



Measurement of RF Interference from an Part No. SPM2335 DX2E 2Ch DSMR Radio Transmitter

For	Horizon Hobby 4015 Fieldstone Road Champaign, IL 61822
P.O. Number	20150215tk-01
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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 Frequency Hopping Spread Spectrum Intentional Radiators within the band 2400-2483.5MHz FCC "Code of Federal Regulations" Title 47, Part 15, Subpart 15B, Section 15.107 and 15.109 for Receivers Industry Canada RSS-247 Industry Canada RSS-GEN

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REVISION HISTORY

Revision	Date	Description
—	05/11/2017	Initial release

Measurement of RF Emissions from a DX2E 2Ch DSMR Radio, Part No. SPM2335 Transmitter

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Horizon Hobby DX2E 2Ch DSMR Radio, Part No. SPM2335, Serial No. S/N 1, transmitter (hereinafter referred to as the EUT). The EUT is a frequency hopping spread spectrum transmitter. The transmitter was designed to transmit and receive in the 2400-2483.5MHz band using an integral antenna. The EUT was submitted for testing by Horizon Hobby located in Champaign, 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 C, Sections 15.207 and 15.247 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 Industry Canada Radio Standards Specification RSS-Gen Section 8.8 and Industry Canada Radio Standards Specification RSS-247 for Transmitters.

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

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°C and the relative humidity was 35%.

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"
- FCC Public Notice, DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems", Released March 30, 2000
- Industry 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"
- Industry Canada RSS-GEN, Issue 4, November 2014, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements for Compliance of Radio Apparatus"

3. EUT SETUP AND OPERATION

3.1 General Description

The EUT is a DX2E 2Ch DSMR Radio, Part No. SPM2335. A block diagram of the EUT setup is shown in Figure 1 and Figure 2.

3.1.1 Power Input

The EUT was powered by 6VDC from a Spektrum NiMH Transmitter Battery Pack.

3.1.2 Peripheral Equipment

No peripheral equipment was submitted with the EUT.

3.1.3 Interconnect Cables

No interconnect cables were submitted with the EUT.

3.1.4 Grounding

The EUT was ungrounded during the tests.

3.2 Software

For all tests the EUT had Firmware Version 10.0 loaded onto the device to provide correct load characteristics.

3.3 Operational Mode

The EUT and all peripheral equipment were energized.

The EUT was energized. The unit was programmed to operate in one of the following modes:

- Transmit at 2405MHz.
- Transmit at 2440MHz.
- Transmit at 2475MHz.
- Frequency Hopping Enabled.

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 which utilizes 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 Transmitter

5.1.1 Powerline Conducted Emissions

5.1.1.1 Requirements

Since the EUT is powered by internal batteries and has no connections to AC power, no conducted emissions are required.

5.1.2 Carrier Frequency Separation

5.1.2.1 Requirements

Per section 15.247 (a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

Per section 15.247(a)(1), alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate within an output power no greater than 125mW (21dBm).

5.1.2.2 Procedures

The antenna port of the EUT was connected to the spectrum analyzer through 10dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to $> 1\%$ of the span. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the peaks of at least two adjacent channels. When the trace had stabilized after multiple scans, the marker-delta function was used to determine the separation between the peaks of the adjacent channels. The analyzer's display was plotted using a 'screen dump' utility.

5.1.2.3 Results

The plots on pages 20 through 22 show that the maximum 20 dB bandwidth was measured to be 1.23MHz. Page 23 shows the carrier frequency separation was measured to be 2.02MHz. As can be seen from these plots, the carrier frequency separation (2.02MHz) is greater than the 20dB bandwidth of the hopping channel (1.234MHz). The 99% bandwidth was measured to be 1.59MHz.

5.1.3 Number of Hopping Frequencies

5.1.3.1 Requirements

Per section 15.247(a)(1)(iii), frequency hopping systems operating in the 2400-2483.5MHz band that employ at least 15 hopping channels must have a maximum peak conducted output power that does not exceed 0.125W (21dBm).

5.1.3.2 Procedures

The antenna port of the EUT was connected to the spectrum analyzer through 10dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to $\geq$ to 1% of the span. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the entire frequency band of operation.

The EUT's signal was allowed to stabilize after multiple scans. The number of hopping frequencies was counted. The analyzer's display was plotted using a 'screen dump' utility.

5.1.3.3 Results

Page 24 shows the number of hopping frequencies. As can be seen from this plot, the number of hopping frequencies is 23 which is equal to (or greater than) 15 which is the minimum number of required hopping frequencies for systems operating in the 2400-2483.5MHz band that have a maximum peak conducted output power that does not exceed 0.125W (21dBm).

5.1.4 Time of Occupancy

5.1.4.1 Requirements

Per section 15.247(a)(1)(iii), for frequency hopping systems operating in the 2400-2483.5MHz band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

5.1.4.2 Procedures

The antenna port of the EUT was connected to the spectrum analyzer through 10dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to 1 MHz. The peak detector and 'Max-Hold' function were engaged. With the span set to 0Hz, the sweep time was adjusted to capture a single event in order to measure the dwell time per hop. The analyzer's display was plotted using a 'screen dump' utility. Then, the sweep time was expanded to 0.4 seconds multiplied by the number of hopping channels employed.

5.1.4.3 Results

Page 25 shows the plot for the time of occupancy (dwell time). As can be seen from the plot, the time of occupancy can be determined by 840uS multiplied by 23. This calculated value is equal to .019 seconds which is less than the 0.4 seconds maximum allowed.

5.1.5 Peak Output Power

5.1.5.1 Requirements

Per section 15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5MHz band that do not employ at least 75 non-overlapping hopping channels, the maximum peak output conducted power shall not be greater than 0.125W (21dBm). 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 0.5 Watt (27dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below 21dBm by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Per 15.247(b)(4)(c)(1)(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

5.1.5.2 Procedures

The EUT was placed on the non-conductive stand and set to transmit. A bilog antenna (double ridged waveguide antenna for all measurements above 1GHz) 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 20dB bandwidth. The span was set to approximately 5 times the 20 dB 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 hopping frequencies.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a dipole antenna (double ridged waveguide antenna for all measurements above 1GHz) 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.

5.1.5.3 Results

The results are presented on page 26. The maximum EIRP measured from the transmitter was 19.3 dBm or 0.085 W which is below the 0.125 Watt limit.

5.1.6 Duty Cycle Factor Measurements

5.1.6.1 Procedures

The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal.

With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer. This trace is obtained by tuning center frequency to the transmitter frequency and then setting a zero span width with 1msec/div (adjust this for what you need). The amplitude settings are adjusted so that the on/off transitions clear the 4th division from the bottom of the display. The markers are set at the beginning and end of the “on-time”. The trace is recorded.

Next the spectrum analyzer center frequency is set to the transmitter frequency with a zero span width and 10msec/div. This shows if the word is longer than 100msec or shorter than 100msec. If the word period is less than 100msec, the display is set to show at least one word. The on-time and off-time are then measured. The on-time is total time signal level exceeds the 4th division. Off-time is time under for the word period. The duty cycle is then computed as the (On-time/ word period) where the word period = (On-time + Off-time).

5.1.6.2 Results

The plots of the duty cycle are shown on data page 27. Duty Cycle = $20 \cdot \log((840 \mu\text{S} \cdot 9)/100\text{mS}) = -22.4\text{dB}$

5.1.7 Radiated Spurious Emissions Measurements

5.1.7.1 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).

5.1.7.2 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 open field 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. 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.

If the dwell time per channel of the hopping signal is less than 100msec, then the reading obtained with the 10 Hz video bandwidth may be further adjusted by a "duty cycle correction factor", derived from $20 \cdot \log(\text{dwell time}/100\text{msec})$. These readings must be no greater than the limits specified in 15.209(a).

5.1.7.3 Results

Preliminary radiated emissions plots with the EUT transmitting at Low Frequency, Middle Frequency, and High Frequency are shown on pages 28 through 50. Final radiated emissions data is presented on data pages 51 through 59. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown in Figures 3 through 6.

5.1.8 Band Edge Compliance

5.1.8.1 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).

5.1.8.2 Procedures

5.1.8.2.1 Low Band Edge

- 1) The EUT was set up inside the test chamber on a non-conductive stand.
- 2) A broadband measuring antenna was placed at a test distance of 3 meters from the EUT.
- 3) The EUT was set to transmit continuously at the channel closest to the low band-edge hopping function disabled.
- 4) The EUT was maximized for worst case emissions at the measuring antenna. The maximum meter reading was recorded.
- 5) 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) $\geq 1\%$ of the span.
 - 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.
- 6) Step 5) was repeated with the frequency hopping function enabled.

5.1.8.2.2 High Band Edge

- 1) The EUT was set to transmit continuously at the channel closest to the high band edge hopping function disabled.
- 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.
- 8) Steps 1 through 7 were repeated with the hopping enabled.

5.1.8.3 Results

Pages 60 through 65 show the radiated band edge compliance results. As can be seen from these plots, the radiated 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.

6. CONCLUSIONS

It was determined that the Horizon Hobby DX2E 2Ch DSMR Radio, Part No. SPM2335 frequency hopping spread spectrum transmitter, Serial No. S/N 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.

It was also determined that the Horizon Hobby DX2E 2Ch DSMR Radio, Part No. SPM2335 frequency hopping spread spectrum transmitter, Serial No. S/N 1, did fully meet the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 8.8 and Section 7.1.2 for receivers and the Industry Canada Radio Standards Specification RSS-Gen Section 8.8 and Radio Standards Specification RSS-247 for transmitters, when tested per ANSI C63.4-2014.

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

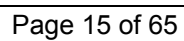
Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW11	PREAMPLIFIER	PMI	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	3/22/2017	3/22/2018
GRD0	SIGNAL GENERATOR	HEWLETT PACKARD	E4432B	US38080222	250KHZ-3.0GHZ	8/24/2016	8/24/2017
GRE2	SIGNAL GENERATOR	AGILENT	E4438C	MY42081749	250KHZ-6GHZ	3/21/2017	3/21/2018
GSE0	SIGNAL GENERATOR (40GHZ)	ROHDE & SCHWARZ	SMB100A	175137	100KHZ-40GHZ	3/3/2017	3/3/2018
GSFA	OSP-B157 OSP MODULE	ROHDE & SCHWARZ	OSP-B157	100867		9/9/2016	9/9/2017
GSFB	OSP120 BASE UNIT	ROHDE & SCHWARZ	OSP120	101246	---	9/9/2016	9/9/2017
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	11/27/2016	11/27/2017
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/4/2016	4/4/2018
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	3/2/2016	3/2/2018
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20HZ-26.5GHZ	5/10/2017	5/10/2018
RBE0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU26	100095	20Hz-26GHz	9/15/2016	9/15/2017
RBG0	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101533	10HZ-44GHZ	11/10/2016	11/10/2017
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	11/22/2016	11/22/2017
TVH4	VARIABLE ATTENUATOR	HEWLETT PACKARD	8496B	3308A71145	DC-18GHZ	1/4/2017	1/4/2019
XPQ4	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000-O/O	1	4.8-20GHZ	9/14/2016	9/14/2017

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.



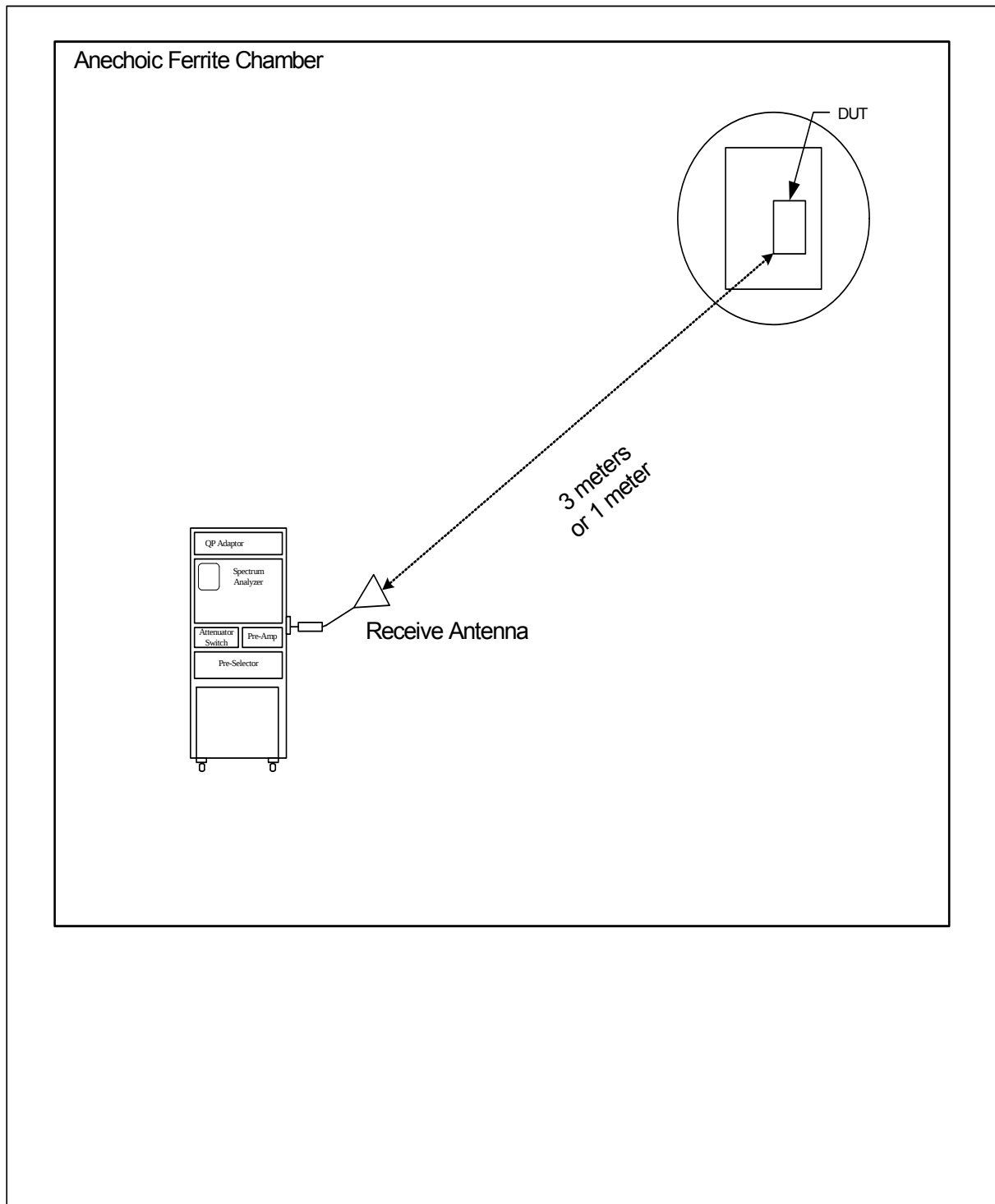
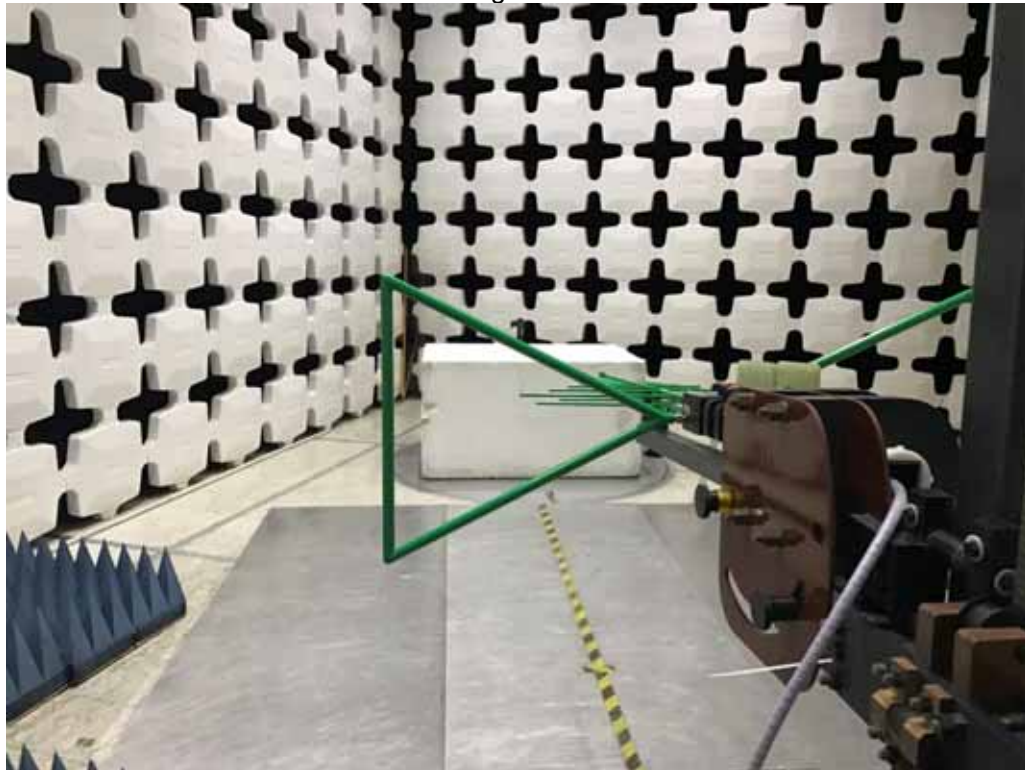


