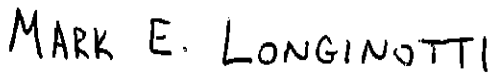
Engineering Test Report No. 2202429-06		
Report Date	December 15, 2022	
Manufacturer Name	Chamberlain Group, LLC	
Manufacturer Address	300 Windsor Drive Oak Brook, IL 60523	
Product Name Brand/Model No.	Residential Jackshaft Opener RJOA MPP	
Date Received	November 23, 2022	
Test Dates	December 2, 2022 through December 7, 2022	
Specifications	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247	
Test Facility	Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515	FCC Reg. Number: 269750 IC Reg. Number: 2987A CAB Identifier: US0107
Signature		
Tested by	Mark E. Longinotti	
Signature		
Approved by	Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894	
PO Number	4900084893	

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 test specification. The data presented in this test report pertains to the EUT on the test dates 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. This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Table of Contents

1. Report Revision History

Revision	Date	Description
–	16 DEC 2022	Initial Release of Engineering Test Report No. 2202429-06

2. Introduction

This document presents the results of a series of electromagnetic compatibility (EMC) tests that were performed on one (1) Residential Jackshaft Opener (hereinafter referred to as the Equipment Under Test (EUT)).

The nature of these measurements is to ensure that the radio module and host remain in compliance with the emissions requirements of the FCC after the integration process.

The EUT was identified as follows:

EUT Identification	
Description	Residential Jackshaft Opener
Model/Part No.	RJOA MPP
Serial No.	Radiated Sample 2
Software/Firmware Version	Security 3.0: bg21 Realtek WiFi/BLE: Ver 7.1 Sub 1GHz: V1.12
Size of EUT	54 cm x 18.5 cm x 16.5 cm
Number of Interconnection Wires	See Section 6 Below
Type of Interconnection Wires	See Section 6 Below
Highest Internal Frequency of the EUT	434.54MHz

The EUT listed above was used throughout the test series.

3. Power Input

The EUT obtained 115V 60Hz power via a 3 wire, 1.75-meter, unshielded power cord.

4. Grounding

The EUT was connected to ground through the third wire of its input power cord.

5. Support Equipment

The EUT was submitted for testing along with the following support equipment:

Description	Model #
Automatic Garage Door Lock	001D8875
Smart Control Panel	880LMW
Safety Reversing Sensors	041-0136
Laptop Computer	Dell Latitude 7480

6. Interconnect Leads

The following interconnect cables were submitted with the test item:

Item	Description
USB Cable	Connects laptop to EUT
2 wires	Used to connect Automatic Garage Door Lock to EUT
2 wires	Used to connect Smart Control Panel to EUT
4 wires	Used to Connect Safety Reversing Sensors to EUT

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. Transmit at 914.75MHz, Realtek BLE Transmit at 2402MHz

This mode was achieved by applying power to the device. The laptop computer was connected to the EUT. The laptop computer was used to program the EUT to transmit at 914.75MHz and to program the Realtek BLE to transmit at 2402MHz.

8.2. Transmit at 914.75MHz, Realtek WiFi Transmit at 2437MHz, 802.11b 11MBPS, Security 3.0 BLE Transmit at 2402MHz

This mode was achieved by applying power to the device. The laptop computer was connected to the EUT. The laptop computer was used to program the EUT to transmit at 914.75MHz, to program the Realtek WiFi to transmit at 2473MHz, 802.11b 11MBPS, and to program the Security 3.0 BLE to transmit at 2402MHz.

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

- ANSI C63.10-2013, “American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices”

- Federal Communications Commission Office of Engineering and Technology Laboratory Division, Guidance For Compliance Measurements On Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 April 2, 2019 KDB 558074 D01v05r02

- Federal Communications Commission Office of Engineering and Technology Laboratory Division, Modular Transmitter Integration Guide Guidance For Host Product Manufacturers, October 13, 2020 KDB 996369 D04 v02

10. Test Plan

No test plan was provided. Instructions were provided by personnel from Chamberlain Group, LLC and used in conjunction with the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247, Innovation, Science, and Economic Development Canada, ICES-003, and ANSI C63.4-2014 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

The following were the laboratory conditions while the EMC tests were performed:

Ambient Parameters	Value
Temperature	22°C
Relative Humidity	23%
Atmospheric Pressure	1017mb

13. Summary

The following EMC test was performed, and the results are shown below:

Test Description	Test Requirements	Test Methods	EUT S/N	Results
Module Integration – Emissions	FCC 15.247	ANSI C63.10:2013	Radiated Sample 2	Conforms

14. 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 (dBµV) = MTR (dBµV) + 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 (dBµV/m) = MTR (dBµV) + AF (dB/m) + CF (dB) + (- PA (dB)) + DC (dB)

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

Formula 2: FS (µV/m) = AntiLog [(FS (dBµV/m))/20]

15. Statement of Conformity

The Chamberlain Group, LLC Residential Jackshaft Opener, Model No. RJOA MPP, Serial No. Radiated Sample 2, did fully conform to requirements for the intermixing of emissions from multiple transmitters in a host product as required by FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 and KDB 996369.

16. 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 test specification. 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.

17. Photographs of EUT


FCC
LiftMaster

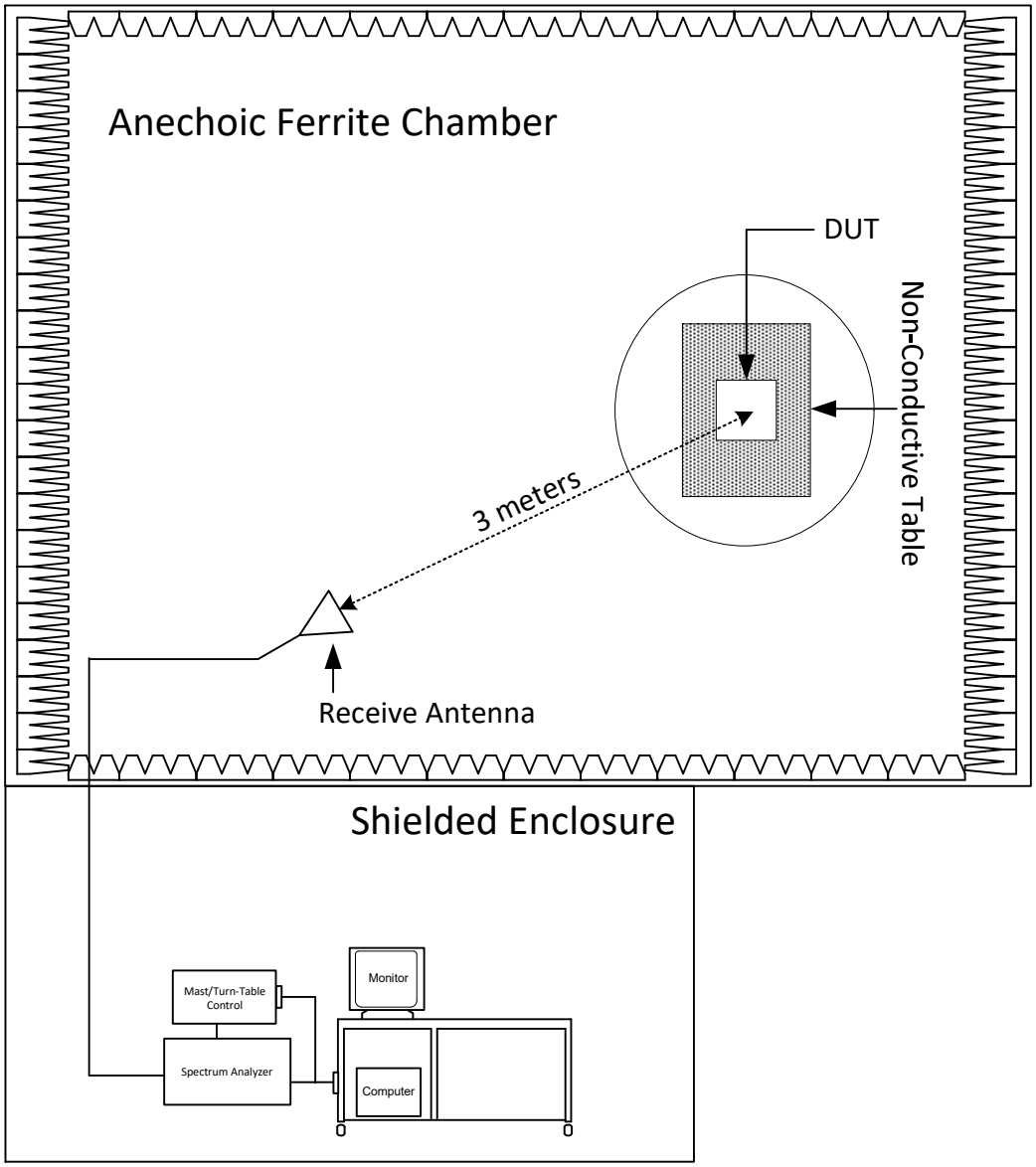
18. Equipment List

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	9/21/2022	9/21/2023
CDZ3	LAB WORKSTATION	ELITE	LWS-10		WINDOWS 10	CNR	
NTA3	BILOG ANTENNA	TESEQ	6112D	32853	25-1000MHz	11/17/2022	11/17/2024
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	4/27/2022	4/27/2024
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	3/31/2022	3/31/2023
SES0	24VDC POWER SUPPLY	P-TRANS	FS-32024-1M	001	18-27VDC	NOTE 1	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XPQ4	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000-O/O	1	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.

