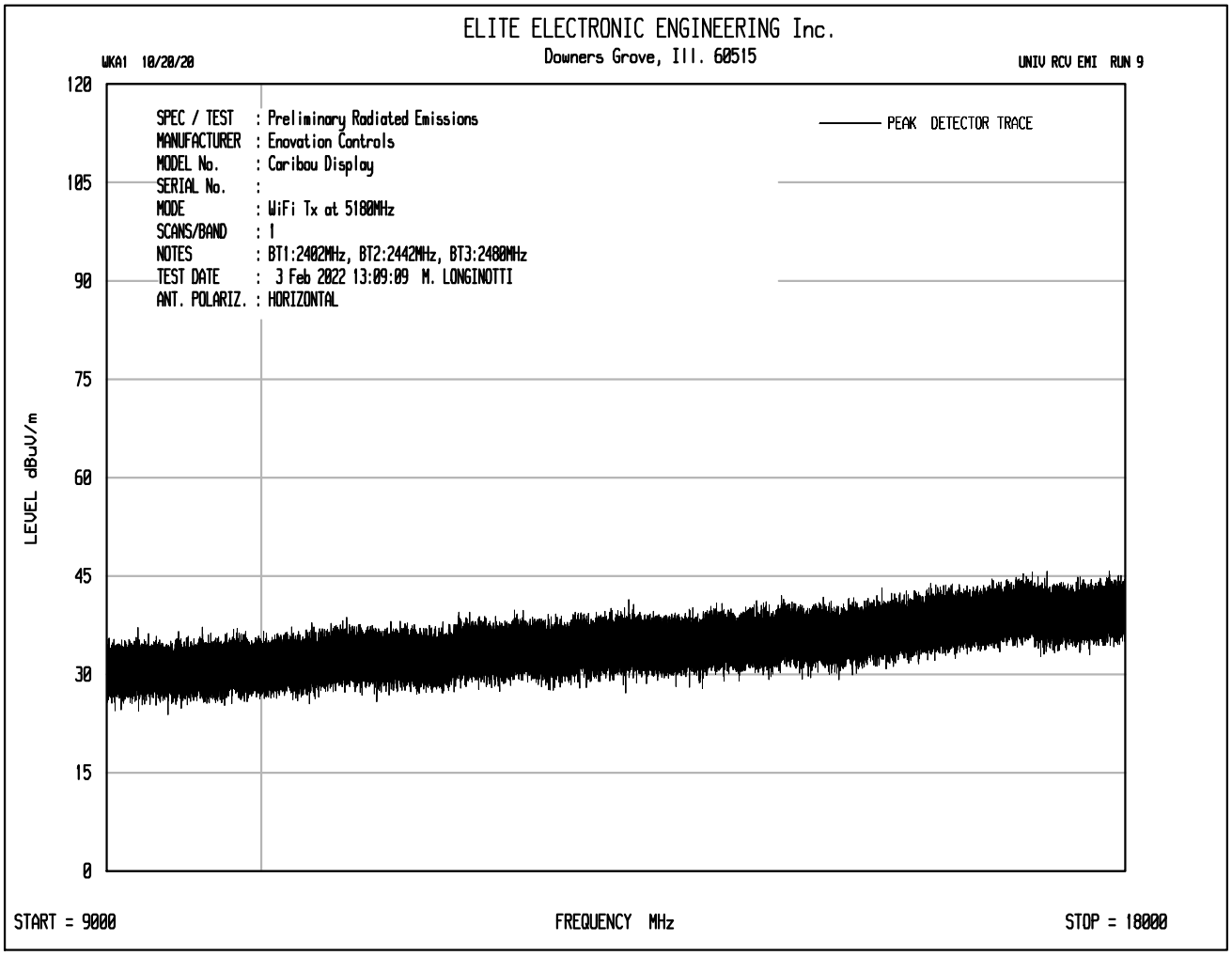
FCC 15.247 and FCC 15.407
1: BLE Module 1, Transmit at 2402MHz
2: BLE Module 2, Transmit at 2442MHz
3: BLE Module 3, Transmit at 2480MHz
4:WiFi Module, Transmit at 5180MHz



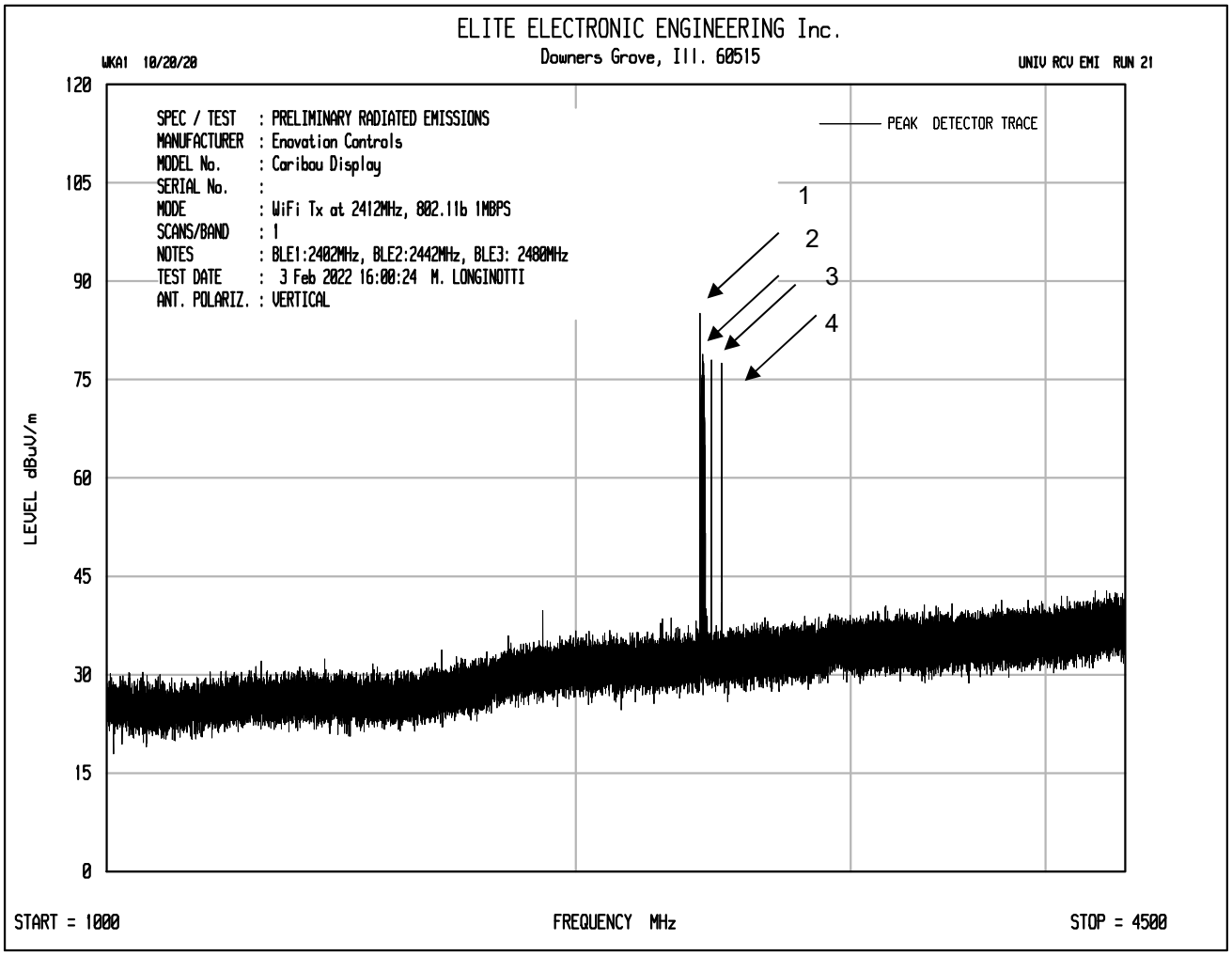
FCC 15.247 and FCC 15.407
1: BLE Module 1, Transmit at 2402MHz
2: BLE Module 2, Transmit at 2442MHz
3: BLE Module 3, Transmit at 2480MHz
4:WiFi Module, Transmit at 5180MHz