Figure 2: BLOCK DIAGRAM OF TEST SETUP FOR RADIATED EMISSIONS ABOVE 18GHZ

Figure 3



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

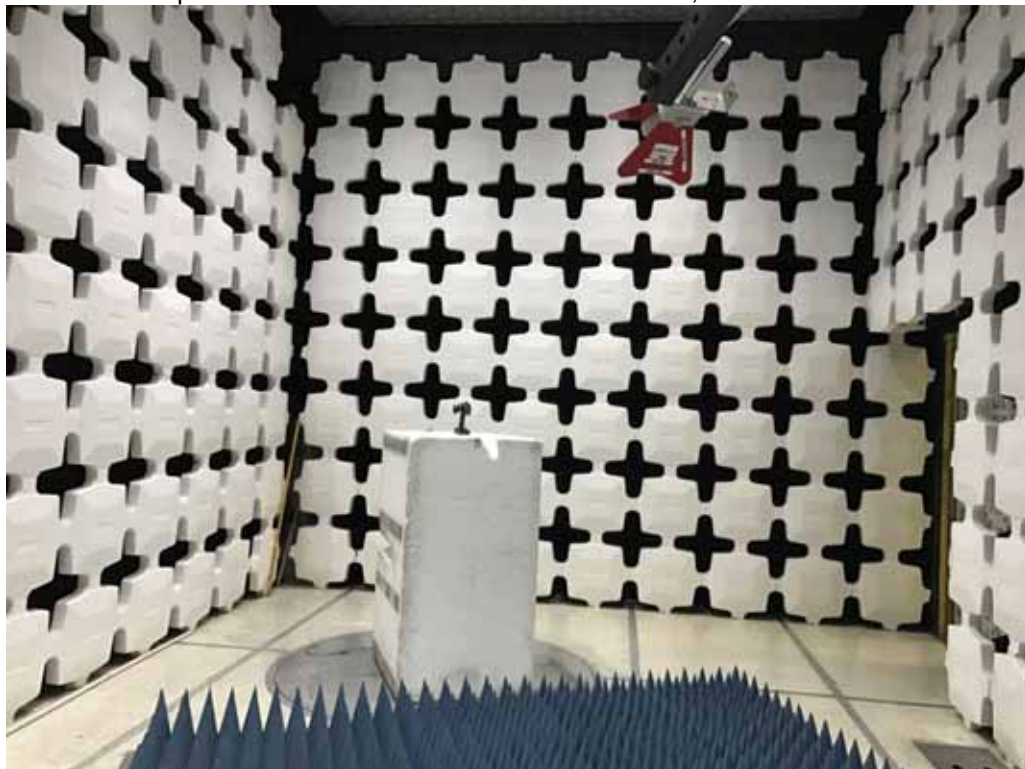


Test Setup for Radiated Emissions – 30MHz to 1GHz, Vertical Polarization

Figure 4



Test Setup for Radiated Emissions – 2GHz to 18GHz, Horizontal Polarization



Test Setup for Radiated Emissions – 2GHz to 18GHz, Vertical Polarization

Figure 5



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



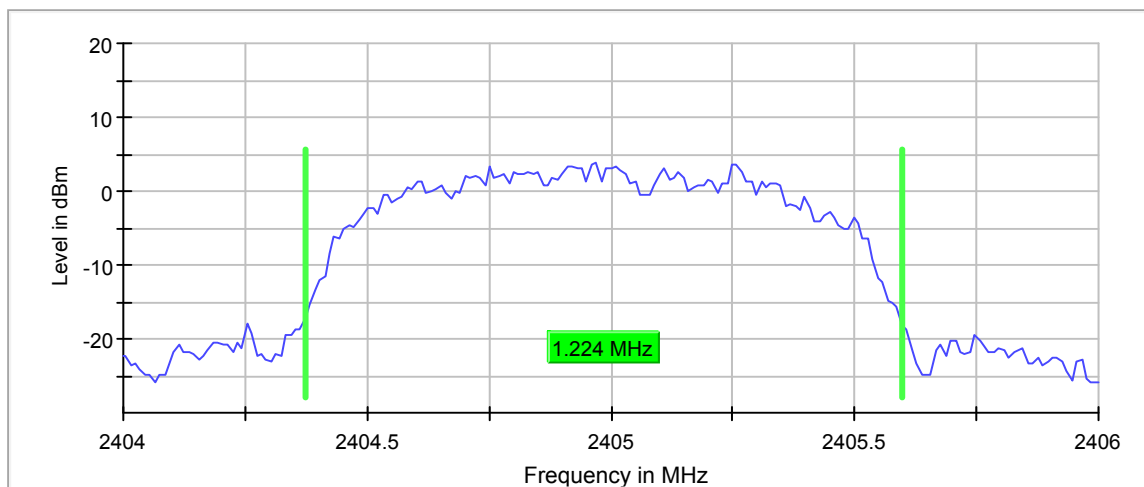
Test Setup for Radiated Emissions – 18GHz to 25GHz, Vertical Polarization

Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Test Mode : Transmitting
 Test Performed : 20dB Bandwidth
 Test Date : March 22, 2017

20 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
2405.000000	1.223881	---	---	2404.363184	2405.587065	-18.3	PASS

Low Frequency:

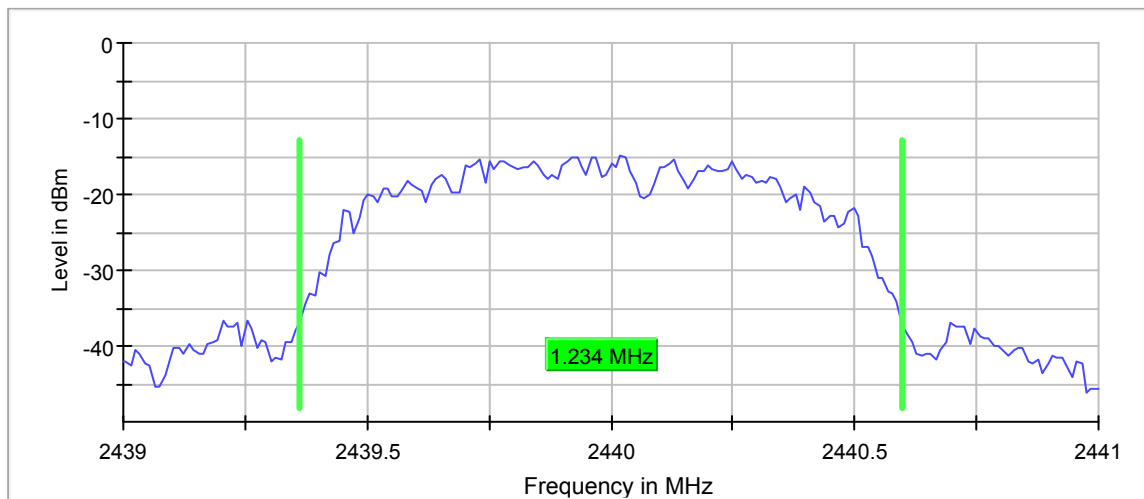


Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Test Mode : Transmitting
 Test Performed : 20dB Bandwidth
 Test Date : March 22, 2017

20 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	1.233831	---	---	2439.363184	2440.597015	-14.9	PASS

Mid Frequency:

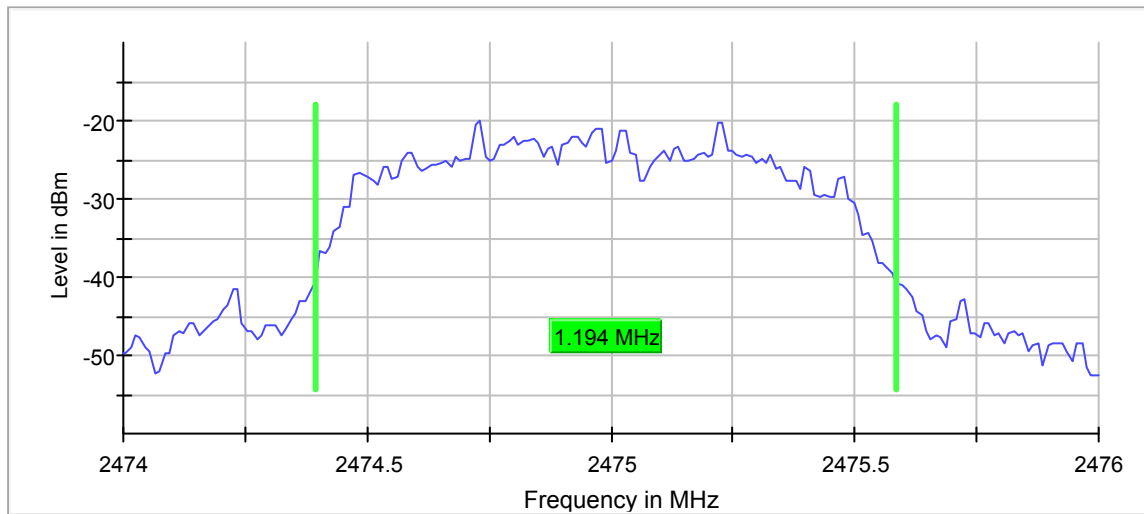


Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Test Mode : Transmitting
 Test Performed : 20dB Bandwidth
 Test Date : March 22, 2017

20 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
2475.000000	1.194030	---	---	2474.393035	2475.587065	-19.9	PASS

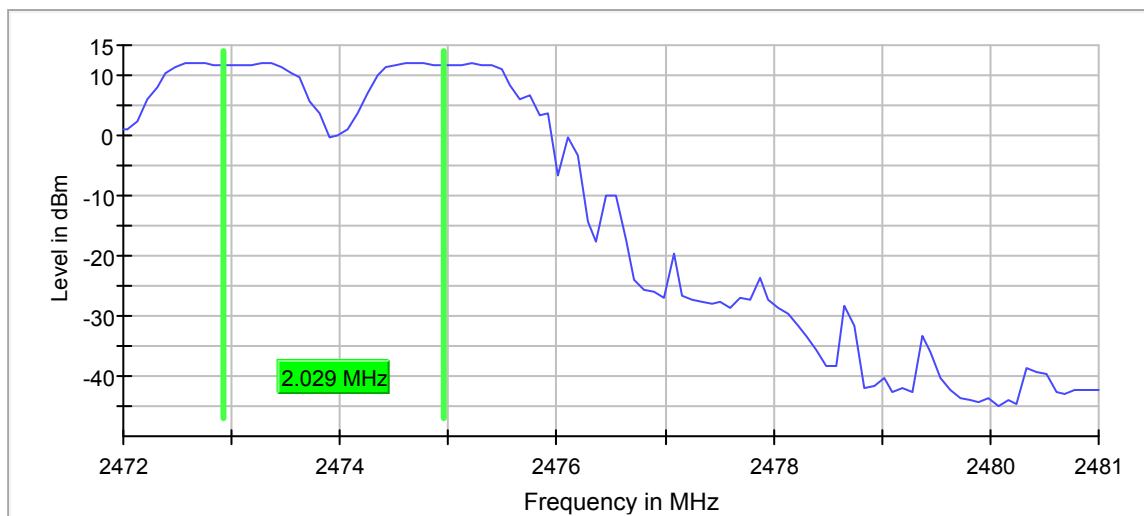
High Frequency:



Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Test Mode : Transmitting
 Test Performed : Carrier Frequency Separation
 Test Date : March 22, 2017

Carrier Frequency Separation

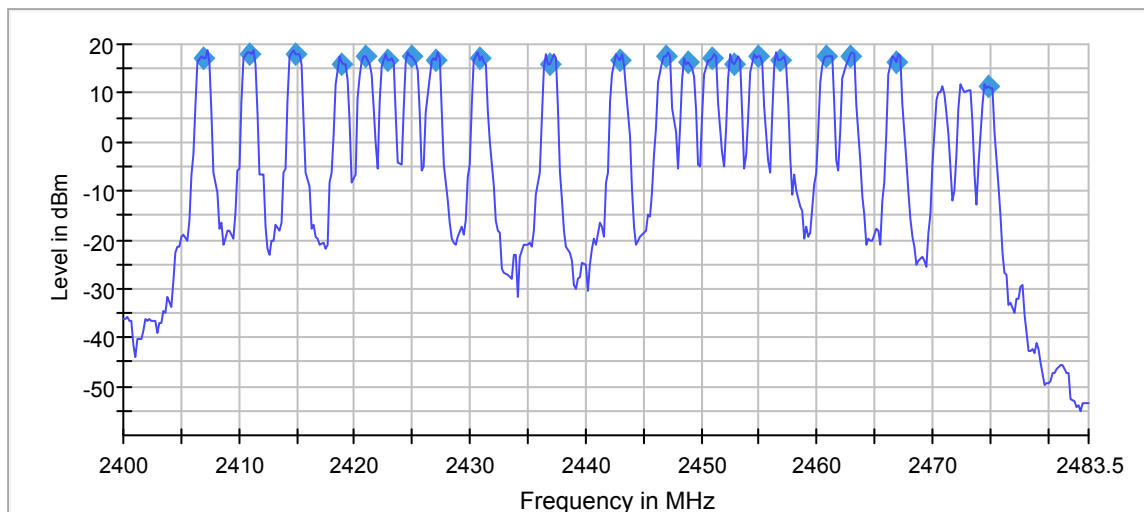
DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)	Result
2475.000000	2.029411	0.822554	---	2472.926471	2474.955882	PASS



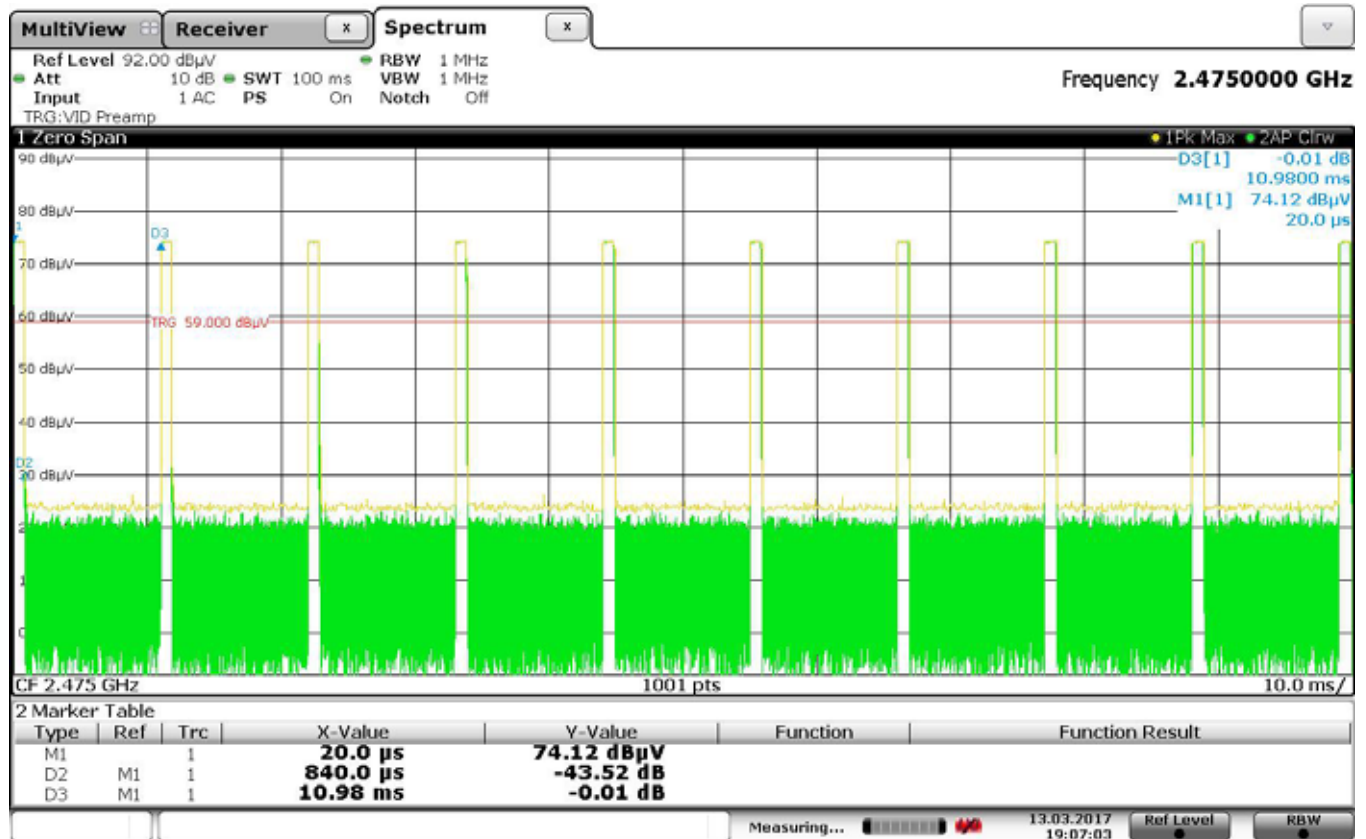
Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Test Mode : Frequency Hopping
 Test Performed : Number of Hopping Freqs = 23
 Test Date : March 22, 2017

Hopping Frequencies

Channels	Limit Min	Limit Max	Result
23	15	---	PASS



Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Test Mode : Frequency Hopping
 Test Performed : Time of Occupancy
 Test Date : March 22, 2017