19. Block Diagram of Test Setup



Radiated Measurements Test Setup

20. Module Integration – Emissions Test

EUT Information	
Manufacturer	Chamberlain Group, LLC
Product	Residential Jackshaft Opener
Model No.	RJOA MPP
Serial No.	Radiated Sample 2
Mode	Transmit at 914.75MHz, Realtek BLE Transmit at 2402MHz and Transmit at 914.75MHz, Realtek WiFi Transmit at 2437MHz, 802.11b 11MBPS, Security 3.0 BLE Transmit at 2402MHz

Test Site Information	
Setup Format	Tabletop
Height of Support	N/A
Type of Test Site	Semi-Anechoic Chamber
Test Site Used	Room 29
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

Requirements
Per 996369 D04 Module Integration Guide v01: 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 radio spectrum is to be investigated with all the transmitters in the final host product functioning to determine that no emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). The testing shall also 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. No emissions exceed the highest limit permitted for any one individual transmitter as required by Section 2.947(f). Radiated Emissions in Non-Restricted Bands: Per FCC 15.247, Section (d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. Radiated Emissions in Restricted Bands: Per 15.247, Section (d), 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).

Procedures

Radiated Emissions in Non-Restricted Bands:

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Preliminary radiated emissions tests were performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3-meter distance from the EUT. The entire frequency range from 30MHz to 25GHz was investigated using a peak detector function.

The final radiated emission tests were then manually performed over the frequency range of 30MHz to 18GHz.

1) The field strength of the fundamental was measured using a double ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive and set to transmit. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.
2) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5-meter-high non-conductive stand and set to transmit. A peak detector with a resolution bandwidth of 100kHz was used on the spectrum analyzer.
3) To ensure that maximum or worst-case emission levels at the fundamental and harmonics were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:
    a) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
    b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
    c) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
    d) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead, the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.
4) All harmonics not in the restricted bands must be at least 20dB below levels measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.

Radiated Emissions in Restricted Bands:

1) The field strengths of all emissions below 1 GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on an 80 cm high non-conductive stand and set to transmit. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
2) The field strengths of all emissions above 1 GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3-meter distance from the EUT. The EUT was placed on a 1.5 meter high non-conductive and set to transmit. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.
3) To ensure that maximum or worst-case emission levels were measured, the following steps were taken when taking all measurements:
    a) The EUT was rotated so that all of its sides were exposed to the receiving antenna.

b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.

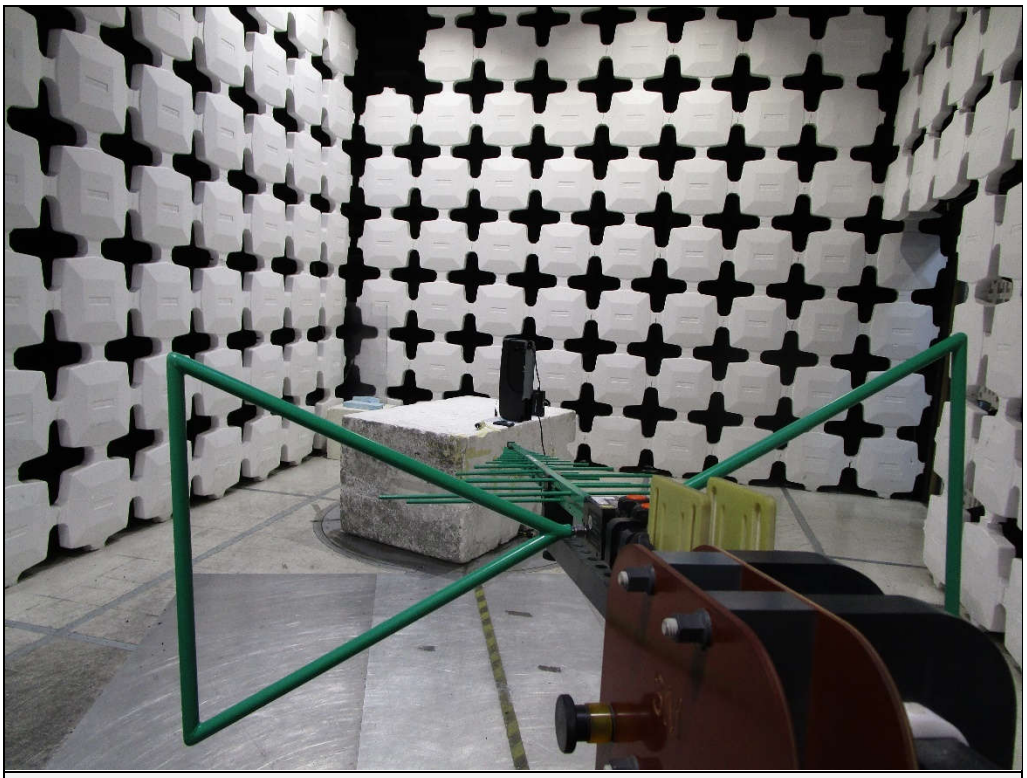
c) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

d) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer, the measuring antenna was not raised or lowered to ensure maximized readings. Instead, the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.

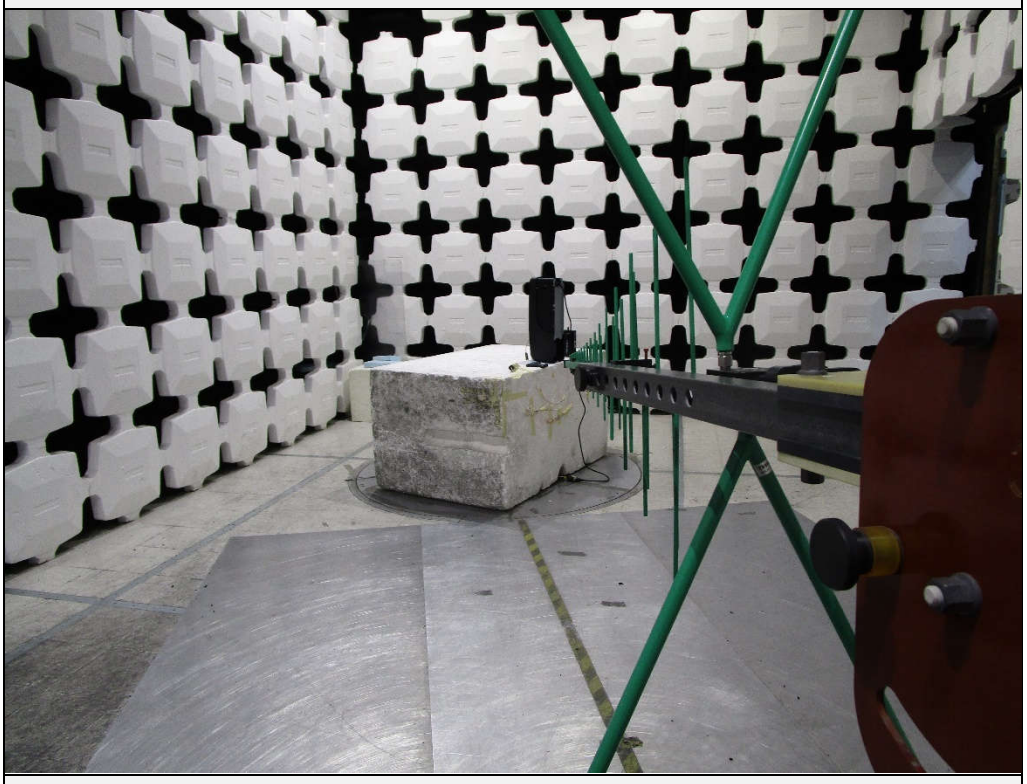
4) For all radiated emissions measurements below 1GHz, if the peak reading is below the limits listed in 15.209(a), no further measurements are required. If, however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.

5) For all radiated emissions measurements above 1GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1GHz must be no greater than 20dB above the limits specified in 15.209(a).

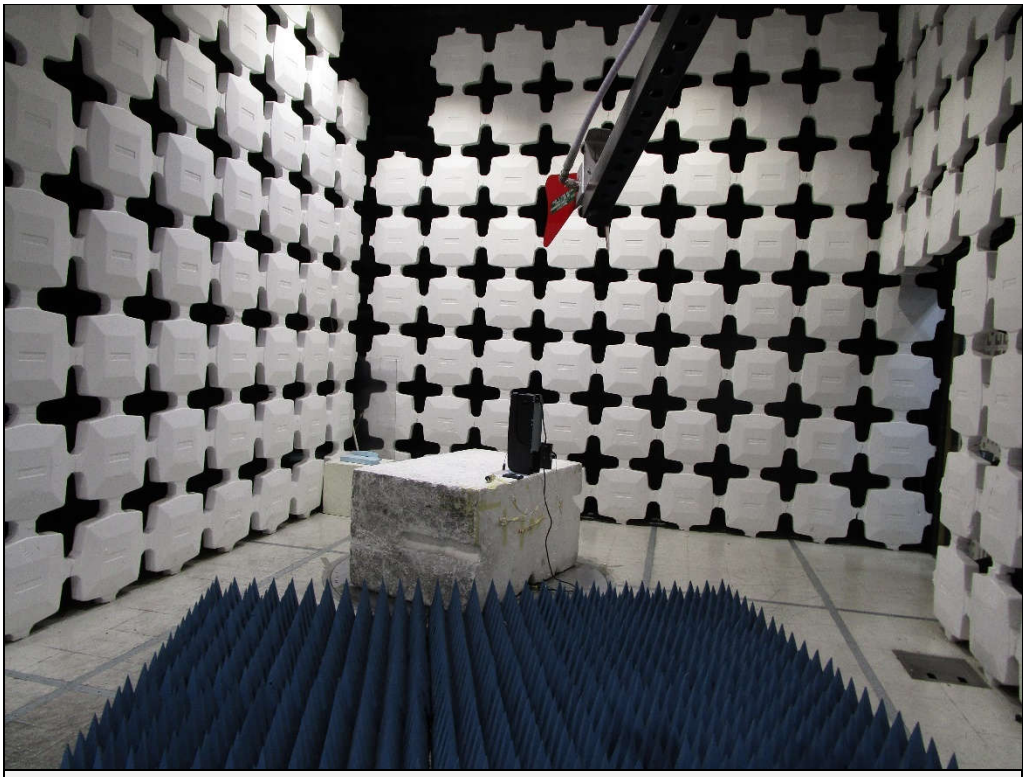
6) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken.