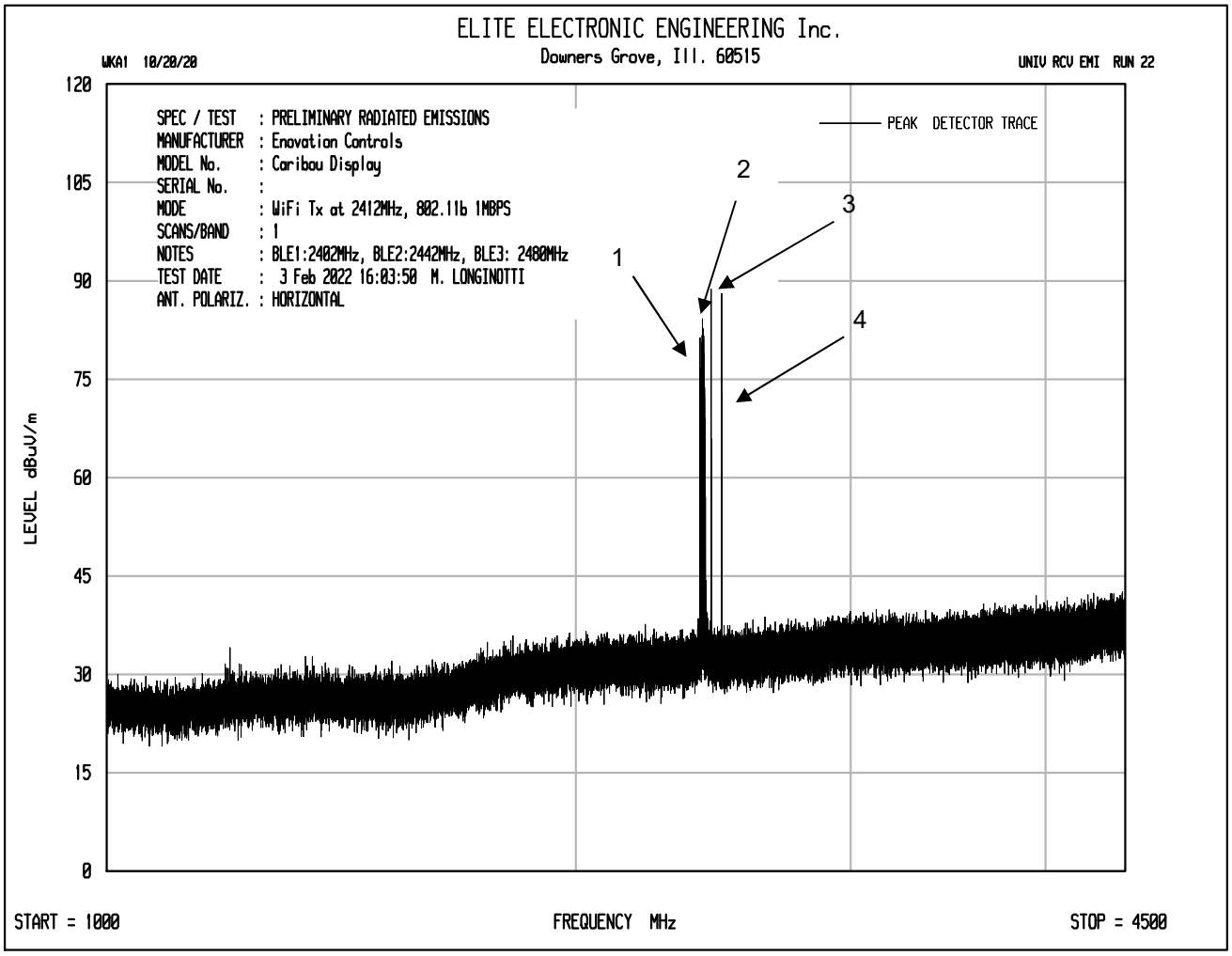
FCC 15.247 and FCC 15.407



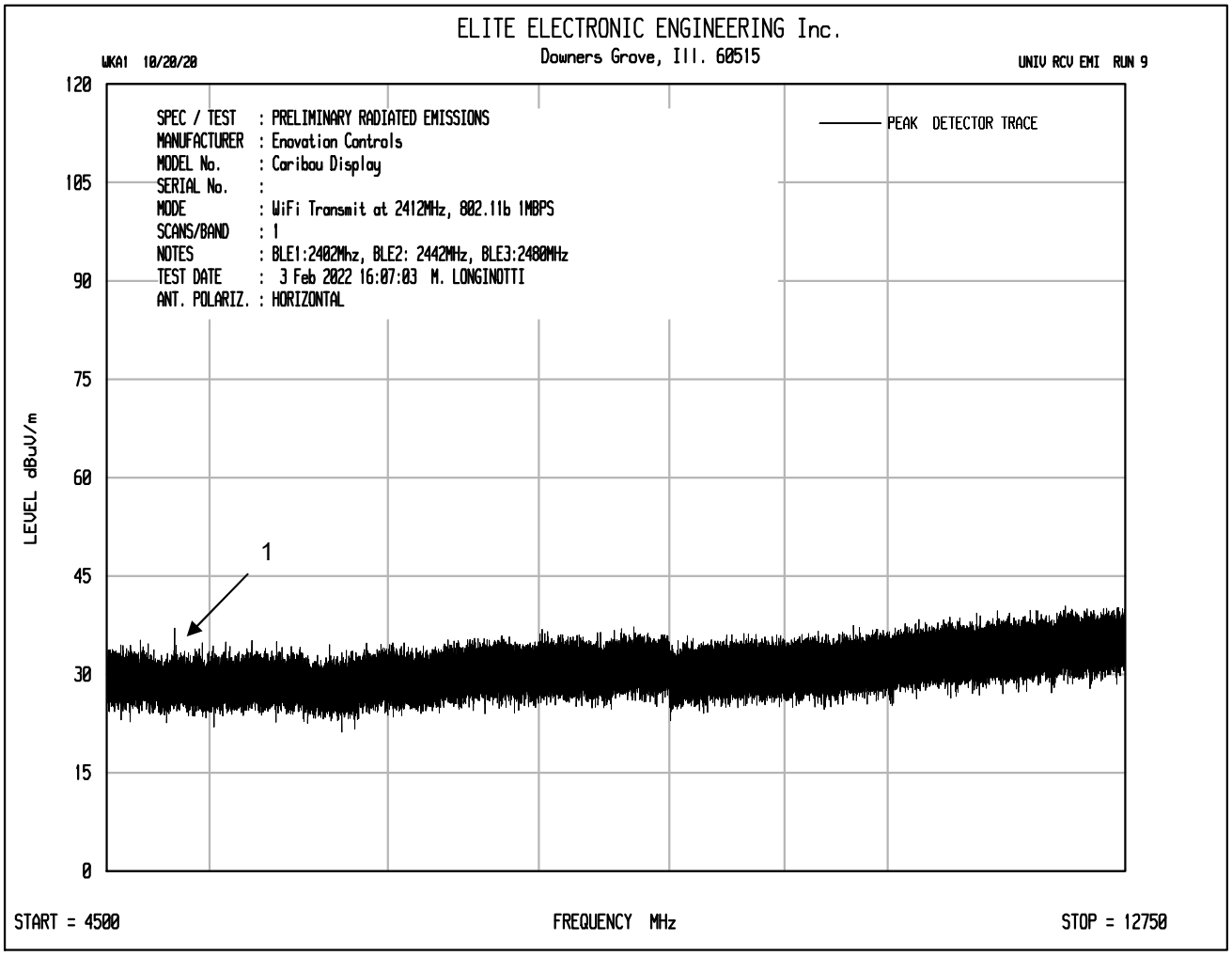
FCC 15.247 and FCC 15.407



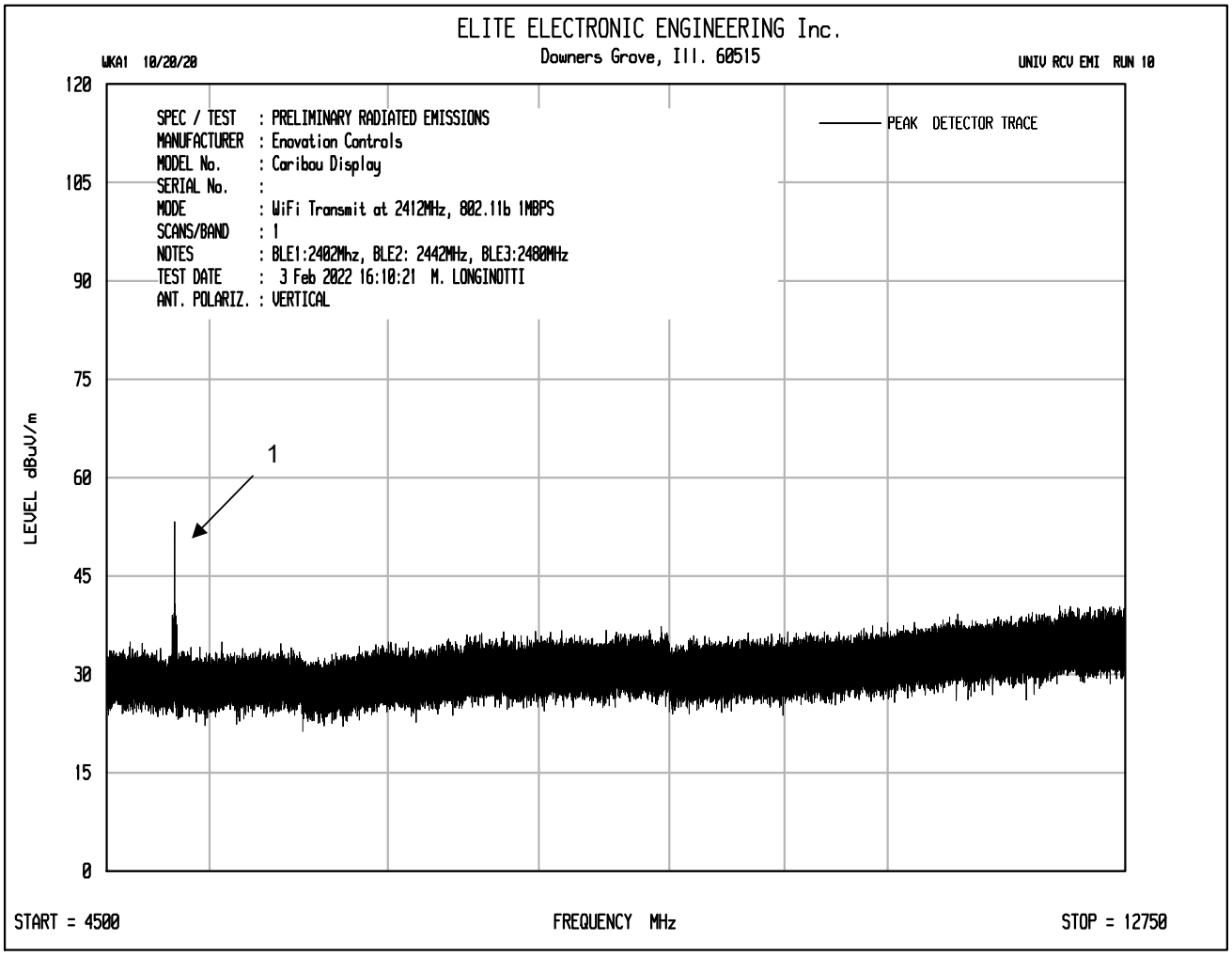
ETSI EN 300 328
1: BLE Module 1, Transmit at 2402MHz
2: WiFi Module, Transmit at 2412MHz
3: BLE Module 2, Transmit at 2442MHz
4: BLE Module 3, Transmit at 2480MHz