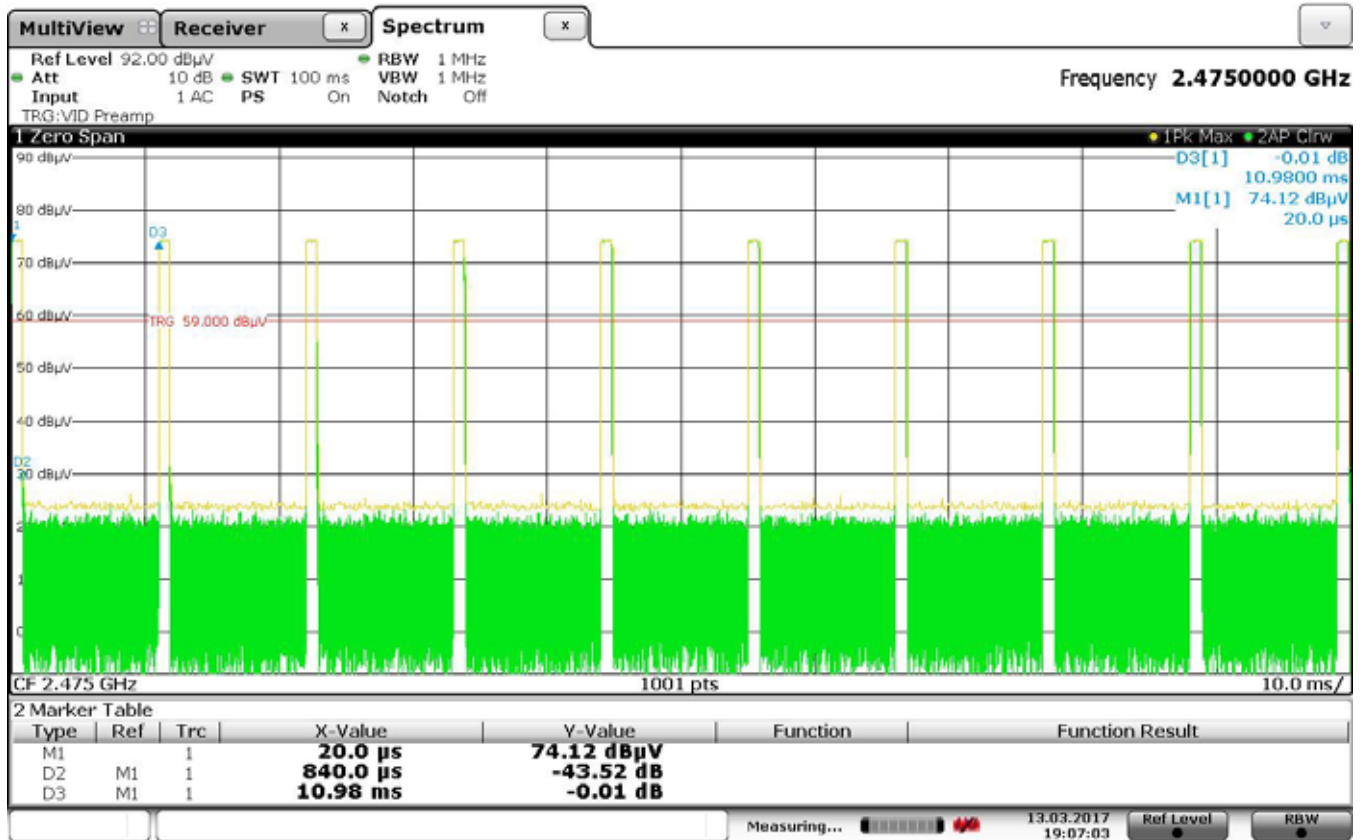


Date: 13.MAR.2017 19:07:03

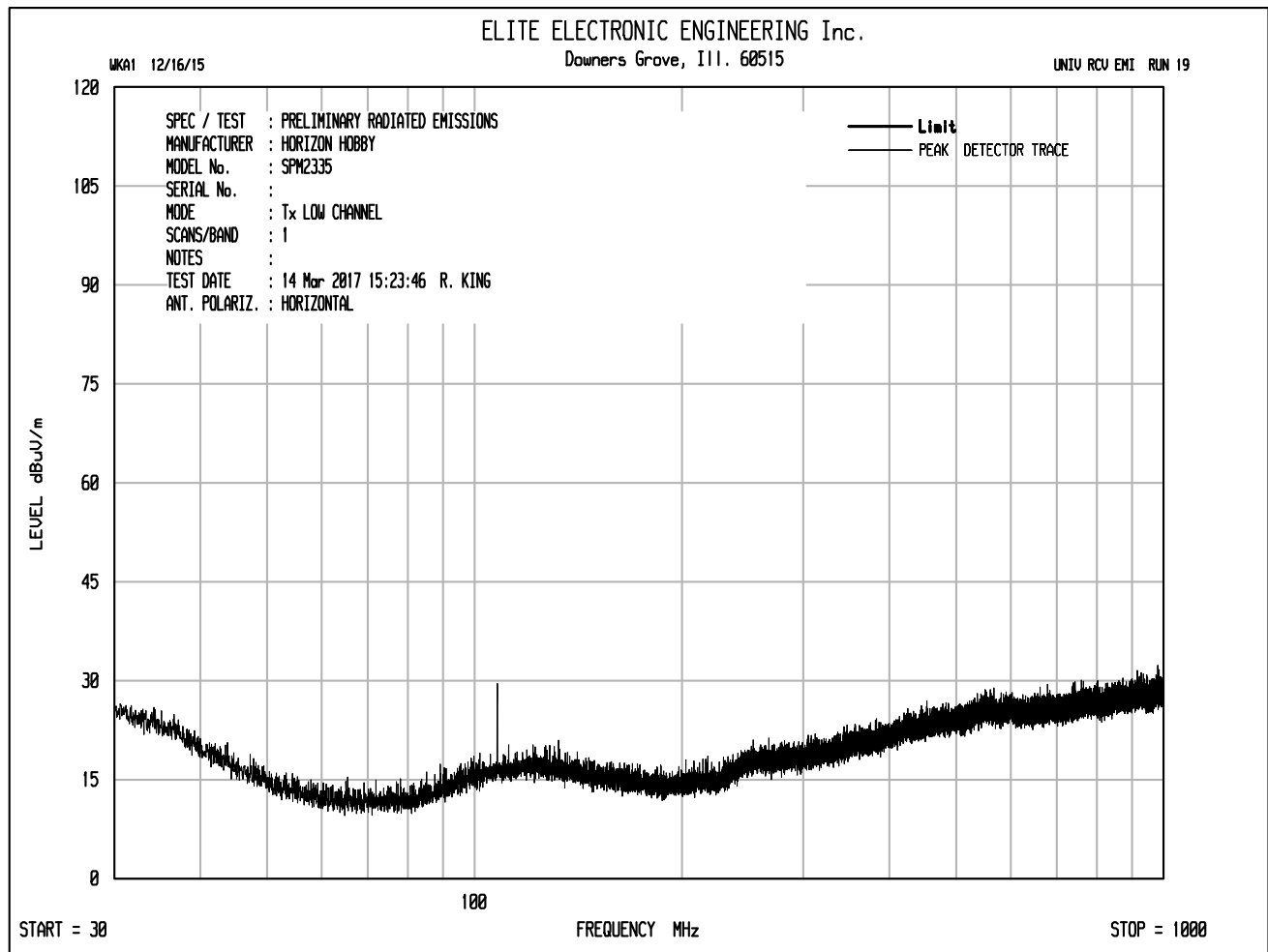
Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Transmitting
 Test Specification : FCC-15.247, RSS-247 Peak Output Power
 Date : March 22, 2017
 Test Distance : 3
 Notes :

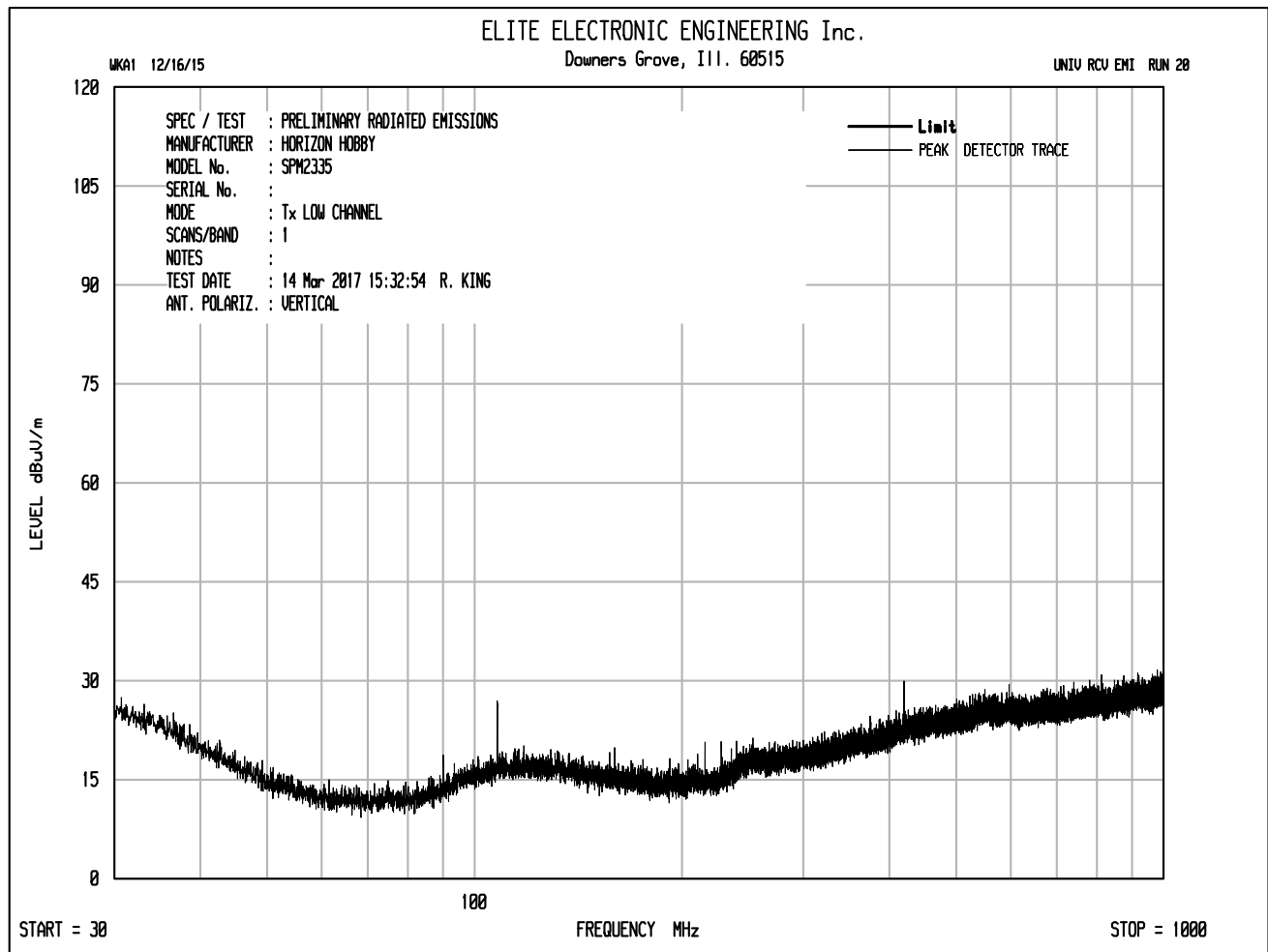
Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2405.00	H	74.4	9.1	4.8	4.1	9.8	27.0	-17.2
2405.00	V	77.9	13.5	4.8	4.1	14.2	27.0	-12.8
2440.00	H	78.7	13.5	4.8	4.2	14.1	27.0	-12.9
2440.00	V	82.9	18.6	4.8	4.2	19.3	27.0	-7.7
2475.00	H	71.0	5.8	4.9	4.2	6.5	27.0	-20.5
2475.00	V	75.0	10.7	4.9	4.2	11.4	27.0	-15.6

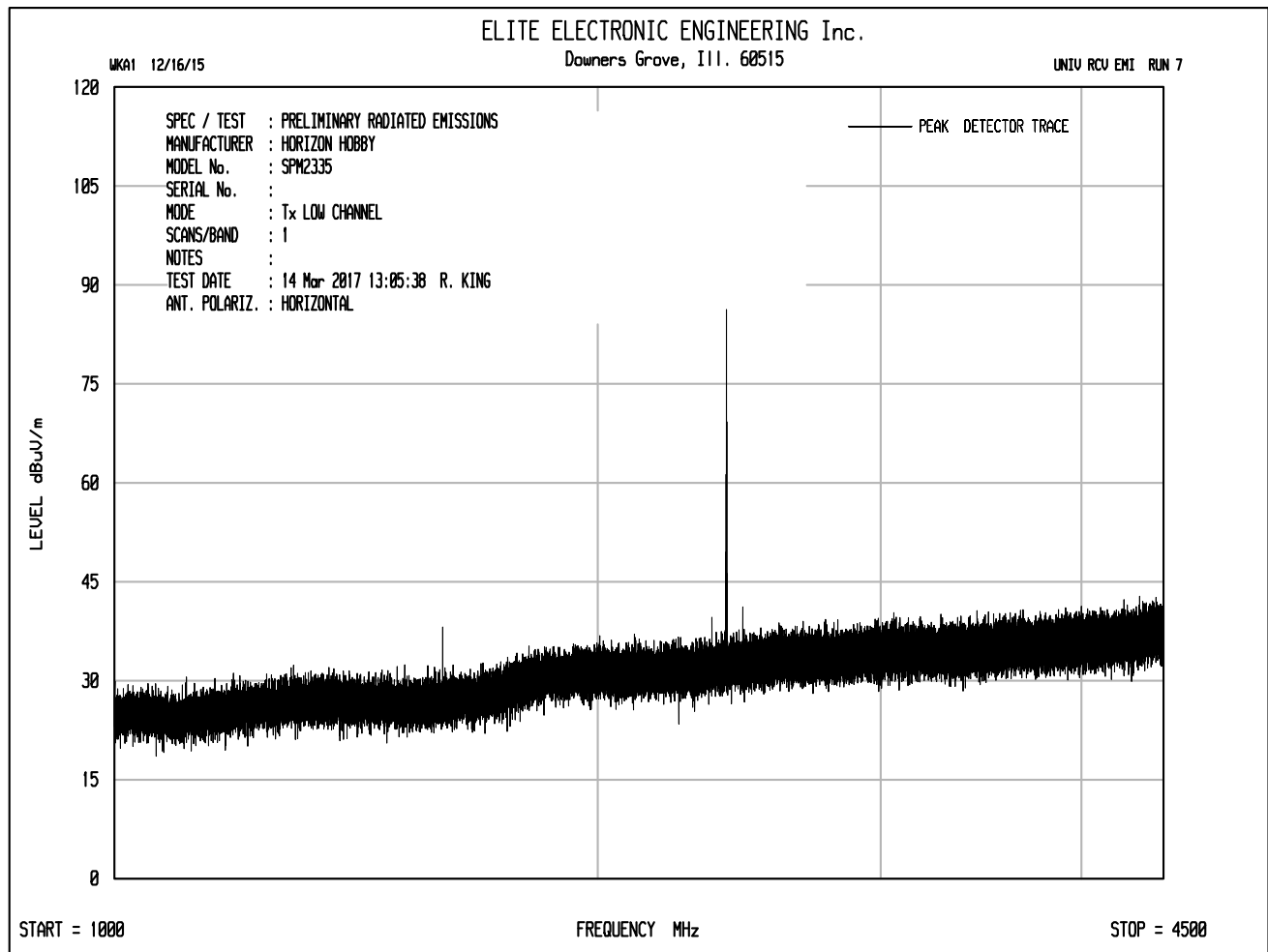
Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Transmitting
 Test Specification : FCC-15.247, RSS-247 Duty Cycle
 Date : March 13, 2017
 Notes : Duty Cycle = $20 \times \text{LOG}((840\mu\text{S} \times 9)/100\text{mS}) = -22.4\text{dB}$