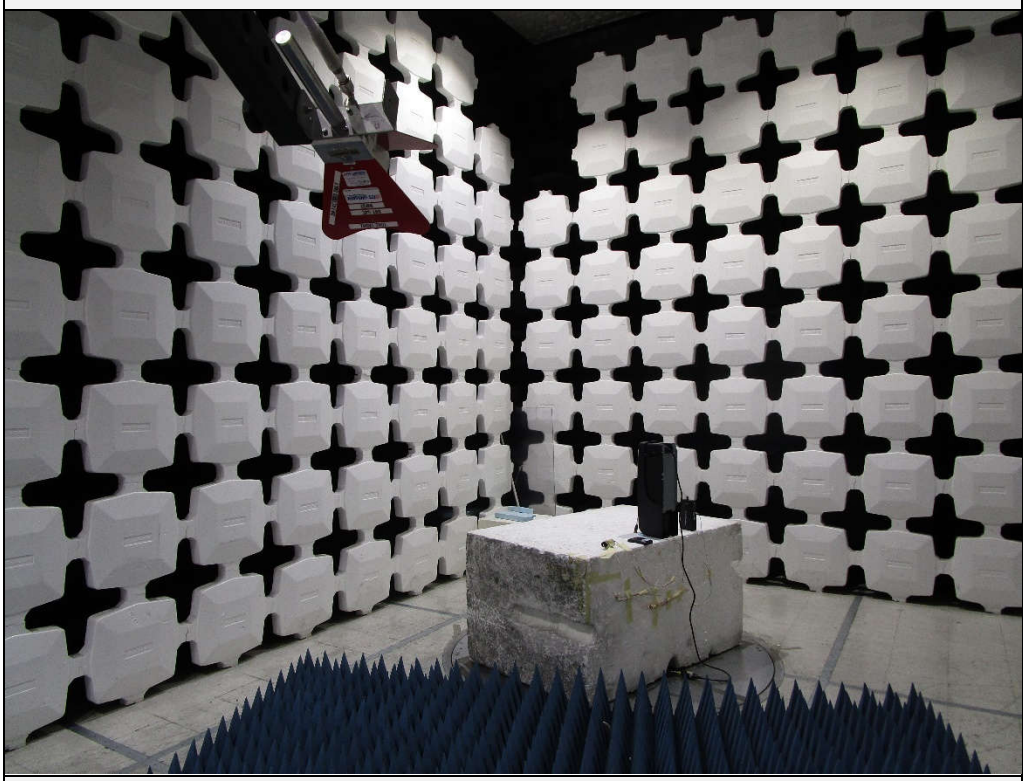
Test Setup for Spurious Emissions: 30MHz to 1GHz, Horizontal Polarization



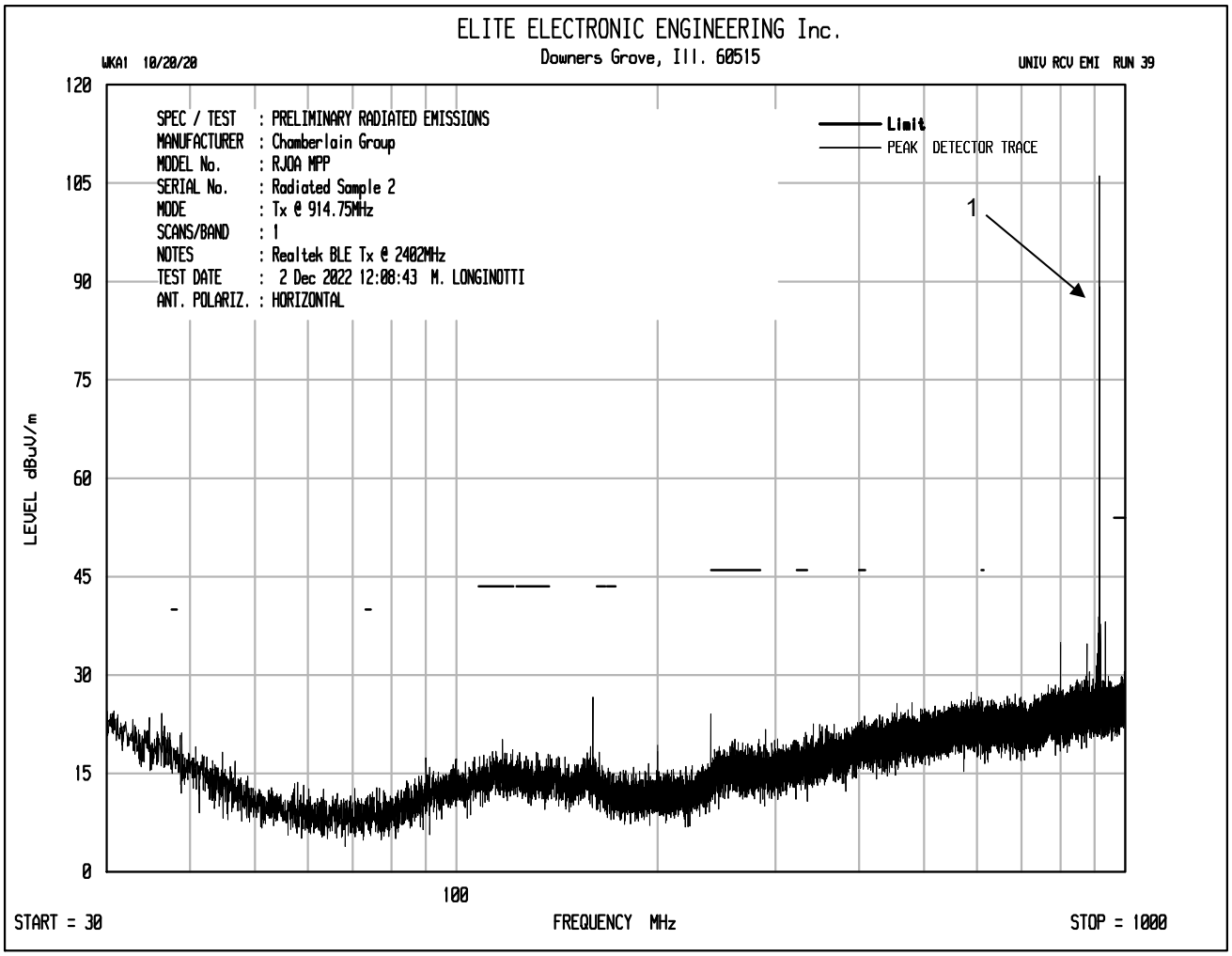
Test Setup for Spurious Emissions: 30MHz to 1GHz, Vertical Polarization



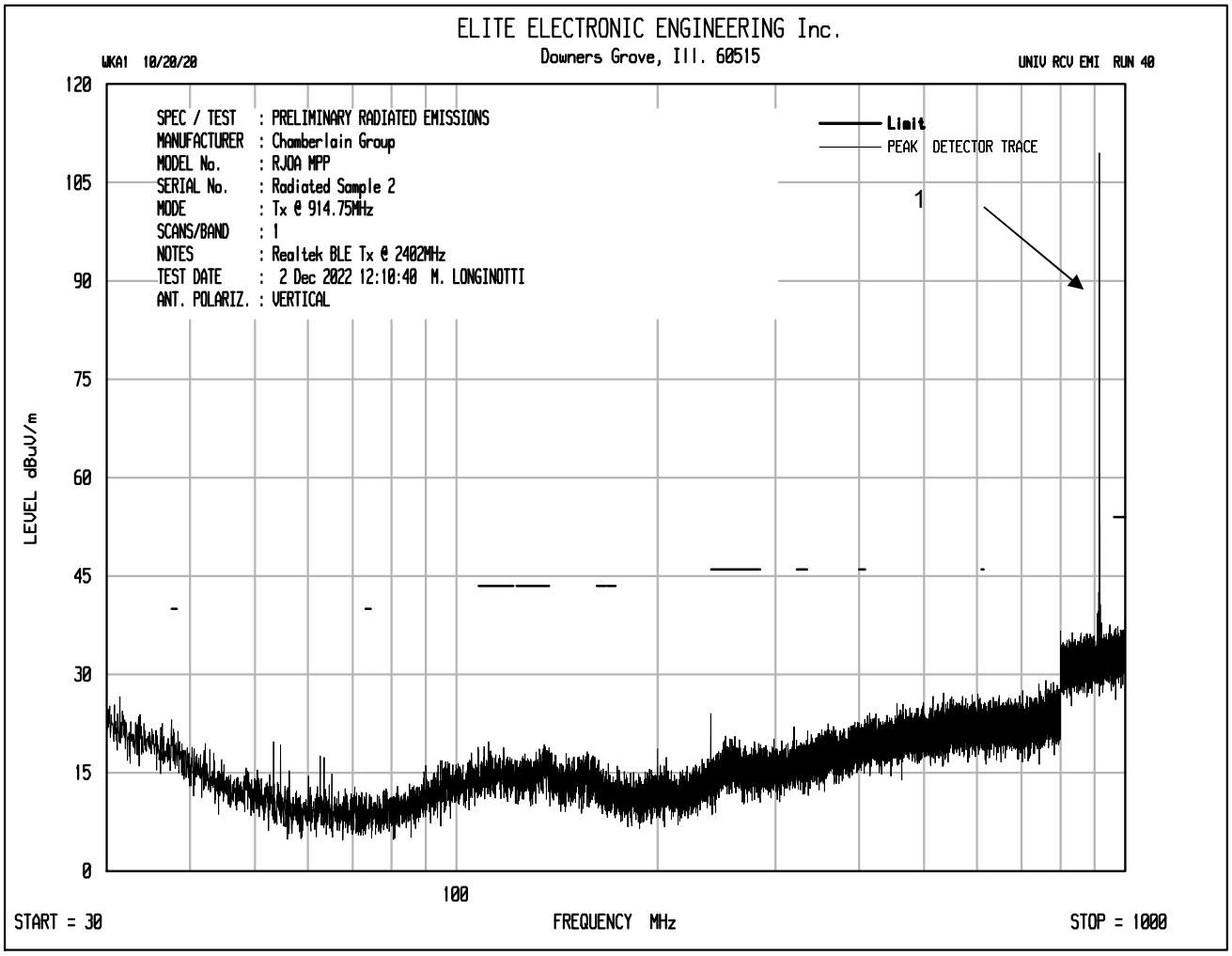
Test Setup for Radiated Emissions: Above 1GHz, Horizontal Polarization



