



Measurement of RF Interference from the Part No. UAHLCAR Rear View Mirror Transceiver

For	Gentex Corporation 380 Riley Street Zeeland, MI 49464
P.O. Number	2640193
Date Tested	April 29 – May 4, 2019
Test Personnel	Javier Cardenas
Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Digital Modulation Intentional Radiators Operating within the band 2400-2483.5MHz Industry Canada RSS-247

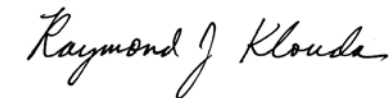
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REVISION HISTORY

Revision	Date	Description
—	14 May 2019	Initial release
A	30 May 2019 By Javier Cardenas	– Added Rev A to the report number on the cover and throughout the report. - Section 1.2 and section 6: Referenced ANSI C63.10-2013.

Measurement of RF Emissions from a Rear View Mirror, Part No. UAHLC A Transceiver

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Gentex Corporation Rear View Mirror, Part No. UAHLC A, Serial No. 905-6033-101561-3, transceiver (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 an internal antenna. The EUT was manufactured and submitted for testing by Gentex Corporation located in Zeeland, MI.

1.2 Purpose

The test series was performed to determine if the EUT meets the radiated RF emissions requirements, and additional provisions of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 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 radiated RF emissions requirements, and additional provisions of the Industry Canada Radio Standards Specification RSS-247 for Transmitters.

Testing was performed in accordance with 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 19C and the relative humidity was 21%.

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
- 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"
- 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"

3. EUT SETUP AND OPERATION

3.1 General Description

The EUT is a Rear View Mirror, Part No. UAHLCA. A block diagram of the EUT setup is shown as Figure 1 and Figure 2.

3.1.1 Power Input

The EUT was powered by 13.5VDC from 2 leads.

3.1.2 Peripheral Equipment

The following peripheral equipment was submitted with the EUT:

Item	Description
Laptop	Provided commands to set the EUT in the correct mode for testing

3.1.3 Grounding

The EUT was ungrounded during the tests.

3.2 Software

The EUT requires Software Version 001 to control the device during testing

3.3 Operational Mode

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

- Transmit at 2402MHz Unmodulated
- Transmit at 2440MHz Unmodulated
- Transmit at 2480MHz Unmodulated
- Transmit at 2402MHz Modulated
- Transmit at 2440MHz Modulated
- Transmit at 2480MHz Modulated

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. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

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 International System Units (SI).

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.

Values of Expanded Measurement Uncertainty (95% Confidence) are presented below:

Measurement Type	Expanded Measurement Uncertainty
Conducted disturbance (mains port) (150 kHz – 30 MHz)	2.7
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.3
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 6 GHz)	3.1
Radiated disturbance (electric field strength on an open area test site or alternative test site) (6 GHz – 18 GHz)	3.2

5. TEST PROCEDURES

5.1 Transmitter

5.1.1 DTS (6dB) Bandwidth

5.1.1.1 Requirements

Per FCC 15.247(a)(2) and RSS 247 Para 5.2 (a), the minimum 6dB bandwidth shall be at least 500kHz for all systems using digital modulation techniques.

5.1.1.2 Procedures

The antenna port of the EUT was connected to the spectrum analyzer through 10dB of attenuation.

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.

5.1.1.3 Results

The plots on pages 19 through 24 show that the minimum 6 dB bandwidth was 739kHz which is greater than the minimum allowable 6dB bandwidth requirement of 500kHz for systems using digital modulation techniques. The 99% bandwidth was measured to be 1.09MHz.

5.1.2 Peak Output Power

5.1.2.1 Requirements

Per FCC section 15.247(b)(3) and RSS 247 Para 5.4 (d), for systems using digital modulation the maximum peak output conducted power shall not be greater than 1.0W (30dBm). Per FCC section 15.247(b)(4) and RSS 247 Para 5.4 (d), 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).

5.1.2.2 Procedures

The antenna port of the EUT was connected to the spectrum analyzer through 10dB of attenuation. The maximum meter reading was recorded. The peak power output was calculated for the low, middle and high channels.

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.

5.1.2.3 Results

The results are presented on pages 25 and 30. The maximum peak conducted output power from the transmitter was 0.73mW (-1.36 dBm) which is below the 1 Watt limit.

5.1.3 Radiated Spurious Emissions Measurements

5.1.3.1 Requirements

Per FCC 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).

Per RSS 247 Para 5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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

5.1.3.2 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 25.0GHz was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to

25.0GHz.

- 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.

5.1.3.3 Results

Preliminary radiated emissions plots with the EUT transmitting at 2402MHz, 2440MHz, and 2480MHz are shown on pages 31 through 54. Final radiated emissions data are presented on data pages 55 through 63. 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 5.

5.1.4 Band Edge Compliance

5.1.4.1 Requirements

Per FCC section 15.247(d) and RSS 247 Para 5.5, 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.

5.1.4.2 Procedures

5.1.4.2.1 Low Band Edge

- 1) The EUT was setup 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.
- 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.

5.1.4.2.2 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.

5.1.4.3 Results

Pages 64 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.

5.1.5 Power Spectral Density

5.1.5.1 Requirement

Per FCC section 15.247(e) and RSS 247 Para 5.2 (b), 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.

5.1.5.2 Procedures

- 1) The antenna port of the EUT was connected to the spectrum analyzer through a 10dB pad.
- 2) The EUT was then placed in the normal operation mode
- 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): $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$
 - 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.

Results

Pages 66 through 68 show the power spectral density results. As can be seen from this plot, the peak power density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

6. CONCLUSIONS

It was determined that the Gentex Corporation Rear View Mirror, Part No. UAHLCa digital modulation transceiver, Serial No. 905-6033-101561-3 did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Intentional Radiators Operating within the 2400-2483.5 MHz band, when tested per ANSI C63.10-2013.