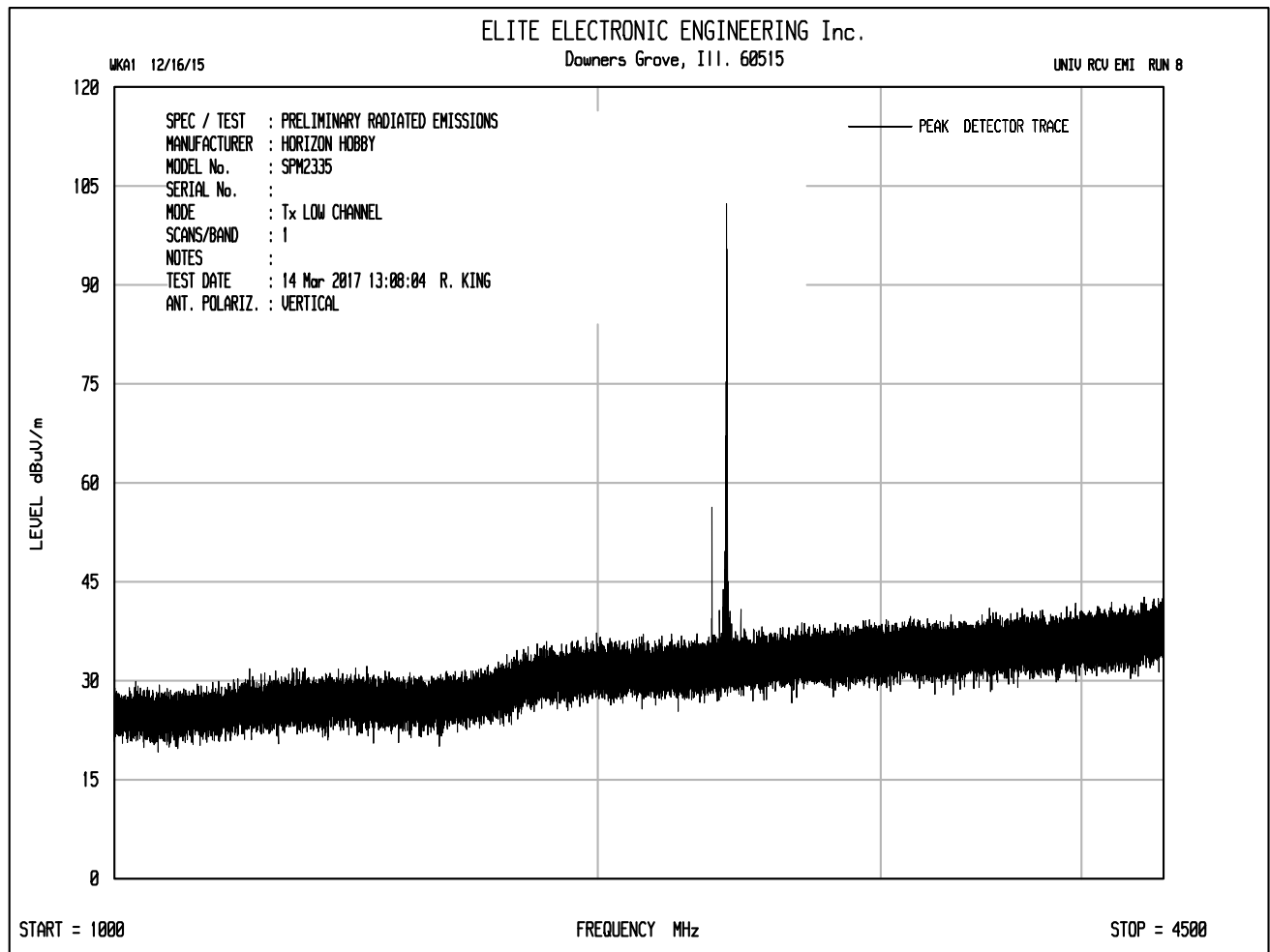


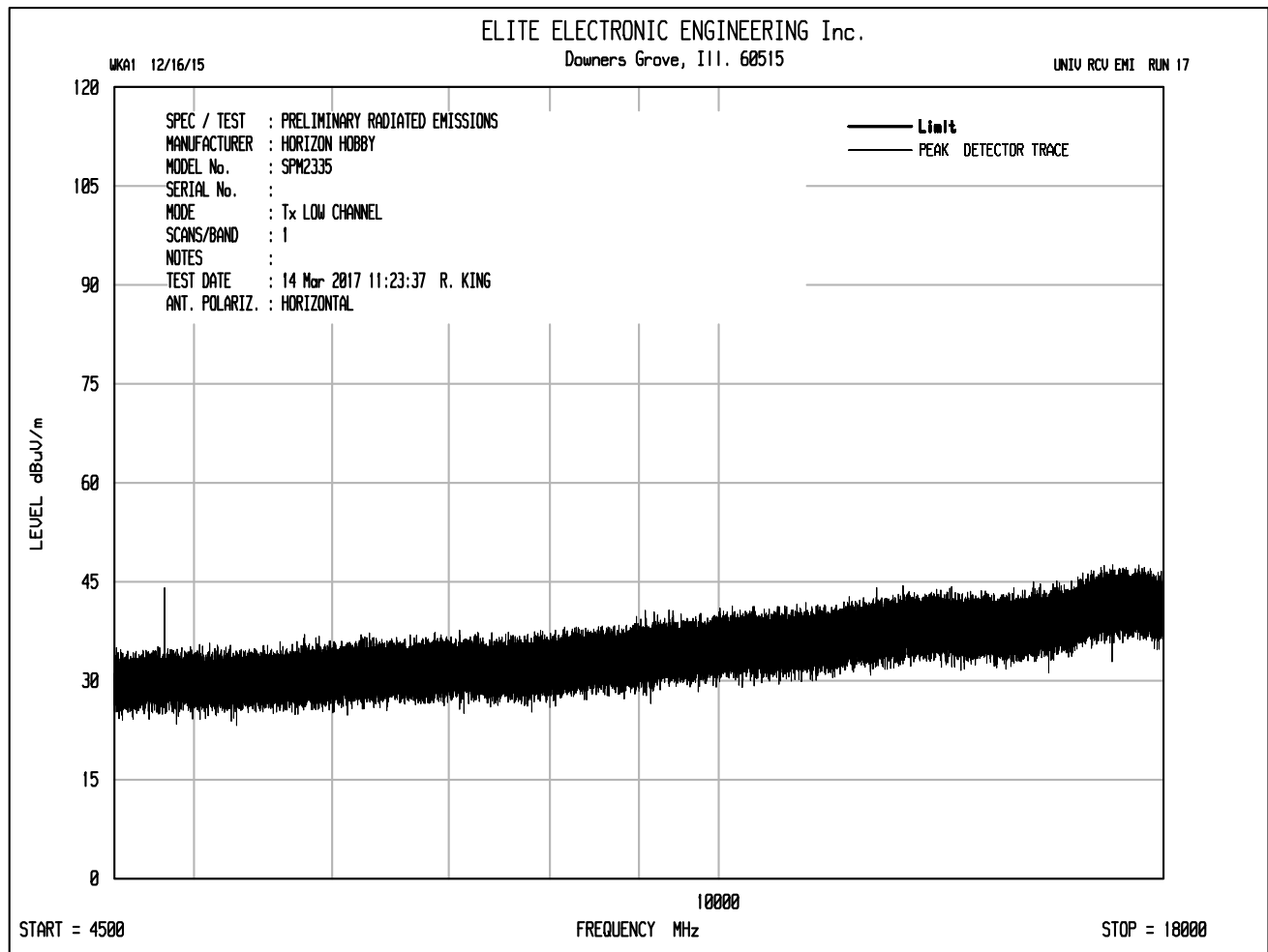
Date: 13.MAR.2017 19:07:03

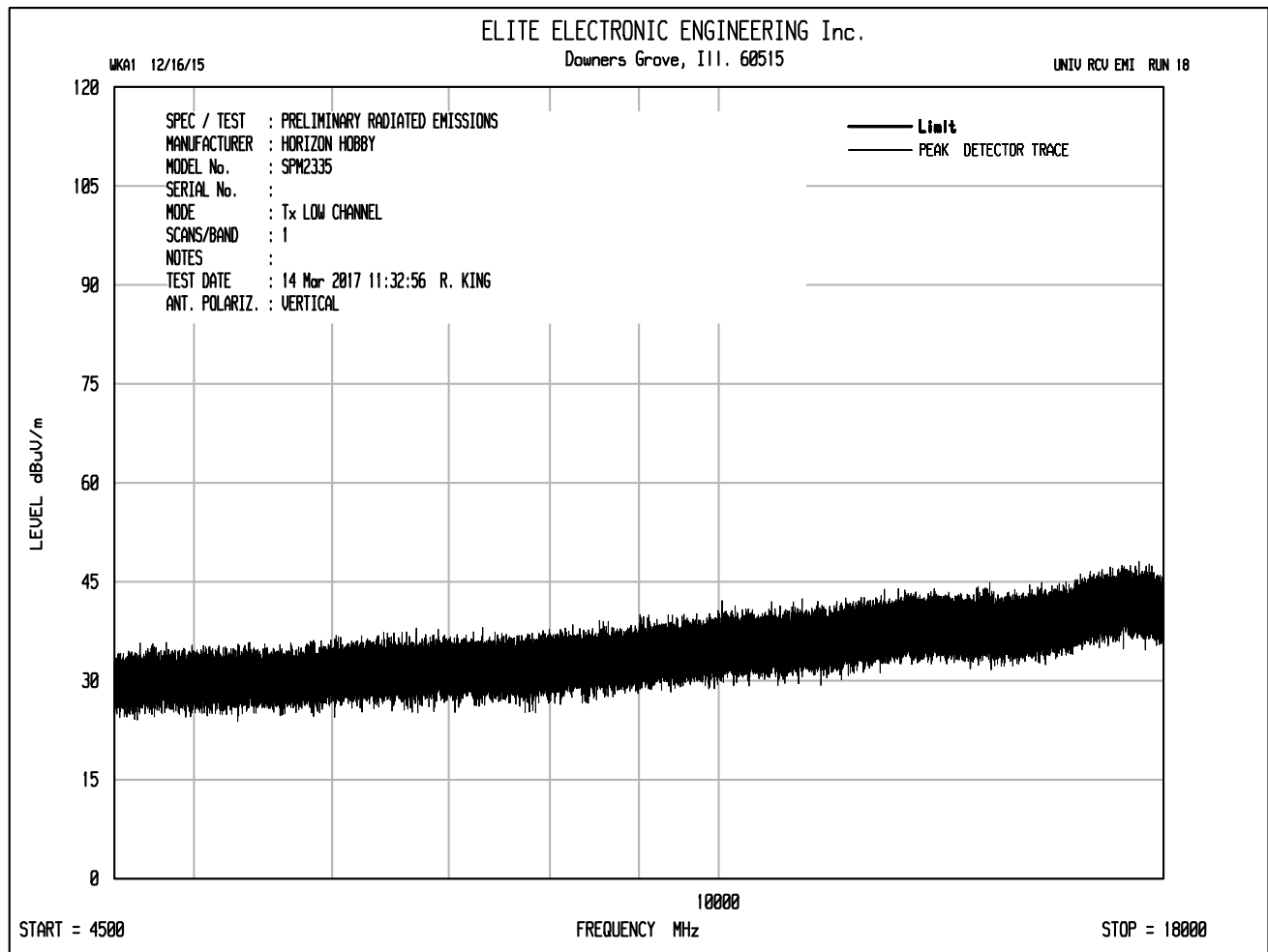


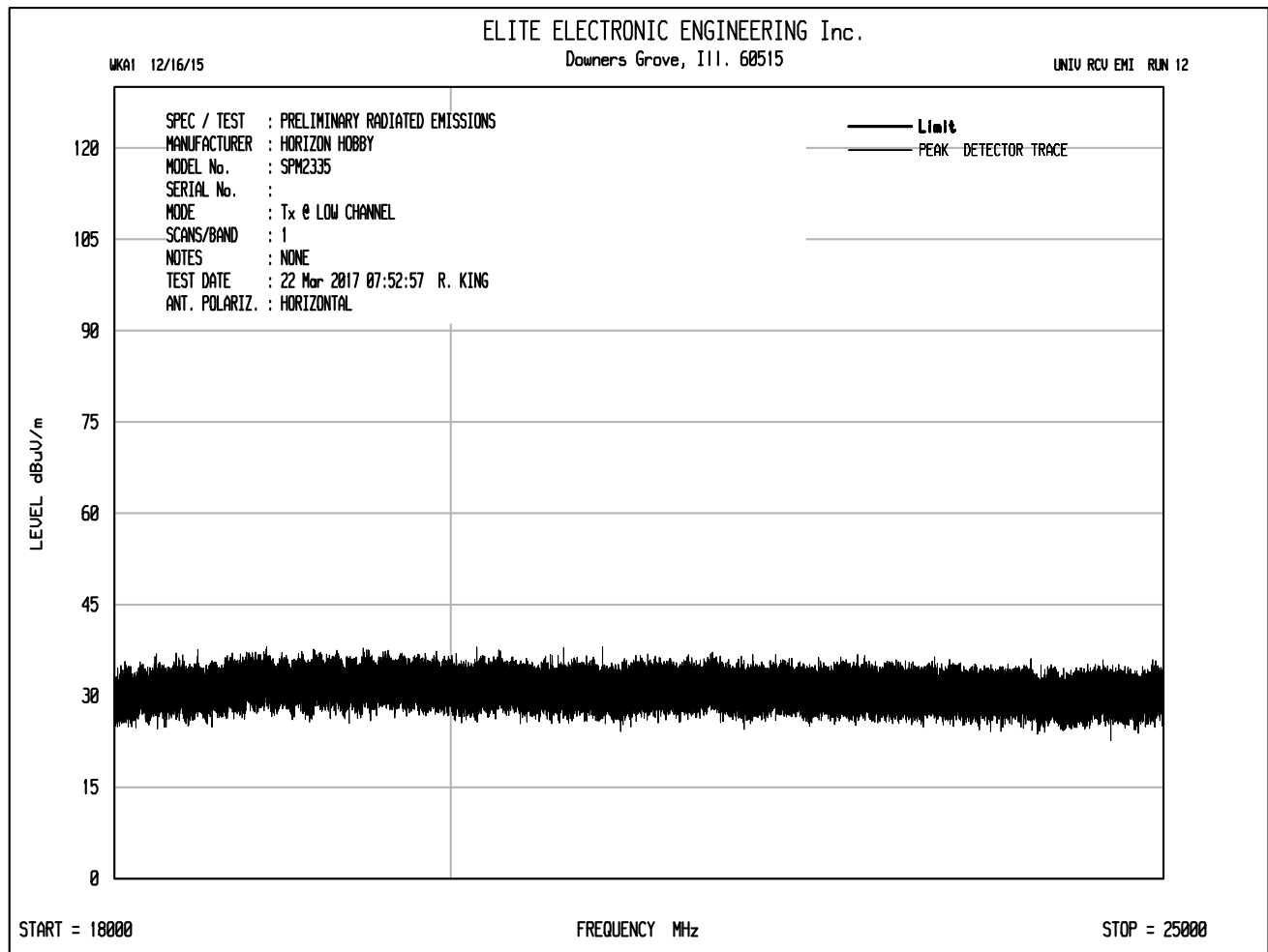


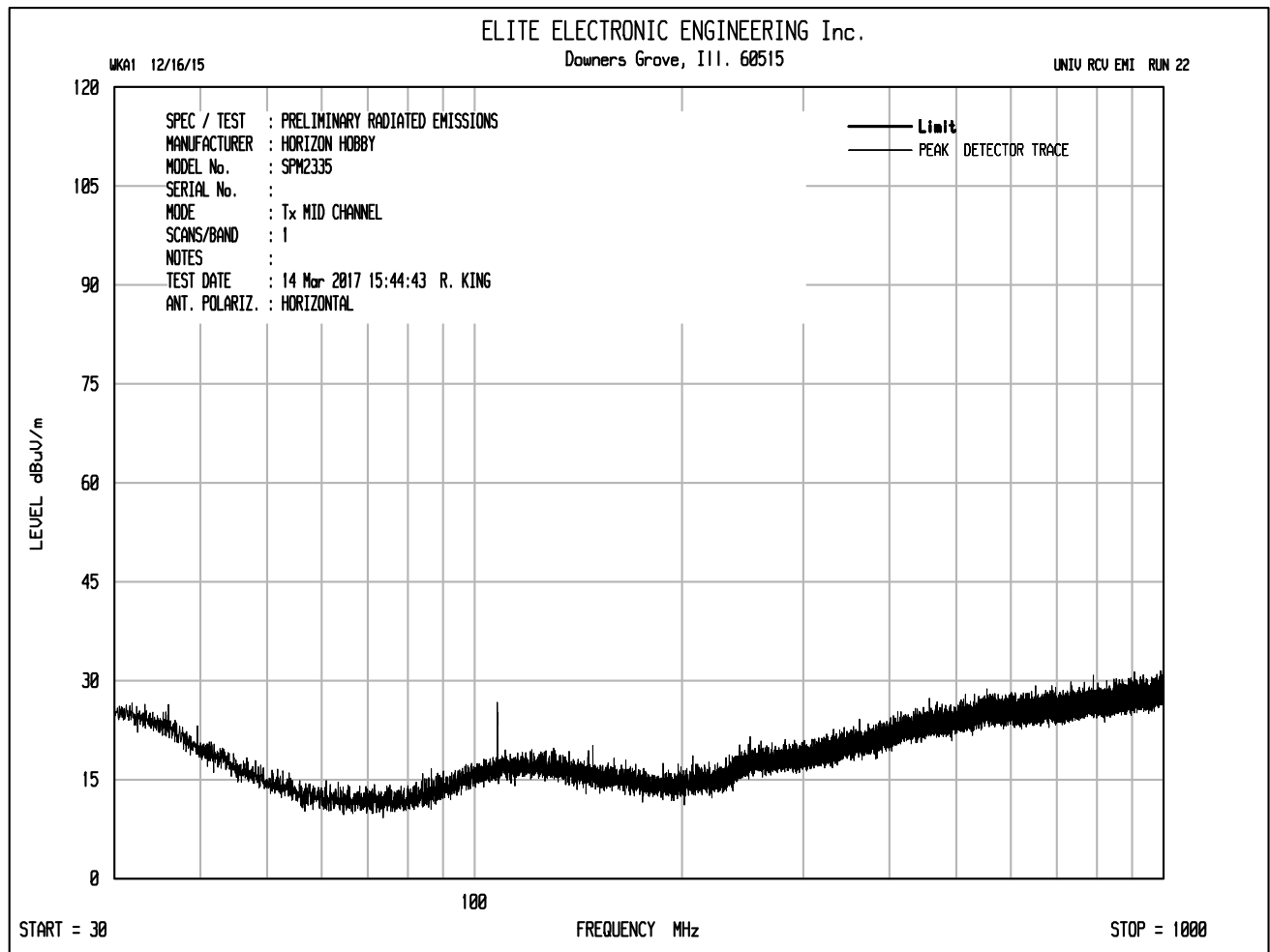


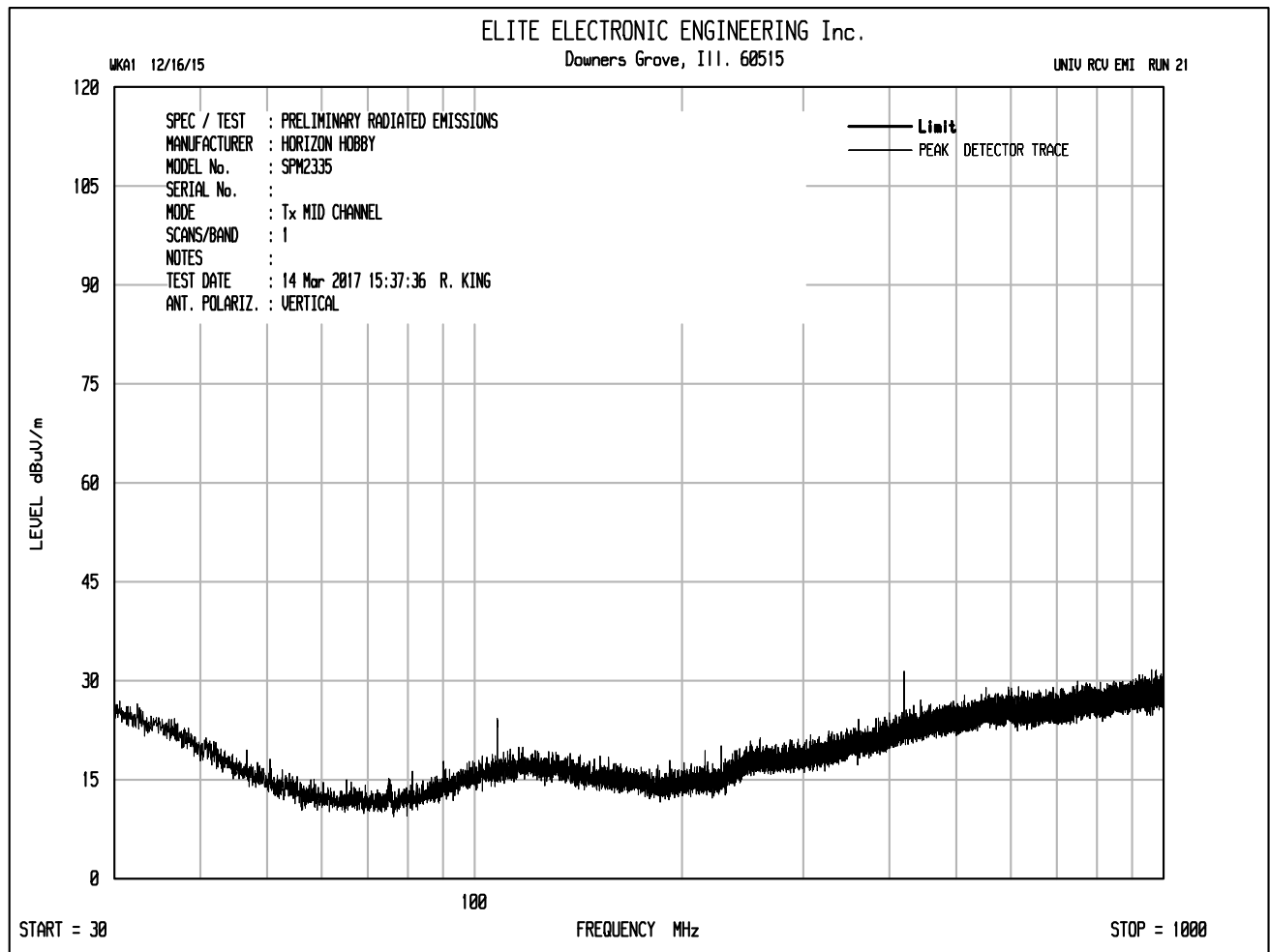


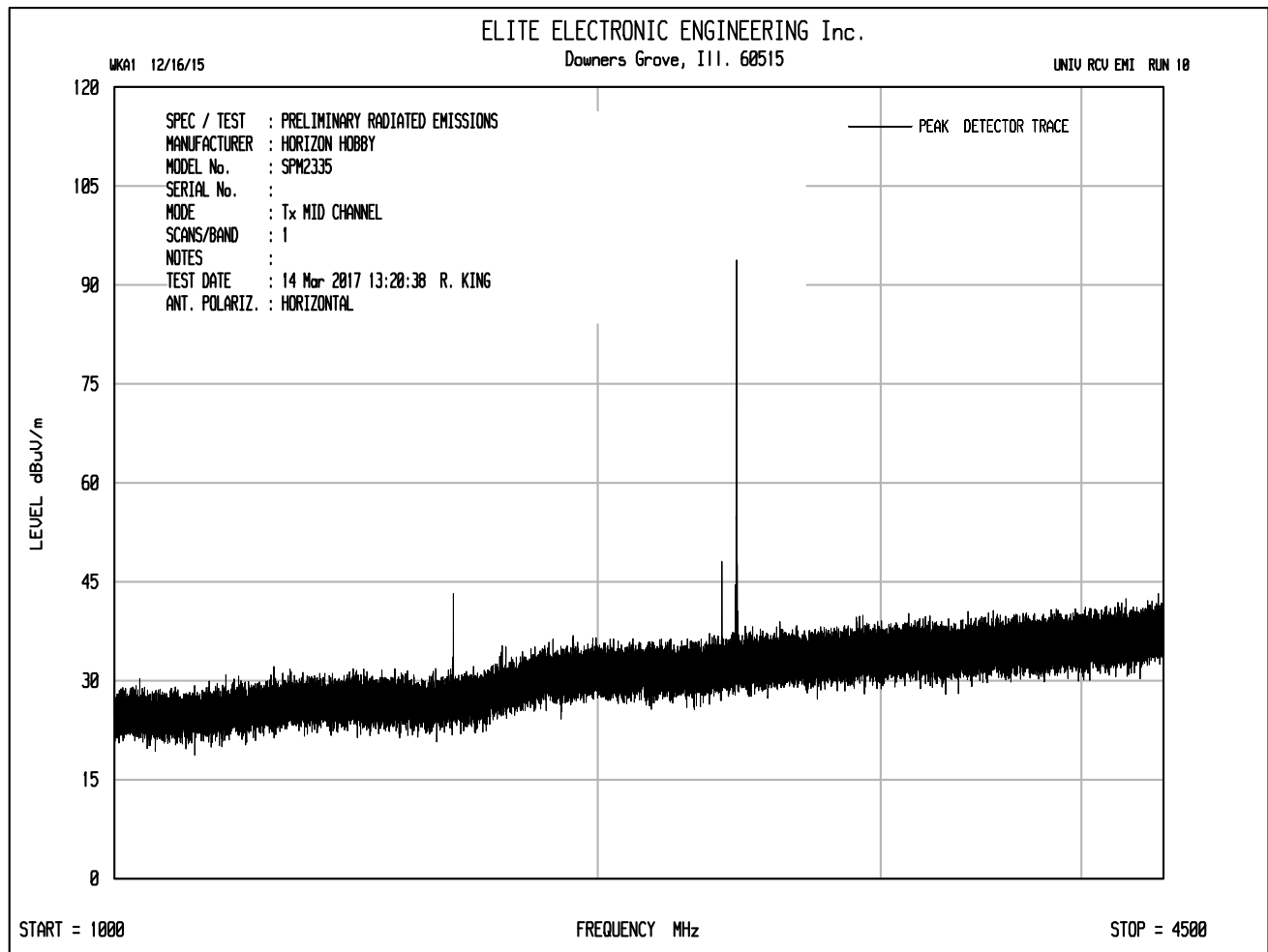


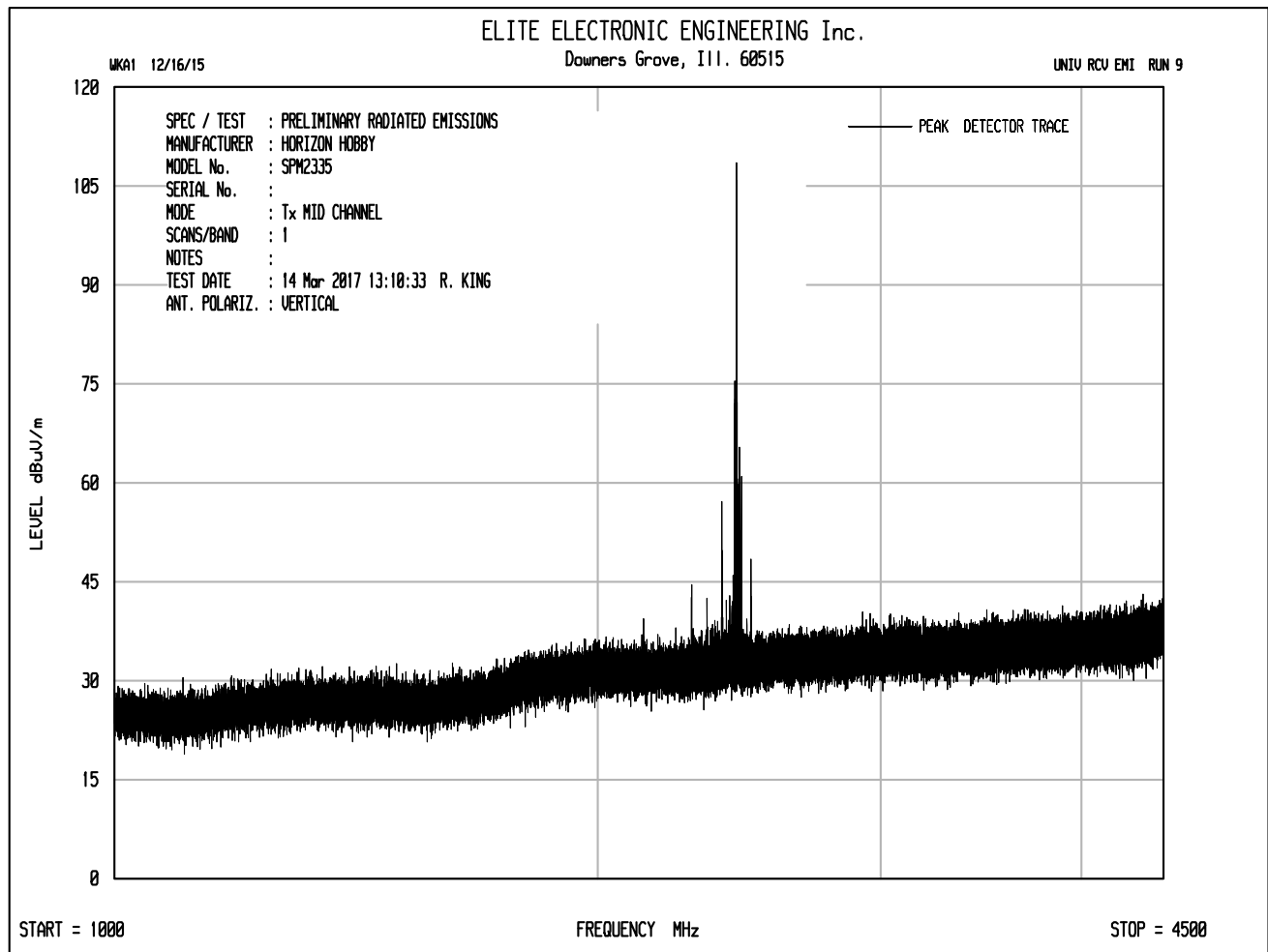