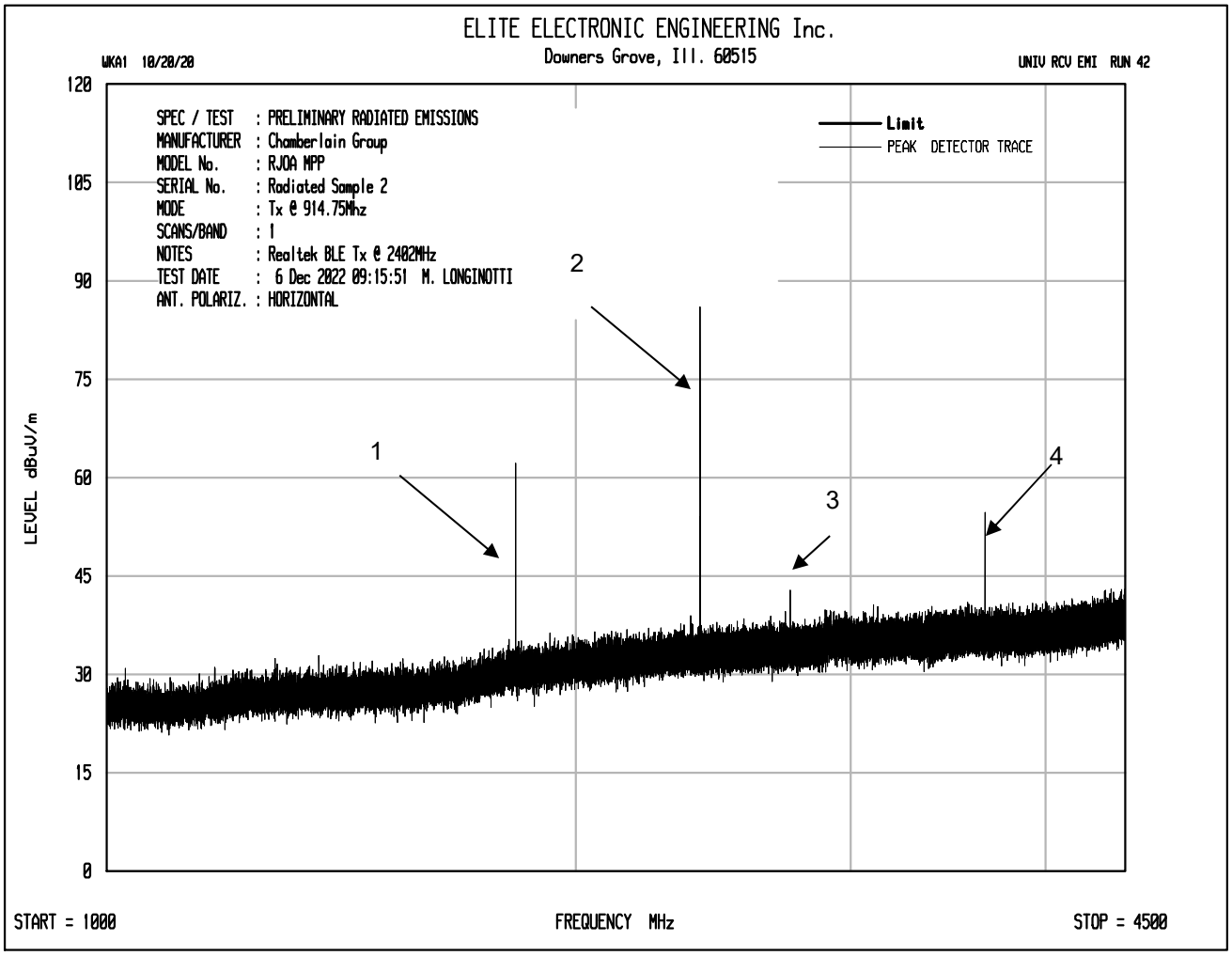
Test Setup for Radiated Emissions: Above 1GHz, Vertical Polarization



