Measurement of RF Interference from a ZB3212F6R4SP2-1 Bluetooth Low Energy Transceiver

For	California Eastern Laboratories 1253 N. Old Rand Road Wauconda, IL 60084
P.O. Number	210814
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Test Personnel	Richard King
Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Digital Modulation Intentional Radiators Operating within the band 2400-2483.5MHz FCC “Code of Federal Regulations” Title 47, Part15, Subpart 15B, Section 15.107 and 15.109 for Receivers Innovation, Science, and Economic Development Canada RSS-247 Innovation, Science, and Economic Development Canada RSS-GEN

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REVISION HISTORY

Revision	Date	Description
—	3 Oct 2017	Initial release
A	4 Oct 2017 By Rick King	- Added Rev A to the report number on the cover and in the header of each page. - Corrected Ch. 37 to Ch. 0 throughout report. - Corrected Ch. 18 to Ch. 19 throughout report. - Page 34 Changed Power Output = 14 to 12.

Measurement of RF Emissions from a
Bluetooth Low Energy Transceiver, Part No. ZB3212F6R4SP2-1

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a California Eastern Laboratories Bluetooth Low Energy Transceiver, Part No. ZB3212F6R4SP2-1 (hereinafter referred to as the EUT). The EUT is a digital modulation transceiver. The transceiver was designed to transmit and receive in the 2400-2483.5 MHz band using a PCB trace antenna with 1.6dBi gain. The EUT was manufactured and submitted for testing by California Eastern Laboratories located in Wauconda, IL.

1.2 Purpose

The test series was performed to determine if the EUT meets the conducted RF emission requirements, radiated RF emissions requirements, and additional provisions of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109, for receivers and Subpart C, Sections 15.207 and 15.249 for Intentional Radiators Operating within the 2400-2483.5 MHz band.

The test series was also performed to determine if the EUT meets the conducted RF emission requirements, radiated RF emissions requirements, and additional provisions of the Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-Gen Section 8.8 and Section 7.1.2 for receivers and Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-Gen Section 8.8 and Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-247 for Transmitters.

Testing was performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

1.3 Deviations, Additions and Exclusions

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

1.4 EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the American Association for Laboratory Accreditation (A2LA), A2LA Lab Code: 1786-01.

1.5 Laboratory Conditions

The temperature at the time of the test was 23.1C° and the relative humidity was 39%.

2. APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subparts B and C, dated 1 October 2016

- ANSI C63.4-2014, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”

- 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 Performing Compliance Measurements On Digital Transmissions Systems (DTS) Operating Under §15.247

April 5, 2017

- Innovation, Science, and Economic Development Canada RSS-247, Issue 2, February 2017, "Spectrum Management and Telecommunications Radio Standards Specification, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs), and License-Exempt Local Area Network (LE-LAN) Devices"

- Innovation, Science, and Economic Development Canada RSS-Gen, Issue 4, November 2014, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements for Compliance of Radio Apparatus"

3. EUT SET-UP AND OPERATION

3.1 General Description

The EUT is a Bluetooth Low Energy Transceiver, Part No. ZB3212F6R4SP2-1. A block diagram of the EUT setup is shown as Figure 1 and Figure 2. A photograph of the EUT is shown as Figure 3.

3.1.1 Power Input

The EUT normally obtains 3.8VDC from a DC power supply.

3.1.2 Peripheral Equipment

The following peripheral equipment was submitted with the EUT:

Item	Description
Laptop computer	HP ProBook Laptop Computer: Running HP SmartRF Studio 7.
Debugger	TI CC Debugger

3.1.3 Interconnect Cables

The following interconnect cables were submitted with the EUT:

Item	Description
USB Cable	Used to connect the HP laptop computer to the TI CC Debugger
Ribbon Cable	Used to connect the TI CC Debugger to the EUT

3.1.4 Grounding

The EUT was not grounded during testing.

3.2 Software

For all tests the EUT had firmware version 2.4 loaded prior to each test.

3.3 Operational Mode

The EUT was energized. The EUT was connected to the laptop computer through a CEL universal EVAL board. The EUT was programmed to continuously transmit separately at each of the following channels:

- Transmit at 2402MHz (Ch. 0), Power Setting = 20 dBm
- Transmit at 2440MHz (Ch. 19), Power Setting = 20 dBm
- Transmit at 2480MHz (Ch. 39), Power Setting = 12 dBm

The CEL universal EVAL board was disconnected from the EUT during radiated testing.

3.4 EUT Modifications

No modifications were required for compliance.

4. TEST FACILITY AND TEST INSTRUMENTATION

4.1 Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

Conducted and radiated emission tests were performed with an EMI receiver utilizing the bandwidths and detectors specified by the FCC.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis with a calibration interval not greater than two years. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4 Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emissions Measurements		
Combined Standard Uncertainty	1.06	-1.06
Expanded Uncertainty (95% confidence)	2.12	-2.12

Radiated Emissions Measurements		
Combined Standard Uncertainty	2.09	-2.09
Expanded Uncertainty (95% confidence)	4.19	-4.19

5. TEST PROCEDURES

5.1 Receiver

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Section 15.101(b), receivers operating above 960MHz are exempt from complying with the technical provisions of part 15.

Per the Innovation, Science, and Economic Development Canada RSS-Gen, Section 5.3, only radiocommunication receivers operating in stand-alone mode within the band 30-960 MHz are subject to Industry Canada requirements, as described above. All other receivers are exempted from any Industry Canada certification, testing, labeling and reporting requirements.

5.2 Transmitter

5.2.1 Powerline Conducted Emissions

5.2.1.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Per 15.207(a) and Industry Canada RSS-Gen section 7.2.4, all radio frequency voltages on the power lines of a transmitter shall be below the values shown below when using a quasi-peak or average detector:

Frequency MHz	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 – 0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5 - 5	56	46
5 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.
Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the EUT is considered to have met both requirements and measurements do not need to be performed using the Average detector.

5.2.1.1 Procedures

The interference on each power lead of the EUT was measured by connecting the measuring equipment to the appropriate meter terminal of the Line Impedance Stabilization Network (LISN). The meter terminal of the LISN not under test was terminated with 50 ohms.

a) The EUT was operated in the transmitting mode.

b) Measurements were first made on the 3.8VDC high line.

c) The frequency range from 150 kHz to 30 MHz was broken up into smaller frequency sub-bands.

d) Conducted emissions measurements were taken on the first frequency sub-band using a peak detector.

e) The data thus obtained was then searched by the computer for the highest levels. Any emissions levels that were within 10dB of the average limit were then measured again using both a quasi-peak detector and an average detector. (If no peak readings were within 10dB of the average limit, quasi-peak and average readings were taken on the highest emissions levels measured during the peak detector scan.)

f) Steps (d) and (e) were repeated for the remainder of the frequency sub-bands until the entire frequency range from 150kHz to 30MHz was investigated. The peak trace was automatically plotted. The plot also shows quasi-peak and average readings that were taken on discrete frequencies. A table showing the quasi-peak and average readings was also generated. This tabular data compares the quasi-peak and average conducted emissions to the applicable conducted emissions limits.

g) Steps (c) through (f) were repeated on the 3.8VDC return line:

5.2.1.2 Results

The plots and tabular data of the peak, quasi-peak, and average conducted voltage levels acquired from each input power line with the EUT operated in the transmitting mode are shown on pages 23 and 26. All power line conducted emissions measured from the EUT were within the specification limits.

Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown as Figure 4.

5.2.2 6dB Bandwidth

5.2.2.1 Requirements

Per 15.247(a)(2),the minimum 6dB bandwidth shall be at least 500kHz for all systems using digital modulation techniques.

5.2.2.2 Procedures

The antenna port of the EUT was connected to the spectrum analyzer through 10dB of attenuation or The EUT was placed on a 1.5 meter high, non-conductive stand and set to transmit. A double ridged waveguide antenna was placed at a test distance of 3 meters from the EUT.

The EUT was allowed to transmit continuously. The transmit channel was set separately to low, middle, and high channels. The resolution bandwidth (RBW) was set to 100kHz, the video bandwidth (VBW) was set to the same as or 3 times greater than the RBW, and the span was set to 3 times the RBW.

The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

5.2.2.3 Results

The plots on pages 27 through 29 show that the minimum 6 dB bandwidth was 780kHz which is greater than minimum allowable 6dB bandwidth requirement of 500kHz for systems using digital modulation techniques. The 99% bandwidth was measured to be 1.313MHz.

5.2.3 Peak Conducted Output Power

5.2.3.1 Requirements

Per section 15.247(b)(3), for systems using digital modulation the maximum peak output conducted power shall not be greater than 1.0W (30dBm).

5.2.3.2 Procedures

The antenna port of the EUT was connected to the spectrum analyzer through 10dB of attenuation. The EUT was set to transmit separately at the low, middle, and high channels. The resolution bandwidth (RBW) was set to greater than the 6dB bandwidth. The 'Max-Hold' function was engaged. The maximum meter reading was recorded. The peak power output was calculated for the low, middle and high channels.

5.2.3.3 Results

The results are presented on pages 30 and 31. The maximum peak conducted output power from the transmitter was 0.077W (18.9dBm) which is below the 1 Watt limit.

5.2.4 Peak EIRP

5.2.4.1 Requirements

Per section 15.247(b)(3), for systems using digital modulation the maximum peak output conducted power shall not be greater than 1.0W (30dBm). Per section 15.247(b)(4), this limit is based on the use of antennas with directional gains that do not exceed 6dBi. Since the limit allows for a 6dBi antenna gain, the maximum EIRP can be increased by 6dB to 4 Watt (36dBm).

5.2.4.2 Procedures

The EUT was placed on a 1.5 meter high, non-conductive stand and set to transmit. A double ridged waveguide antenna was placed at a test distance of 3 meters from the EUT. The resolution bandwidth (RBW) of the

spectrum analyzer was set to greater than the 6dB bandwidth. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle and high channels.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a double ridged waveguide antenna was then set in place of the EUT and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss (and antenna gain for all measurements above 1GHz), as required. The peak power output was calculated for low, middle, and high hopping frequencies.

5.2.4.3 Results

The results are presented on pages 32 and 34. The maximum EIRP measured from the transmitter was 21.3dBm or 0.13 W which is below the 4 Watt limit.

5.2.5 Radiated Spurious Emissions Measurements

5.2.5.1 Requirements

Per section 15.247(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 20 dB 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Paragraph 15.209(a) has the following radiated emission limits:

Frequency MHz	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

5.2.5.2 Procedures

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 emission tests were then manually performed over the frequency range of 30MHz to 25GHz.

1) For all harmonics not in the restricted bands, the following procedure was used:

a) 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 stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

b) 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. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

c) 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:

   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.

   iv) 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.

d) All harmonics not in the restricted bands must be at least 20 dB below levels measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.

2) For all emissions in the restricted bands, the following procedure was used:

a) 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 80cm high non-conductive stand. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

b) 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 stand. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.

c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:

   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.

   iv) 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.

d) For all radiated emissions measurements below 1 GHz, 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.

e) For all radiated emissions measurements above 1 GHz, 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 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).

f) 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.

5.2.5.3 Results

Preliminary radiated emissions plots with the EUT transmitting at 2402MHz, 2440MHz, and 2480MHz are shown on pages 35 through 58. Final radiated emissions data are presented on data pages 59 through 67. As can be seen from the data, all emissions measured from the EUT were within the specification limits. See data pages 59 through 67 for details.

Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown as Figures 5 through 7.

5.2.6 Band Edge Compliance

5.2.6.1 Requirements

Per section 15.247(d), the emissions at the band-edges must be at least 20dB below the highest level measured within the band but attenuation below the general limits listed in 15.209(a) is not required. In addition, the radiated emissions which fall in the restricted band beginning at 2483.5 MHz must meet the general limits of 15.209(a).

5.2.6.2 Procedures

5.2.6.2.1 Low Band Edge

1) The antenna port of the EUT was connected to the spectrum analyzer through 10dB of attenuation.
2) The EUT was set to transmit continuously at the channel closest to the low band-edge.
3) To determine the band edge compliance, the following spectrum analyzer settings were used:
    a. Center frequency = low band-edge frequency.
    b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
    c. Resolution bandwidth (RBW) = 100kHz, Video bandwidth (VBW) = 300kHz.
    d. The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
    e. The marker was set on the peak of the in-band emissions. A display line was placed 20dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20dB down display line. (All emissions to the left of the center frequency (band-edge) must be below the display line.)
    f. The analyzer's display was plotted using a 'screen dump' utility.

5.2.6.2.2 High Band Edge

1) The EUT was set to transmit continuously at the channel closest to the high band-edge.
2) A double ridged waveguide was placed 3 meters away from the EUT. The antenna was connected to the input of a spectrum analyzer.
3) The center frequency of the analyzer was set to the high band edge (2483.5MHz)
4) The resolution bandwidth was set to 1MHz.
5) To ensure that the maximum or worst case emission level was measured, the following steps were taken:

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 from 1 to 4 meters for each antenna polarization to maximize the readings.

6) The highest measured peak reading was recorded.
7) The highest measured average reading was recorded.

5.2.6.3 Results

Page 68 shows the low band-edge antenna port conducted emissions compliance results. Pages 69 through 70 show the radiated band-edge compliance results. As can be seen from these plots, the emissions at the low end band-edge are within the 20 dB down limits. The radiated emissions at the high end band-edge are within the general limits.

5.2.7 Power Spectral Density

5.2.7.1 Requirement

Per section 15.247(e), the peak power spectral density from the intentional radiator shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2.7.2 Procedures

1) The antenna port of the EUT was connected to the spectrum analyzer through a 10dB pad.
2) The EUT was set to transmit continuously at the lowest channel.
3) To determine the power spectral density, the following spectrum analyzer settings were used:
    a. Center frequency = transmit frequency
    b. Span = 1.5 times the DTS (6 dB) bandwidth
    c. Resolution bandwidth (RBW): 3kHz ≤ RBW ≤ 100kHz
    d. Sweep time = auto
    e. The peak detector and 'Max-Hold' function was engaged.
    f. The display line represents the 8 dBm limit
    g. The analyzer's display was plotted using a 'screen dump' utility.

4) If measured value exceeds limit, reduce RBW (no less than 3kHz) and repeat.
5) Steps 1) through 4) were repeated separately for the mid channel and the high channel.
6) The EUT was placed on the non-conductive stand and set to transmit at the mid channel.
7) At the high channel, a broadband measuring antenna was placed near the EUT.
8) To determine the power spectral density, the following spectrum analyzer settings were used:
    a. Center frequency = transmit frequency
    b. Resolution bandwidth (RBW) greater than the 20dB bandwidth.
    c. Sweep time = auto
    d. The peak detector and 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
    e. The analyzer's display was plotted using a 'screen dump' utility.
9) This reading corresponds to the peak EIRP measured for the mid channel.
10) Turn on Display Line 1 and place it at the peak of the measured level. Turn on Display Line 2 and place it at the corresponding +8dBm level (e.g. if the peak output power is +18dBm then the +8dBm level will be 10dB down from the radiated level and if the peak output power is +6dBm then the +8dBm level will be 2dB above the radiated level.)
11) To determine the power spectral density, the following spectrum analyzer settings were used:
    a. Center frequency = transmit frequency
    b. Span =1.5times the channel bandwidth
    c. Resolution bandwidth (RBW) ≥3kHz
    d. Video bandwidth (VBW) ≥ 3 x RBW

e. Sweep time = auto couple
f. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The peak detector and 'Max-Hold' function was engaged.

12) The analyzer's display was plotted using a 'screen dump' utility.

5.2.7.3 Results

Pages 71 through 73 show the power spectral density results. As can be seen from these plots, the peak power spectral density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

6. CONCLUSIONS

It was determined that the California Eastern Laboratories Bluetooth Low Energy Transceiver, Part No. ZB3212F6R4SP2-1, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109 for receivers and Subpart C, Sections 15.207 and 15.247 for Intentional Radiators Operating within the 2400-2483.5 MHz band, when tested per ANSI C63.4-2014 and ANSI C63.10-2013.

It was also determined that the California Eastern Laboratories Bluetooth Low Energy Transceiver, Part No. ZB3212F6R4SP2-1, did fully meet the conducted and radiated RF emission requirements of the Innovation, Science, and Economic Development Canada Radio Standards Specification, RSS-Gen, Section 8.8 and Section 7.1.2 for receivers and the Innovation, Science, and Economic Development Canada Radio Standards Specification RSS-Gen Section 8.8 and Radio Standards Specification RSS-247 for transmitters, when tested per ANSI C63.4-2014 and ANSI C63.10-2013.

7. 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 test specifications.

The data presented in this test report pertains to the EUT at the test date. Any electrical or mechanical modification made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

8. ENDORSEMENT DISCLAIMER

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

9. EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW0	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-30-20G20R6G	PL2926/0646	20GHZ-26.5GHZ	3/22/2017	3/22/2018
APW11	PREAMPLIFIER	PMI	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	3/22/2017	3/22/2018
GSFA	OSP-B157 OSP MODULE	ROHDE & SCHWARZ	OSP-B157	100867		9/9/2016	10/9/2017
GSFB	OSP120 BASE UNIT	ROHDE & SCHWARZ	OSP120	101246	---	9/9/2016	10/9/2017
NHG1	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	8/18/2017	8/18/2018
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/18/2016	5/18/2018
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/4/2016	4/4/2018
PLF1	CISPR16 50UH LISN	ELITE	CISPR16/70A	001	.15-30MHz	5/8/2017	5/8/2018
PLF3	CISPR16 50UH LISN	ELITE	CISPER16/70A	003	.15-30MHz	5/8/2017	5/8/2018
RBG0	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101533	10HZ-44GHZ	11/10/2016	11/10/2017
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	1/11/2017	1/11/2018
T1EA	10DB 25W ATTENUATOR	WEINSCHEL	46-10-34	BN2316	DC-18GHZ	1/6/2016	1/6/2018
XLJR	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	---	DC-2GHZ	7/7/2016	7/7/2018
XOB2	ADAPTER	HEWLETT PACKARD	K281C,012	09407	18-26.5GHZ	NOTE 1	
XPR0	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000	001	4.8-20GHZ	9/12/2017	9/12/2019

I/O: Initial Only N/A: Not Applicable
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.