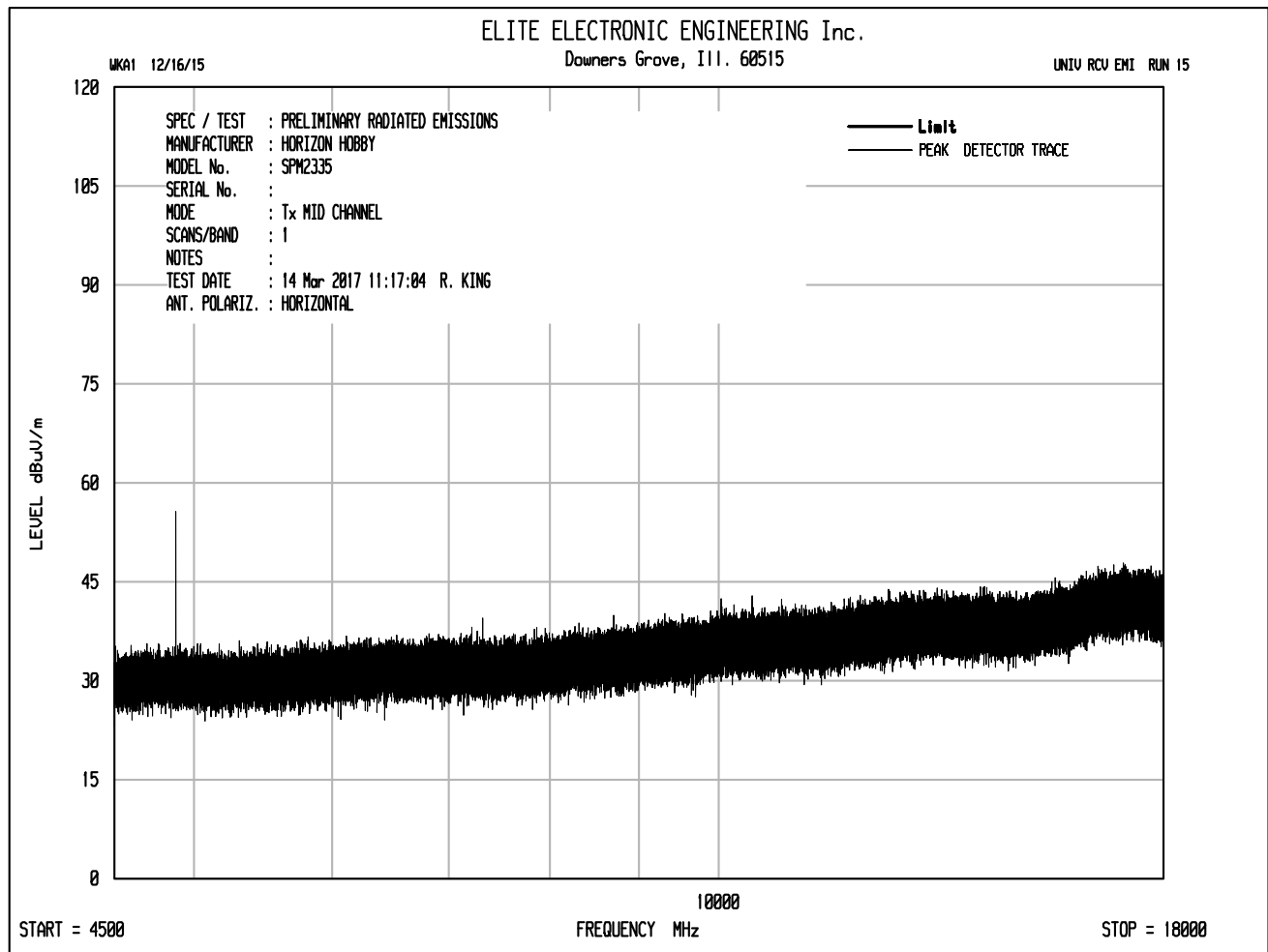


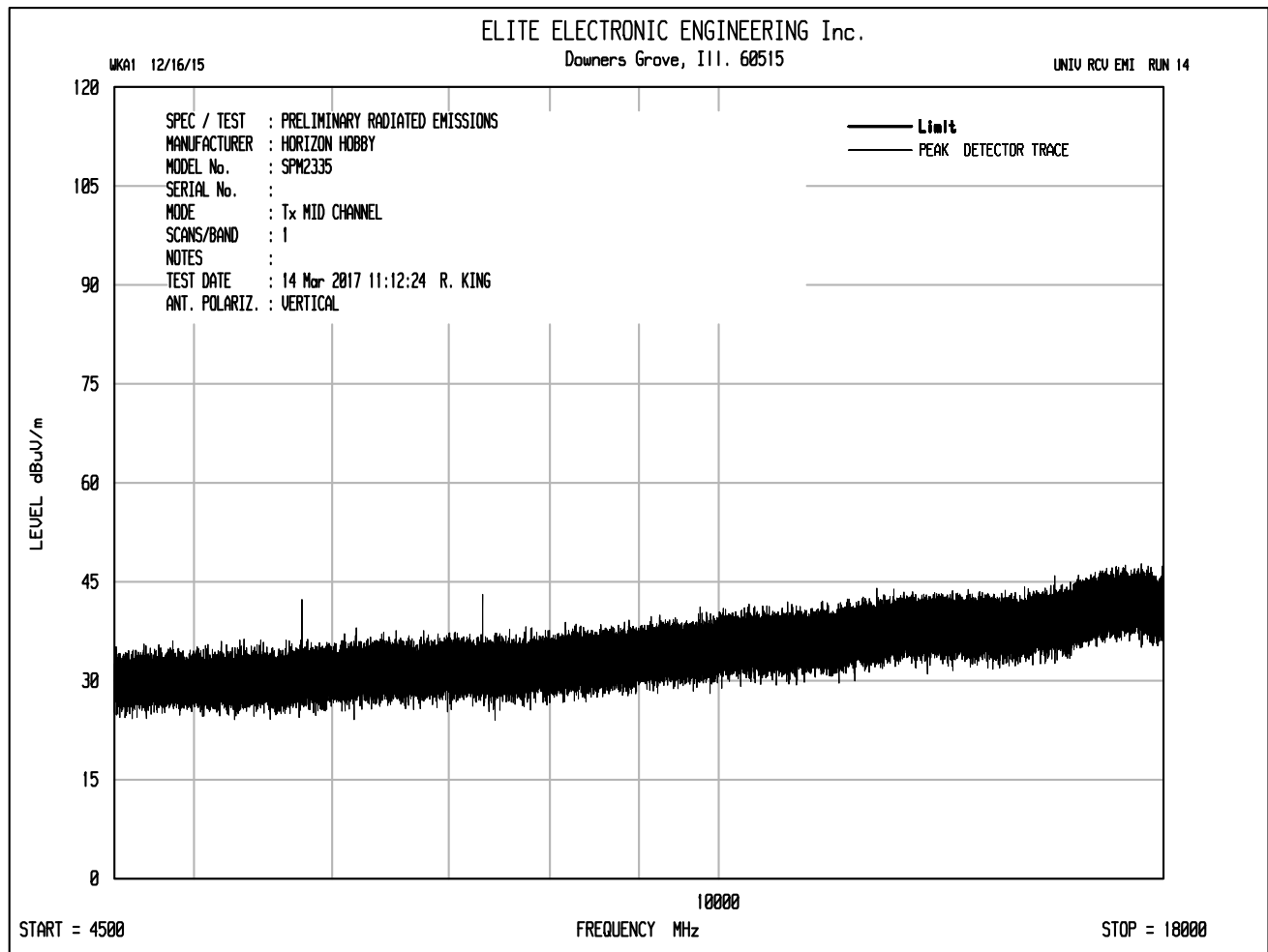


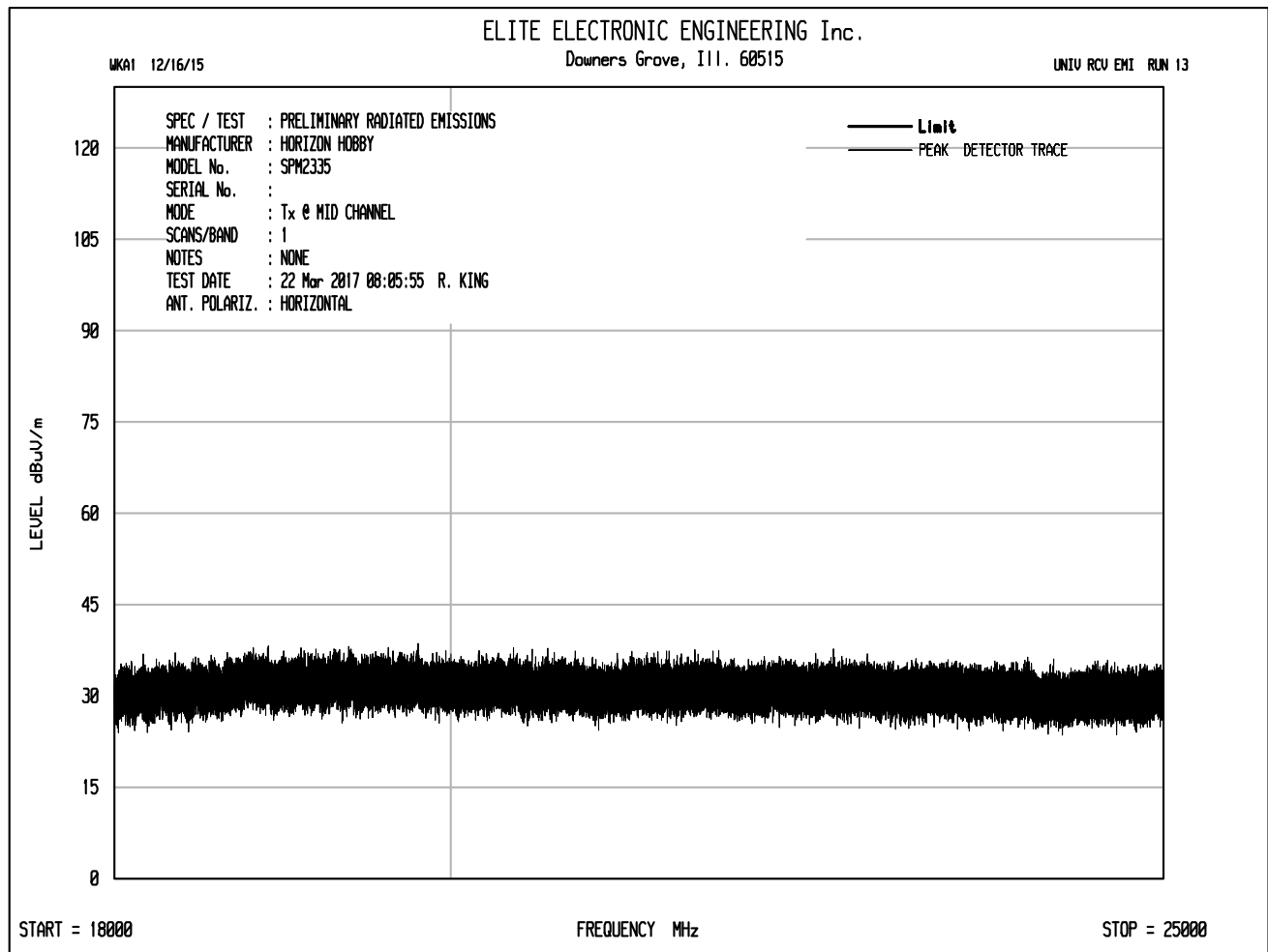


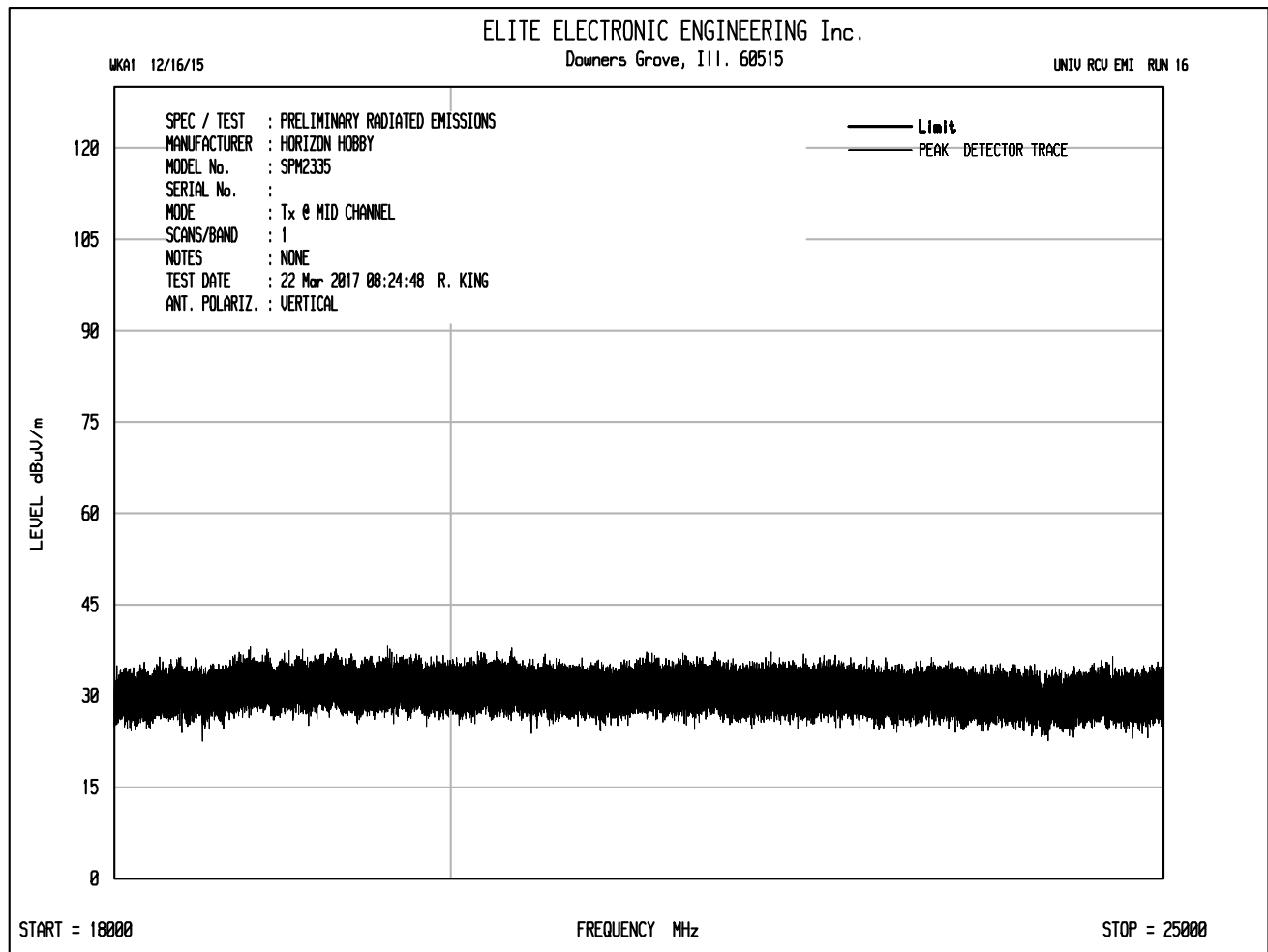


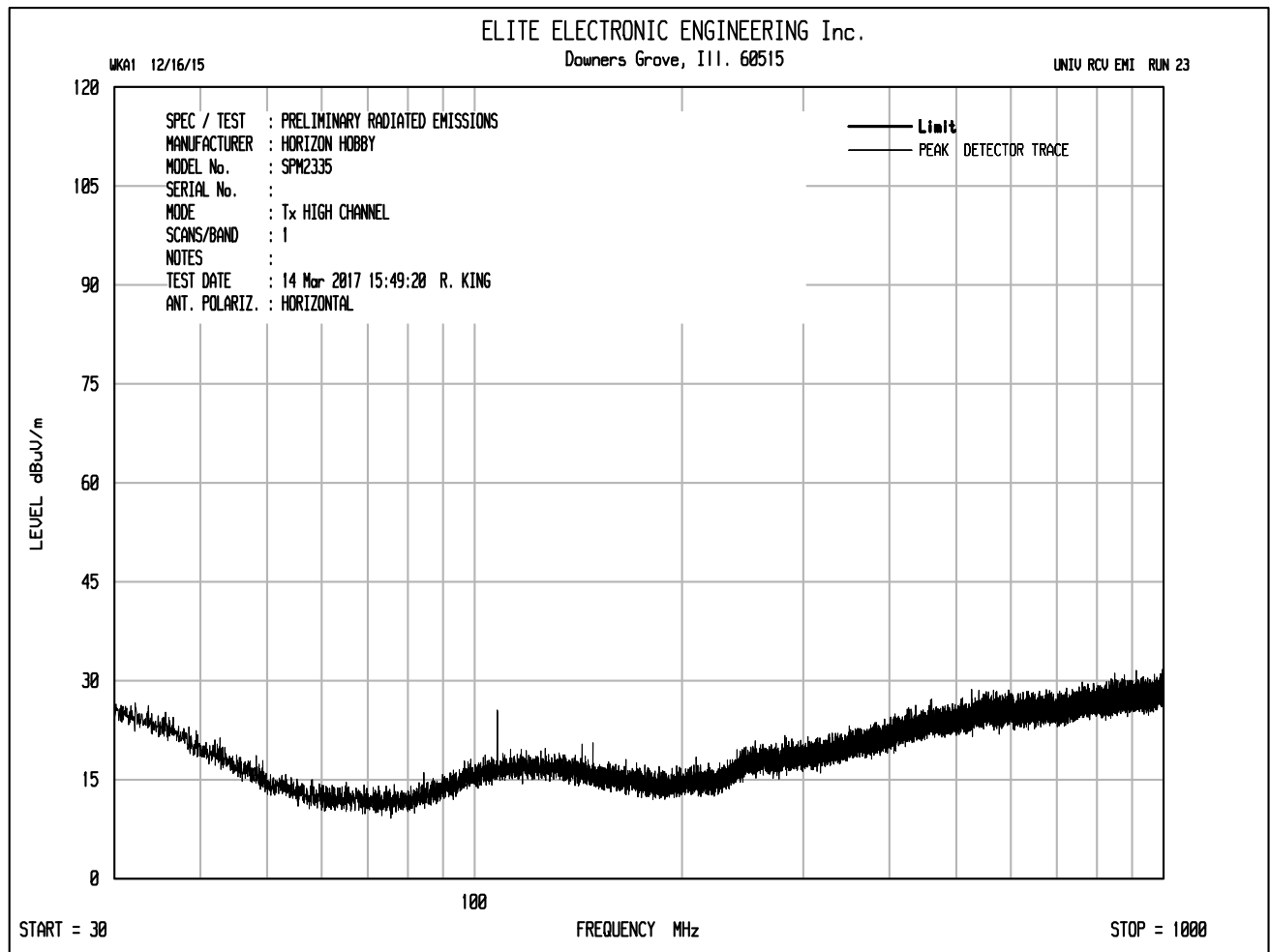


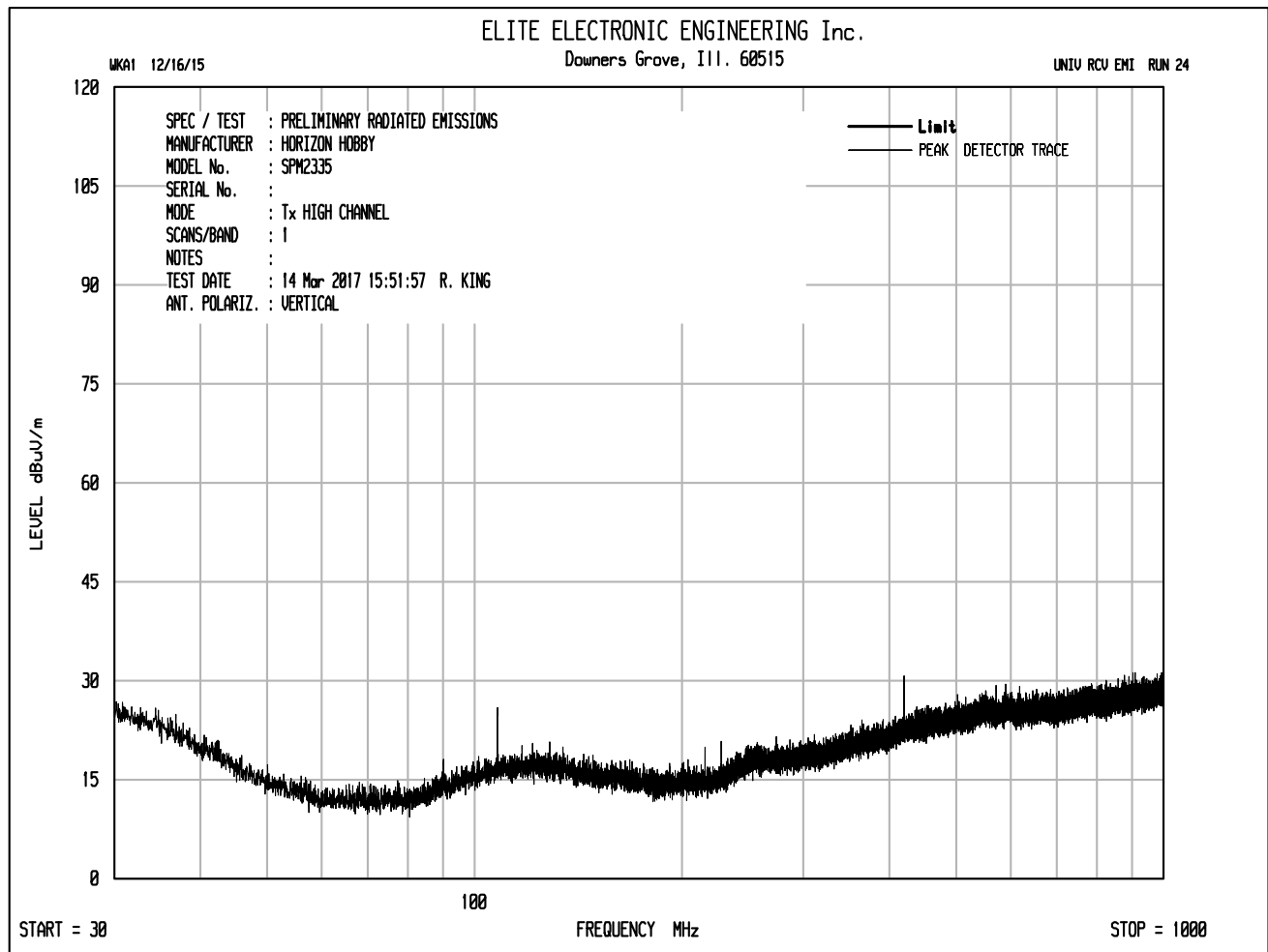


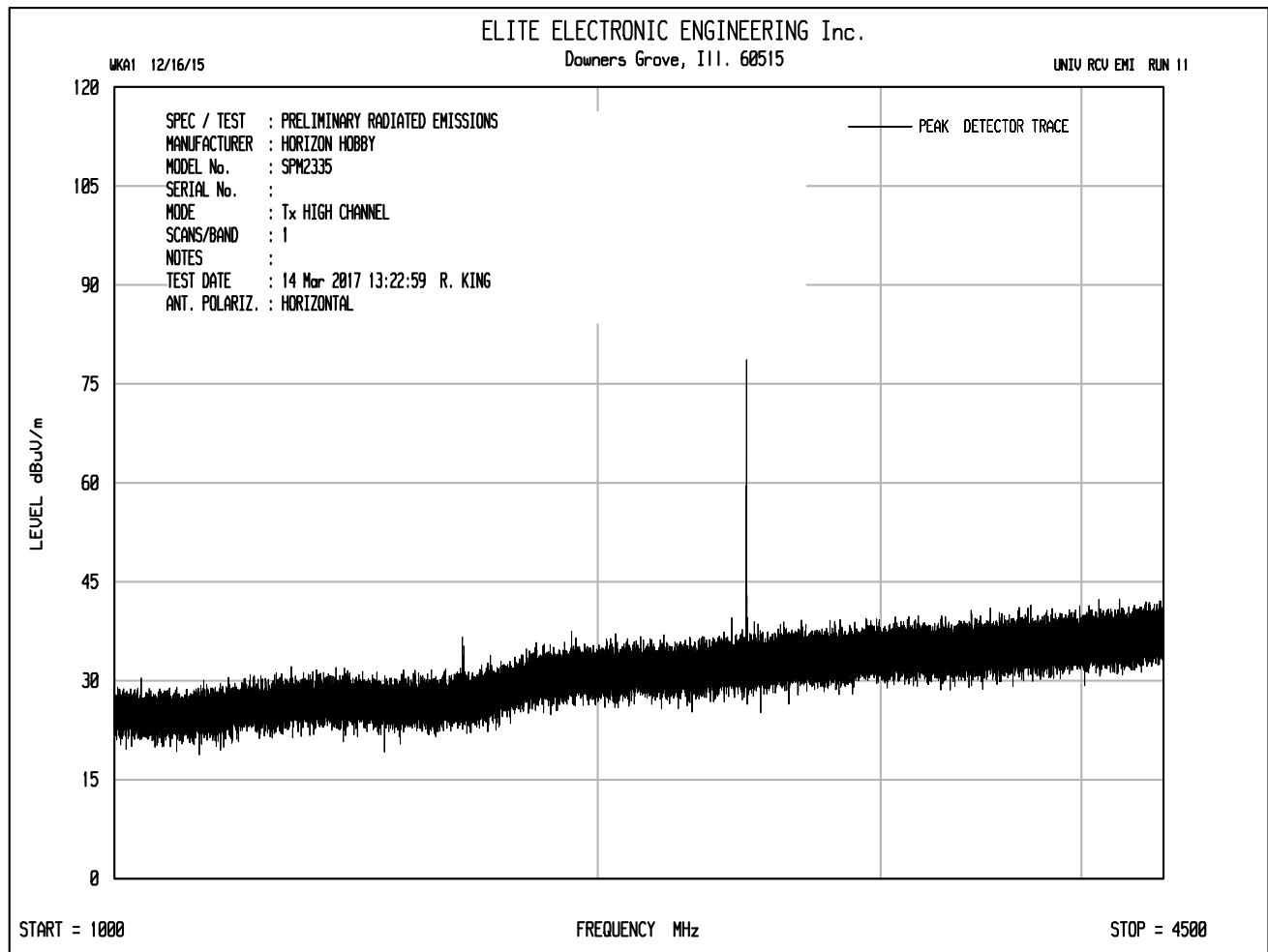


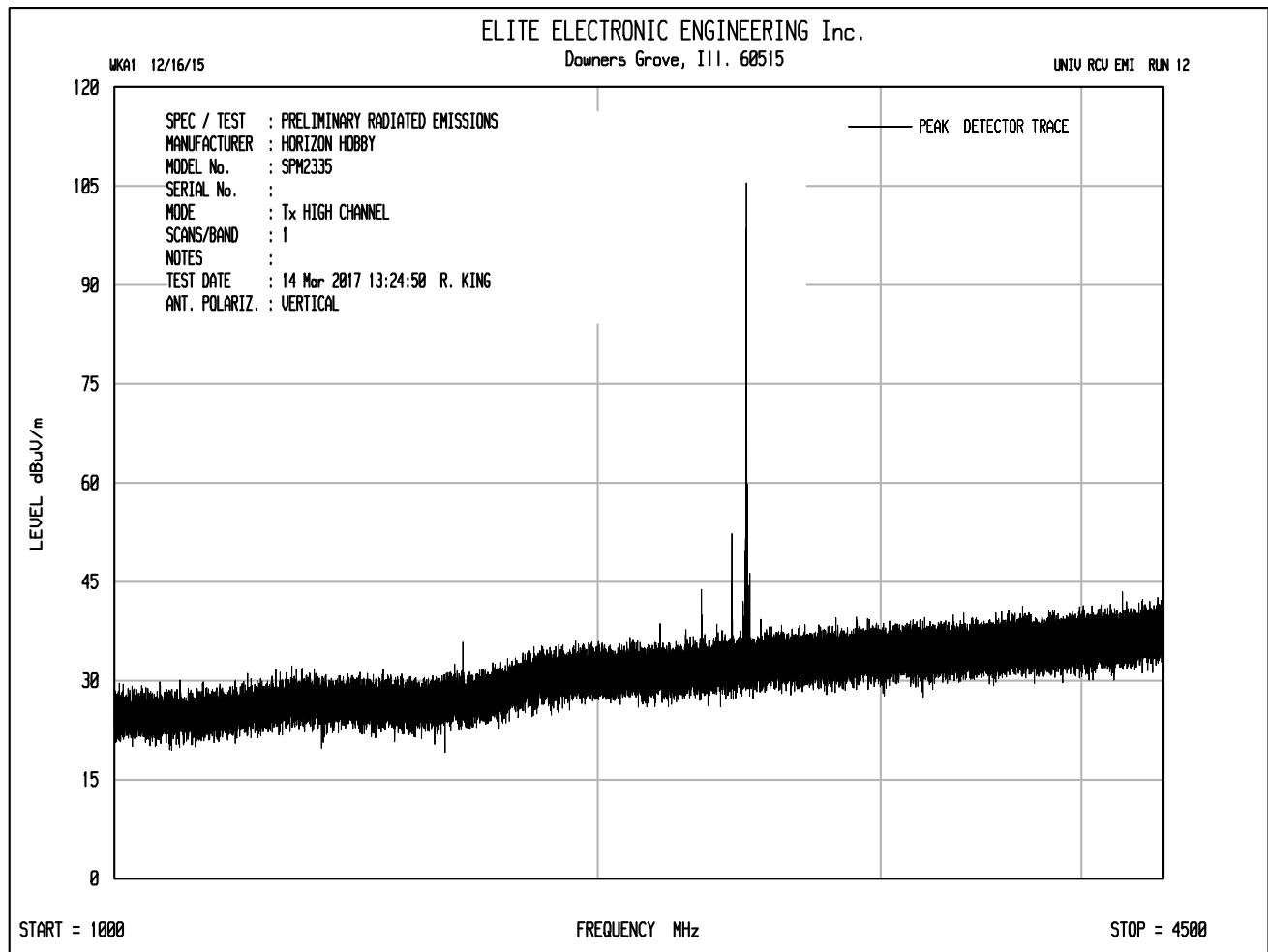


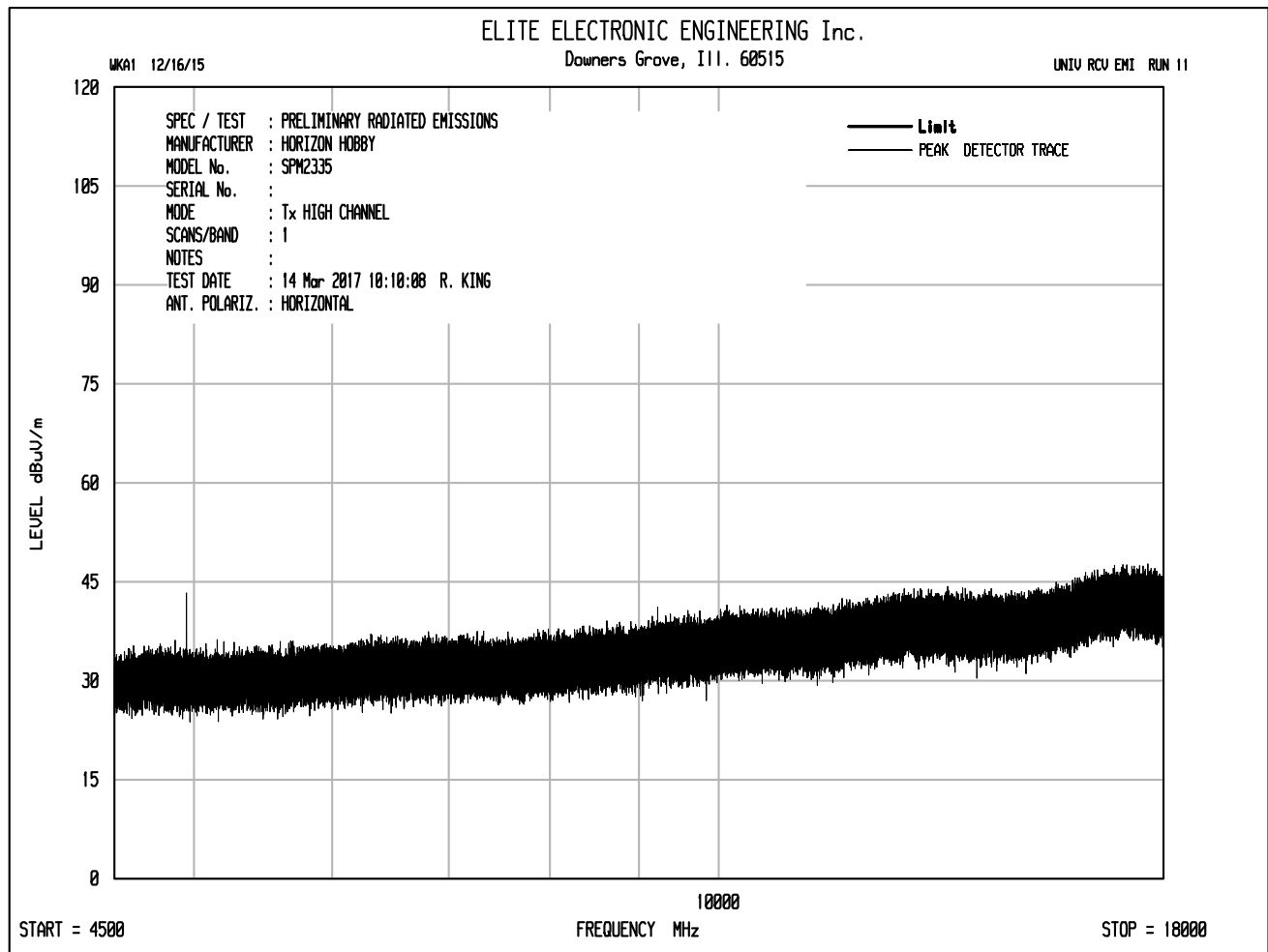