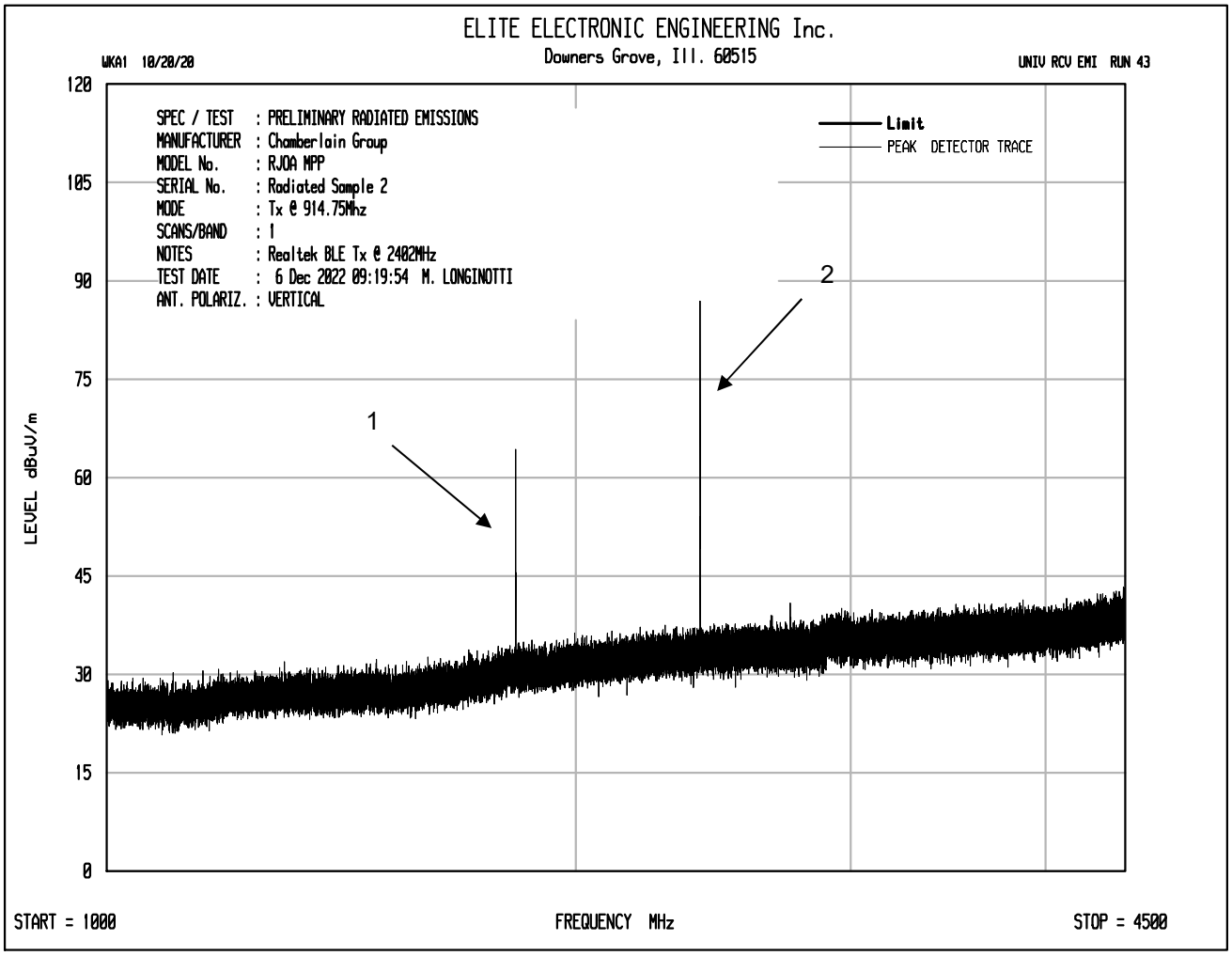
1 – Transmit at 914.75MHz



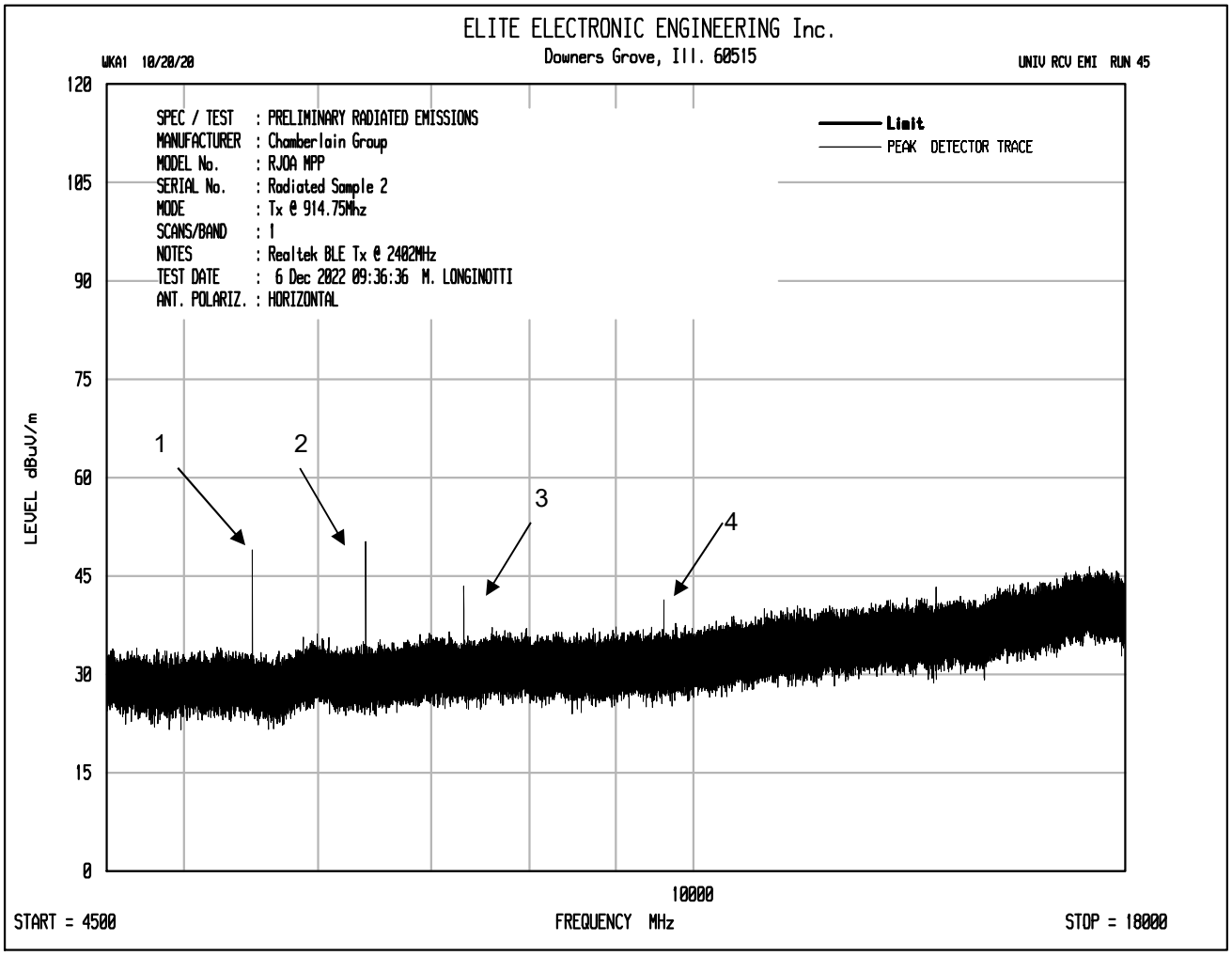
1 – Transmit at 914.75MHz



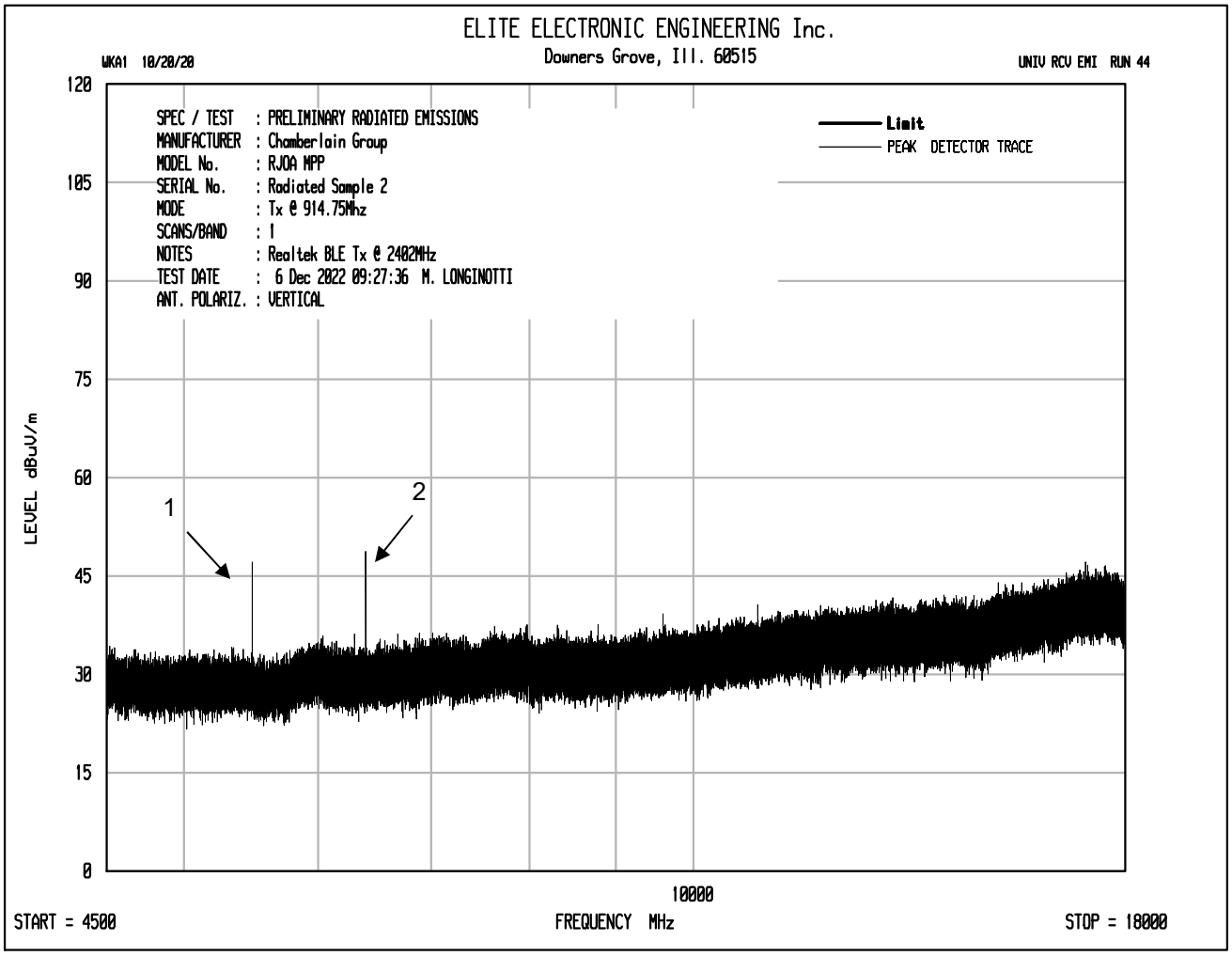
1 – 1829.5MHz (2nd harmonic of 914.75MHz)
2 – Transmit at 2402MHz BLE
3 – 2744.25MHz (3rd harmonic of 914.75MHz)
4 – Transmit at 3659MHz (4th harmonic of 914.75MHz)



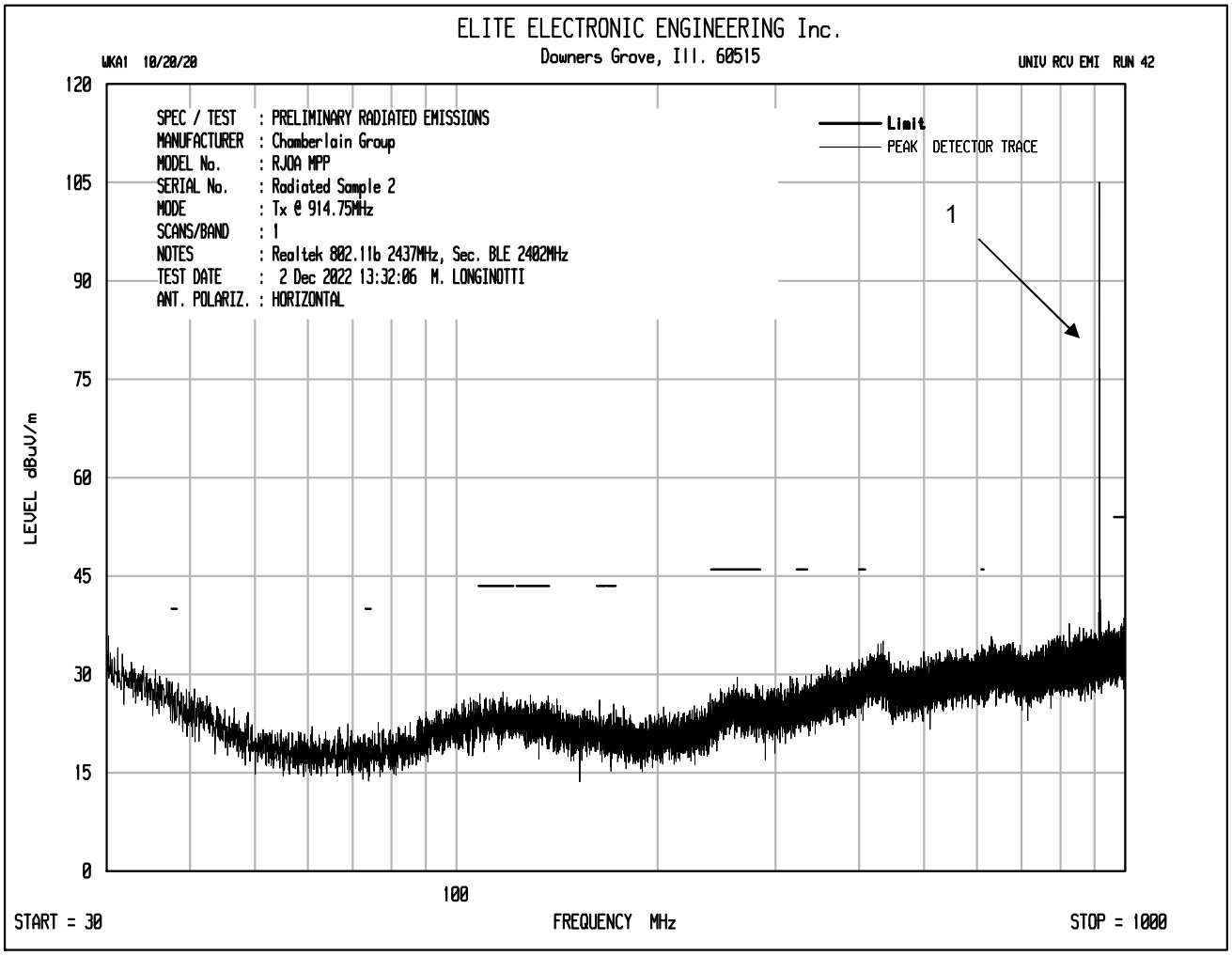
1 – 1829.5MHz (2nd harmonic of 914.75MHz)
2 – Transmit at 2402MHz BLE