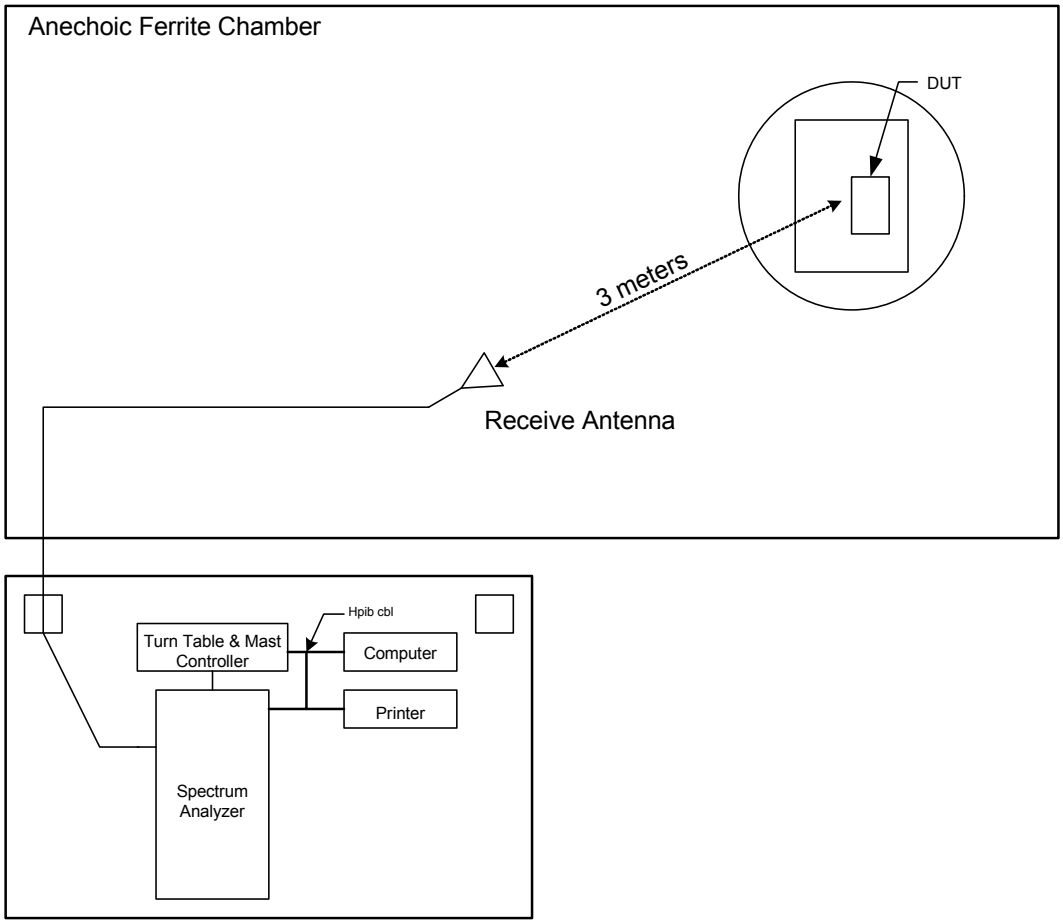


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

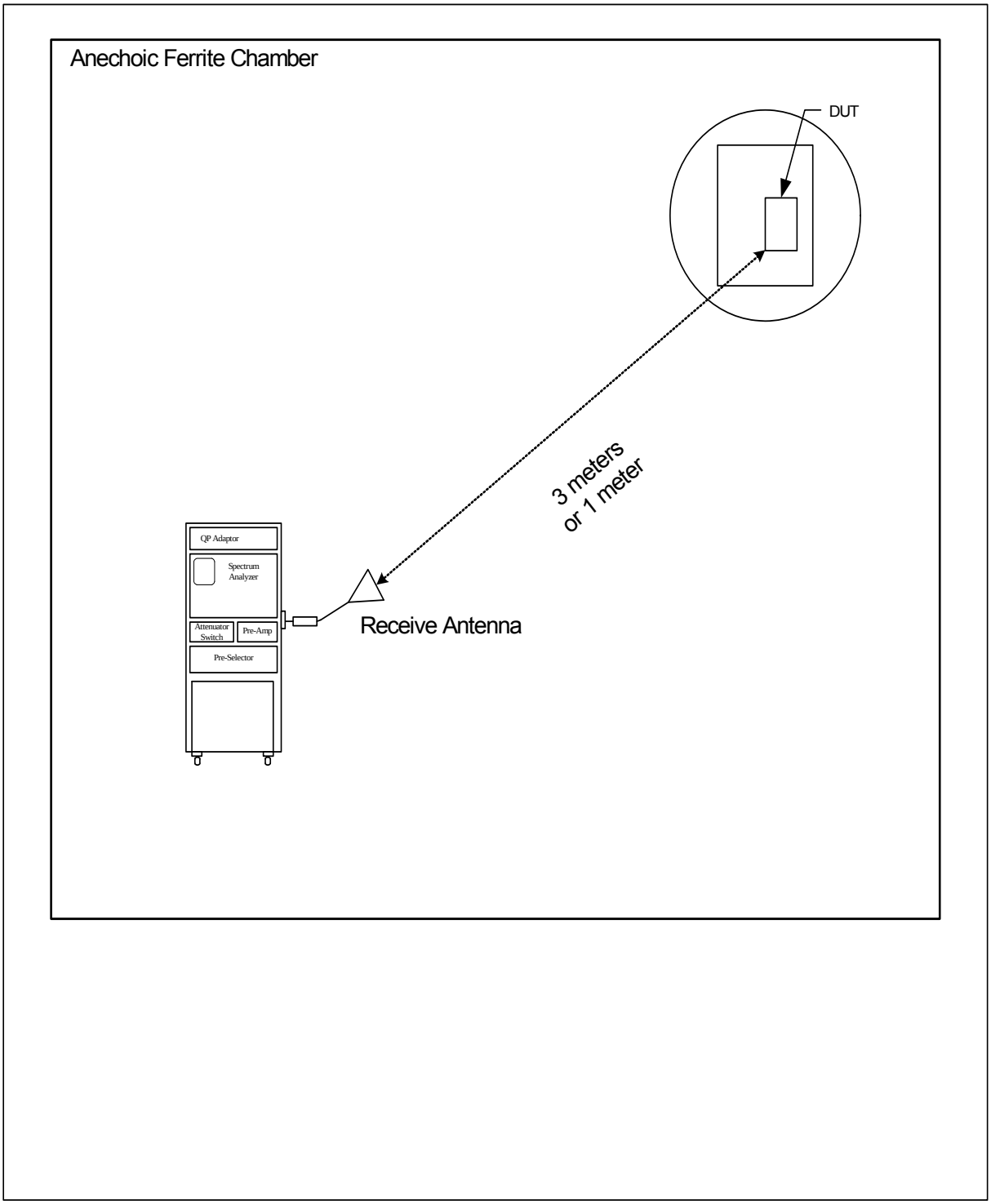
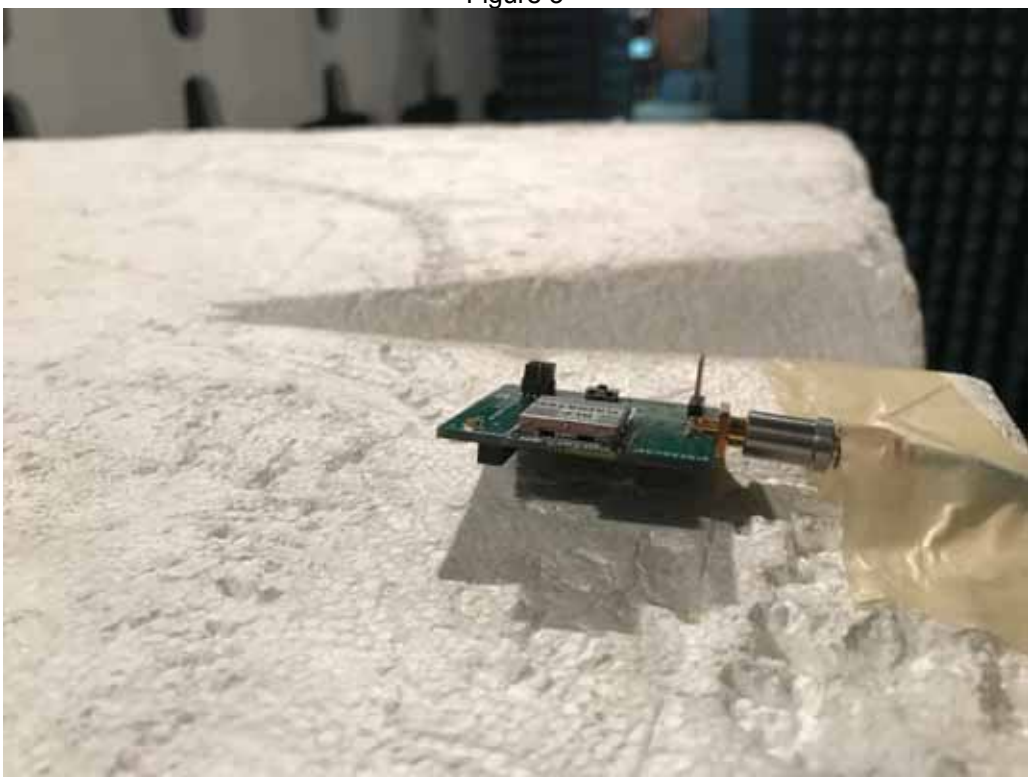


Figure 2: BLOCK DIAGRAM OF TEST SETUP FOR RADIATED EMISSIONS ABOVE 18GHZ

Figure 3



Photograph of EUT

Figure 4

Photograph of the Conducted Emissions Setup

Figure 5

Test Setup for Radiated Emissions – 30MHz to 1GHz, Horizontal Polarization

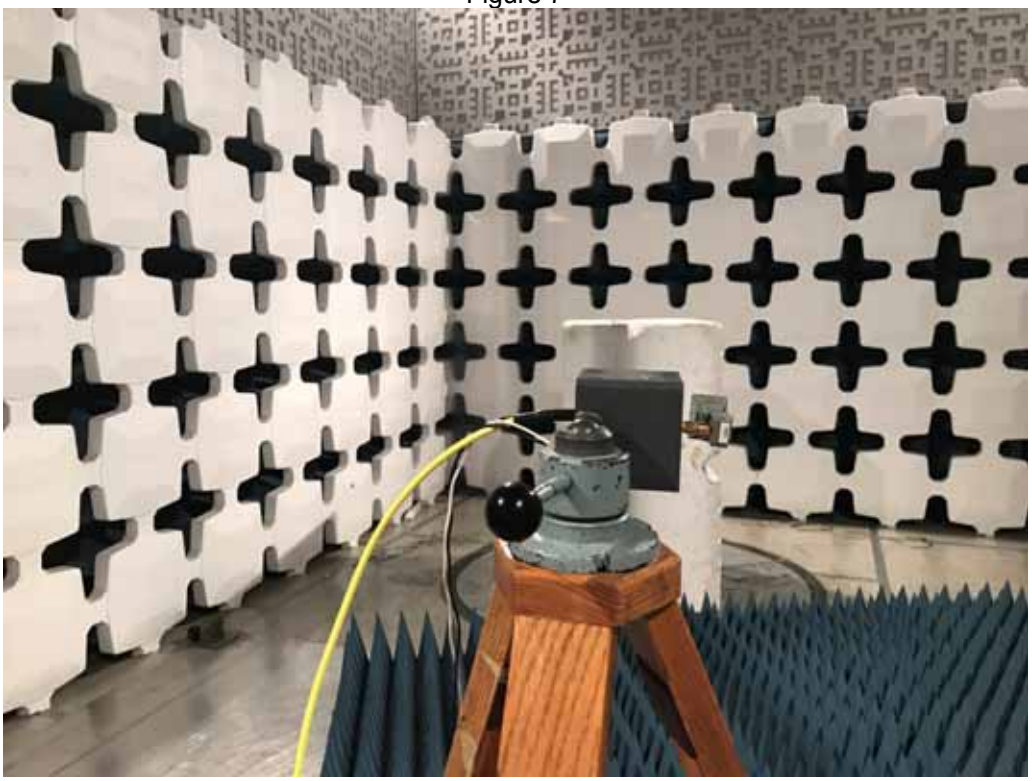
Test Setup for Radiated Emissions – 30MHz to 1GHz, Vertical Polarization

Figure 6

Test Setup for Radiated Emissions – 1GHz to 18GHz, Horizontal Polarization

Test Setup for Radiated Emissions – 1GHz to 18GHz, Vertical Polarization

Figure 7



Test Setup for Radiated Emissions – 18GHz to 25GHz, Horizontal Polarization

Test Setup for Radiated Emissions – 18GHz to 25GHz, Vertical Polarization

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 04/23/2015

Manufacturer	:	CALIFORNIA EASTERN LABS
Model	:	ZB3212F6R4SP2-1
DUT Revision	:	BLE
Serial Number	:	121
DUT Mode	:	Tx @ MID CHANNEL
Line Tested	:	L1
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	BLE
Test Engineer	:	R. King
Limit	:	Class B
Test Date	:	Sep 22, 2017 03:46:47 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

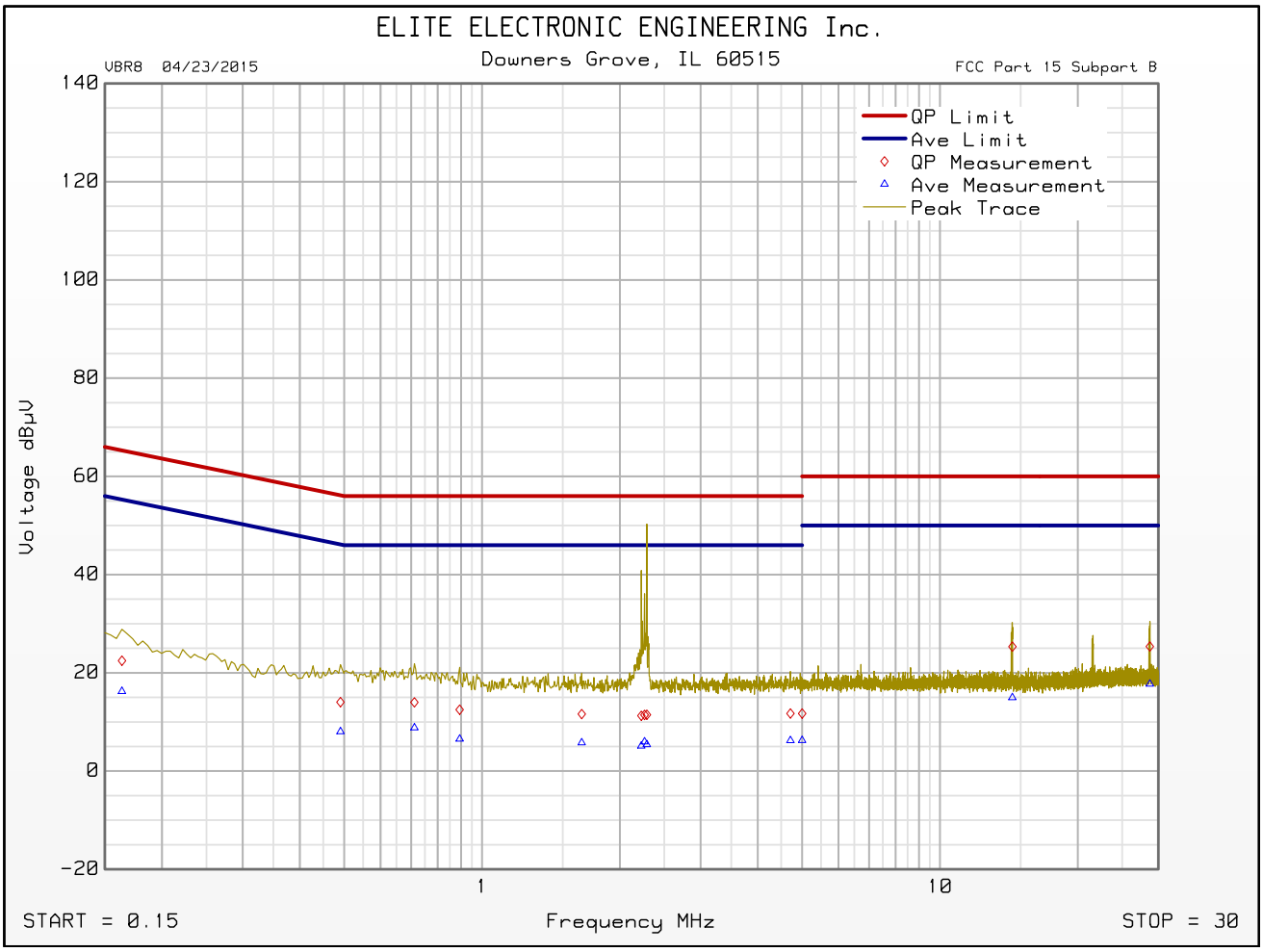
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.164	22.5	65.3		16.2	55.3	
0.491	14.0	56.2		8.0	46.2	
0.712	14.0	56.0		8.8	46.0	
0.894	12.5	56.0		6.5	46.0	
1.651	11.6	56.0		5.8	46.0	
2.291	11.5	56.0		5.4	46.0	
4.715	11.7	56.0		6.2	46.0	
5.000	11.7	56.0		6.2	46.0	
14.391	25.3	60.0		15.0	50.0	
28.729	25.4	60.0		17.7	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VBR8 04/23/2015

Manufacturer	:	CALIFORNIA EASTERN LABS
Model	:	ZB3212F6R4SP2-1
DUT Revision	:	BLE
Serial Number	:	121
DUT Mode	:	Tx @ MID CHANNEL
Line Tested	:	L1
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	BLE
Test Engineer	:	R. King
Limit	:	Class B
Test Date	:	Sep 22, 2017 03:46:47 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VBR8 04/23/2015

Manufacturer	:	CALIFORNIA EASTERN LABS
Model	:	ZB3212F6R4SP2-1
DUT Revision	:	BLE
Serial Number	:	121
DUT Mode	:	Tx @ MID CHANNEL
Line Tested	:	L2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	BLE
Test Engineer	:	R. King
Limit	:	Class B
Test Date	:	Sep 22, 2017 03:53:39 PM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 10 dB margin below limit

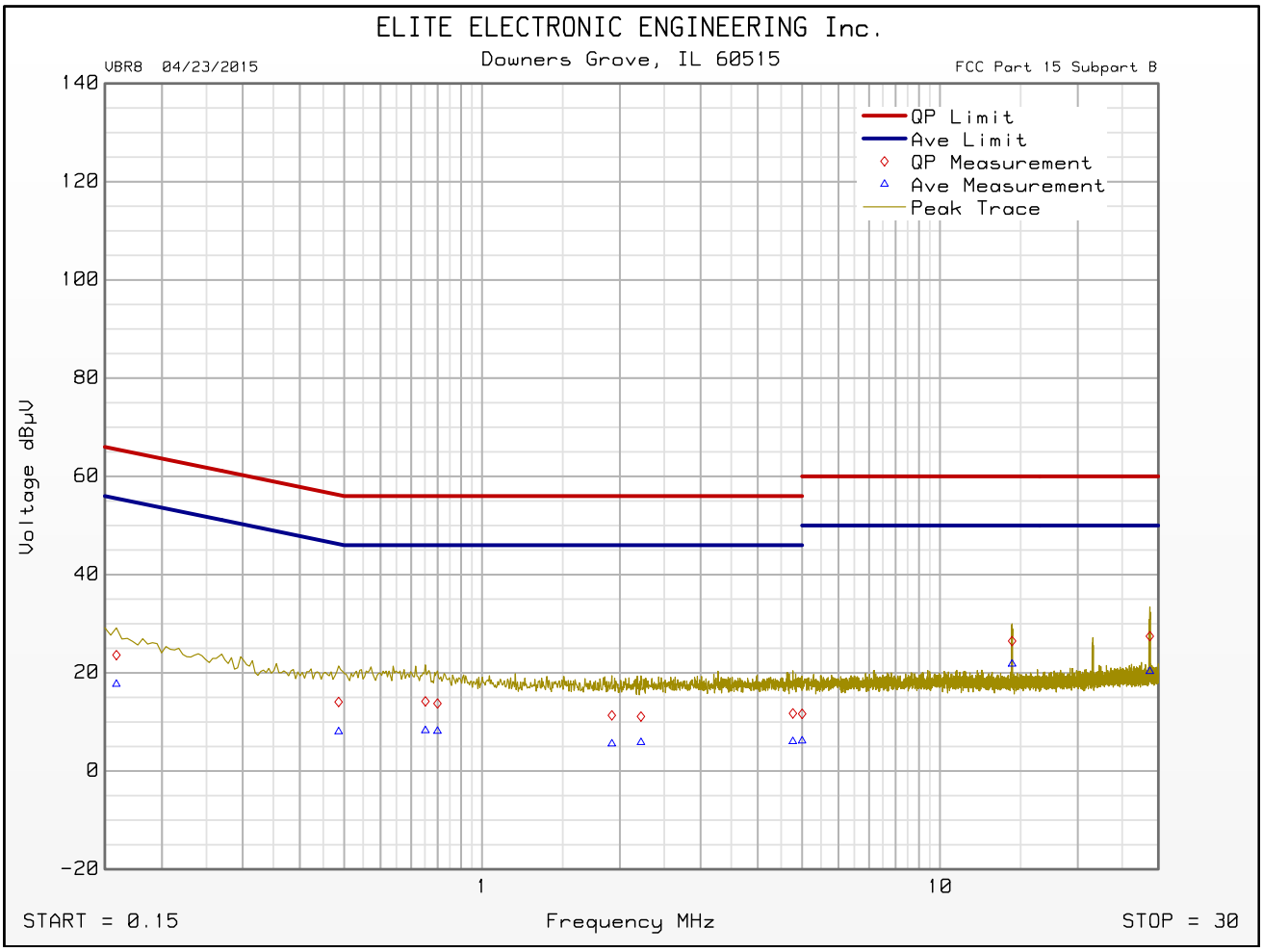
Freq MHz	Quasi-peak Level dBµV	Quasi-peak Limit dBµV	Excessive Quasi-peak Emissions	Average Level dBµV	Average Limit dBµV	Excessive Average Emissions
0.159	23.6	65.5		17.7	55.5	
0.486	14.1	56.2		8.0	46.2	
0.752	14.2	56.0		8.3	46.0	
0.799	13.8	56.0		8.1	46.0	
1.921	11.3	56.0		5.5	46.0	
2.223	11.1	56.0		5.8	46.0	
4.774	11.7	56.0		6.0	46.0	
5.000	11.6	56.0		6.2	46.0	
14.373	26.5	60.0		21.8	50.0	
28.729	27.5	60.0		20.3	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

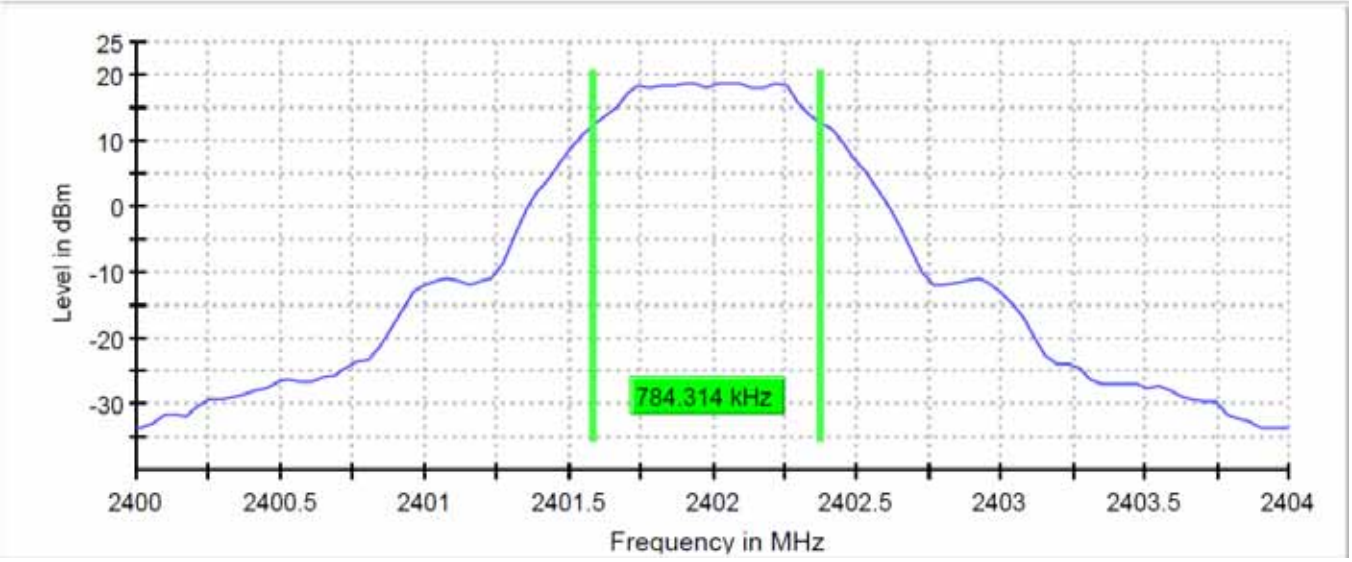
Cumulative Data

VBR8 04/23/2015

Manufacturer	:	CALIFORNIA EASTERN LABS
Model	:	ZB3212F6R4SP2-1
DUT Revision	:	BLE
Serial Number	:	121
DUT Mode	:	Tx @ MID CHANNEL
Line Tested	:	L2
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-10
Notes	:	BLE
Test Engineer	:	R. King
Limit	:	Class B
Test Date	:	Sep 22, 2017 03:53:39 PM