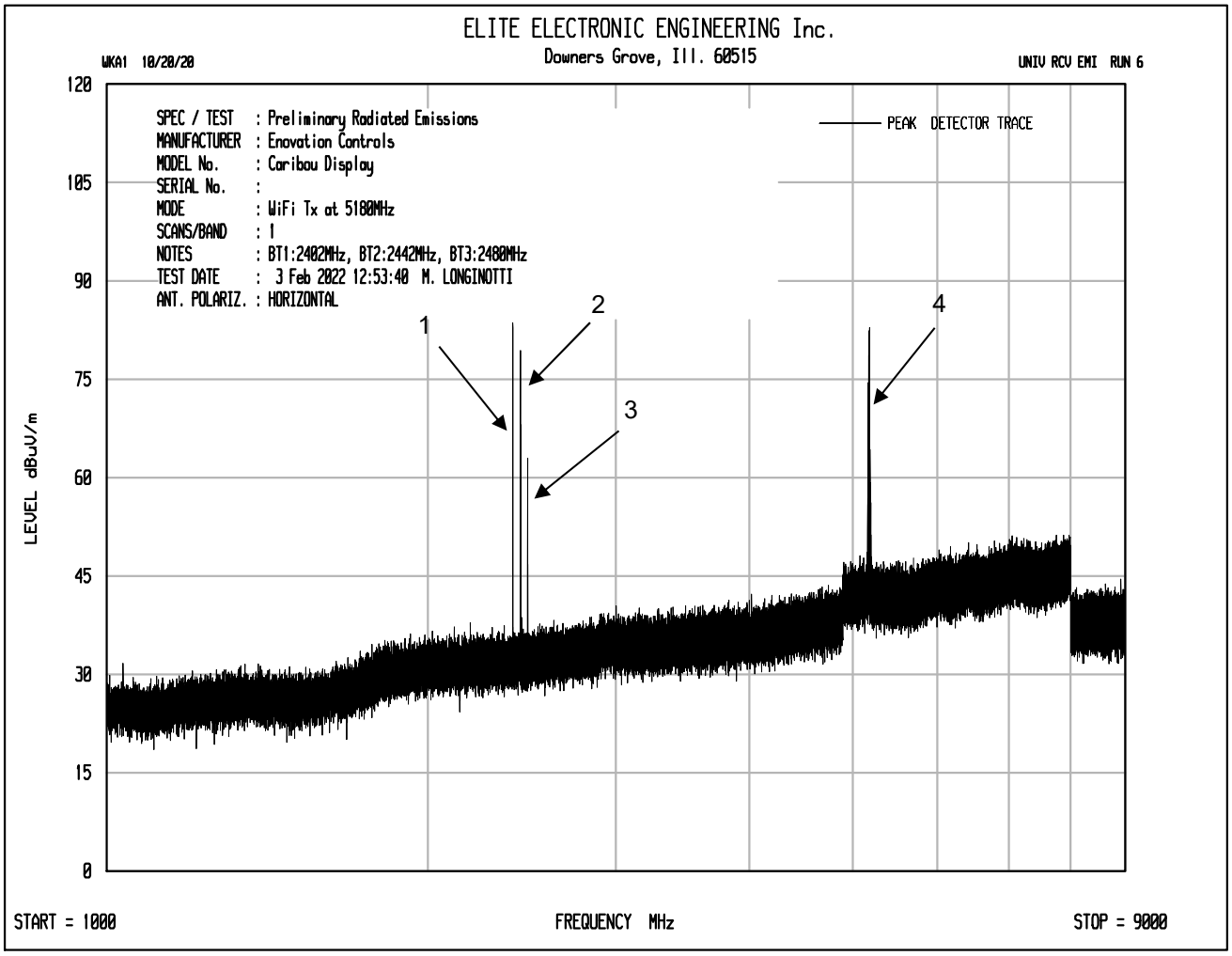
ETSI EN 300 328
1: BLE Module 1, Transmit at 2402MHz
2: WiFi Module, Transmit at 2412MHz
3: BLE Module 2, Transmit at 2442MHz
4: BLE Module 3, Transmit at 2480MHz