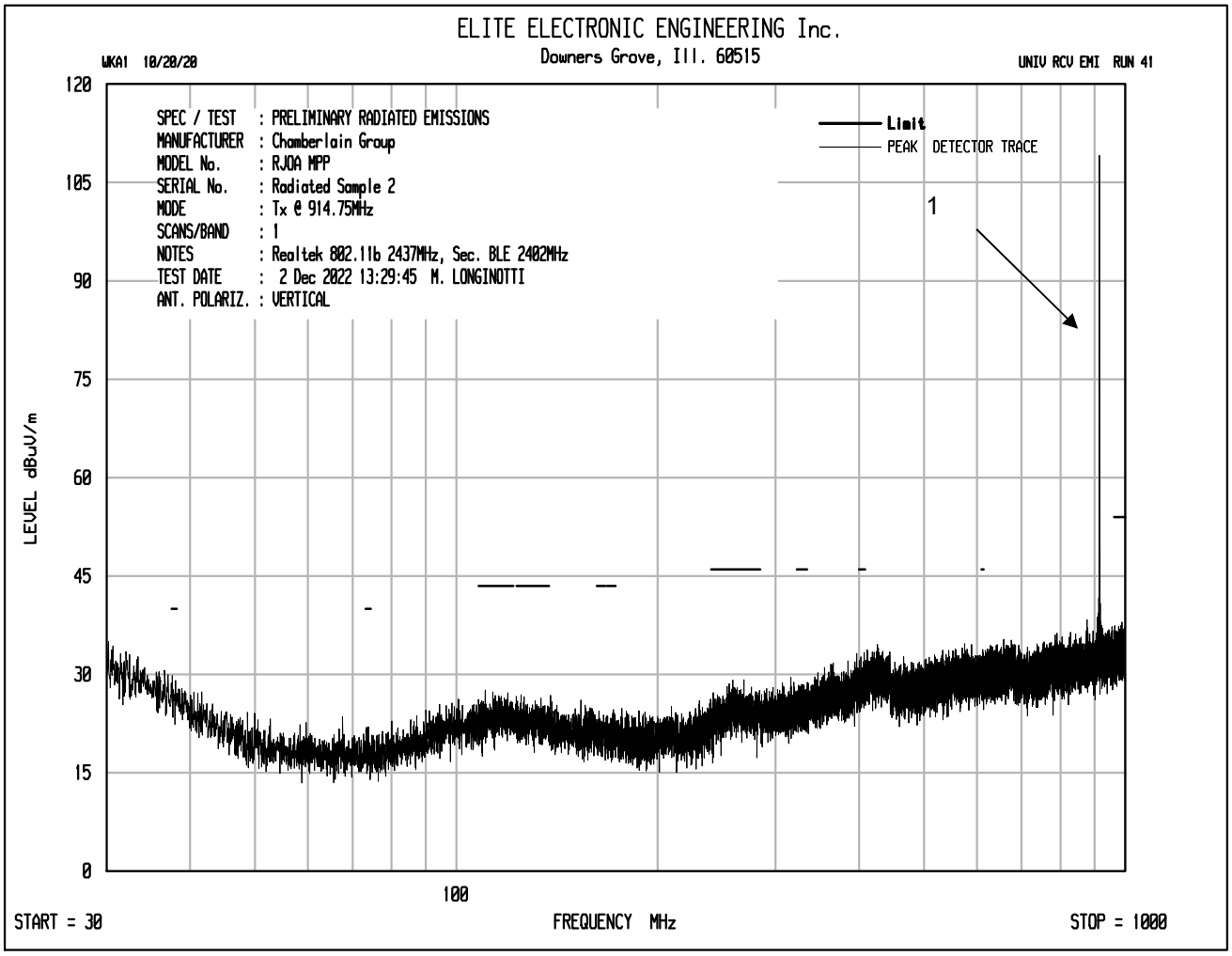
1 – 5488.5MHz (6th harmonic of 914.75MHz)
2 – 6403.25MHz (7th harmonic of 914.75MHz)
3 – 7318MHz (8th harmonic of 914.75MHz)
4 – 9608MHz (4th harmonic of 2402MHz)



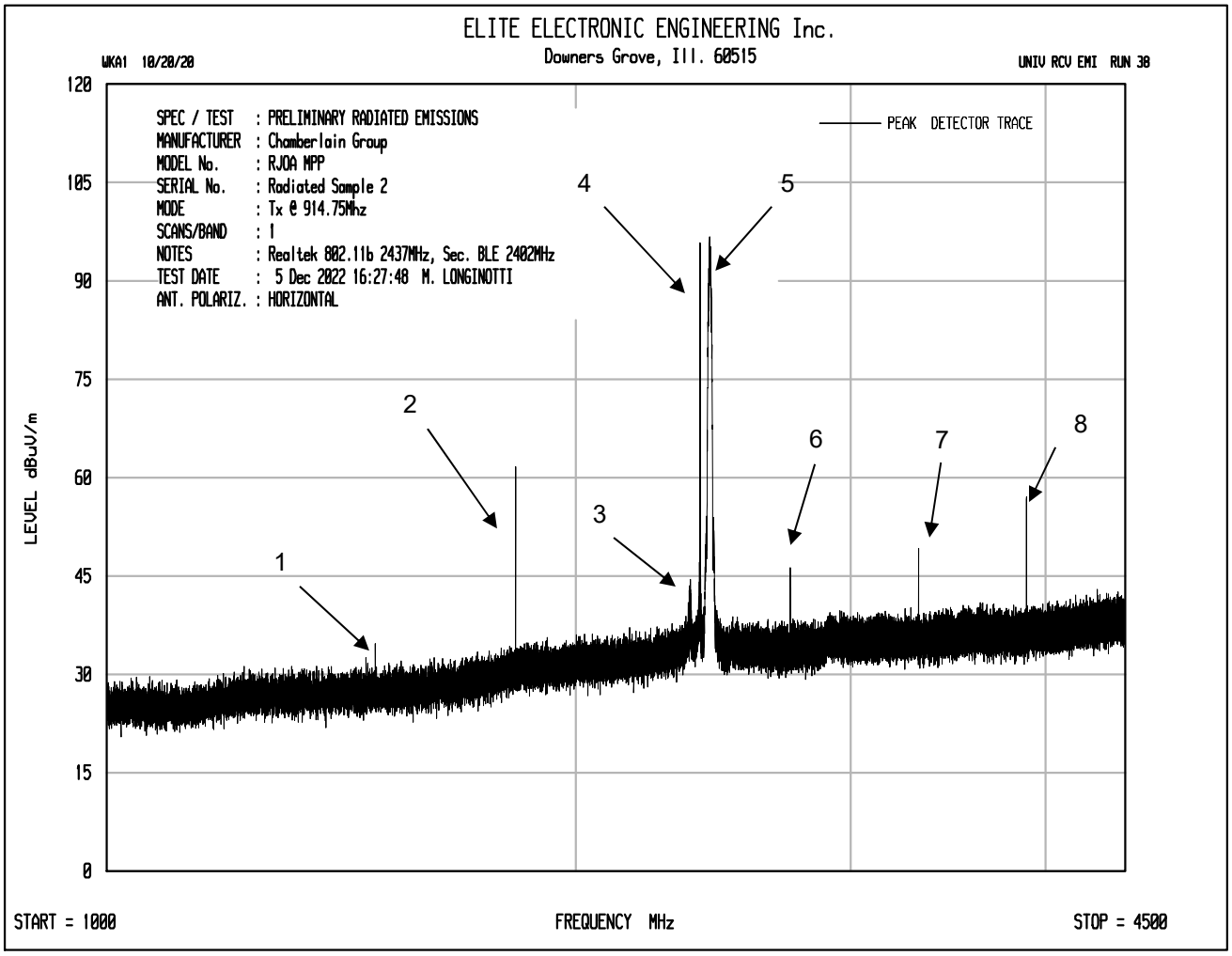
1 – 5488.5MHz (6th harmonic of 914.75MHz)
2 – 6403.25MHz (7th harmonic of 914.75MHz)