Emissions Meet QP Limit
Emissions Meet Ave Limit

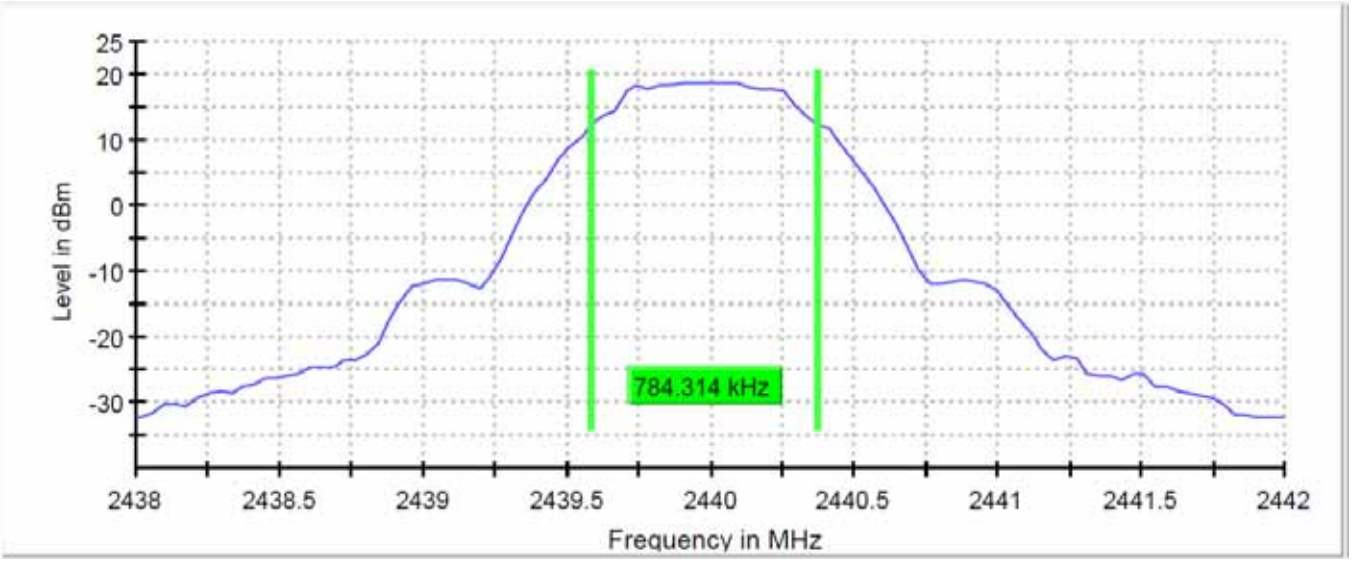


6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2402.000000	0.784314	0.500000	---	2401.588235	2402.372549	18.8	PASS

FCC 15.247 6dB Bandwidth

MANUFACTURER : California Eastern Laboratories
MODEL NUMBER : ZB3212F6R4SP2-1
SERIAL NUMBER : 121
TEST MODE : Transmit at 2402MHz (Ch. 0), Power Setting = 20dBm
TEST DATE : September 11, 2017
NOTES : 6dB bandwidth = 784.3kHz
EQUIPMENT USED : GSFA, GSFB, RBG0



6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2440.000000	0.784314	0.500000	---	2439.588235	2440.372549	18.7	PASS

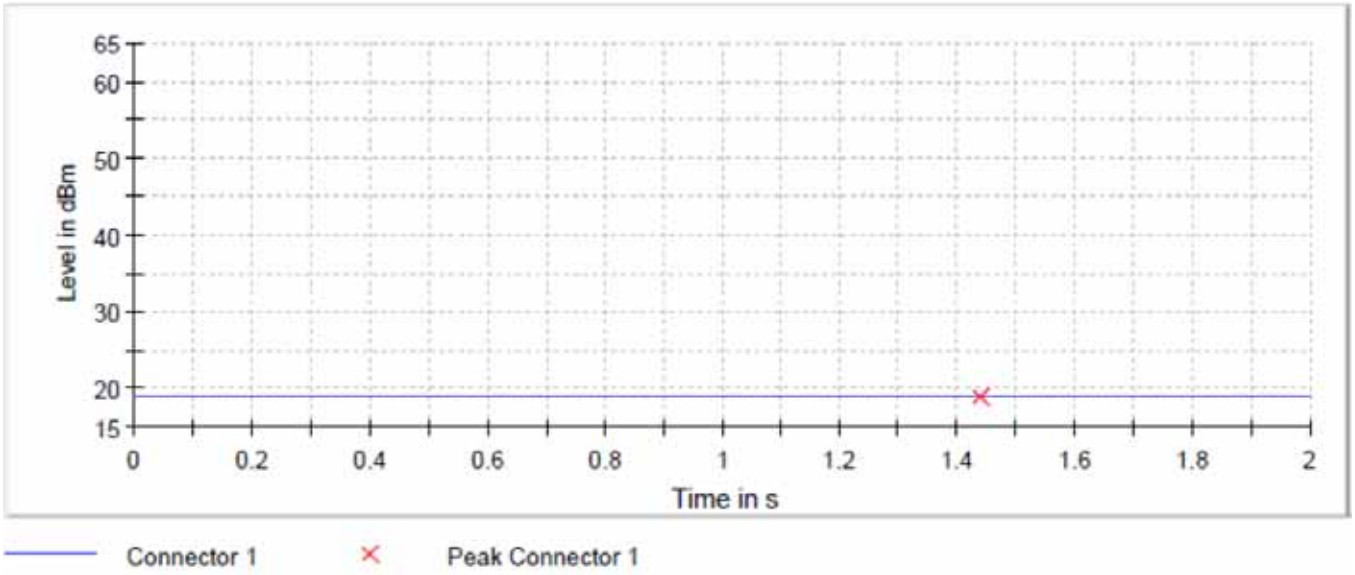
FCC 15.247 6dB Bandwidth

MANUFACTURER : California Eastern Laboratories
MODEL NUMBER : ZB3212F6R4SP2-1
SERIAL NUMBER : 121
TEST MODE : Transmit at 2440MHz (Ch. 19), Power Setting = 20dBm
TEST DATE : September 11, 2017
NOTES : 6dB bandwidth = 784.3kHz
EQUIPMENT USED : GSFA, GSFB, RBG0

Date: 2.OCT.2017 08:02:09

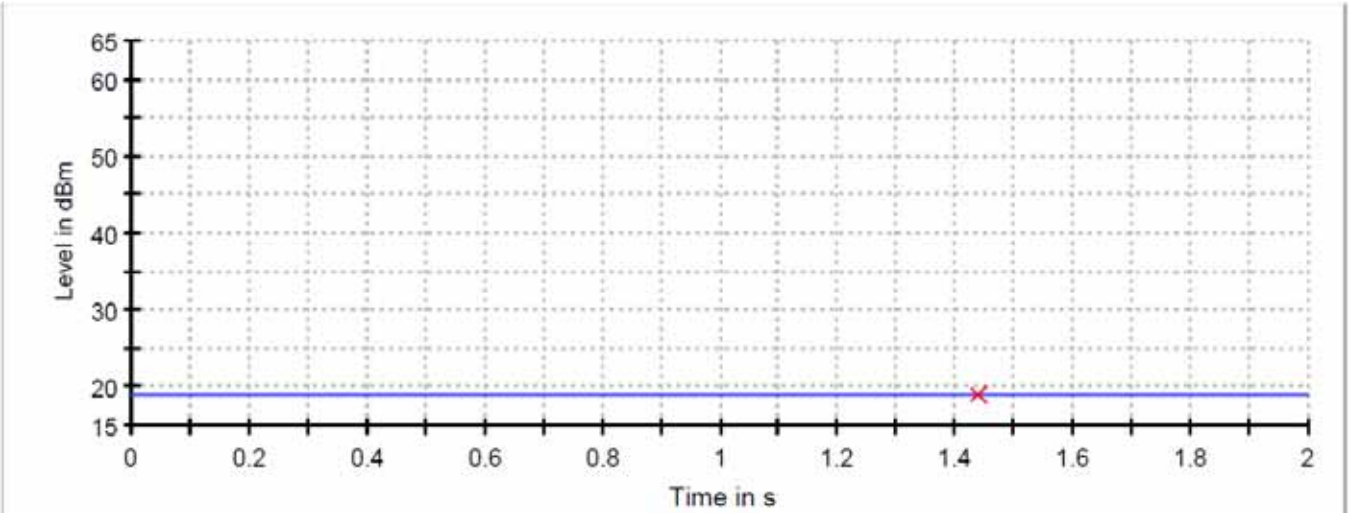
FCC 15.247 6dB Bandwidth

MANUFACTURER	:	California Eastern Laboratories
MODEL NUMBER	:	ZB3212F6R4SP2-1
SERIAL NUMBER	:	121
TEST MODE	:	Transmit at 2480MHz (Ch. 39), Power Setting = 12dBm
TEST DATE	:	September 11, 2017
NOTES	:	6dB bandwidth = 780.0kHz
EQUIPMENT USED	:	NWQ1, RBG3



FCC 15.247 Antenna Conducted Peak Output Power

MANUFACTURER	:	California Eastern Laboratories
MODEL NUMBER	:	ZB3212F6R4SP2-1
SERIAL NUMBER	:	121
TEST MODE	:	Transmit at 2402MHz (Ch. 0), Power Setting = 20dBm
TEST DATE	:	September 11, 2017
NOTES	:	Antenna Conducted Output Power = 18.9dBm
EQUIPMENT USED	:	GSFA, GSFB, RBG0



FCC 15.247 Antenna Conducted Peak Output Power

MANUFACTURER	:	California Eastern Laboratories
MODEL NUMBER	:	ZB3212F6R4SP2-1
SERIAL NUMBER	:	121
TEST MODE	:	Transmit at 2440MHz (Ch. 19), Power Setting = 20dBm
TEST DATE	:	September 11, 2017
NOTES	:	Antenna Conducted Output Power = 18.7dBm
EQUIPMENT USED	:	GSFA, GSFB, RBG0

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2402MHz (Ch. 0), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Output Power
Date : September 11-15, 2017
Test Distance : 3 meters
Notes :

Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2402.00	H	80.3	18.3	4.8	2.7	20.3	36.0	-15.7
2402.00	V	75.9	14.2	4.8	2.7	16.3	36.0	-19.7

EIRP = Sig. Gen. Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Checked BY Richard E. King :

Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2440MHz (Ch. 19), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Output Power
Date : September 11-15, 2017
Test Distance : 3 meters
Notes :

Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2440.00	H	81.1	19.2	4.8	2.8	21.3	36.0	-14.7
2440.00	V	76.7	15.0	4.8	2.8	17.1	36.0	-18.9

EIRP = Sig. Gen. Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Checked BY Richard E. King :

Richard E. King

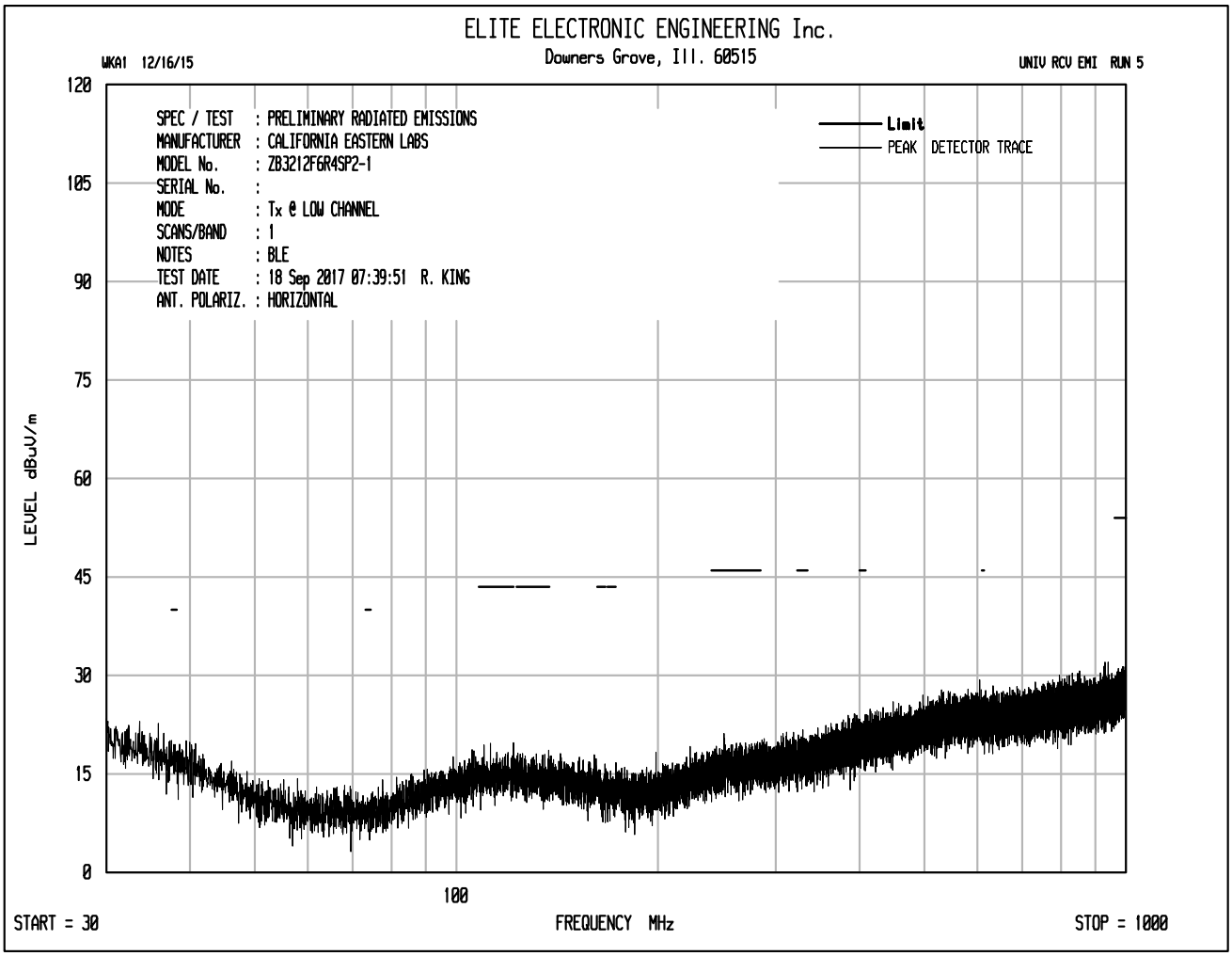
Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2480MHz (Ch. 39), Power Setting = 12dBm
Test Specification : FCC-15.247, RSS-247 Peak Output Power
Date : September 11-15, 2017
Test Distance : 3 meters
Notes :

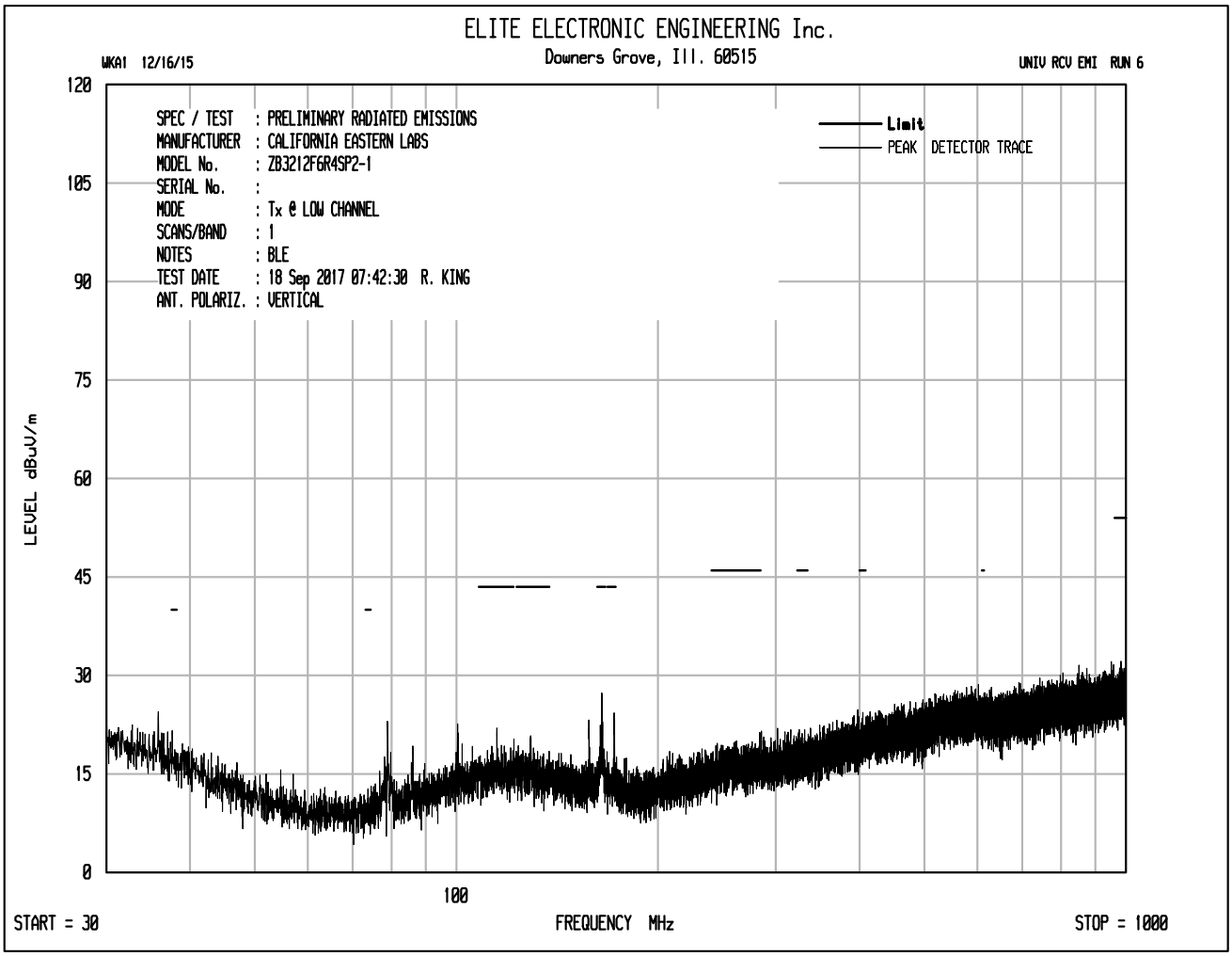
Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2480.00	H	72.3	10.5	4.9	2.8	12.6	36.0	-23.4
2480.00	V	68.1	6.5	4.9	2.8	8.6	36.0	-27.4