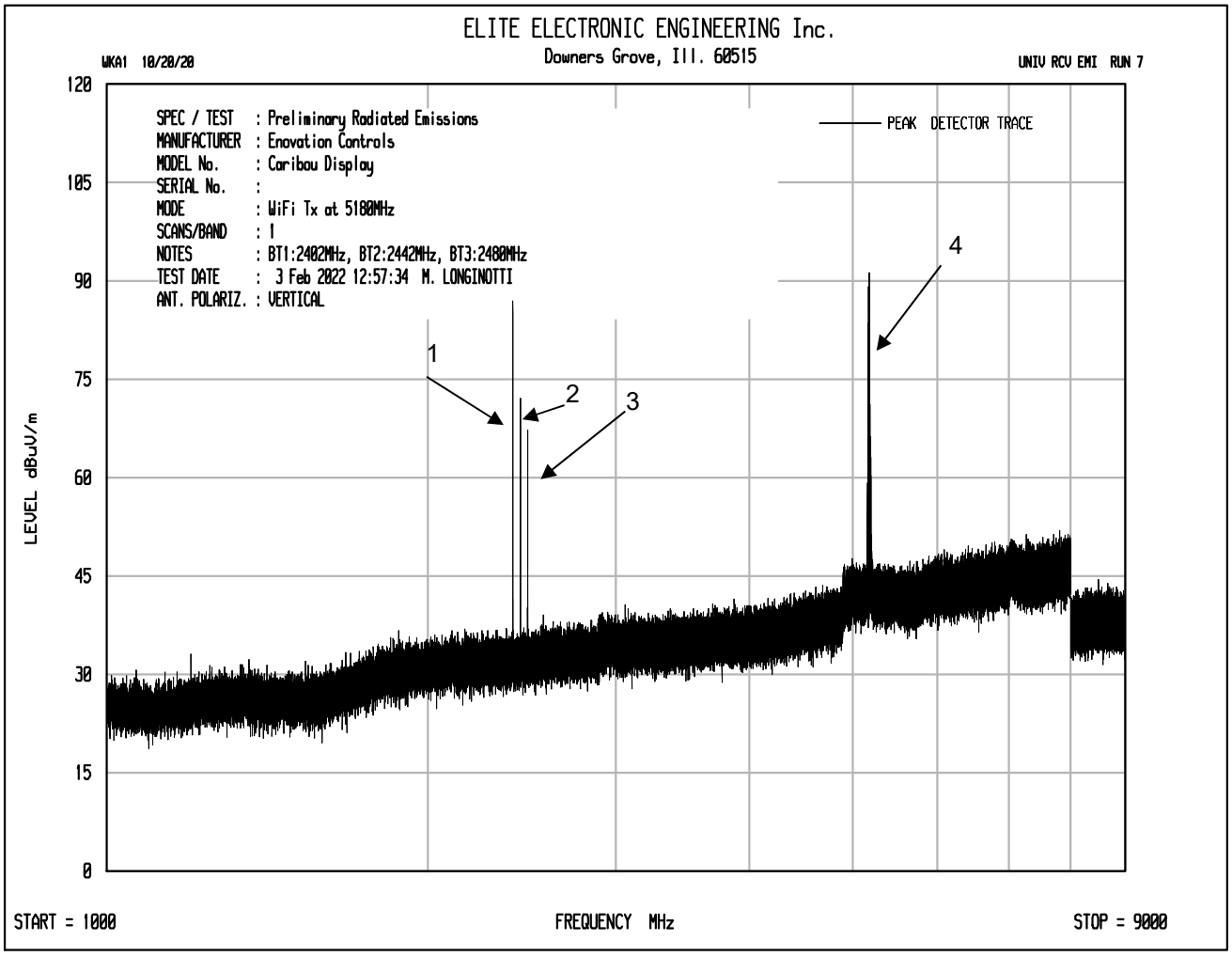
ETSI EN 300 328
1 – 4824MHz (2nd harmonic of 2412MHz)



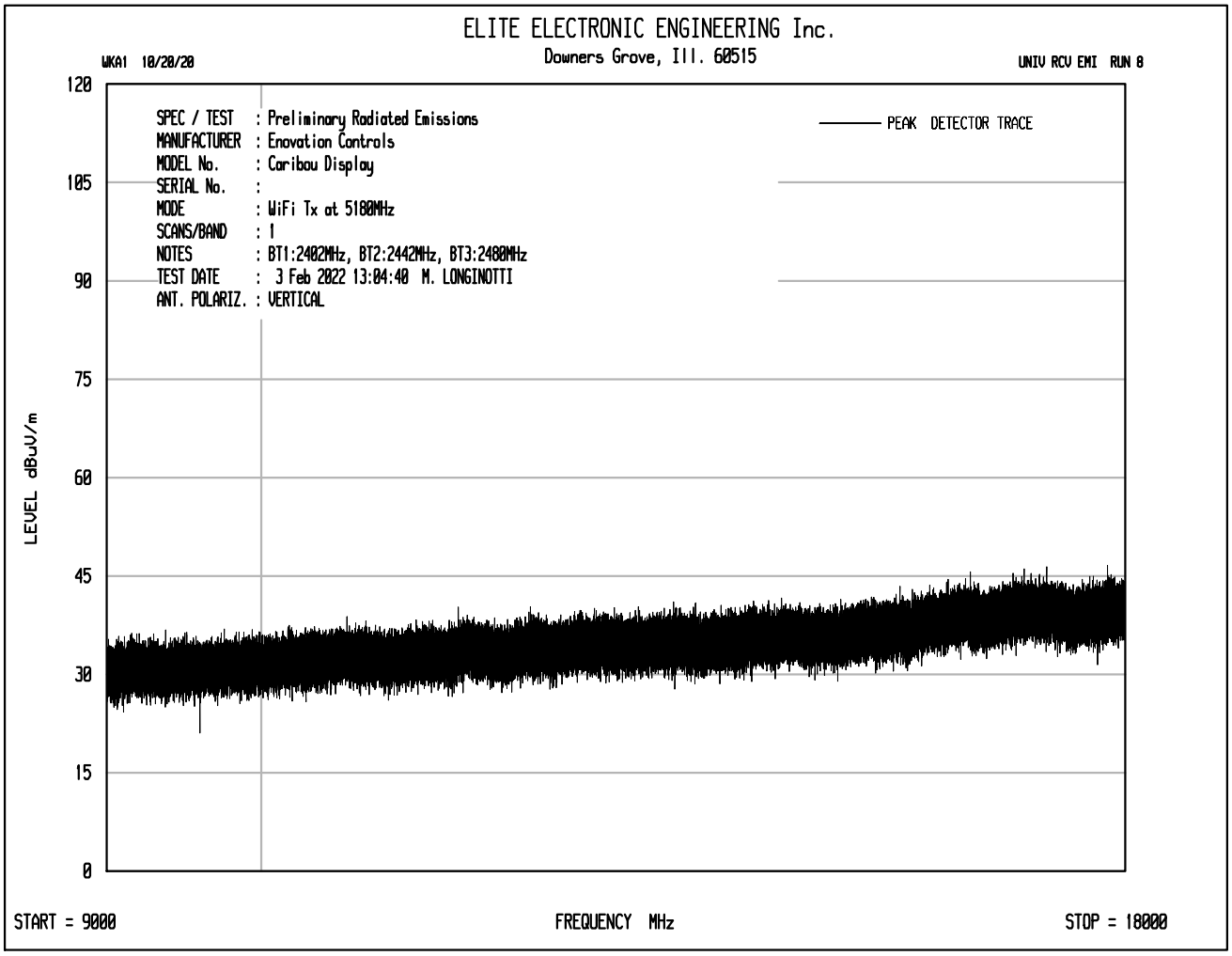
ETSI EN 300 328
1 – 4824MHz (2nd harmonic of 2412MHz)