1 – Transmit at 914.75MHz

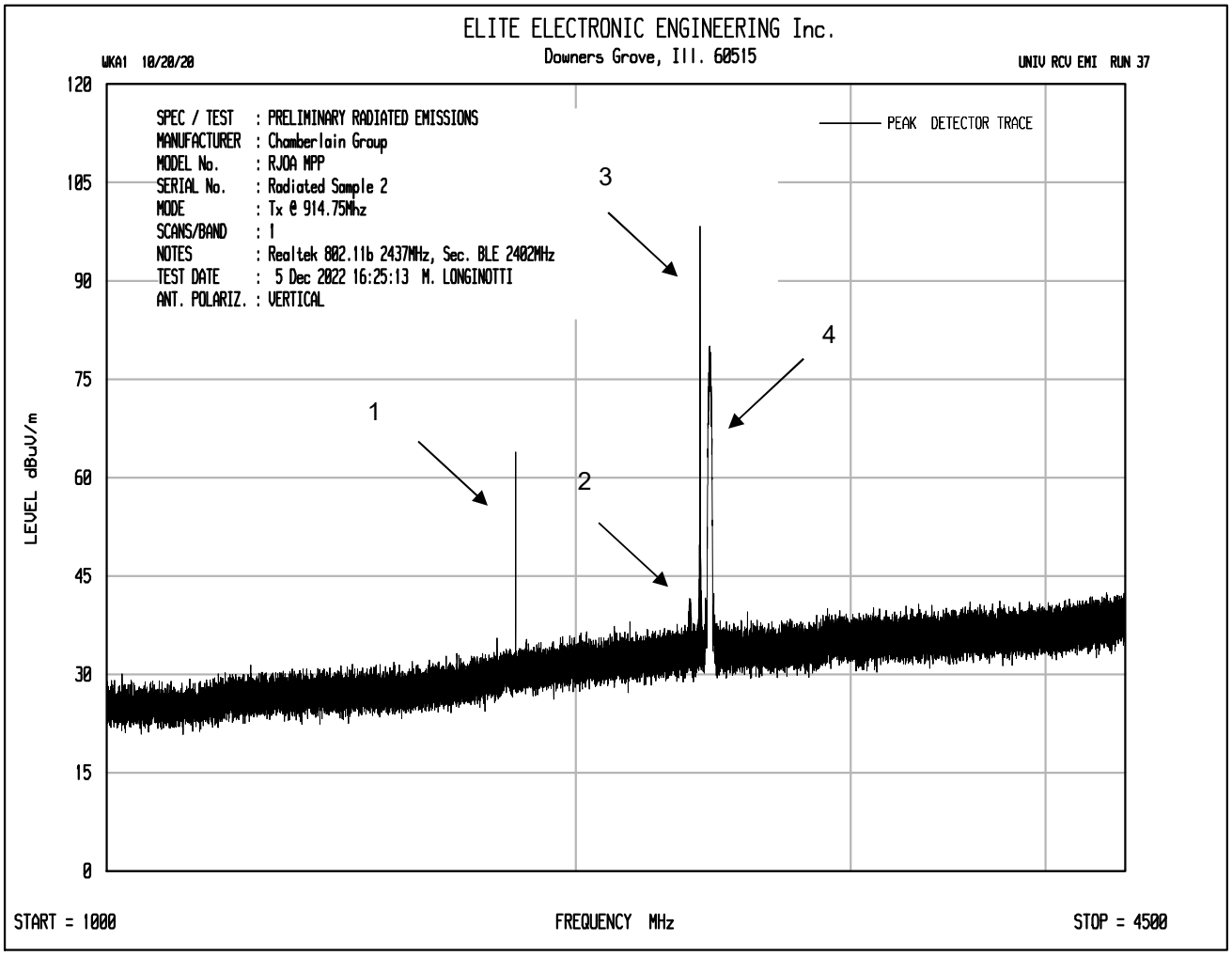


1 – Transmit at 914.75MHz



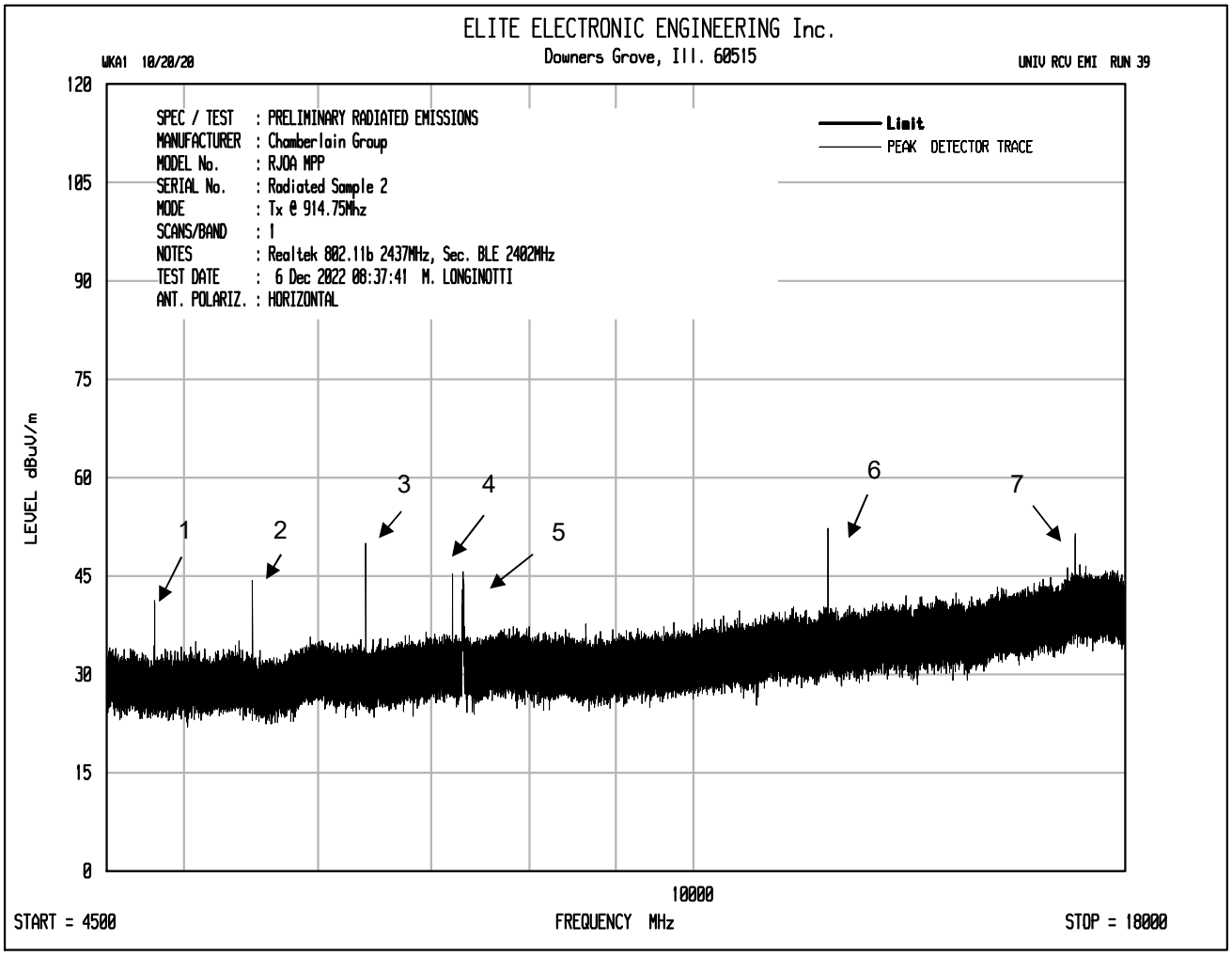
1 – 1487.25MHz (2402MHz – 914.75MHz)
2 – 1829.25MHz (2nd harmonic of 914.75MHz)
3 – 2367MHz (2 x 2402MHz – 2437MHz)
4 – Transmit at 2402MHz
5 – Transmit at 2437MHz
6 – 2744.25MHz (3rd harmonic of 914.75MHz)
7 – 3316.75MHz (914.75MHz + 2402MHz)
8 – 3889.25MHz (2 x 2402MHz – 914.75MHz)

Note: Frequencies in bold above are emissions that occur due to the intermixing of emissions with other transmitters on the EUT.

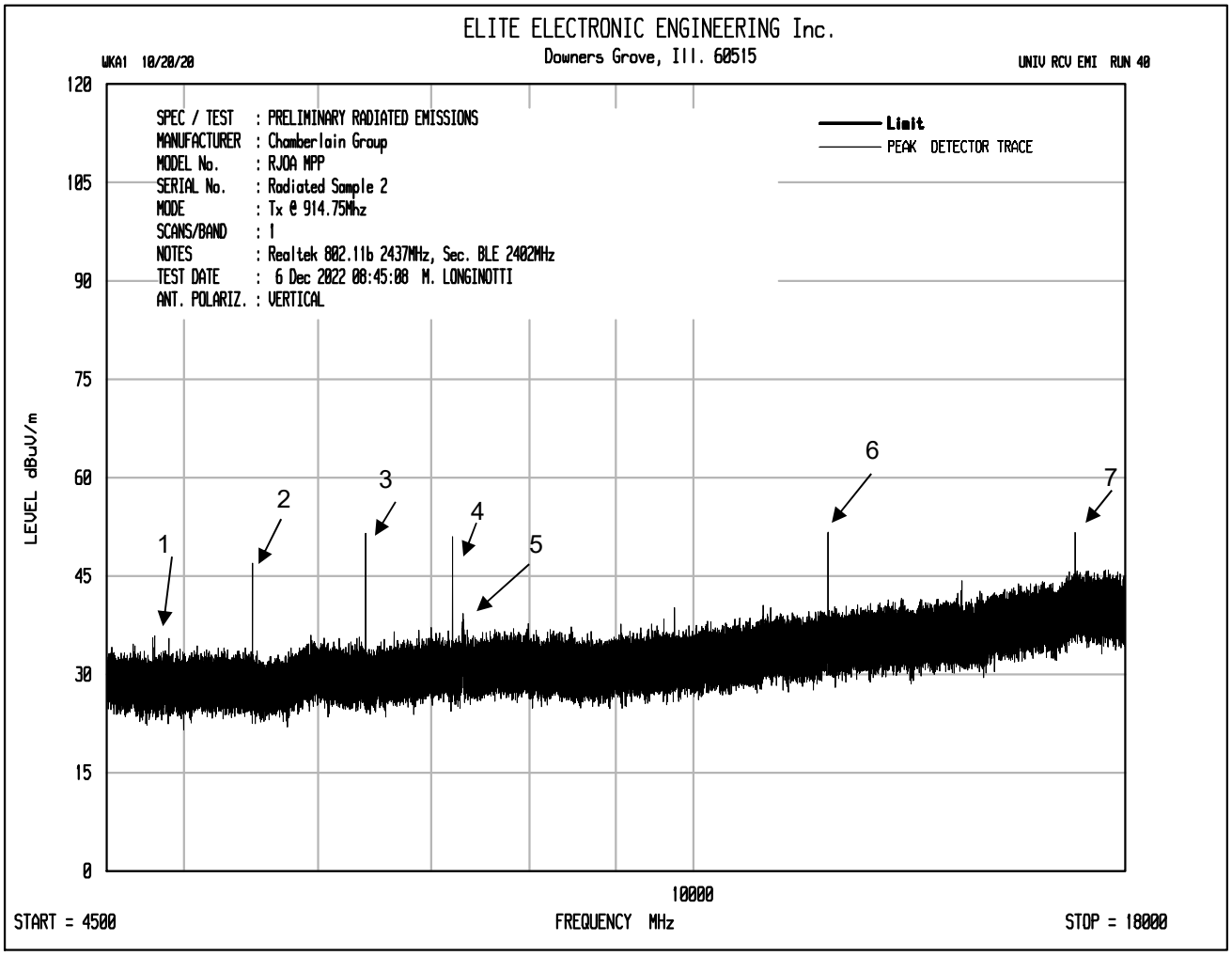


1 – 1829.25MHz (2nd harmonic of 914.75MHz)
2 – 2367MHz (2 x 2402MHz – 2437MHz)
3 – Transmit at 2402MHz
4 – Transmit at 2437MHz

Note: Frequencies in bold above are emissions that occur due to the intermixing of emissions with other transmitters on the EUT.