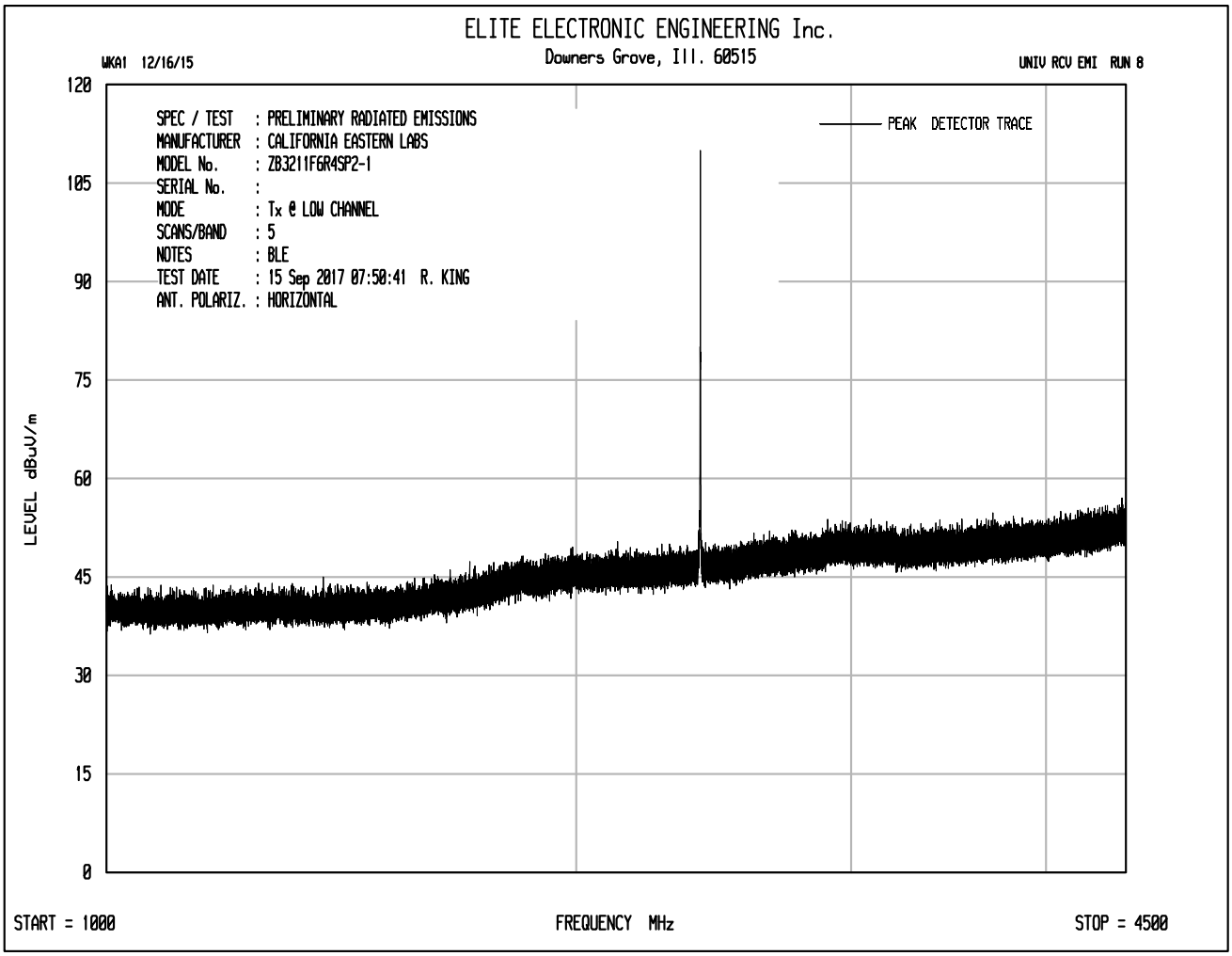
EIRP = Sig. Gen. Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

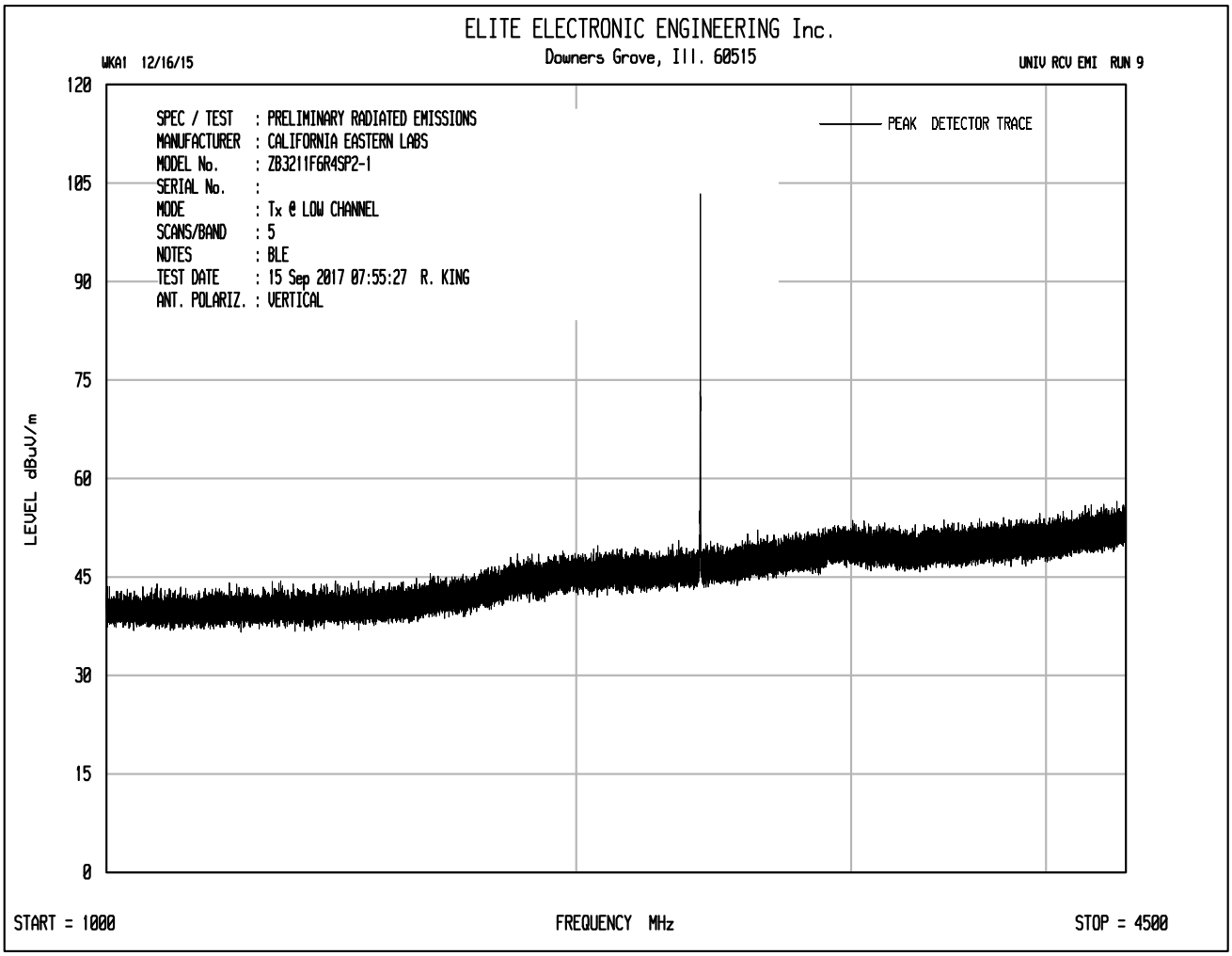
Checked BY Richard E. King :

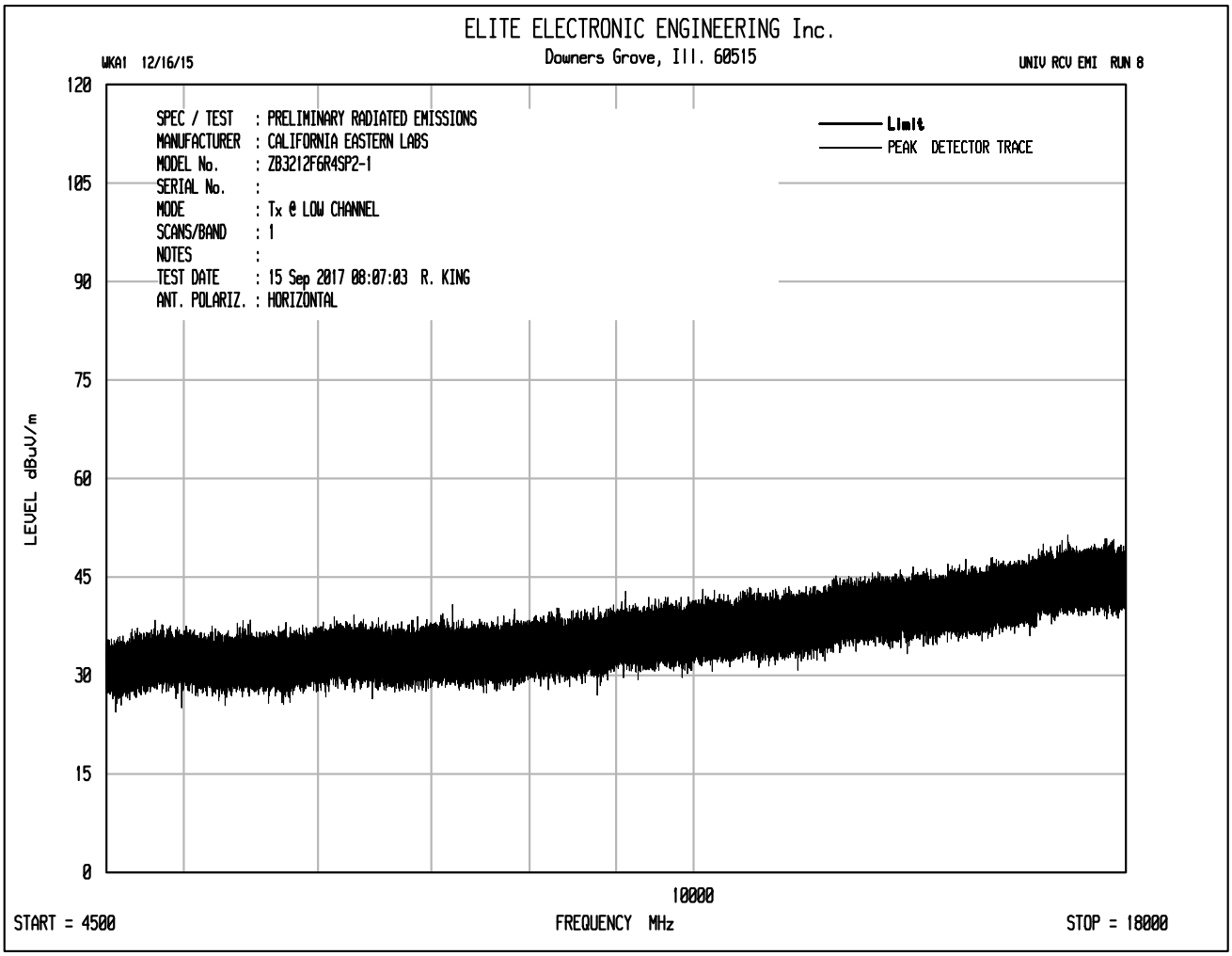
Richard E. King

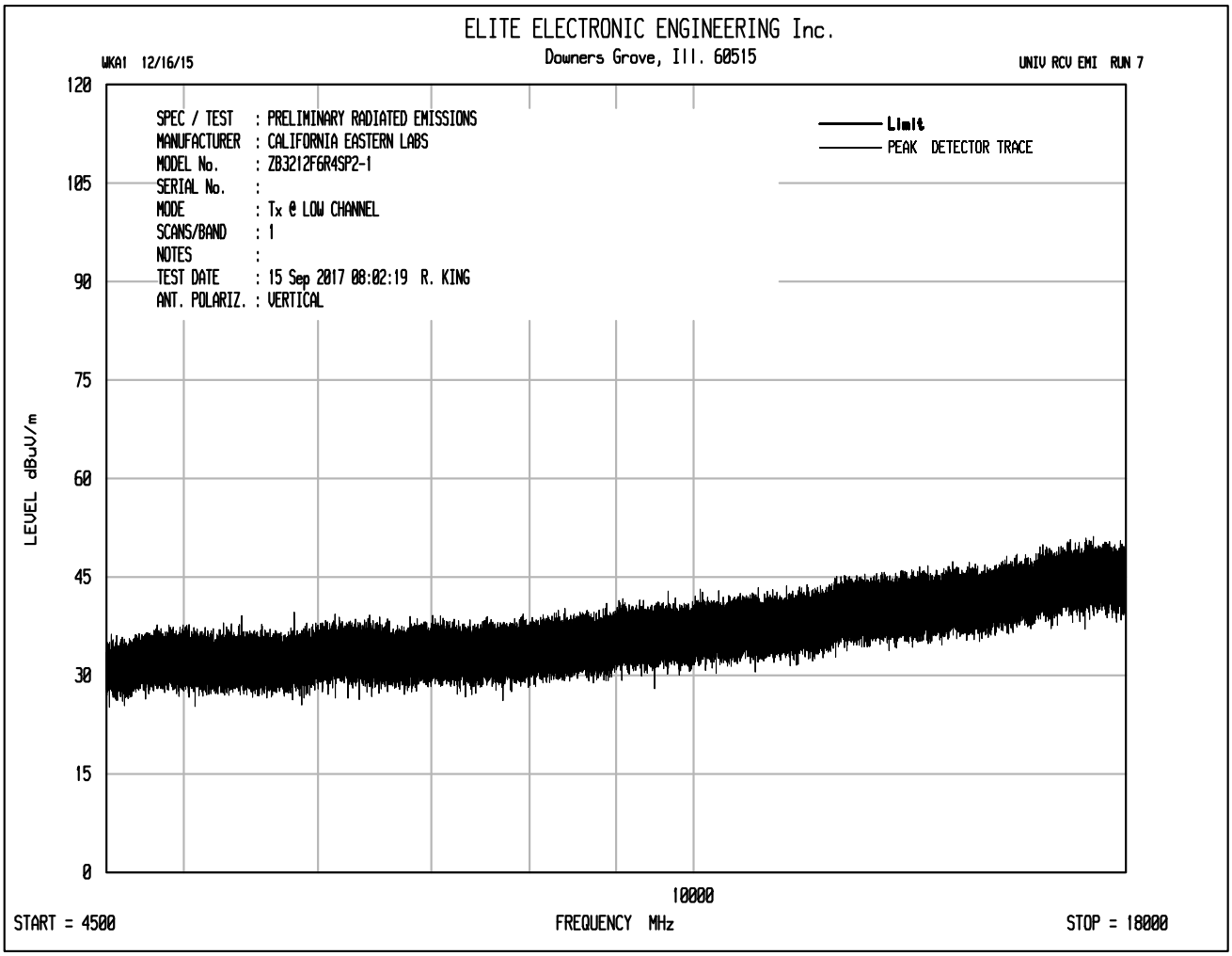

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 07:39:51 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

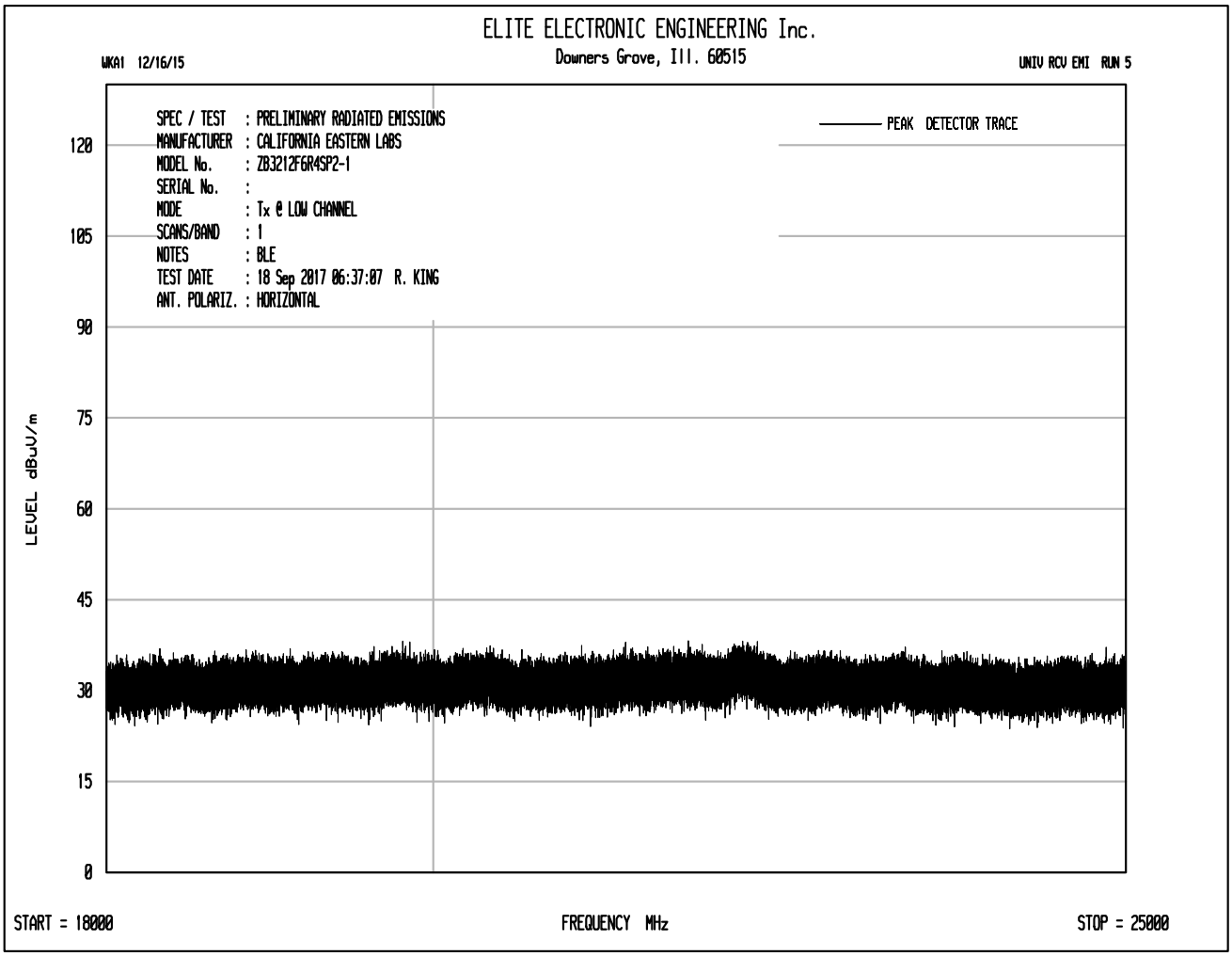

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 6
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 07:42:30 R. KING
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

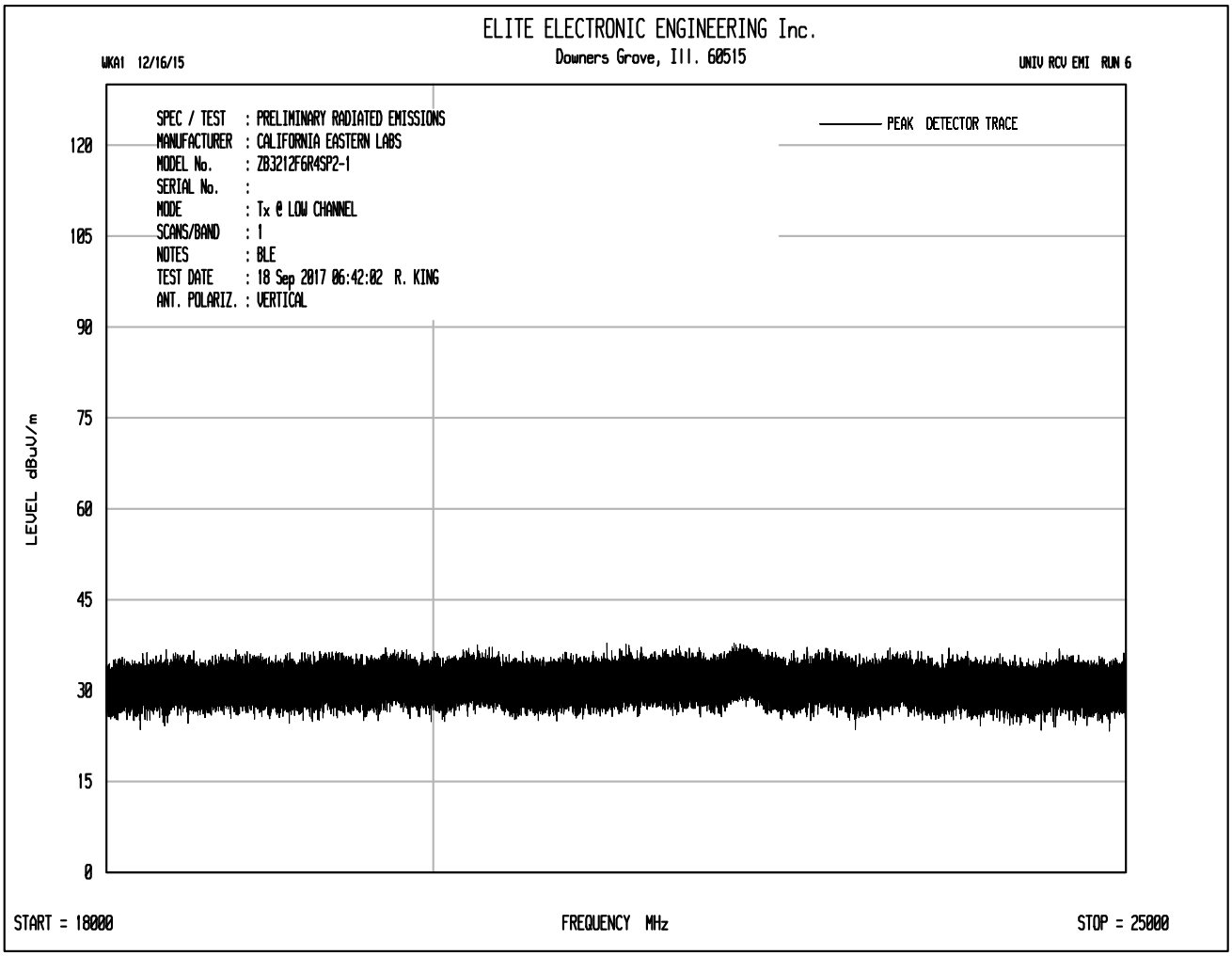

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 8
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3211F6R4SP2-1
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 5
NOTES : BLE
TEST DATE : 15 Sep 2017 07:50:41 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500