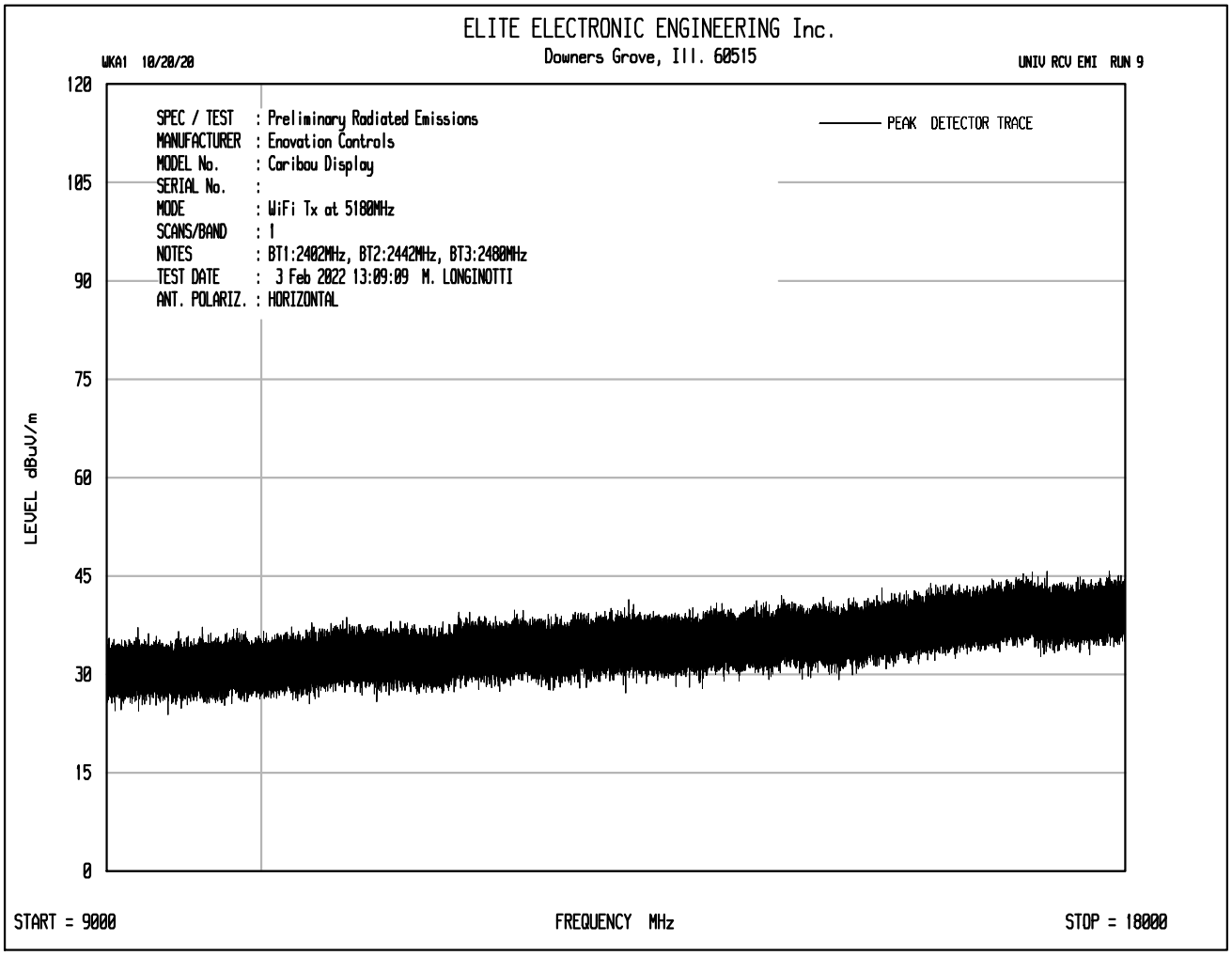
ETSI EN 300 328 and ETSI EN 301 893
1: BLE Module 1, Transmit at 2402MHz
2: BLE Module 2, Transmit at 2442MHz
3: BLE Module 3, Transmit at 2480MHz
4:WiFi Module, Transmit at 5180MHz



ETSI EN 300 328 and ETSI EN 301 893
1: BLE Module 1, Transmit at 2402MHz
2: BLE Module 2, Transmit at 2442MHz
3: BLE Module 3, Transmit at 2480MHz
4:WiFi Module, Transmit at 5180MHz



ETSI EN 300 328 and ETSI EN 301 893



ETSI EN 300 328 and ETSI EN 301 893

21. Scope of Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

ELITE ELECTRONIC ENGINEERING, INC.
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ELECTRICAL

Valid to: June 30, 2021 Certificate Number: 1786.01

In recognition of the successful completion of the A2LA Accreditation Program evaluation process, accreditation is granted to this laboratory to perform the following automotive electromagnetic compatibility and other electrical tests:

Test Technology:	Test Method(s)[1]:
Transient Immunity	ISO 7637-2 (including emissions); ISO 7637-3; ISO 16750-2:2012, Sections 4.6.3 and 4.6.4; CS-11979, Section 6.4; CS.00054, Section 5.9; EMC-CS-2009.1 (CI220); FMC1278 (CI220, CI221, CI222); GMW 3097, Section 3.5; SAE J1113-11; SAE J1113-12
Electrostatic Discharge (ESD)	ISO 10605 (2001, 2008); CS-11979 Section 7.0; CS.00054, Section 5.10; EMC-CS-2009.1 (CI 280); FMC1278 (CI280); SAE J1113-13; GMW 3097 Section 3.6
Conducted Emissions	CISPR 25 (2002, 2008), Sections 6.2 and 6.3; CISPR 25 (2016), Sections 6.3 and 6.4; CS-11979, Section 5.1; CS.00054, Sections 5.6.1 and 5.6.2; GMW 3097, Section 3.3.2; EMC-CS-2009.1 (CE 420); FMC1278 (CE420, CE421)
Radiated Emissions Anechoic	CISPR 25 (2002, 2008), Section 6.4; CISPR 25 (2016), Section 6.5; CS-11979, Section 5.3; CS.00054, Section 5.6.3; GMW 3097, Section 3.3.1; EMC-CS-2009.1 (RE 310); FMC1278 (RE310)
Vehicle Radiated Emissions	CISPR 12; ICES-002