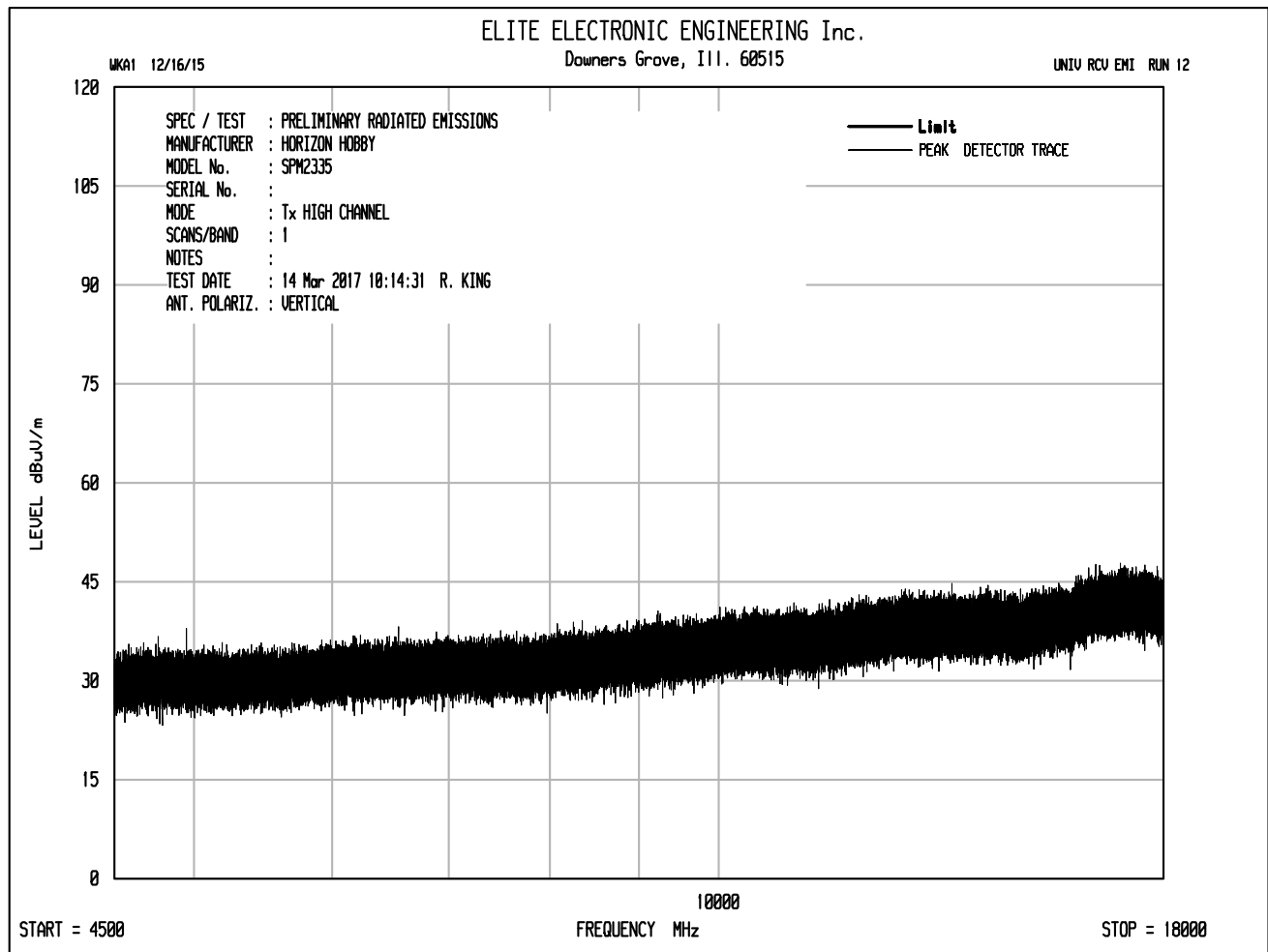


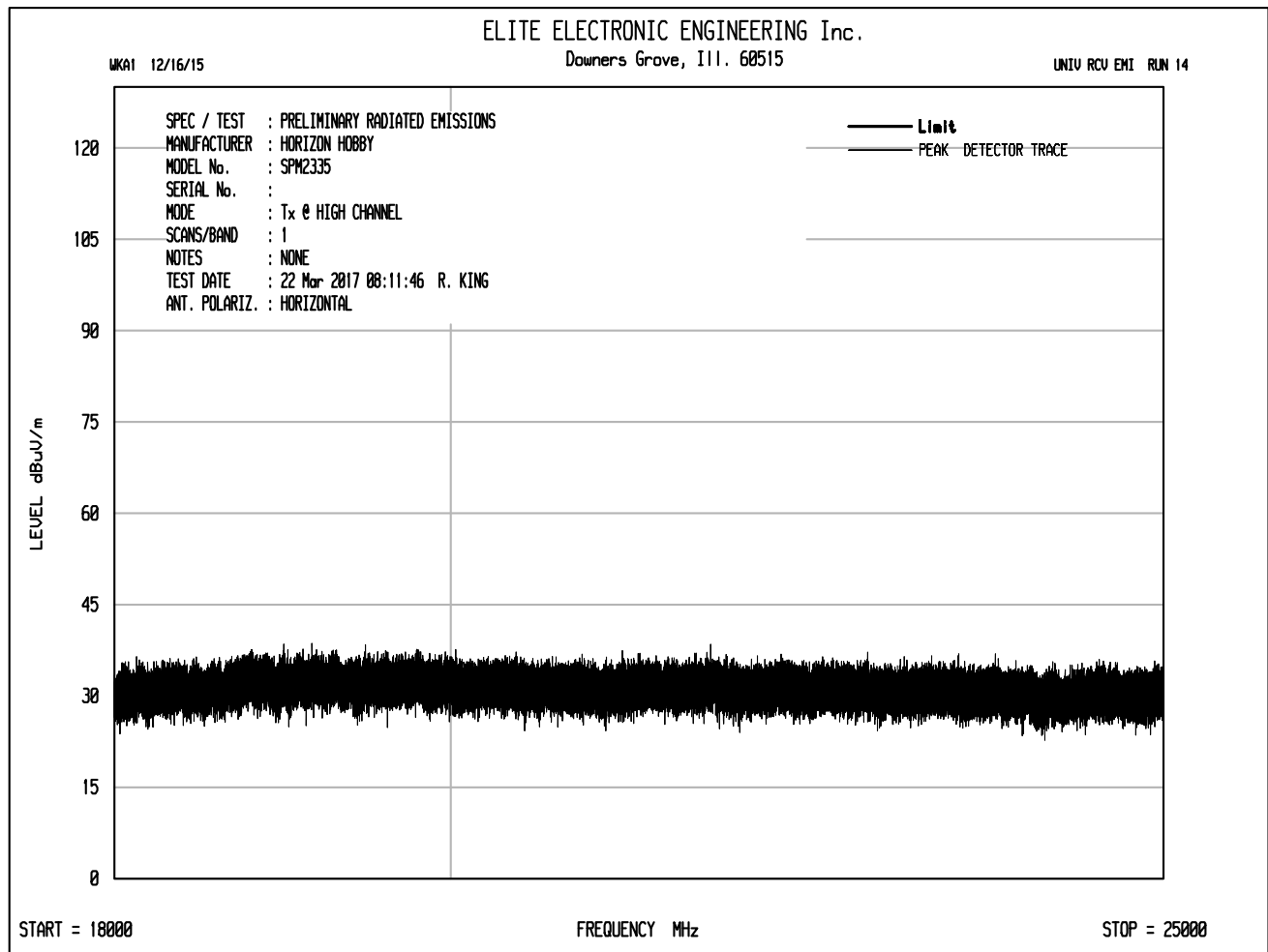


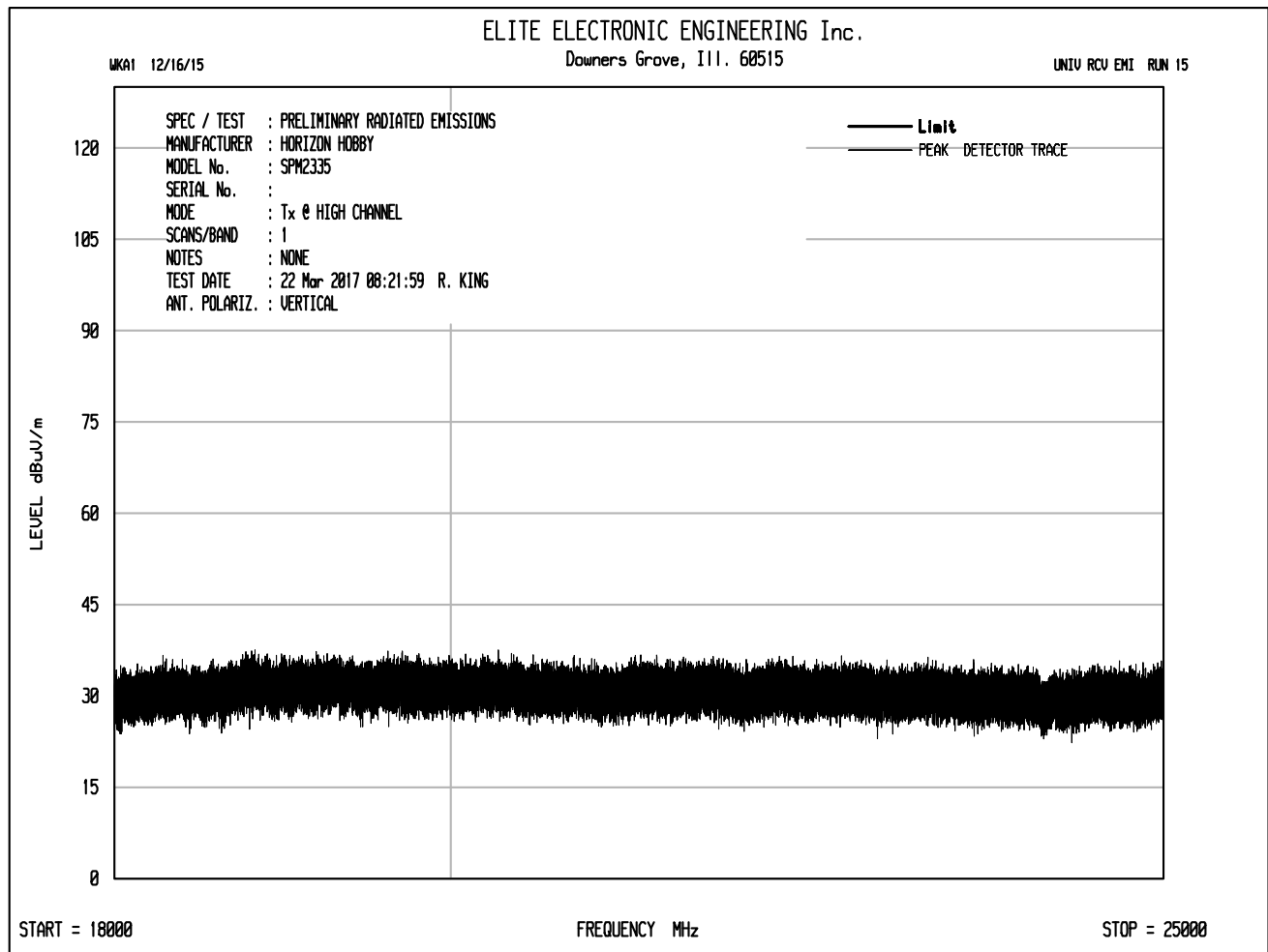














Manufacturer : Horizon Hobby
Test Item : DX2E 2Ch DSMR Radio
Model No. : SPM2335
Mode : Tx @ Low Channel (2405MHz)
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : March 22, 2017
Test Distance : 3
Notes : Peak Detector with 1MHz Resolution Bandwidth

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)
4810.00	H	58.5		3.7	34.6	-40.2	56.5	668.2	5000.0	-17.5
4810.00	V	61.1		3.7	34.6	-40.2	59.1	902.5	5000.0	-14.9
12025.00	H	49.0	*	6.1	38.7	-39.7	54.1	507.0	5000.0	-19.9
12025.00	V	49.1	*	6.1	38.7	-39.7	54.2	512.9	5000.0	-19.8
19240.00	H	35.6	*	2.2	40.4	-28.5	49.7	304.4	5000.0	-24.3
19240.00	V	35.6	*	2.2	40.4	-28.5	49.7	304.4	5000.0	-24.3