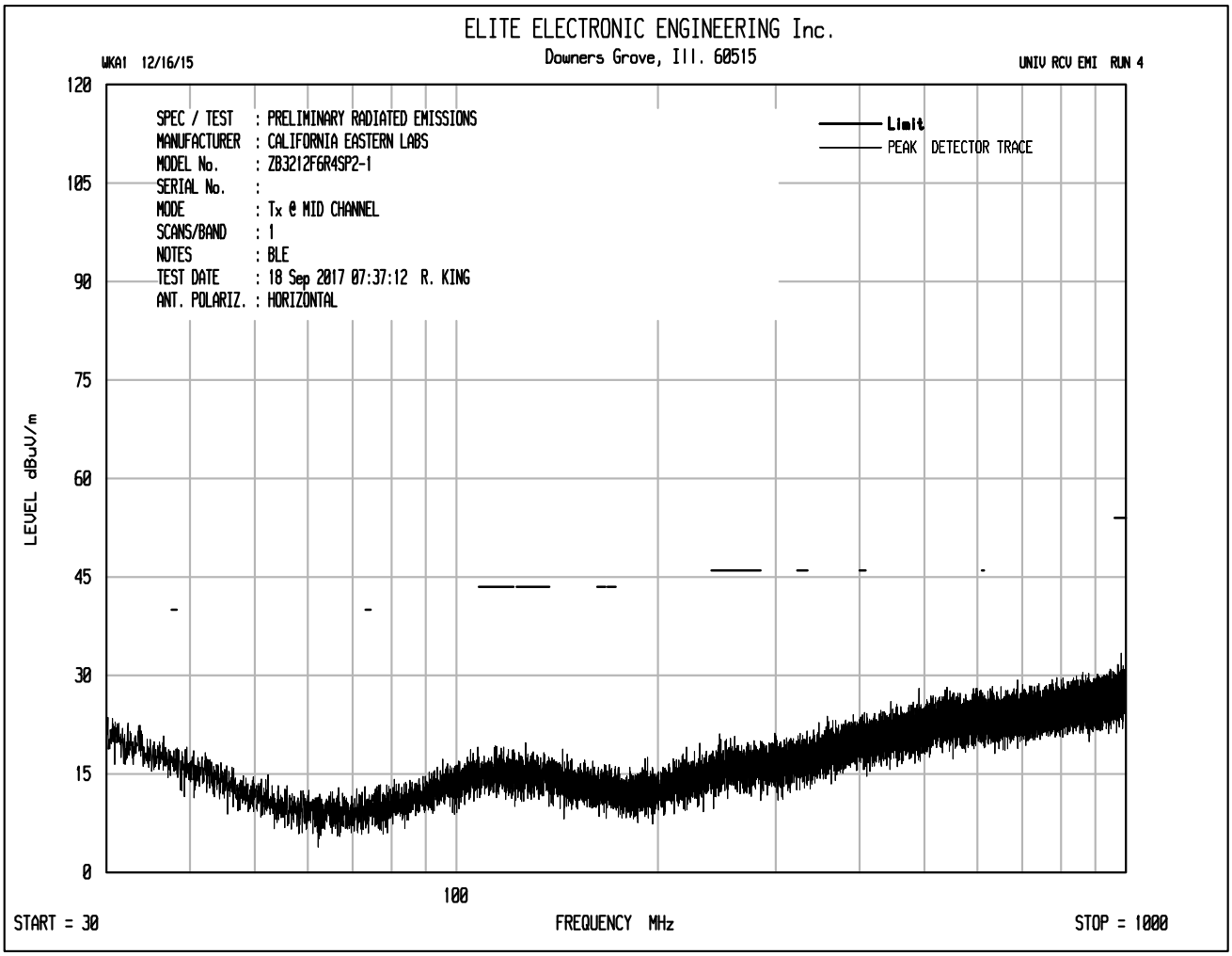

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 9
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3211F6R4SP2-1
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 5
NOTES : BLE
TEST DATE : 15 Sep 2017 07:55:27 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500

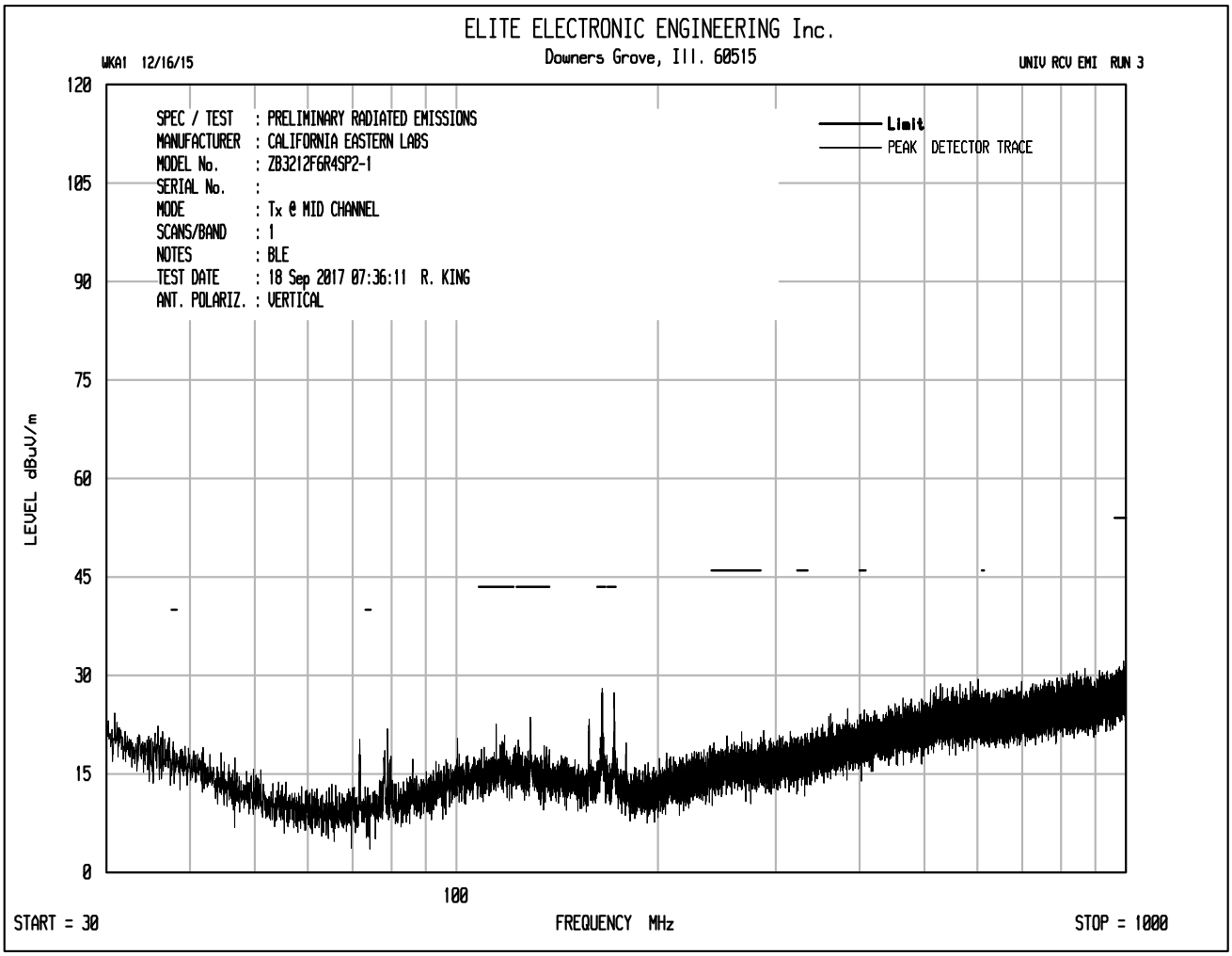

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 8
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES :
TEST DATE : 15 Sep 2017 08:07:03 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000

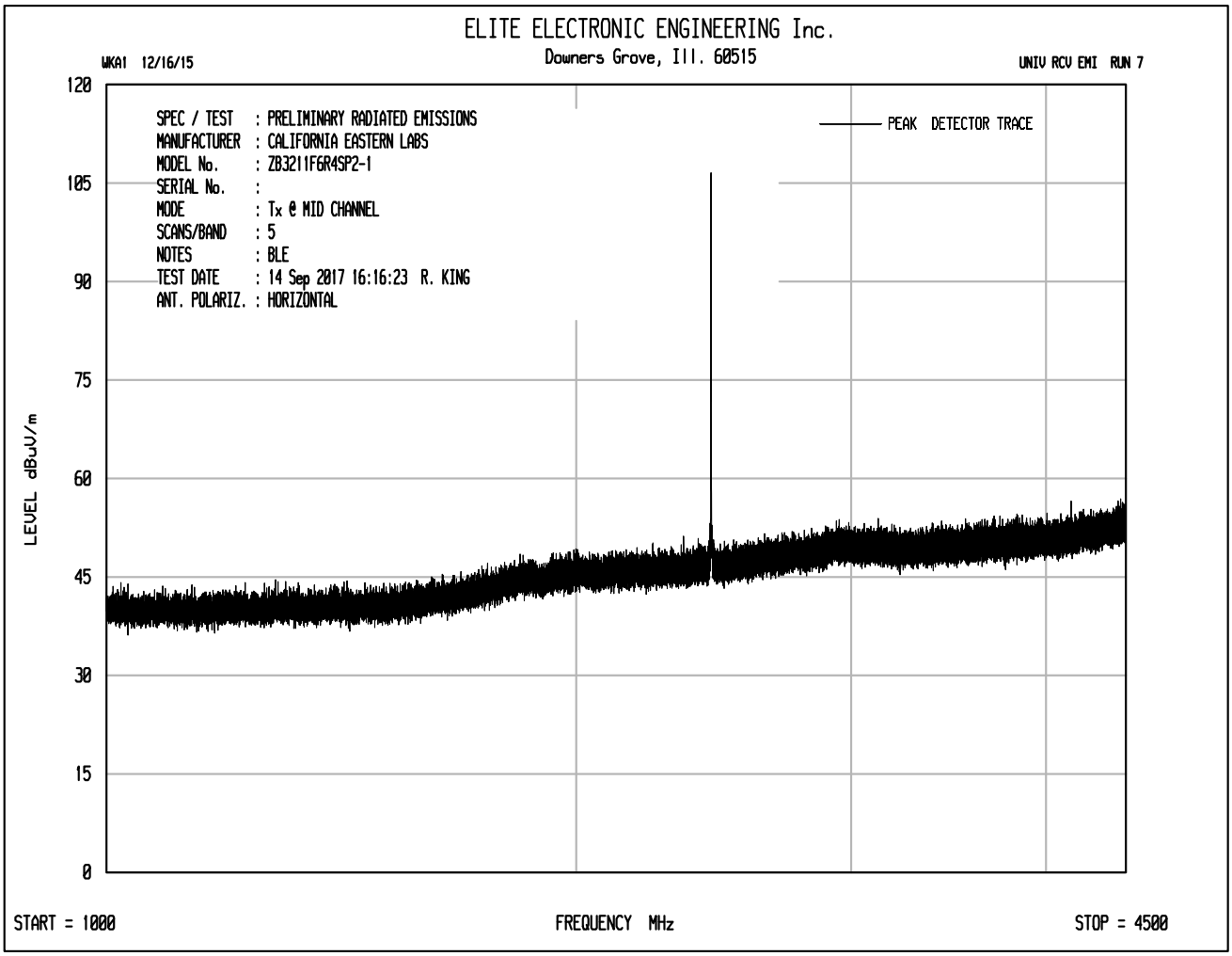

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES :
TEST DATE : 15 Sep 2017 08:02:19 R. KING
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000

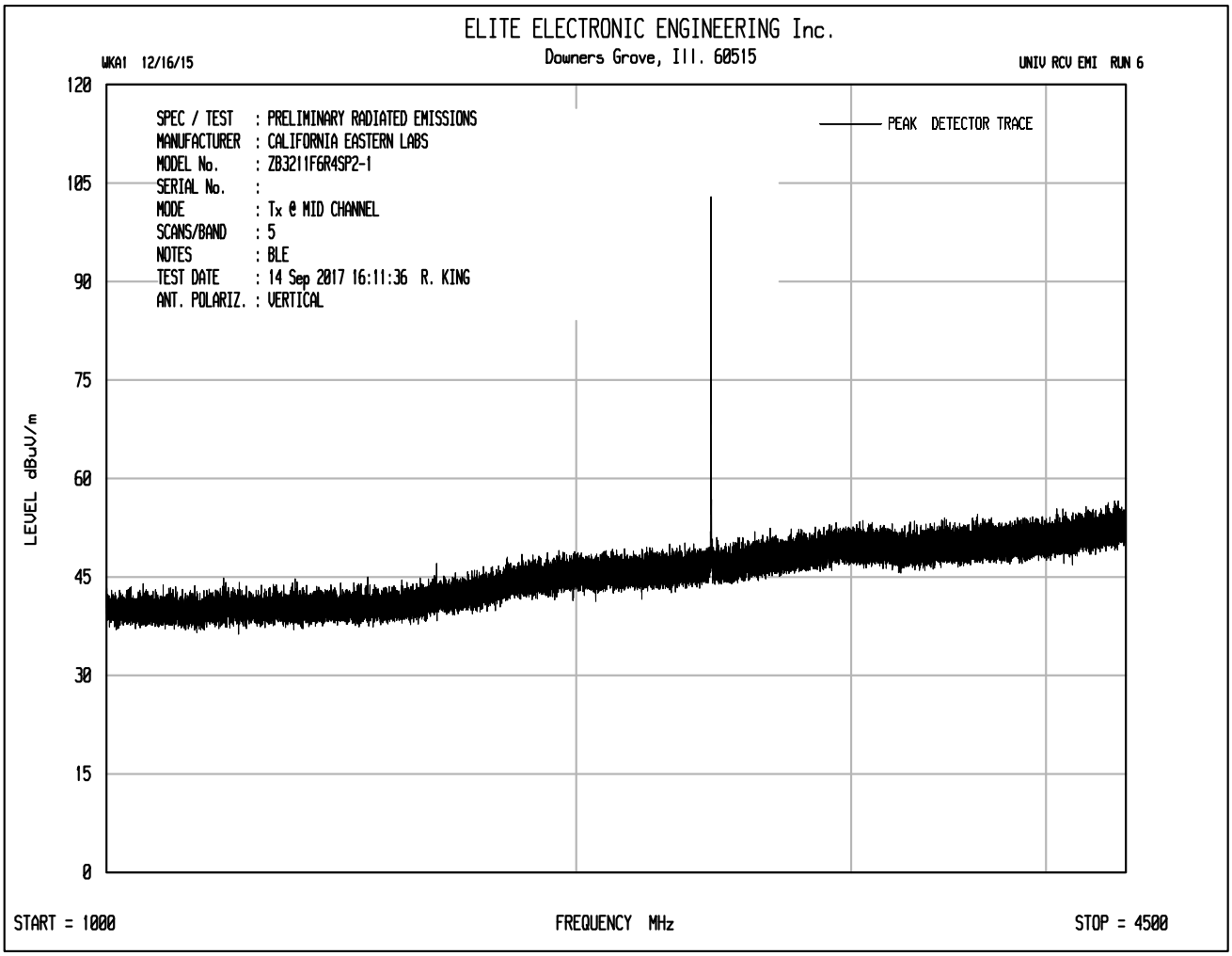

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 06:37:07 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

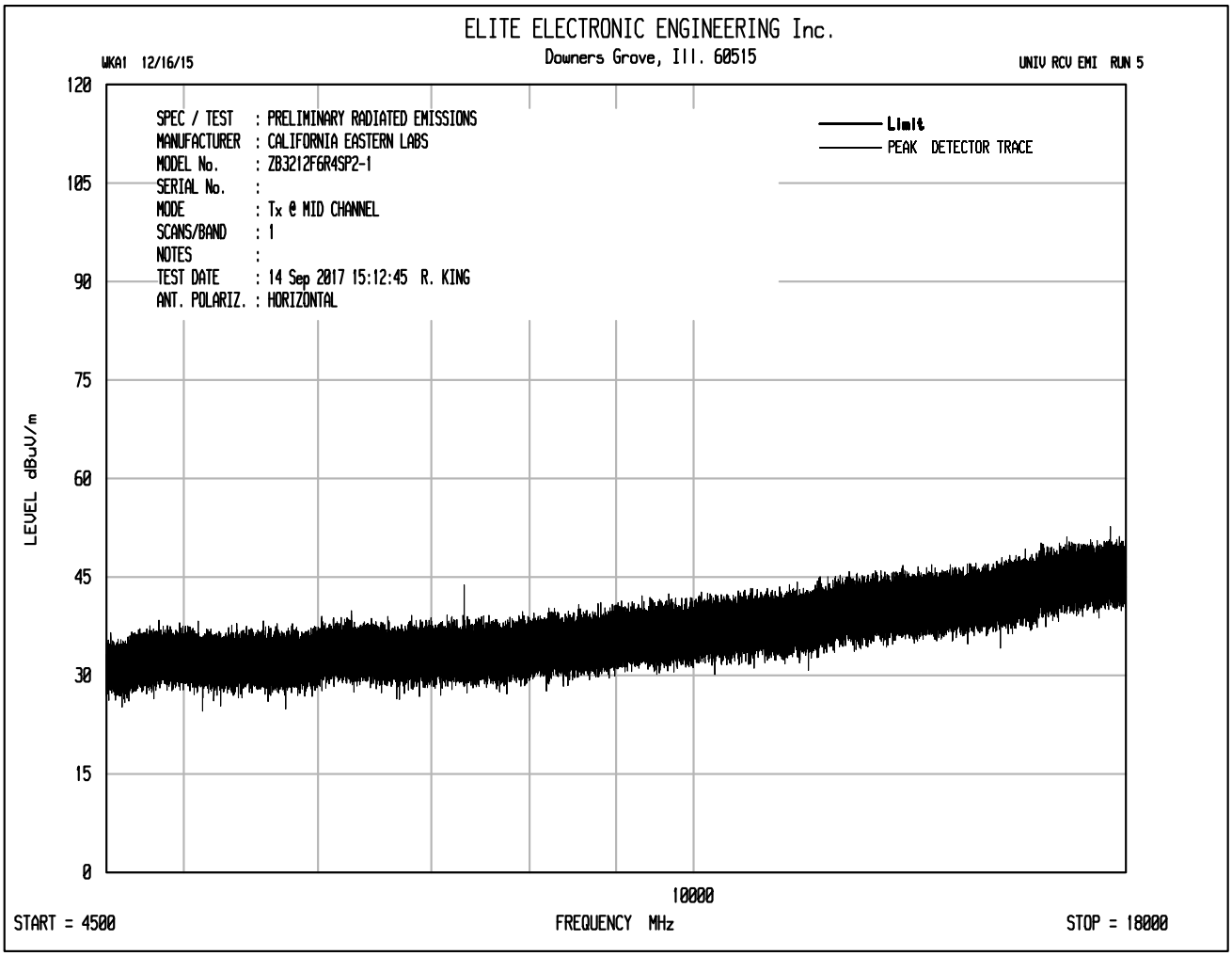

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 6
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 06:42:02 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

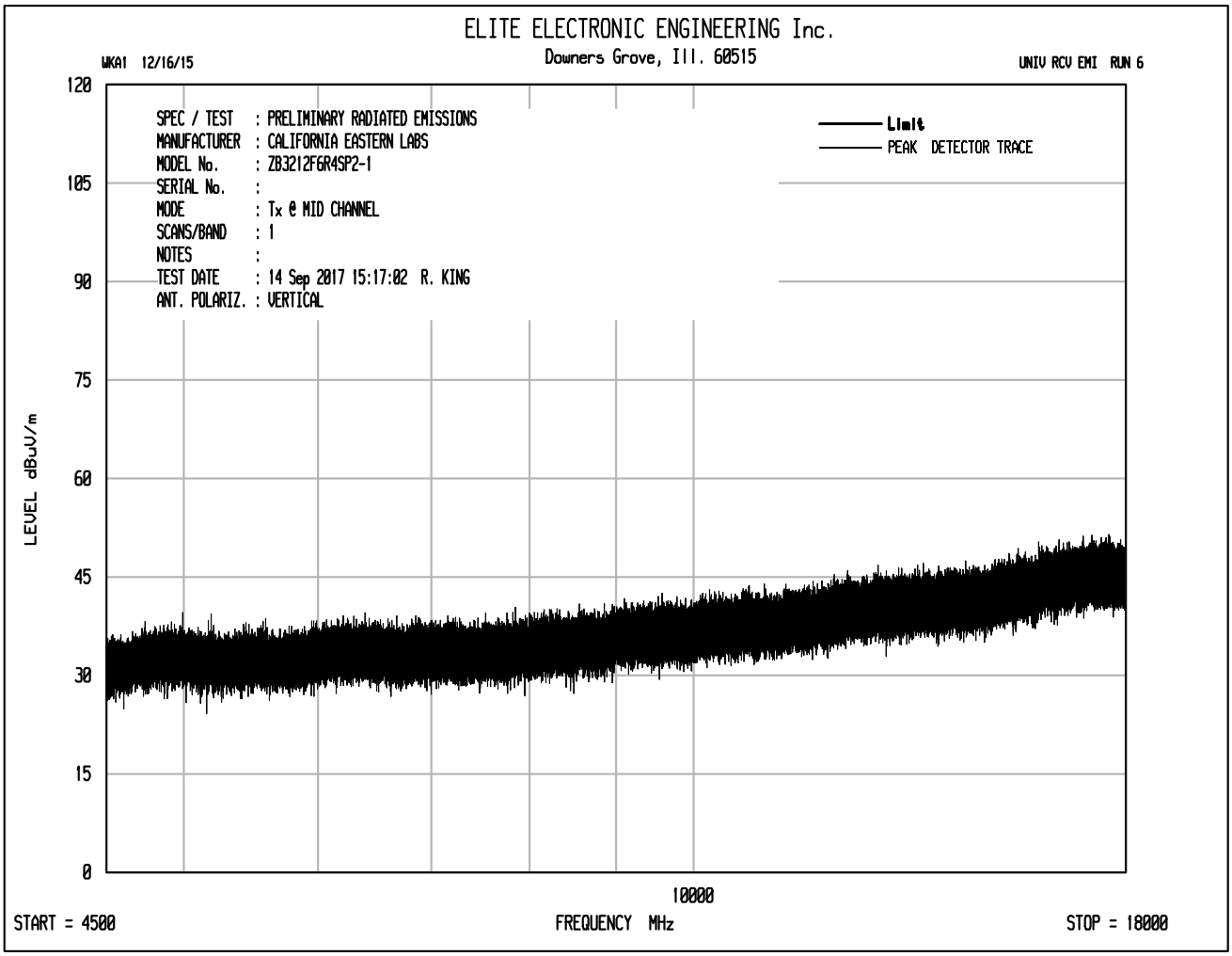

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 07:37:12 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