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Test Technology:	Test Method(s) [1]:
Bulk Current Injection (BCI)	ISO 11452-4; CS-11979, Section 6.1; CS.00054, Section 5.8.1; GMW 3097, Section 3.4.1; SAE J1113-4; EMC-CS-2009.1 (RI112); FMC1278 (RI112)
Bulk Current Injections (BCI) *(Closed Loop Method)*	ISO 11452-4; SAE J1113-4
Radiated Immunity Anechoic *(Including Radar Pulse)*	ISO 11452-2; ISO 11452-5; CS-11979, Section 6.2; CS.00054, Section 5.8.2; GMW 3097, Section 3.4.2; EMC-CS-2009.1 (RI114); FMC1278 (RI114); SAE J1113-21
Radiated Immunity Magnetic Field	ISO 11452-8
Radiated Immunity Reverb	ISO/IEC 61000-4-21; GMW 3097, Section 3.4.3; EMC-CS-2009.1 (RI114); FMC1278 (RI114); ISO 11452-11
Radiated Immunity *(Portable Transmitters)*	ISO 11452-9; EMC-CS-2009.1 (RI115); FMC1278 (RI115)
Vehicle Radiated Immunity (ALSE)	ISO 11451-2
Electrical Loads	ISO 16750-2, Sections 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.11, and 4.12
Dielectric Withstand Voltage	MIL-STD-202, Method 301; EIA-364-20D
Insulation Resistance	MIL-STD-202, Method 302; SAE/USCAR-2, Revision 6, Section 5.5.1; EIA-364-21D
Contact Resistance	MIL-STD-202, Method 307; SAE/USCAR-2, Revision 6, Section 5.3.1; EIA/ECA-364-23C; USCAR21-3 Section 4.5.3
DC Resistance	MIL-STD-202, Method 303
Contact Chatter	MIL-STD-202, Method 310; SAE/USCAR-2, Revision 6, Section 5.1.9
Voltage Drop	SAE/USCAR-2, Revision 6, Section 5.3.2; USCAR21-3 Section 4.5.6

Test Technology:	Test Method(s) [1]:
Emissions	
Radiated and Conducted (3m Semi-anechoic chamber, up to 40 GHz)	47 CFR, FCC Part 15 B (using ANSI C63.4:2014); 47 CFR, FCC Part 18 (using FCC MP-5:1986); ICES-001; ICES-003; ICES-005; IEC/CISPR 11, Ed. 4.1 (2004-06); AS/NZS CISPR 11 (2004); IEC/CISPR 11 Ed 5 (2009-05) + A1 (2010); KN 11 (2008-5) with RRL Notice No. 2008-3 (May 20, 2008); CISPR 11; EN 55011; KN 11; CNS 13803 (1997, 2003); CISPR 14-1; EN 55014-1; AS/NZS CISPR 14.1; KN 14-1; IEC/CISPR 22 (1997); EN 55022 (1998) + A1(2000); EN 55022 (1998) + A1(2000) + A2(2003); EN 55022 (2006); IEC/CISPR 22 (2008-09); AS/NZS CISPR 22 (2004); AS/NZS CISPR 22, 3rd Edition (2006); KN 22 (up to 6 GHz); CNS 13438 (up to 6 GHz); VCCI V-3 (up to 6 GHz); CISPR 32; EN 55032; KN 32
Current Harmonics	IEC 61000-3-2; EN 61000-3-2; KN 61000-3-2
Flicker and Fluctuations	IEC 61000-3-3; EN 61000-3-3; KN 61000-3-3
Immunity	
Electrostatic Discharge	IEC 61000-4-2, Ed. 1.2 (2001); IEC 61000-4-2 (1995) + A1(1998) + A2(2000); EN 61000-4-2 (1995); EN 61000-4-2 (2009-05); KN 61000-4-2 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-2; EN 61000-4-2; KN 61000-4-2; IEEE C37.90.3 2001
Radiated Immunity	IEC 61000-4-3 (1995) + A1(1998) + A2(2000); IEC 61000-4-3, Ed. 3.0 (2006-02); IEC 61000-4-3, Ed. 3.2 (2010); KN 61000-4-3 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-3; EN 61000-4-3; KN 61000-4-3; IEEE C37.90.2 2004
Electrical Fast Transient/Burst	IEC 61000-4-4, Ed. 2.0 (2004-07); IEC 61000-4-4, Ed. 2.1 (2011); IEC 61000-4-4 (1995) + A1(2000) + A2(2001); KN 61000-4-4 (2008-5); RRL Notice No. 2008-5 (May 20, 2008); IEC 61000-4-4; EN 61000-4-4; KN 61000-4-4
Surge	IEC 61000-4-5 (1995) + A1(2000); IEC 61000-4-5, Ed 1.1 (2005-11); EN 61000-4-5 (1995) + A1(2001); KN 61000-4-5 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-5; EN 61000-4-5; KN 61000-4-5; IEEE C37.90.1 2012

Test Technology:	Test Method(s) [1]:
Immunity (cont'd)	
Conducted Immunity	IEC 61000-4-6 (1996) + A1(2000); IEC 61000-4-6, Ed 2.0 (2006-05); IEC 61000-4-6 Ed. 3.0 (2008); KN 61000-4-6 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); EN 61000-4-6 (1996) + A1(2001); IEC 61000-4-6; EN 61000-4-6; KN 61000-4-6
Power Frequency Magnetic Field Immunity	IEC 61000-4-8 (1993) + A1(2000); IEC 61000-4-8 (2009); EN 61000-4-8 (1994) + A1(2000); KN 61000-4-8 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-8; EN 61000-4-8; KN 61000-4-8
Voltage Dips, Short Interrupts, and Line Voltage Variations	IEC 61000-4-11, Ed. 2 (2004-03); KN 61000-4-11 (2008-5); RRL Notice No. 2008-4 (May 20, 2008); IEC 61000-4-11; EN 61000-4-11; KN 61000-4-11
Ring Wave	IEC 61000-4-12, Ed. 2 (2006-09); EN 61000-4-12:2006; IEC 61000-4-12; EN 61000-4-12; KN 61000-4-12
Generic and Product Specific EMC Standards	IEC/EN 61000-6-1; AS/NZS 61000-6-1; KN 61000-6-1; IEC/EN 61000-6-2; AS/NZS 61000-6-2; KN 61000-6-2; IEC/EN 61000-6-3; AS/NZS 61000-6-3; KN 61000-6-3; IEC/EN 61000-6-4; AS/NZS 61000-6-4; KN 61000-6-4; EN 50130-4; IEC 61326-1; IEC/CISPR 14-2; EN 55014-2; AS/NZS CISPR 14.2; KN 14-2; IEC/CISPR 24; AS/NZS CISPR 24; EN 55024; KN 24; IEC 60601-1-2; JIS T0601-1-2
TxRx EMC Requirements	EN 301 489-1; EN 301 489-3; EN 301 489-9; EN 301 489-17; EN 301 489-19; EN 301 489-52;
European Radio Test Standards	ETSI EN 300 086-1; ETSI EN 300 086-2; ETSI EN 300 113-1; ETSI EN 300 113-2; ETSI EN 300 220-1; ETSI EN 300 220-2; ETSI EN 300 330-1; ETSI EN 300 330-2; ETSI EN 300 440-1; ETSI EN 300 440-2; ETSI EN 300 422-1; ETSI EN 300 422-2; ETSI EN 300 328; ETSI EN 301 893; ETSI EN 301 511; ETSI EN 301 908-1; ETSI EN 908-2; ETSI EN 908-13; ETSI EN 301 413; ETSI EN 302 502