1 – 4808MHz (2nd harmonic of 2402MHz)
2 – 5488.5MHz (6th harmonic of 914.75MHz)
3 – 6403.25MHz (7th harmonic of 914.75MHz)
4 – 7206MHz (3rd harmonic of 914.75MHz)
5 – 7311MHz (3rd harmonic of 2437MHz)
6 – 12010MHz (5th harmonic of 2402MHz)
7 – 16814MHz (7th harmonic of 2402MHz)



1 – 4808MHz (2nd harmonic of 2402MHz)
2 – 5488.5MHz (6th harmonic of 914.75MHz)
3 – 6403.25MHz (7th harmonic of 914.75MHz)
4 – 7206MHz (3rd harmonic of 914.75MHz)
5 – 7311MHz (3rd harmonic of 2437MHz)
6 – 12010MHz (5th harmonic of 2402MHz)
7 – 16814MHz (7th harmonic of 2402MHz)

Test Details	
Manufacturer	Chamberlain Group, LLC
Model No.	RJOA MPP
Serial No.	Radiated Sample 2
Test	Host Product Testing – Peak Measurements in the Restricted Bands
Mode	Transmit at 914.75MHz, Realtek WiFi Transmit at 2437MHz, 802.11b 11MBPS, Security 3.0 BLE Transmit at 2402MHz
Date Tested	December 6, 2022 and December 7, 2022
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
1487.25	H	18.0		2.0	29.3	0.0	49.3	291.3	5000.0	-24.7
1487.25	V	16.8		2.0	29.3	0.0	48.1	253.7	5000.0	-25.9
2367.00	H	30.4		2.6	32.6	0.0	65.6	1896.4	5000.0	-8.4
2367.00	V	30.3		2.6	32.6	0.0	65.5	1874.7	5000.0	-8.5
3889.25	H	27.0		3.4	34.9	0.0	65.3	1839.1	5000.0	-8.7
3889.25	V	25.7		3.4	34.9	0.0	64.0	1583.5	5000.0	-10.0

Test Details	
Manufacturer	Chamberlain Group, LLC
Model No.	RJOA MPP
Serial No.	Radiated Sample 2
Test	Host Product Testing – Average Measurements in the Restricted Bands
Mode	Transmit at 914.75MHz, Realtek WiFi Transmit at 2437MHz, 802.11b 11MBPS, Security 3.0 BLE Transmit at 2402MHz
Date Tested	December 6, 2022 and December 7, 2022
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
1487.25	H	2.6		2.0	29.3	0.0	0.0	33.9	49.5	500.0	-20.1
1487.25	V	1.9		2.0	29.3	0.0	0.0	33.2	45.6	500.0	-20.8
2367.00	H	17.8		2.6	32.6	0.0	0.0	53.0	444.6	500.0	-1.0
2367.00	V	17.4		2.6	32.6	0.0	0.0	52.6	424.5	500.0	-1.4
3889.25	H	9.7		3.4	34.9	0.0	0.0	48.0	251.0	500.0	-6.0
3889.25	V	8.4		3.4	34.9	0.0	0.0	46.7	216.1	500.0	-7.3

Test Details	
Manufacturer	Chamberlain Group, LLC
Model No.	RJOA MPP
Serial No.	Radiated Sample 2
Test	Host Product Testing – Peak Measurements in the Non-Restricted Bands
Mode	Transmit at 914.75MHz, Realtek WiFi Transmit at 2437MHz, 802.11b 11MBPS, Security 3.0 BLE Transmit at 2402MHz
Date Tested	December 6, 2022 and December 7, 2022
Notes	

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB/m)	Pre Amp (dB)	Peak Total dBuV/m at 3m	Peak Total uV/m at 3 m	Peak Limit uV/m at 3 m	Margin (dB)
914.75	V	110.2		1.6	26.5	0.0	138.3	8187128.7		
3316.75	H	16.8		3.1	33.5	0.0	53.4	466.2	818712.9	-64.9
3316.75	V	10.6		3.1	33.5	0.0	47.2	228.3	818712.9	-71.1

21. Scope of Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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ELECTRICAL

Valid To: June 30, 2023 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; ECE Regulation 10.06 Annex 10
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);

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Test Technology:	Test Method(s) [1]:
Vehicle Radiated Emissions	CISPR 12; CISPR 36; ICES-002; ECE Regulation 10.06 Annex 5
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); ECE Regulation 10.06 Annex 9
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; ECE Regulation 10.06 Annex 9
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; ECE Regulation 10.06 Annex 6
Vehicle Product Specific EMC Standards	EN 14982; EN ISO 13309; ISO 13766; EN 50498; EC Regulation No. 2015/208; EN 55012
Electrical Loads	ISO 16750-2
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; KS C 9811; CNS 13803 (1997, 2003); CISPR 14-1; EN 55014-1; AS/NZS CISPR 14.1; CISPR 16-2-1 (2008); CISPR 16-2-1; KS C 9814-1; 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; KS C 9832; KN 32; ECE Regulation 10.06 Annex 7 (Broadband) ECE Regulation 10.06 Annex 8 (Narrowband) ECE Regulation 10.06 Annex 14 (Conducted)

Test Technology:	Test Method(s) [1]:
Emissions (cont'd)	
Cellular Radiated Spurious Emissions	ETSI TS 151 010-1 GSM; 3GPP TS 51.010-1, Sec 12; ETSI TS 134 124 UMTS; 3GPP TS 34.124; ETSI TS 136 124 LTE; E-UTRA; 3GPP TS 36.124
Current Harmonics	IEC 61000-3-2; EN 61000-3-2; KN 61000-3-2; KS C 9610-3-2; ECE Regulation 10.06 Annex 11
Flicker and Fluctuations	IEC 61000-3-3; EN 61000-3-3; KN 61000-3-3; KS C 9610-3-3; ECE Regulation 10.06 Annex 12
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; KS C 9610-4-2; 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; KS C 9610-4-3; 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; KS C 9610-4-4; ECE Regulation 10.06 Annex 15
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; KS C 9610-4-5; IEEE C37.90.1 2012; IEEE STD C62.41.2 2002; ECE Regulation 10.06 Annex 16

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; KS C 9610-4-6
Power Frequency Magnetic Field Immunity (*Down to 3 A/m*)	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; KS C 9610-4-8
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; KS C 9610-4-11
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; IEEE STD C62.41.2 2002
Generic and Product Specific EMC Standards	IEC/EN 61000-6-1; AS/NZS 61000-6-1; KN 61000-6-1; KS C 9610-6-1; IEC/EN 61000-6-2; AS/NZS 61000-6-2; KN 61000-6-2; KS C 9610-6-2; IEC/EN 61000-6-3; AS/NZS 61000-6-3; KN 61000-6-3; KS C 9610-6-3; IEC/EN 61000-6-4; AS/NZS 61000-6-4; KN 61000-6-4; KS C 9610-6-4; EN 50130-4; EN 61326-1; EN 50121-3-2; EN 12895; EN 50270; EN 50491-1; EN 50491-2; EN 50491-3; EN 55015; EN 60730-1; EN 60945; IEC 60533; EN 61326-2-6; EN 61800-3; IEC/CISPR 14-2; EN 55014-2; AS/NZS CISPR 14.2; KN 14-2; KS C 9814-2; IEC/CISPR 24; AS/NZS CISPR 24; EN 55024; KN 24; IEC/CISPR 35; AS/NZS CISPR 35; EN 55035; KN 35; KS C 9835; 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 301 489-20

Test Technology:	Test Method(s) [1]:
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 300 220-3-1; ETSI EN 300 220-3-2; 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 303 413; ETSI EN 302 502; EN 303 340; EN 303 345-2; EN 303 345-3; EN 303 345-4
Canadian Radio Tests	RSS-102 (RF Exposure Evaluation [MEAS]); RSS-102 (Nerve Stimulation [MEAS]) (5Hz to 400kHz); SPR-002; 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-247; RSS-248; RSS-251; RSS-252; RSS-287; RSS-288; RSS-310; RSS-GEN
Mexico Radio Tests	IFT-008-2015; NOM-208-SCFI-2016
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 (July 15, 2020)
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; KS X 3124; KS X 3125; KS X 3130; KS X 3126; KS X 3129
Vietnam Radio Test Standards	QCVN 47:2015/BTTTT; QCVN 54:2020/BTTTT; QCVN 55:2011/BTTTT; QCVN 65:2013/BTTTT; QCVN 73:2013/BTTTT; QCVN 74:2020/BTTTT; QCVN 112:2017/BTTTT; QCVN 117:2020//BTTTT
Vietnam EMC Test Standards	QCVN 18:2014/BTTTT; QCVN 86:2019/BTTTT; QCVN 96:2015/BTTTT; QCVN 118:2018/BTTTT

Test Technology:	Test Method(s) [1]:
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 (using ANSI/TIA-603-E, TIA-102.CAAA-E, ANSI C63.26:2015)
OTA (Over the Air) Performance GSM, GPRS, EGPRS UMTS (W-CDMA) LTE including CAT M1 A-GPS for UMTS/GSM LTS A-GPS, A-GLONASS, SIB8/SIB16 Large Device/Laptop/Tablet Testing Integrated Device Testing WiFi 802.11 a/b/g/n/a	CTIA Test Plan for Wireless Device Over-the-Air Performance (Method for Measurement for Radiated Power and Receiver Performance) V3.8.2; CTIA Test Plan for RF Performance Evaluation of WiFi Mobile Converged Devices V2.1.0
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, edition, version, etc. is not identified in the scope of accreditation, laboratories may use the version that immediately precedes the current version for a period of one year from the date of publication of the standard measurement method, per part C., Section 1 of A2LA *R101 - General Requirements- Accreditation of ISO-IEC 17025 Laboratories*.

Testing Activities Performed in Support of FCC 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-NII without DFS Intentional Radiators Part 15E	ANSI C63.10:2013	40000
U-NII 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
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

Testing Activities Performed in Support of FCC 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)
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 19th day of May 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1786.01
Valid to June 30, 2023

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