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

Checked BY RICHARD E. KING :

Richard E. King



Manufacturer : Horizon Hobby
Test Item : DX2E 2Ch DSMR Radio
Model No. : SPM2335
Mode : Tx @ Low Channel (2405MHz)
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : March 22, 2017
Test Distance : 3
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
4810.00	H	35.3		3.7	34.6	-40.2	-22.4	10.9	3.5	500.0	-43.0
4810.00	V	35.6		3.7	34.6	-40.2	-22.4	11.2	3.6	500.0	-42.8
12025.00	H	33.7	*	6.1	38.7	-39.7	-22.4	16.4	6.6	500.0	-37.6
12025.00	V	33.8	*	6.1	38.7	-39.7	-22.4	16.5	6.7	500.0	-37.4
19240.00	H	21.2	*	2.2	40.4	-28.5	-22.4	12.9	4.4	500.0	-41.1
19240.00	V	21.2	*	2.2	40.4	-28.5	-22.4	12.9	4.4	500.0	-41.1

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

Checked BY RICHARD E. KING :

Richard E. King

Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Tx @ Low Channel (2405MHz)
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
 Date : March 22, 2017
 Test Distance : 3
 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)
2405.00	H	74.4		2.6	32.0	0.0	109.0	280301.3		
2405.00	V	77.0		2.6	32.0	0.0	111.5	377681.0		
7215.00	H	44.4		4.6	35.7	-40.1	44.7	171.5	37768.1	-46.9
7215.00	V	45.7		4.6	35.7	-40.1	45.9	198.3	37768.1	-45.6
9620.00	H	37.5	*	5.2	36.6	-39.6	39.7	97.0	37768.1	-51.8
9620.00	V	38.5	*	5.2	36.6	-39.6	40.8	109.1	37768.1	-50.8
14430.00	H	38.0	*	6.6	39.6	-40.0	44.2	163.0	37768.1	-47.3
14430.00	V	37.7	*	6.6	39.6	-40.0	43.9	157.3	37768.1	-47.6
16835.00	H	38.4	*	7.2	41.7	-38.9	48.4	262.9	37768.1	-43.1
16835.00	V	37.8	*	7.2	41.7	-38.9	47.8	245.1	37768.1	-43.8
21645.00	H	24.1	*	2.2	40.6	-28.6	38.2	81.3	37768.1	-53.3
21645.00	V	24.1	*	2.2	40.6	-28.6	38.2	81.3	37768.1	-53.3
24050.00	H	26.7	*	2.2	40.6	-30.1	39.5	94.5	37768.1	-52.0
24050.00	V	26.7	*	2.2	40.6	-30.1	39.5	94.5	37768.1	-52.0

Checked BY RICHARD E. KING :

Richard E. King

Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Tx @ Mid Channel (2440MHz)
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : March 22, 2017
 Test Distance : 3
 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	63.8		3.7	34.5	-40.3	61.8	1231.0	5000.0	-12.2
4880.00	V	61.5		3.7	34.5	-40.3	59.5	946.8	5000.0	-14.5
7320.00	H	59.7		4.7	35.7	-40.1	60.0	997.9	5000.0	-14.0
7320.00	V	59.2		4.7	35.7	-40.1	59.5	946.5	5000.0	-14.5
12200.00	H	50.9	*	6.1	38.8	-39.6	56.2	643.6	5000.0	-17.8
12200.00	V	50.9	*	6.1	38.8	-39.6	56.1	641.4	5000.0	-17.8
19520.00	H	35.4	*	2.2	40.4	-28.5	49.5	298.6	5000.0	-24.5
19520.00	V	35.4	*	2.2	40.4	-28.5	49.5	298.6	5000.0	-24.5

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

Checked BY RICHARD E. KING :

Richard E. King

Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Tx @ Mid Channel (2440MHz)
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : March 22, 2017
 Test Distance : 3
 Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
4880.00	H	37.7		3.7	34.5	-40.3	-22.4	13.3	4.6	500.0	-40.7
4880.00	V	37.3		3.7	34.5	-40.3	-22.4	12.9	4.4	500.0	-41.0
7320.00	H	36.16		4.7	35.7	-40.1	-22.4	14.1	5.0	500.0	-39.9
7320.00	V	36.2		4.7	35.7	-40.1	-22.4	14.1	5.1	500.0	-39.9
12200.00	H	34.9	*	6.1	38.8	-39.6	-22.4	17.8	7.7	500.0	-36.2
12200.00	V	35.1	*	6.1	38.8	-39.6	-22.4	17.9	7.9	500.0	-36.0
19520.00	H	21.2	*	2.2	40.4	-28.5	-22.4	12.9	4.4	500.0	-41.1
19520.00	V	21.2	*	2.2	40.4	-28.5	-22.4	12.9	4.4	500.0	-41.1

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

Checked BY RICHARD E. KING :

Richard E. King



Manufacturer : Horizon Hobby
Test Item : DX2E 2Ch DSMR Radio
Model No. : SPM2335
Mode : Tx @ Mid Channel (2440MHz)
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : March 22, 2017
Test Distance : 3
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	78.1		2.6	32.1	0.0	112.8	436868.3		
2440.00	V	82.3		2.6	32.1	0.0	117.0	707702.2		
9760.00	H	49.7		5.2	36.9	-39.6	52.3	411.2	70770.2	-44.7
9760.00	V	45.6		5.2	36.9	-39.6	48.2	257.4	70770.2	-48.8
14640.00	H	39.2	*	6.7	39.6	-40.2	45.3	184.8	70770.2	-51.7
14640.00	V	39.2	*	6.7	39.6	-40.2	45.3	184.6	70770.2	-51.7
17080.00	H	40.1	*	7.3	41.6	-38.8	50.2	323.2	70770.2	-46.8
17080.00	V	40.5	*	7.3	41.6	-38.8	50.6	339.6	70770.2	-46.4
21960.00	H	26.3	*	2.2	40.6	-29.2	39.9	99.1	70770.2	-57.1
21960.00	V	26.3	*	2.2	40.6	-29.2	39.9	99.1	70770.2	-57.1
24400.00	H	26.8	*	2.2	40.6	-30.2	39.4	93.7	70770.2	-57.6
24400.00	V	26.8	*	2.2	40.6	-30.2	39.4	93.7	70770.2	-57.6

Checked BY Richard E. King :

Richard E. King

Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Tx @ High Channel (2475MHz)
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : March 22, 2017
 Test Distance : 3
 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)
4950.00	H	58.1		3.7	34.5	-40.3	56.0	631.9	5000.0	-18.0
4950.00	V	58.5		3.7	34.5	-40.3	56.5	668.5	5000.0	-17.5
7425.00	H	49.5	*	4.7	35.6	-40.0	49.8	307.6	5000.0	-24.2
7425.00	V	50.0	*	4.7	35.6	-40.0	50.3	328.5	5000.0	-23.6
12375.00	H	48.4	*	6.1	38.8	-39.5	53.7	486.6	5000.0	-20.2
12375.00	V	47.7	*	6.1	38.8	-39.5	53.1	449.5	5000.0	-20.9
19800.00	H	35.5	*	2.2	40.4	-28.1	50.1	318.8	5000.0	-23.9
19800.00	V	35.5	*	2.2	40.4	-28.1	50.1	318.8	5000.0	-23.9
22275.00	H	36.9	*	2.2	40.6	-29.0	50.6	340.7	5000.0	-23.3
22275.00	V	36.9	*	2.2	40.6	-29.0	50.6	340.7	5000.0	-23.3

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

Checked BY RICHARD E. KING :

Richard E. King

Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Tx @ High Channel (2475MHz)
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : March 22, 2017
 Test Distance : 3
 Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
4950.00	H	36.9		3.7	34.5	-40.3	-22.4	12.4	4.2	500.0	-41.6
4950.00	V	36.7		3.7	34.5	-40.3	-22.4	12.3	4.1	500.0	-41.7
7425.00	H	34.79	*	4.7	35.6	-40.0	-22.4	12.7	4.3	500.0	-41.3
7425.00	V	35.6	*	4.7	35.6	-40.0	-22.4	13.5	4.7	500.0	-40.5
12375.00	H	33.3	*	6.1	38.8	-39.5	-22.4	16.2	6.5	500.0	-37.8
12375.00	V	33.0	*	6.1	38.8	-39.5	-22.4	16.0	6.3	500.0	-38.0
19800.00	H	21.2	*	2.2	40.4	-28.1	-22.4	13.3	4.6	500.0	-40.7
19800.00	V	21.2	*	2.2	40.4	-28.1	-22.4	13.4	4.7	500.0	-40.6
22275.00	H	21.6	*	2.2	40.6	-29.0	-22.4	12.9	4.4	500.0	-41.0
22275.00	V	21.6	*	2.2	40.6	-29.0	-22.4	12.9	4.4	500.0	-41.0

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

Checked BY RICHARD E. KING :

Richard E. King



Manufacturer : Horizon Hobby
Test Item : DX2E 2Ch DSMR Radio
Model No. : SPM2335
Mode : Tx @ High Channel (2475MHz)
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : March 22, 2017
Test Distance : 3
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)
2475.00	H	70.0		2.7	32.1	0.0	104.8	174381.9		
2475.00	V	74.3		2.7	32.1	0.0	109.1	284447.1		
9900.00	H	38.9	*	5.3	37.0	-39.5	41.6	120.5	28444.7	-47.5
9900.00	V	38.9	*	5.3	37.0	-39.5	41.7	120.9	28444.7	-47.4
14850.00	H	38.9	*	6.8	39.6	-40.4	44.9	176.5	28444.7	-44.1
14850.00	V	38.0	*	6.8	39.6	-40.4	44.1	160.1	28444.7	-45.0
17325.00	H	39.0	*	7.3	41.4	-39.1	48.6	269.8	28444.7	-40.5
17325.00	V	39.3	*	7.3	41.4	-39.1	48.9	278.7	28444.7	-40.2
24750.00	H	26.7	*	2.2	40.6	-30.7	38.9	87.7	28444.7	-50.2
24750.00	V	26.7	*	2.2	40.6	-30.7	38.9	87.7	28444.7	-50.2

Checked BY RICHARD E. KING :

Richard E. King

Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Tx @ Low Channel (2405MHz)
 Test Specification : FCC-15.247, RSS-247 Band-edge Compliance
 Date : March 22, 2017

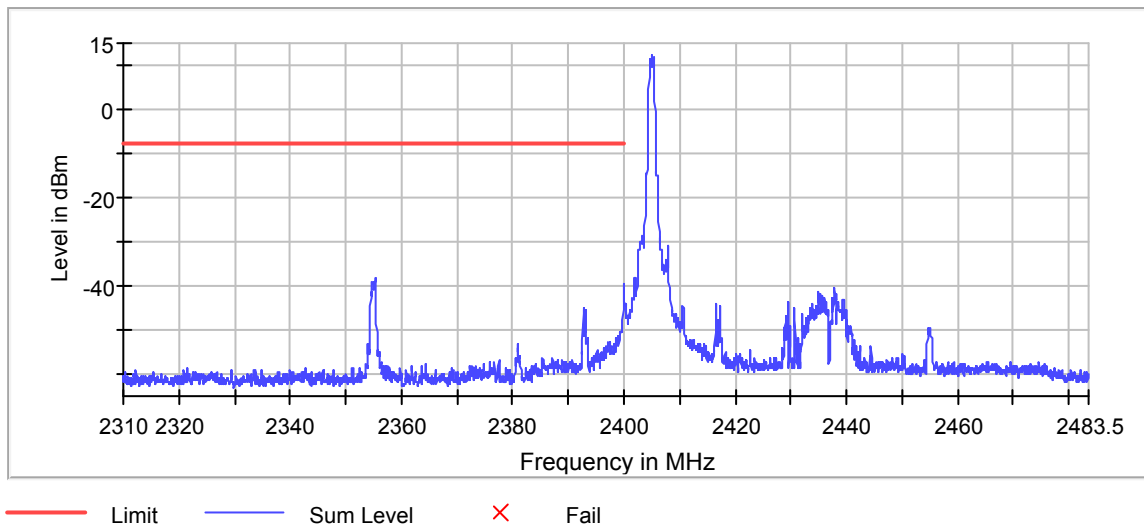
Band Edge

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2355.249861	-38.2	30.5	-7.7	PASS
2355.199889	-38.8	31.1	-7.7	PASS
2354.950028	-38.9	31.2	-7.7	PASS
2355.000000	-39.0	31.3	-7.7	PASS
2355.299833	-39.1	31.4	-7.7	PASS
2354.800111	-39.3	31.6	-7.7	PASS
2354.850083	-39.4	31.6	-7.7	PASS
2354.900056	-39.5	31.8	-7.7	PASS
2355.049972	-39.7	32.0	-7.7	PASS
2399.925042	-40.5	32.8	-7.7	PASS
2354.750139	-40.6	32.9	-7.7	PASS
2355.099944	-41.0	33.3	-7.7	PASS
2355.349806	-41.1	33.3	-7.7	PASS
2355.149917	-41.1	33.4	-7.7	PASS
2354.550250	-41.4	33.7	-7.7	PASS

In-band Peak

Frequency (MHz)	Level (dBm)
2404.972023	12.3

Low Frequency:



Manufacturer : Horizon Hobby
 Test Item : DX2E 2Ch DSMR Radio
 Model No. : SPM2335
 Mode : Frequency Hopping
 Test Specification : FCC-15.247, RSS-247 Band-edge Compliance
 Date : March 22, 2017

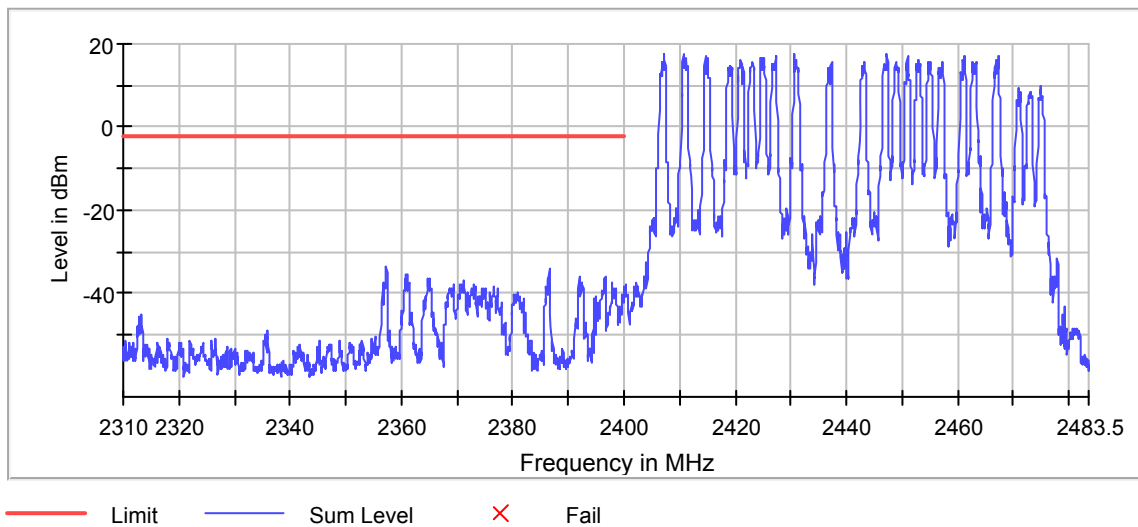
Band Edge

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2357.248751	-33.4	31.0	-2.4	PASS
2357.298723	-33.6	31.2	-2.4	PASS
2386.582454	-34.1	31.7	-2.4	PASS
2386.532482	-34.2	31.8	-2.4	PASS
2357.198778	-34.5	32.1	-2.4	PASS
2386.632426	-35.1	32.6	-2.4	PASS
2357.348695	-35.2	32.8	-2.4	PASS
2360.946696	-35.5	33.1	-2.4	PASS
2360.896724	-35.7	33.3	-2.4	PASS
2391.979456	-35.9	33.5	-2.4	PASS
2360.996669	-36.0	33.5	-2.4	PASS
2396.576902	-36.1	33.7	-2.4	PASS
2396.626874	-36.1	33.7	-2.4	PASS
2391.929484	-36.1	33.7	-2.4	PASS
2364.644642	-36.4	34.0	-2.4	PASS

In-band Peak

Frequency (MHz)	Level (dBm)
2410.668612	17.6

Low Frequency:





Manufacturer : Horizon Hobby
Test Item : DX2E 2Ch DSMR Radio
Model No. : SPM2335
Mode : Tx @ High Channel (2475MHz)
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : March 22, 2017
Test Distance : 3
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	26.7		2.7	32.2	0.0	61.6	1196.0	5000.0	-12.4
2483.50	V	28.4		2.7	32.2	0.0	63.2	1449.6	5000.0	-10.8

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

Checked BY RICHARD E. KING :

Richard E. King



Manufacturer : Horizon Hobby
Test Item : DX2E 2Ch DSMR Radio
Model No. : SPM2335
Mode : Tx @ High Channel (2475MHz)
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : March 22, 2017
Test Distance : 3
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
2483.50	H	11.1		2.7	32.2	0.0	-22.4	23.6	15.1	500.0	-30.4
2483.50	V	11.2		2.7	32.2	0.0	-22.4	23.6	15.1	500.0	-30.4

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

Checked BY RICHARD E. KING :

Richard E. King



Manufacturer : Horizon Hobby
Test Item : DX2E 2Ch DSMR Radio
Model No. : SPM2335
Mode : Frequency Hopping
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : March 22, 2017
Test Distance : 3
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	27.6		2.7	32.2	0.0	62.4	1322.0	5000.0	-11.6
2483.50	V	27.7		2.7	32.2	0.0	62.5	1337.3	5000.0	-11.5

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

Checked BY RICHARD E. KING :

Richard E. King



Manufacturer : Horizon Hobby
Test Item : DX2E 2Ch DSMR Radio
Model No. : SPM2335
Mode : Frequency Hopping
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : March 22, 2017
Test Distance : 3
Notes : Average Detector with 1MHz Resolution Bandwidth

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	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)
2483.50	H	10.9		2.7	32.2	0.0	-22.4	23.3	14.7	500.0	-30.7
2483.50	V	10.8		2.7	32.2	0.0	-22.4	23.2	14.5	500.0	-30.8

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

Checked BY RICHARD E. KING :

Richard E. King