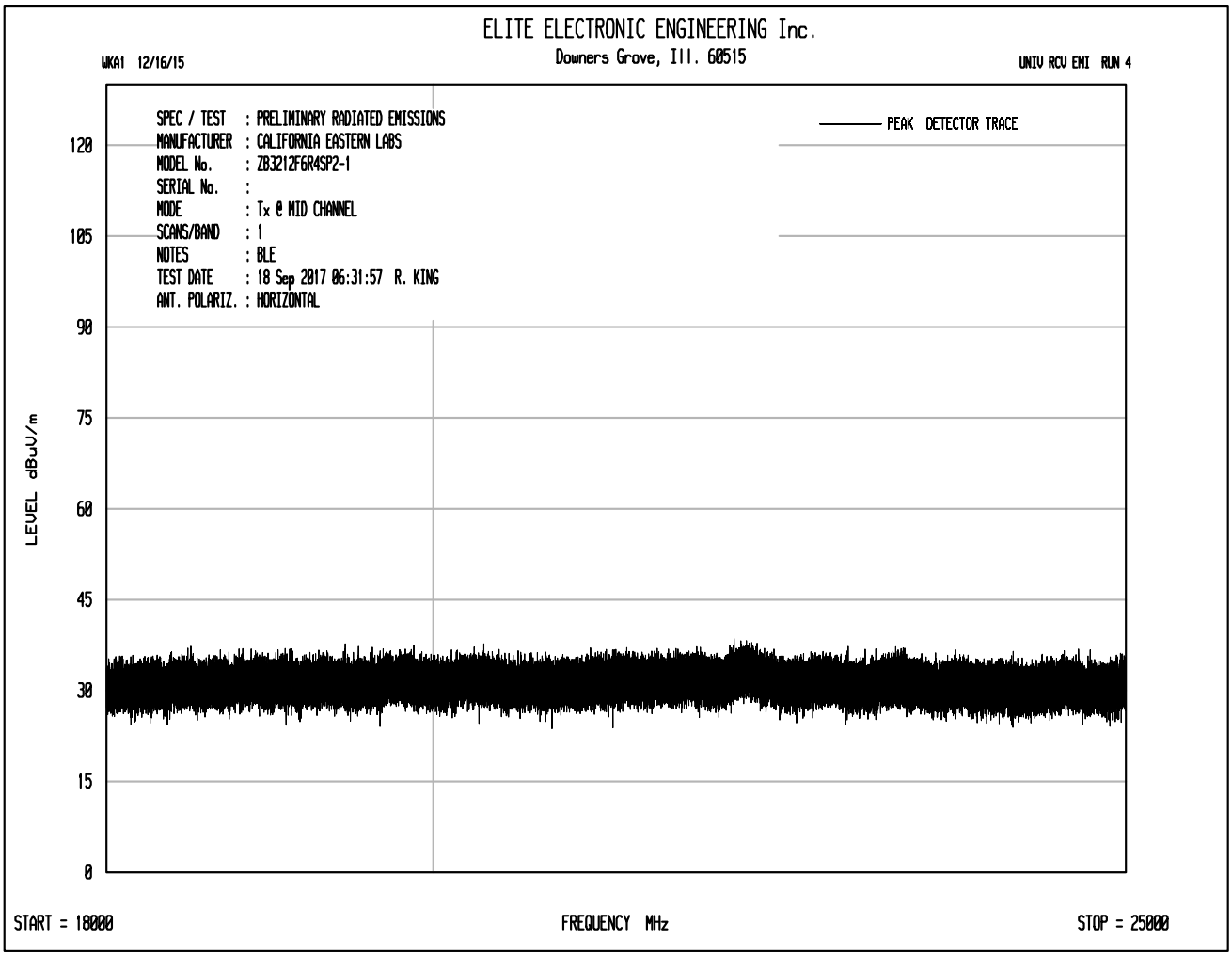

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 07:36:11 R. KING
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

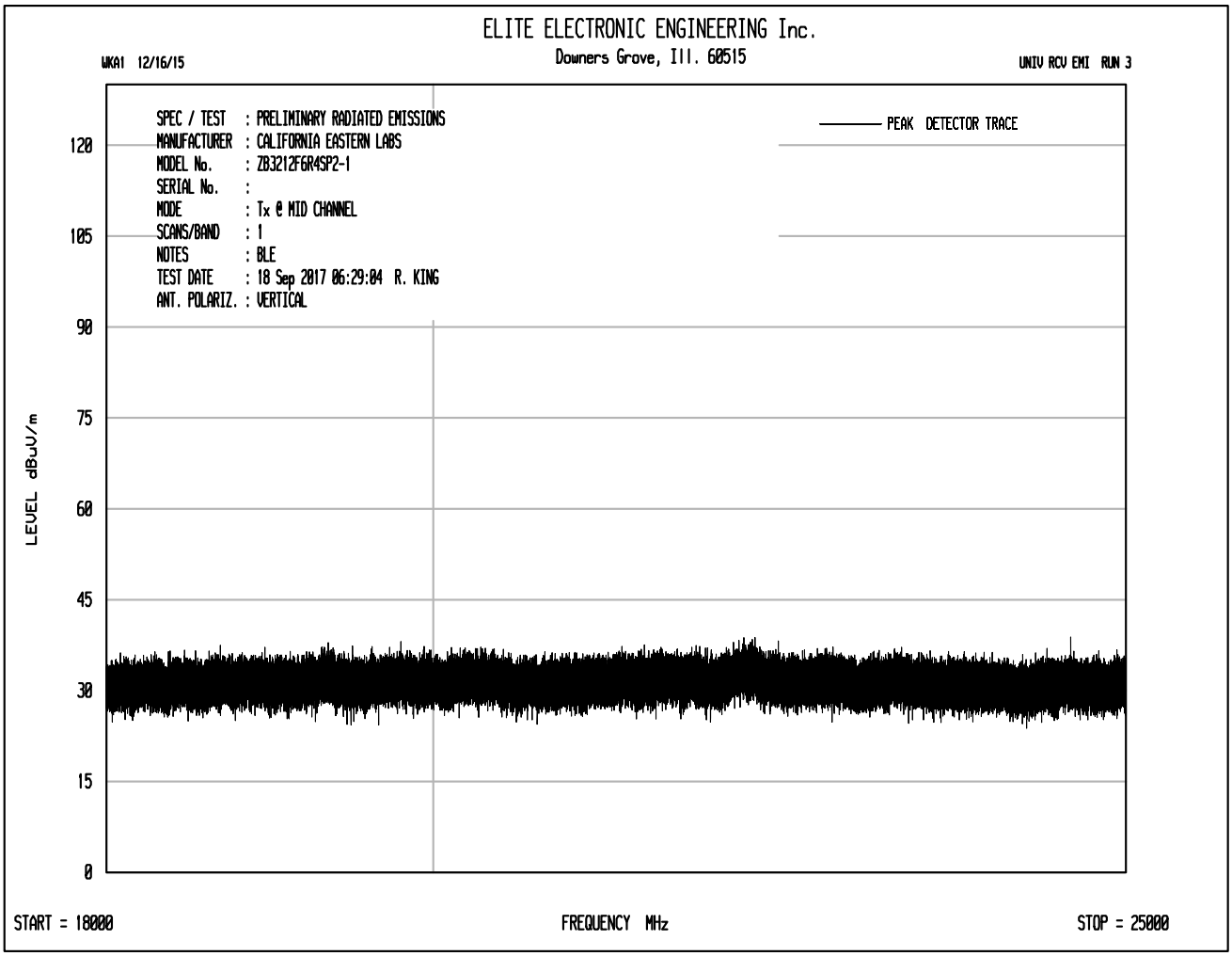

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3211F6R4SP2-1
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 5
NOTES : BLE
TEST DATE : 14 Sep 2017 16:16:23 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500

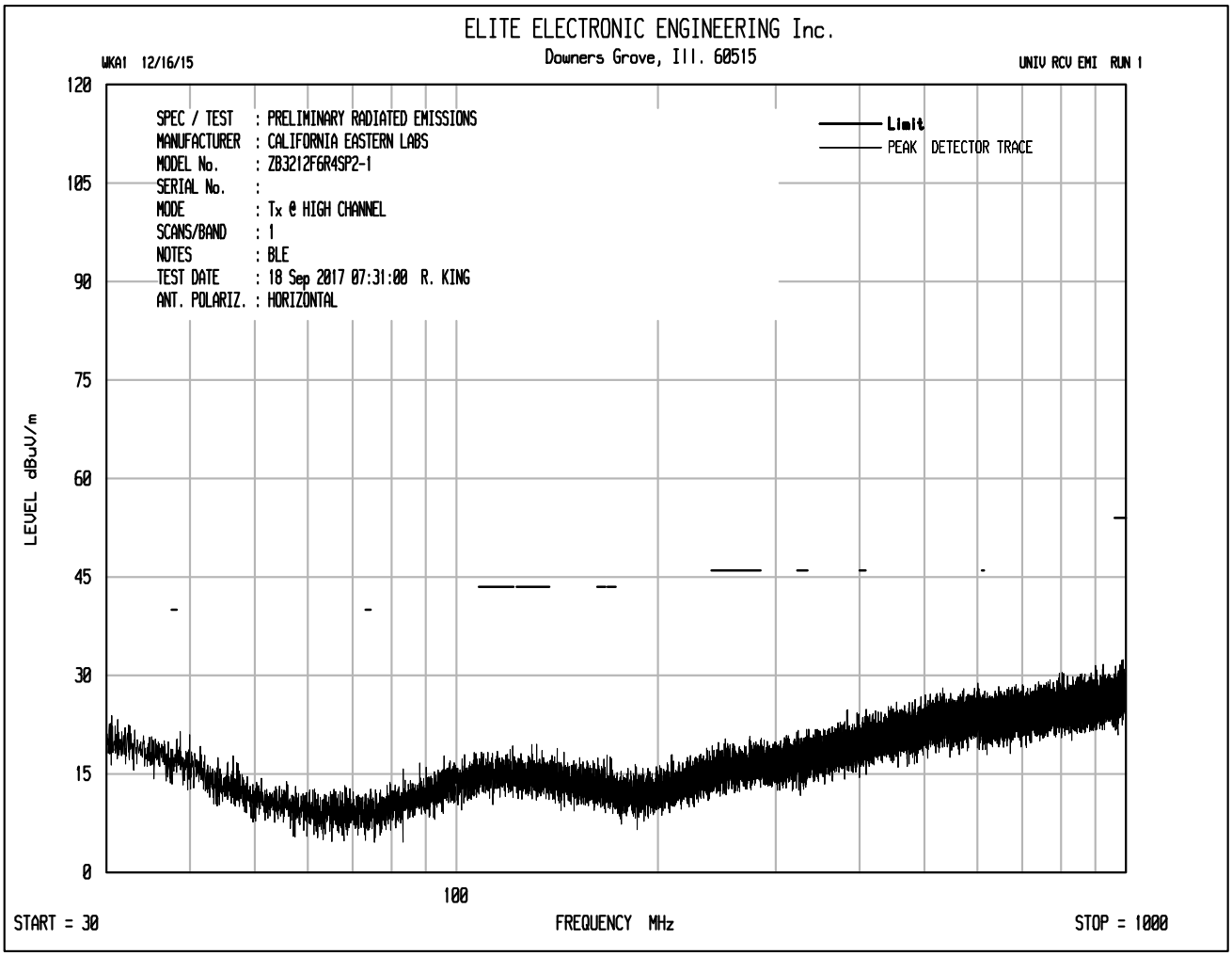

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 6
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3211F6R4SP2-1
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 5
NOTES : BLE
TEST DATE : 14 Sep 2017 16:11:36 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500

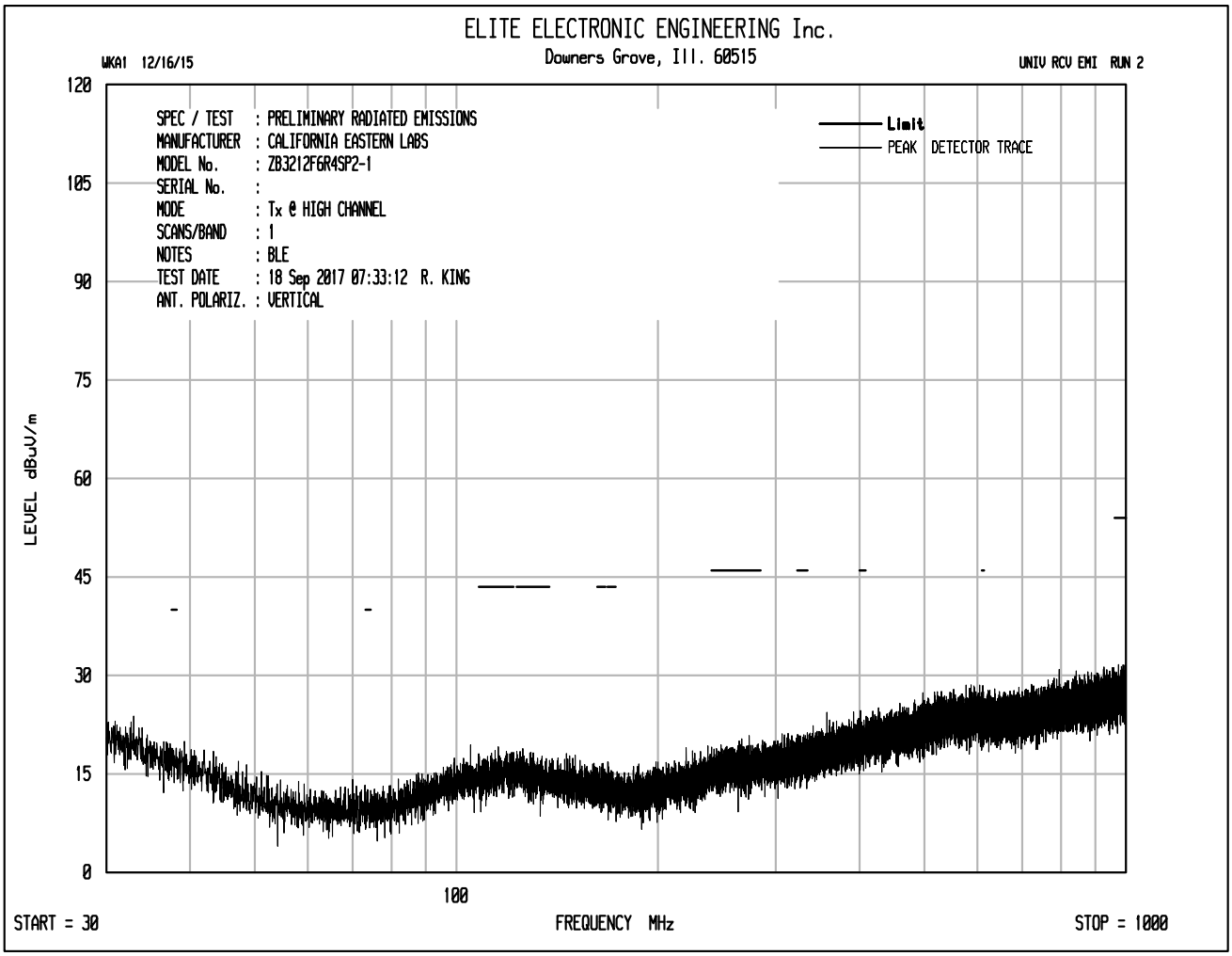

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Sep 2017 15:12:45 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000

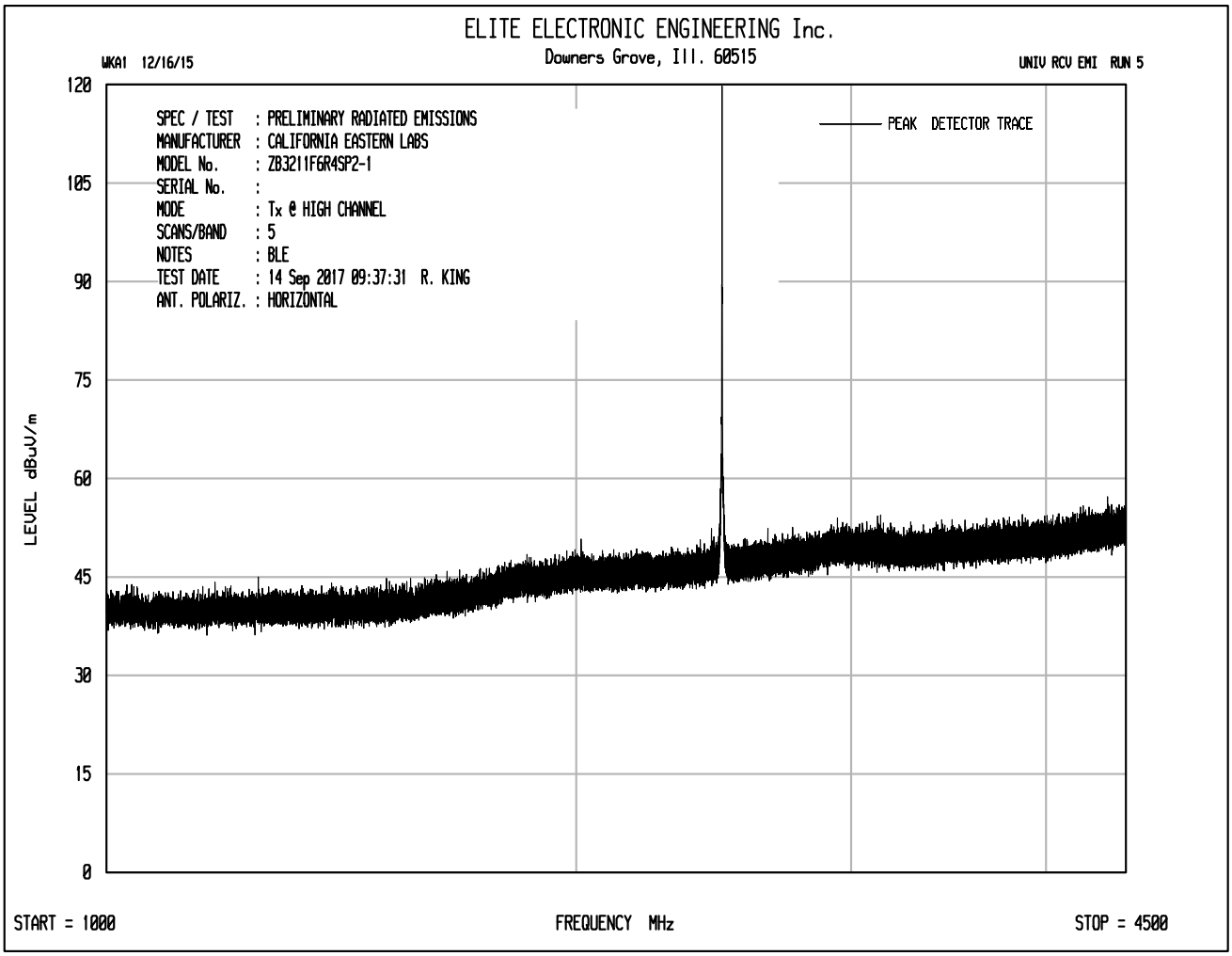

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 6
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Sep 2017 15:17:02 R. KING
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000