Test Technology:	Test Method(s)[1]:
Canadian Radio Tests	RSS-102 (RF Exposure Evaluation only); RSS-111; RSS-112; RSS-117; RSS-119; RSS-123; RSS-125; RSS-127; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134; RSS-135; RSS-137; RSS-139; RSS-140; RSS-141; RSS-142; RSS-170; RSS-181; RSS-182; RSS-191; RSS-192; RSS-194; RSS-195; RSS-196; RSS-197; RSS-199; RSS-210; RSS-211; RSS-213; RSS-215; RSS-216; RSS-220; RSS-222; RSS-236; RSS-238; RSS-243; RSS-244; RSS-246; RSS-247; RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-GEN
Mexico Radio Tests	IFT-008; NOM-208-SCFI
Japan Radio Tests	Radio Law No. 131, Ordinance of MPT No. 37, 1981, MIC Notification No. 88:2004, Table No. 22-11; ARIB STD-T66, Regulation 18
Taiwan Radio Tests	LP-0002
Australia/New Zealand Radio Tests	AS/NZS 4268; Radiocommunications (Short Range Devices) Standard (2014)
Hong Kong Radio Tests	HKCA 1039 Issue 6; HKCA 1042; HKCA 1033 Issue 7; HKCA 1061; HKCA 1008; HKCA 1043; HKCA 1057; HKCA 1073
Korean Radio Test Standards	KN 301 489-1; KN 301 489-3; KN 301 489-9; KN 301 489-17; KN 301 489-52
Unlicensed Radio Frequency Devices *(3 Meter Semi-Anechoic Room)*	47 CFR FCC Part 15C, 15D, 15E, 15F, 15G, 15H (using ANSI C63.10:2013, ANSI C63.17:2013 and FCC KDB 905462 D02 (v02))
Licensed Radio Service Equipment	47 CFR FCC Parts 20, 22, 24, 25, 27, 30, 73, 74, 80, 87, 90, 95, 96, 97, 101; ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015;
Electrical Measurements and Simulation	
AC Voltage / Current (1mV to 5kV) 60 Hz (0.1V to 250V) up to 500 MHz (1µA to 150A) 60 Hz DC Voltage / Current (1mV to 15 kV) / (1µA to 10A) Power Factor / Efficiency / Crest Factor (Power to 30kW) Resistance (1mΩ to 4000MΩ) Surge (Up to 10 kV / 5 kA) (Combination Wave and Ring Wave)	FAA AC 150/5345-10H FAA AC 150/5345-43J FAA AC 150/5345-44K FAA AC 150/5345-46E FAA AC 150/5345-47C FAA EB 67D

On the following products and materials:
Telecommunications Terminal Equipment (TTE), Radio Equipment, Network Equipment, Information Technology Equipment (ITE), Automotive Electronic Equipment, Automotive Hybrid Electronic Devices, Maritime Navigation and Radio Communication Equipment and Systems, Vehicles, Boats and Internal Combustion Engine Driven Devices, Automotive, Aviation, and General Lighting Products, Medical Electrical Equipment, Motors, Industrial, Scientific and Medical (ISM) Radio-Frequency Equipment, Household Appliances, Electric Tools, Low-voltage Switchgear and Control gear, Programmable Controllers, Electrical Equipment for Measurement, Control and Laboratory Use, Base Materials, Power and Data Transmission Cables and Connectors

[1] When the date, revision or edition of a test method standard is not identified on the scope of accreditation, the laboratory is expected to be using the current version within one year of the date of publication, per part C., Section 1 of A2LA *R101 - General Requirements - Accreditation of ISO-IEC 17025 Laboratories*.

Testing Activities Performed in Support of FCC Declaration of Conformity and Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1[2]

Rule Subpart/Technology	**Test Method**	**Maximum Frequency (MHz)**
Unintentional Radiators Part 15B	ANSI C63.4:2014	40000
Industrial, Scientific, and Medical Equipment Part 18	FCC MP-5 (February 1986)	40000
Intentional Radiators Part 15C	ANSI C63.10:2013	40000
Unlicensed Personal Communication Systems Devices Part 15D	ANSI C63.17:2013	40000
U-NIII without DFS Intentional Radiators Part 15E	ANSI C63.10:2013	40000
U-NIII with DFS Intentional Radiators Part 15E	FCC KDB 905462 D02 (v02)	40000
UWB Intentional Radiators Part 15F	ANSI C63.10:2013	40000
BPL Intentional Radiators Part 15G	ANSI C63.10:2013	40000
White Space Device Intentional Radiators Part 15H	ANSI C63.10:2013	40000

Testing Activities Performed in Support of FCC Declaration of Conformity and Certification in Accordance with 47 Code of Federal Regulations and FCC KDB 974614, Appendix A, Table A.1[2]

Rule Subpart/Technology	Test Method	Maximum Frequency (MHz)
Commercial Mobile Services (FCC Licensed Radio Service Equipment) Parts 22 (cellular), 24, 25 (below 3 GHz), and 27	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
General Mobile Radio Services (FCC Licensed Radio Service Equipment) Parts 22 (non-cellular), 90 (below 3 GHz), 95, 97, and 101 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment) Part 96	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
Maritime and Aviation Radio Services Parts 80 and 87	ANSI/TIA-603-E; ANSI C63.26:2015	40000
Microwave and Millimeter Bands Radio Services Parts 25, 30, 74, 90 (above 3 GHz), 97 (above 3 GHz), and 101	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
Broadcast Radio Services Parts 73 and 74 (below 3 GHz)	ANSI/TIA-603-E; TIA-102.CAAA-E; ANSI C63.26:2015	40000
Signal Boosters Part 20 (Wideband Consumer Signal Boosters, Provider-specific signal boosters, and Industrial Signal Boosters) Section 90.219	ANSI C63.26:2015	40000

[2]Accreditation does not imply acceptance to the FCC equipment authorization program. Please see the FCC website (https://apps.fcc.gov/oetcf/eas/) for a listing of FCC approved laboratories.

Accredited Laboratory

A2LA has accredited

ELITE ELECTRONIC ENGINEERING INC.

Downers Grove, IL

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 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 8th day of August 2019.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1786.01
Valid to June 30, 2021

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