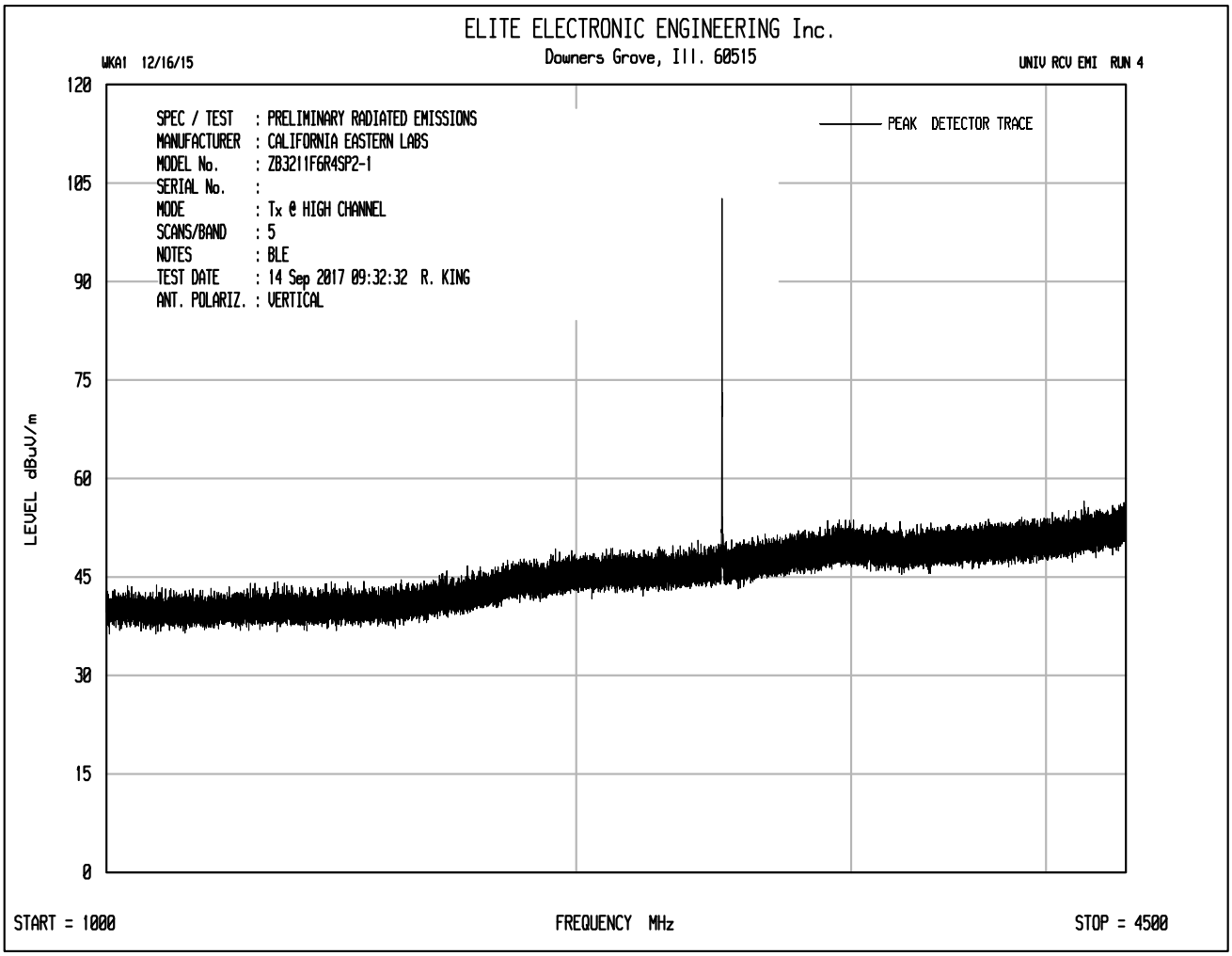

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 06:31:57 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

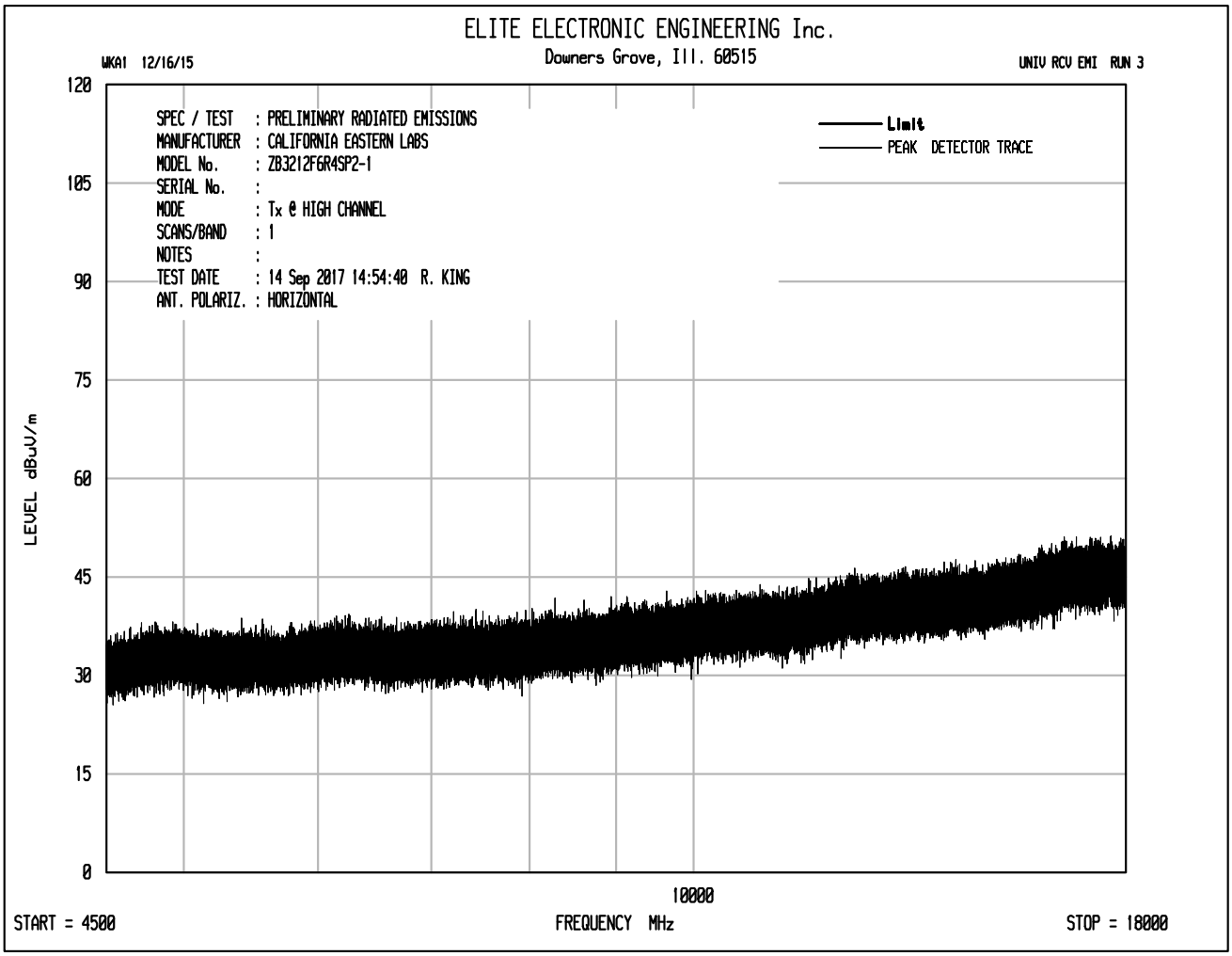

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 06:29:04 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

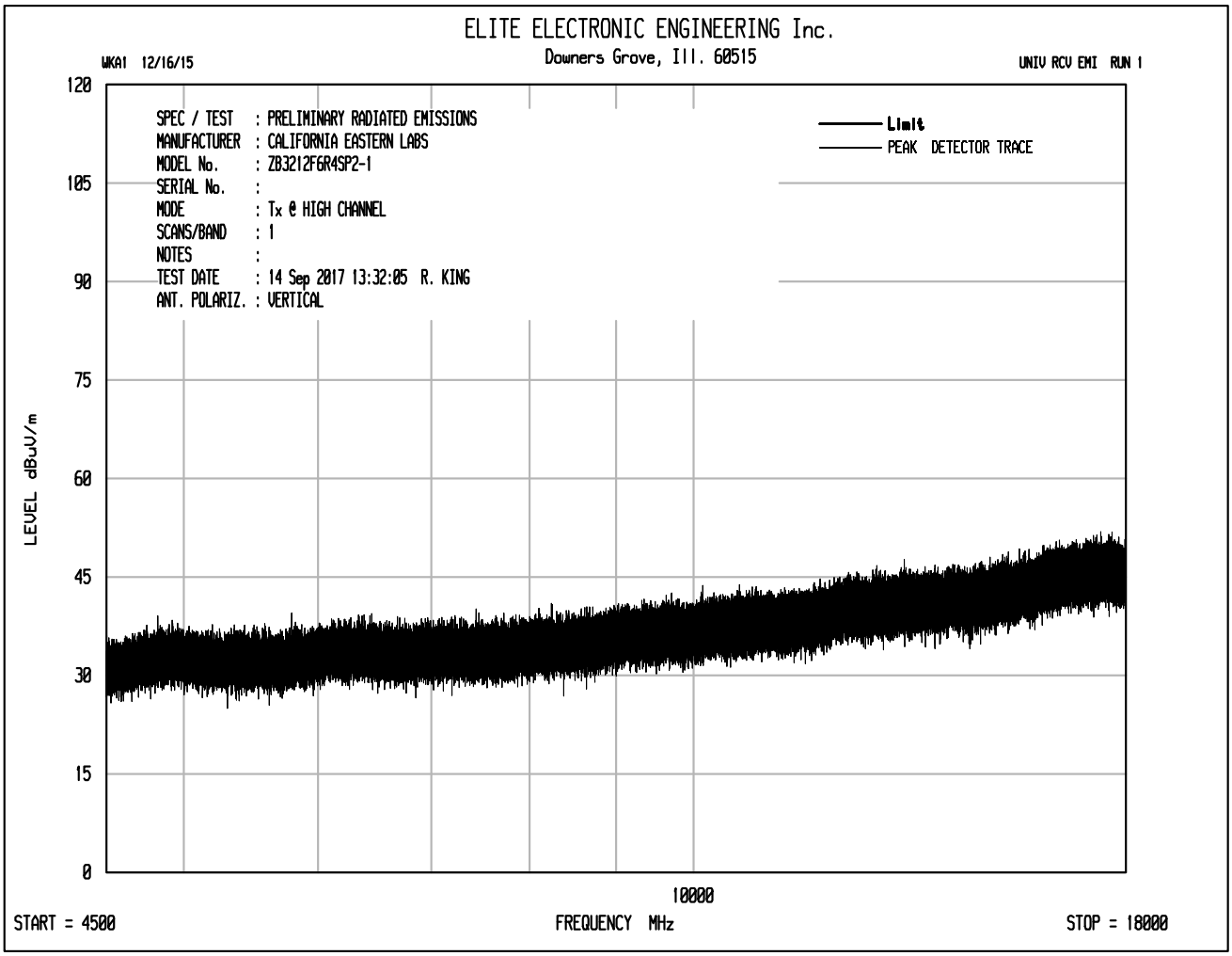

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 1
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 07:31:00 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

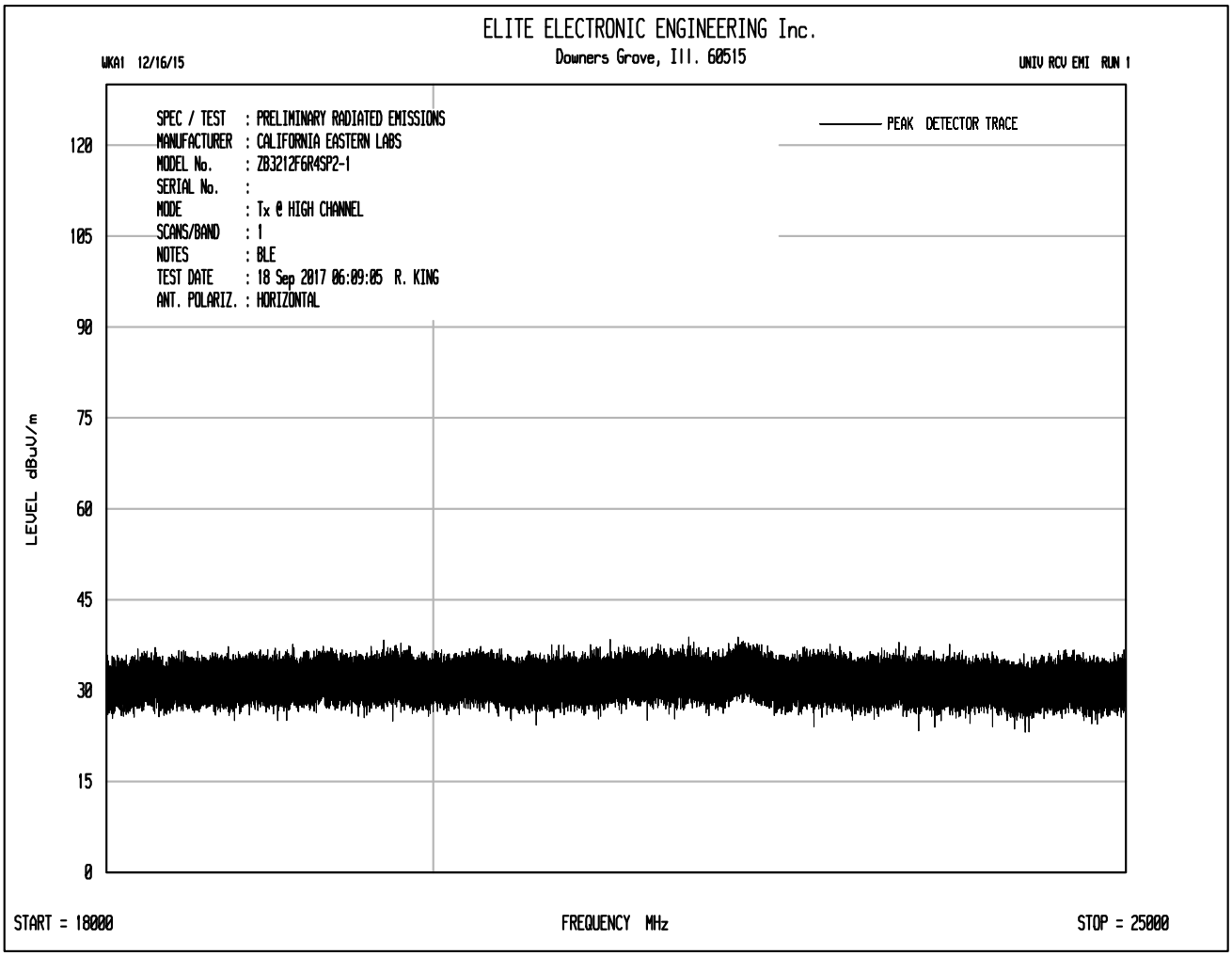

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 07:33:12 R. KING
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000

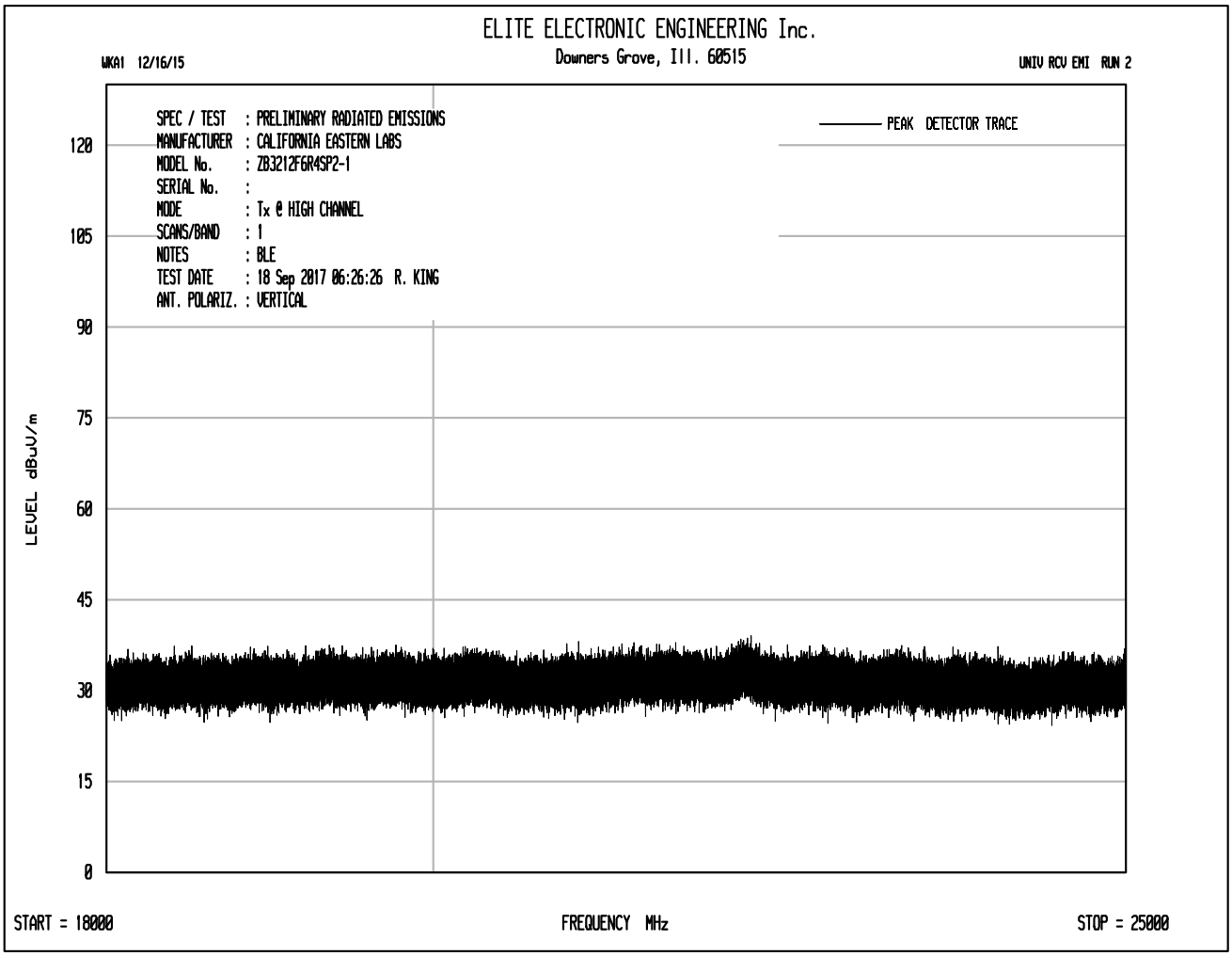

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3211F6R4SP2-1
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 5
NOTES : BLE
TEST DATE : 14 Sep 2017 09:37:31 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 4
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3211F6R4SP2-1
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 5
NOTES : BLE
TEST DATE : 14 Sep 2017 09:32:32 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Sep 2017 14:54:40 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 1
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES :
TEST DATE : 14 Sep 2017 13:32:05 R. KING
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
10000
START = 4500
FREQUENCY MHz
STOP = 18000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 1
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 06:09:05 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 12/16/15
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CALIFORNIA EASTERN LABS
MODEL No. : ZB3212F6R4SP2-1
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : BLE
TEST DATE : 18 Sep 2017 06:26:26 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 18000
FREQUENCY MHz
STOP = 25000

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2402MHz, Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
4804.00	H	52.0	*	5.7	36.8	-39.3	55.2	576.6	5000.0	-18.8
4804.00	V	51.2	*	5.7	36.8	-39.3	54.4	525.8	5000.0	-19.6
12010.00	H	49.0	*	8.6	41.9	-39.2	60.3	1039.3	5000.0	-13.6
12010.00	V	49.9	*	8.6	41.9	-39.2	61.2	1152.8	5000.0	-12.7
19216.00	H	33.4	*	2.2	40.4	-28.6	47.4	235.4	5000.0	-26.5
19216.00	V	32.3	*	2.2	40.4	-28.6	46.3	207.4	5000.0	-27.6

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2402MHz (Ch. 0), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4804.00	H	41.2	*	5.7	36.8	-39.3	44.4	166.3	500.0	-9.6
4804.00	V	39.1	*	5.7	36.8	-39.3	42.3	130.6	500.0	-11.7
12010.00	H	34.0	*	8.6	41.9	-39.2	45.3	184.8	500.0	-8.6
12010.00	V	34.0	*	8.6	41.9	-39.2	45.3	184.8	500.0	-8.6
19216.00	H	19.2	*	2.2	40.4	-28.6	33.2	45.9	500.0	-20.7
19216.00	V	19.4	*	2.2	40.4	-28.6	33.4	47.0	500.0	-20.5

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2402MHz (Ch. 0), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Peak Detector with 100kHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
2402.00	H	79.8		4.3	33.0	0.0	117.1	717594.0		
2402.00	V	75.3		4.3	33.0	0.0	112.6	427443.6		
7206.00	H	47.5		6.9	38.3	-39.4	53.3	460.2	71759.4	-43.9
7206.00	V	48.8		6.9	38.3	-39.4	54.6	534.5	71759.4	-42.6
9608.00	H	39.4	*	8.2	39.4	-39.3	47.7	242.3	71759.4	-49.4
9608.00	V	40.0	*	8.2	39.4	-39.3	48.3	259.7	71759.4	-48.8
14412.00	H	37.8	*	9.6	43.1	-38.3	52.2	407.0	71759.4	-44.9
14412.00	V	37.3	*	9.6	43.1	-38.3	51.7	384.2	71759.4	-45.4
16814.00	H	37.9	*	10.9	43.8	-37.5	55.2	573.0	71759.4	-42.0
16814.00	V	38.1	*	10.9	43.8	-37.5	55.4	586.4	71759.4	-41.8
21618.00	H	22.3	*	2.2	40.6	-28.7	36.4	66.4	71759.4	-60.7
21618.00	V	23.1	*	2.2	40.6	-28.7	37.2	72.8	71759.4	-59.9
24020.00	H	22.9	*	2.2	40.6	-30.0	35.8	61.5	71759.4	-61.3
24020.00	V	24.1	*	2.2	40.6	-30.0	37.0	70.6	71759.4	-60.1

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2440MHz (Ch. 19), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
4880.00	H	50.3	*	5.7	36.7	-39.3	53.4	465.3	5000.0	-20.6
4880.00	V	51.3	*	5.7	36.7	-39.3	54.4	523.9	5000.0	-19.6
7320.00	H	54.4		6.9	38.2	-39.4	60.1	1010.2	5000.0	-13.9
7320.00	V	52.2		6.9	38.2	-39.4	57.9	787.8	5000.0	-16.1
12200.00	H	50.1	*	8.9	41.7	-39.1	61.6	1207.2	5000.0	-12.3
12200.00	V	50.4	*	8.9	41.7	-39.1	61.9	1251.0	5000.0	-12.0
19520.00	H	33.4	*	2.2	40.4	-28.5	47.5	237.2	5000.0	-26.5
19520.00	V	32.3	*	2.2	40.4	-28.5	46.4	209.0	5000.0	-27.6

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2440MHz (Ch. 19), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4880.0	H	41.2	*	5.7	36.7	-39.3	44.3	163.8	500.0	-9.7
4880.0	V	39.1	*	5.7	36.7	-39.3	42.2	128.6	500.0	-11.8
7320.0	H	44.6		6.9	38.2	-39.4	50.2	325.0	500.0	-3.7
7320.0	V	40.3		6.9	38.2	-39.4	45.9	198.1	500.0	-8.0
12200.0	H	35.3	*	8.9	41.7	-39.1	46.8	218.9	500.0	-7.2
12200.0	V	35.3	*	8.9	41.7	-39.1	46.9	220.4	500.0	-7.1
19520.0	H	19.2	*	2.2	40.4	-28.5	33.3	46.3	500.0	-20.7
19520.0	V	19.4	*	2.2	40.4	-28.5	33.5	47.3	500.0	-20.5

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2440MHz (Ch. 19), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Peak Detector with 100kHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
2440.00	H	79.1		4.3	33.1	0.0	116.5	669137.1		
2440.00	V	74.7		4.3	33.1	0.0	112.1	401342.5		
9760.00	H	40.7	*	8.2	39.5	-39.3	49.2	287.4	66913.7	-47.3
9760.00	V	39.7	*	8.2	39.5	-39.3	48.2	255.8	66913.7	-48.4
14640.00	H	38.6	*	9.7	42.7	-38.2	52.7	431.9	66913.7	-43.8
14640.00	V	38.6	*	9.7	42.7	-38.2	52.7	431.9	66913.7	-43.8
17080.00	H	37.9	*	11.0	44.7	-37.6	56.0	632.0	66913.7	-40.5
17080.00	V	38.1	*	11.0	44.7	-37.6	56.2	646.8	66913.7	-40.3
21960.00	H	22.3	*	2.2	40.6	-29.2	35.9	62.5	66913.7	-60.6
21960.00	V	23.1	*	2.2	40.6	-29.2	36.7	68.6	66913.7	-59.8
24400.00	H	22.9	*	2.2	40.6	-30.2	35.5	59.8	66913.7	-61.0
24400.00	V	24.1	*	2.2	40.6	-30.2	36.7	68.7	66913.7	-59.8

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2480MHz (Ch. 39), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
4960.00	H	50.6	*	5.8	36.5	-39.3	53.6	476.8	5000.0	-20.4
4960.00	V	51.2	*	5.8	36.5	-39.3	54.2	512.1	5000.0	-19.8
7440.00	H	51.5	*	6.9	38.1	-39.4	57.1	714.0	5000.0	-16.9
7440.00	V	50.5	*	6.9	38.1	-39.4	56.1	636.4	5000.0	-17.9
12400.00	H	50.2	*	9.4	41.5	-39.0	62.2	1280.9	5000.0	-11.8
12400.00	V	50.2	*	9.4	41.5	-39.0	62.1	1270.7	5000.0	-11.9
19840.00	H	33.4	*	2.2	40.4	-28.2	47.9	247.6	5000.0	-26.1
19840.00	V	32.3	*	2.2	40.4	-28.2	46.8	218.1	5000.0	-27.2
22320.00	H	22.3	*	2.2	40.6	-29.1	36.0	63.4	5000.0	-37.9
22320.00	V	23.1	*	2.2	40.6	-29.1	36.8	69.6	5000.0	-37.1

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2480MHz (Ch. 39), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
4960.00	H	37.5	*	5.8	36.5	-39.3	40.4	104.7	500.0	-13.6
4960.00	V	35.0	*	5.8	36.5	-39.3	37.9	78.7	500.0	-16.1
7440.00	H	39.30	*	6.9	38.1	-39.4	44.9	175.3	500.0	-9.1
7440.00	V	39.1	*	6.9	38.1	-39.4	44.7	171.3	500.0	-9.3
12400.00	H	34.3	*	9.4	41.5	-39.0	46.2	203.7	500.0	-7.8
12400.00	V	34.5	*	9.4	41.5	-39.0	46.4	208.0	500.0	-7.6
19840.00	H	19.2	*	2.2	40.4	-28.2	33.7	48.3	500.0	-20.3
19840.00	V	19.4	*	2.2	40.4	-28.2	33.9	49.4	500.0	-20.1
22320.00	H	20.6	*	2.2	40.6	-29.1	34.3	52.2	500.0	-19.6
22320.00	V	20.5	*	2.2	40.6	-29.1	34.2	51.6	500.0	-19.7

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King

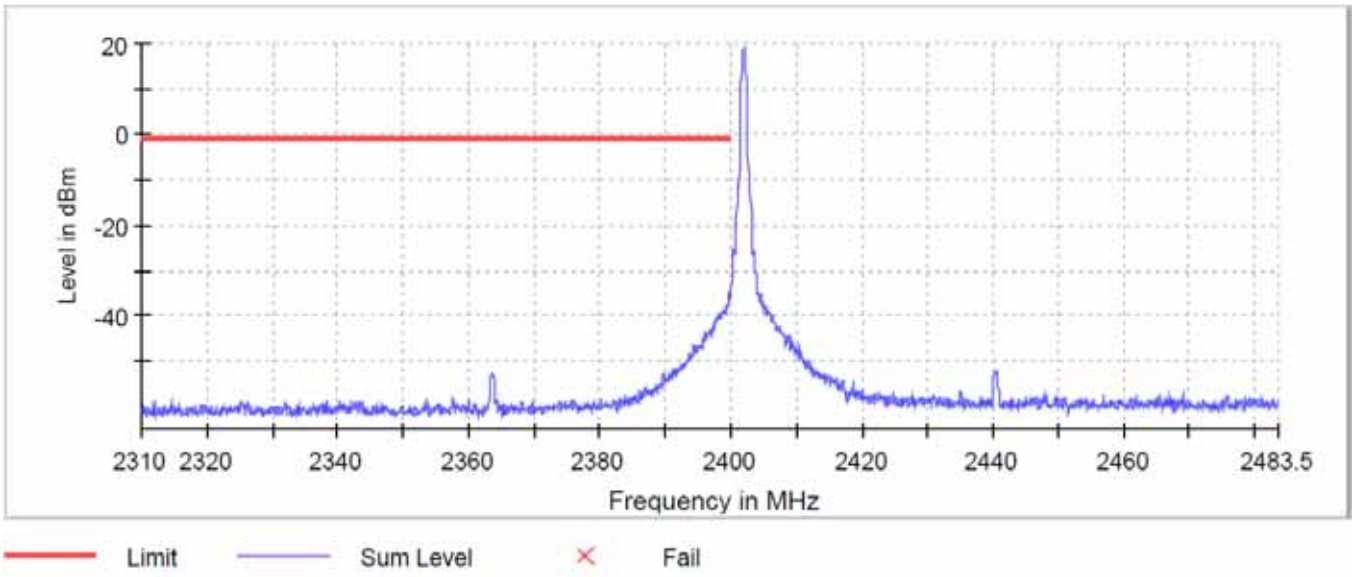
Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2480MHz (Ch. 39), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Peak Detector with 100kHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
2480.00	H	70.6		4.3	33.2	0.0	108.1	254880.2		
2480.00	V	66.4		4.3	33.2	0.0	103.9	157157.8		
9920.00	H	41.6	*	8.3	39.8	-39.2	50.4	331.0	25488.0	-37.7
9920.00	V	40.9	*	8.3	39.8	-39.2	49.7	305.1	25488.0	-38.4
14880.00	H	38.8	*	9.8	42.2	-38.2	52.7	430.8	25488.0	-35.4
14880.00	V	38.1	*	9.8	42.2	-38.2	52.0	398.4	25488.0	-36.1
17360.00	H	39.0	*	11.0	44.8	-37.7	57.0	706.5	25488.0	-31.1
17360.00	V	40.1	*	11.0	44.8	-37.7	58.1	803.7	25488.0	-30.0
24800.00	H	22.9	*	2.2	40.6	-30.9	34.8	55.0	25488.0	-53.3
24800.00	V	24.1	*	2.2	40.6	-30.9	36.0	63.1	25488.0	-52.1

Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp

Checked BY Richard E. King :

Richard E. King



FCC 15.247 Low Frequency Band Edge Compliance

MANUFACTURER	:	California Eastern Laboratories
MODEL NUMBER	:	ZB3212F6R4SP2-1
SERIAL NUMBER	:	121
TEST MODE	:	Transmit at 2402MHz (Ch. 0), Power Setting = 20dBm
NOTES	:	The trace represents the highest power measured inside the band with a 100kHz
	:	bandwidth. The red lines represents the 20dB down level from the peak in a
	:	100kHz bandwidth and the low frequency band edge.
TEST DATE	:	September 11, 2017
EQUIPMENT USED	:	GSFA, GSFB, RBG0

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2480MHz (Ch. 39), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions at High Band Edge
Date : September 11-15, 2017
Test Distance : 3 meters

Notes : Peak Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
2483.50	H	30.3		4.3	33.2	0.0	67.8	2464.9	5000.0	-6.1
2483.50	V	25.1		4.3	33.2	0.0	62.7	1360.8	5000.0	-11.3

Checked BY Richard E. King :

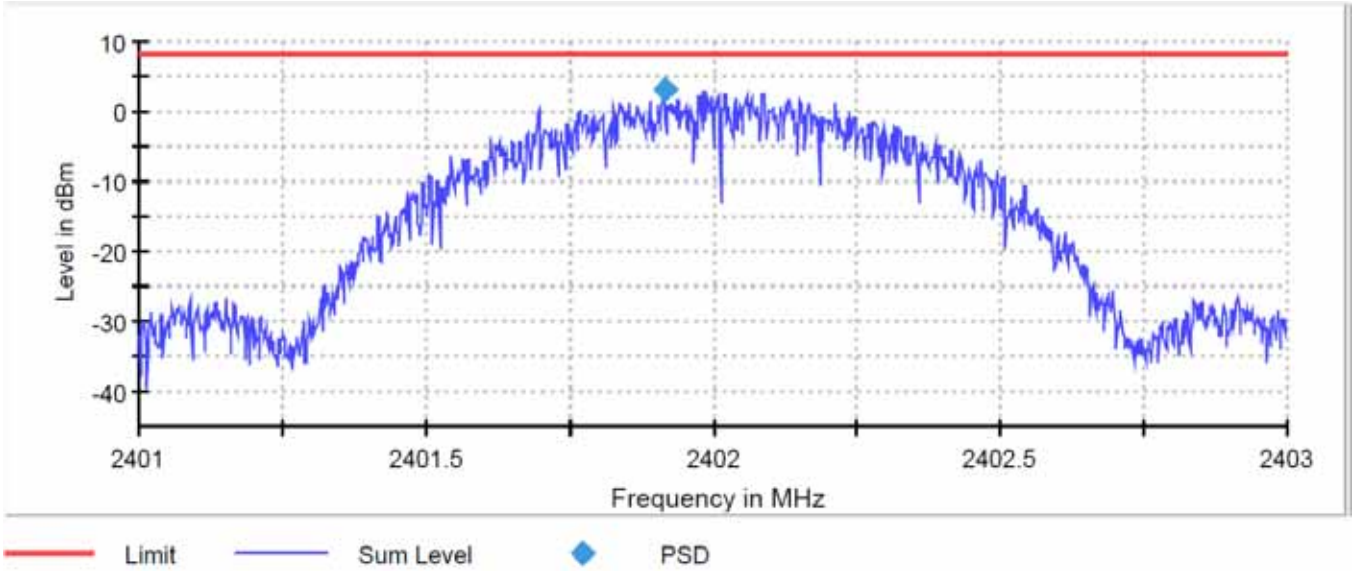
Richard E. King

Manufacturer : California Eastern Laboratories
Test Item : Bluetooth Low Energy Transceiver
Model No. : ZB3212F6R4SP2-1
Serial No. : 121
Mode : Transmit at 2480MHz (Ch. 39), Power Setting = 20dBm
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions at High Band Edge
Date : September 11-15, 2017
Test Distance : 3 meters
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2483.50	H	15.3		4.3	33.2	0.0	52.9	439.8	500.0	-1.1
2483.50	V	8.7		4.3	33.2	0.0	46.3	205.5	500.0	-7.7

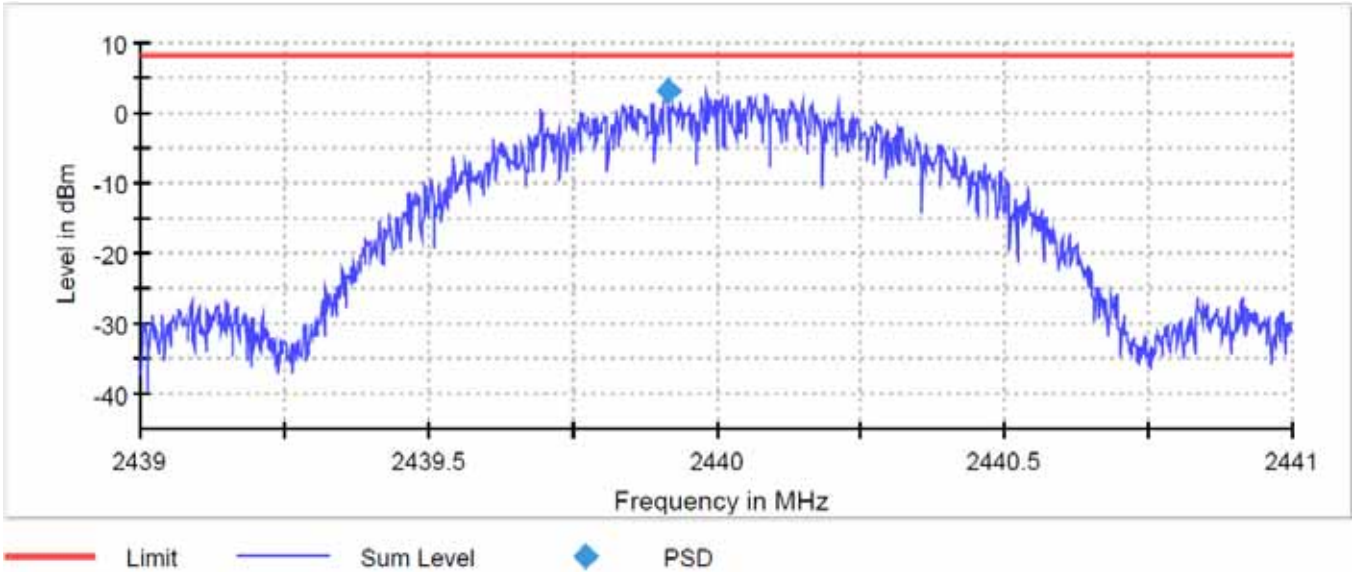
Checked BY Richard E. King :

Richard E. King



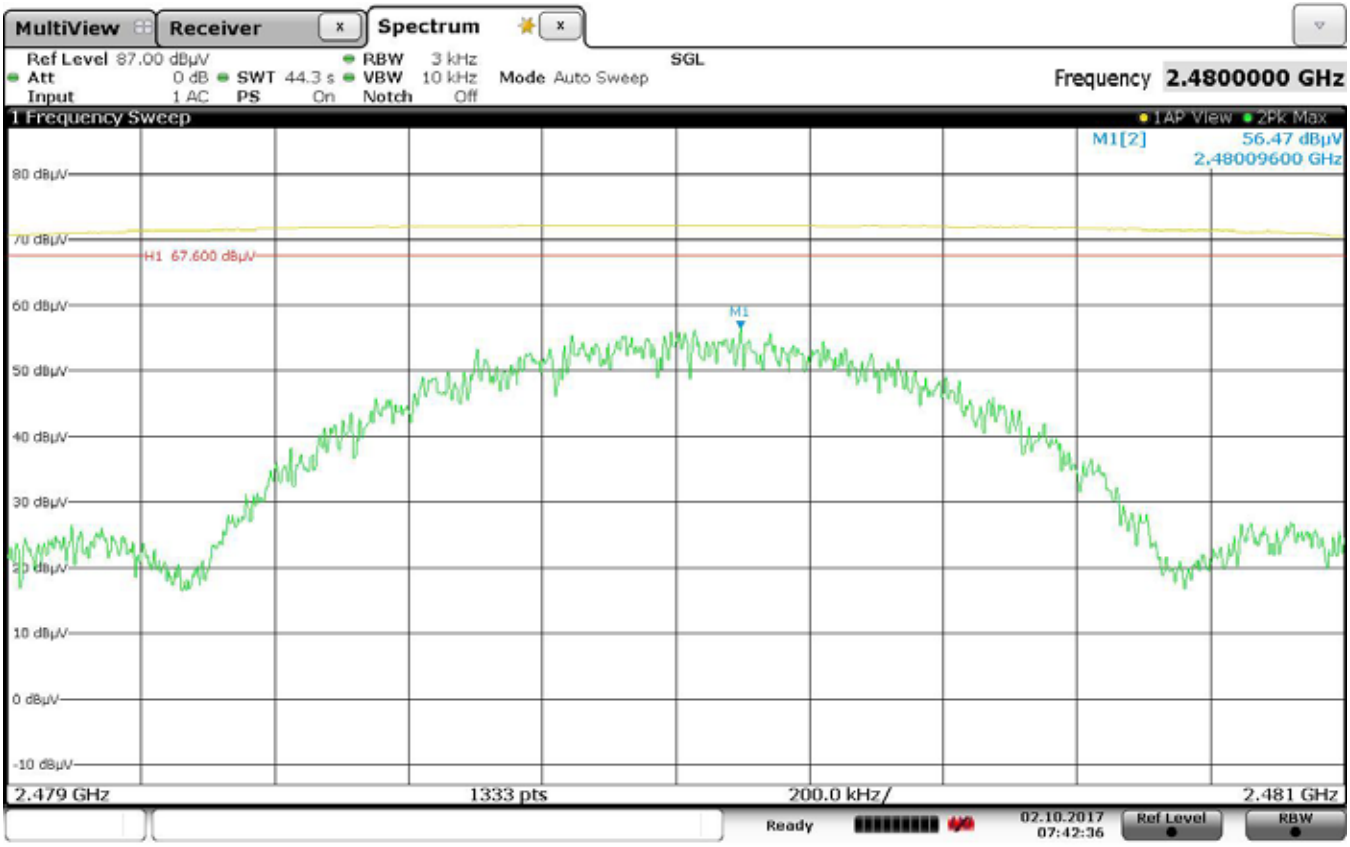
FCC 15.247 Power Spectral Density

MANUFACTURER	:	California Eastern Laboratories
MODEL NUMBER	:	ZB3212F6R4SP2-1
SERIAL NUMBER	:	121
TEST MODE	:	Transmit at 2402MHz (Ch. 0), Power Setting = 20dBm
NOTES	:	Power Spectral Density = 3.25 dBm in a 3kHz RBW
TEST DATE	:	September 11, 2017
EQUIPMENT USED	:	GSFA, GSFB, RBG0



FCC 15.247 Power Spectral Density

MANUFACTURER	:	California Eastern Laboratories
MODEL NUMBER	:	ZB3212F6R4SP2-1
SERIAL NUMBER	:	121
TEST MODE	:	Transmit at 2440MHz (Ch. 19), Power Setting = 20dBm
NOTES	:	Power Spectral Density = 3.15dBm in a 3kHz RBW
TEST DATE	:	September 11, 2017
EQUIPMENT USED	:	GSFA, GSFB, RBG0



Date: 2.OCT.2017 07:42:36

FCC 15.247 Power Spectral Density

MANUFACTURER	:	California Eastern Laboratories
MODEL NUMBER	:	ZB3212F6R4SP2-1
SERIAL NUMBER	:	121
TEST MODE	:	Transmit at 2480MHz (Ch. 39)
NOTES	:	Power Spectral Density = less than 8 dBm in a 3kHz RBW
TEST DATE	:	October 2, 2017
EQUIPMENT USED	:	NWQ1, RBG3