It was also determined that the Gentex Corporation Rear View Mirror, Part No. UAHLCa digital modulation transceiver, Serial No. 905-6033-101561-3 did fully meet the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification RSS-247 for transmitters, when tested per 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

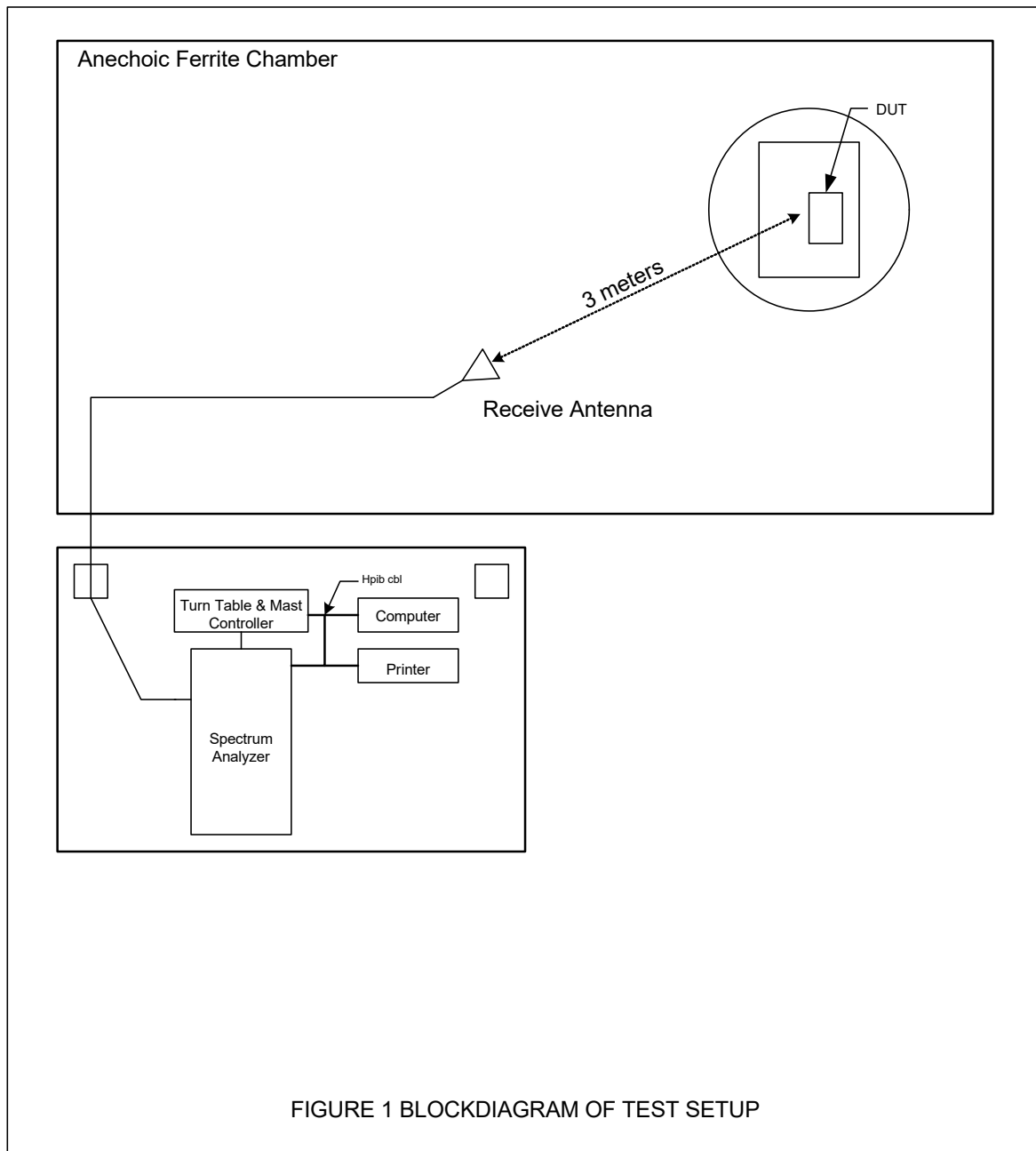
Table 9-1 Equipment List

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	4/8/2019	4/8/2020
APW11	PREAMPLIFIER	PMI	PE2-35-120-5R0-10-12-SFF	PL11685/1241	1GHZ-20GHZ	4/8/2019	4/8/2020
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
GRE2	SIGNAL GENERATOR	AGILENT	E4438C	MY42081749	250KHZ-6GHZ	2/28/2019	2/28/2020
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	6/28/2018	6/28/2020
NHG1	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ	NOTE 1	
NSDS1	UNIVERSAL SPHERICAL DIPOLE SOURCE	AET	USDS-H	AET-1116		NOTE 1	
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	5/31/2018	5/31/2020
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	3/22/2018	3/22/2020
RBG2	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101591	2HZ-44GHZ	2/21/2019	2/21/2020
SES0	24VDC POWER SUPPLY	P-TRANS	FS-32024-1M	001	18-27VDC	NOTE 1	
SMAH	POWER SUPPLY	MASTECH	HY3020EX	1014	30 Volt, 20 Amp	NOTE 1	
VBV2	CISPR EN FCC ICES RE.EXE	ELITE	CISPR EN FCC ICES RE.EXE	---	---	N/A	
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
XPR0	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000	001	4.8-20GHZ	9/12/2017	9/12/2019

N/A – Not Applicable

Note 1 – Equipment is calibrated at time of operation

I/O – Initial calibration only



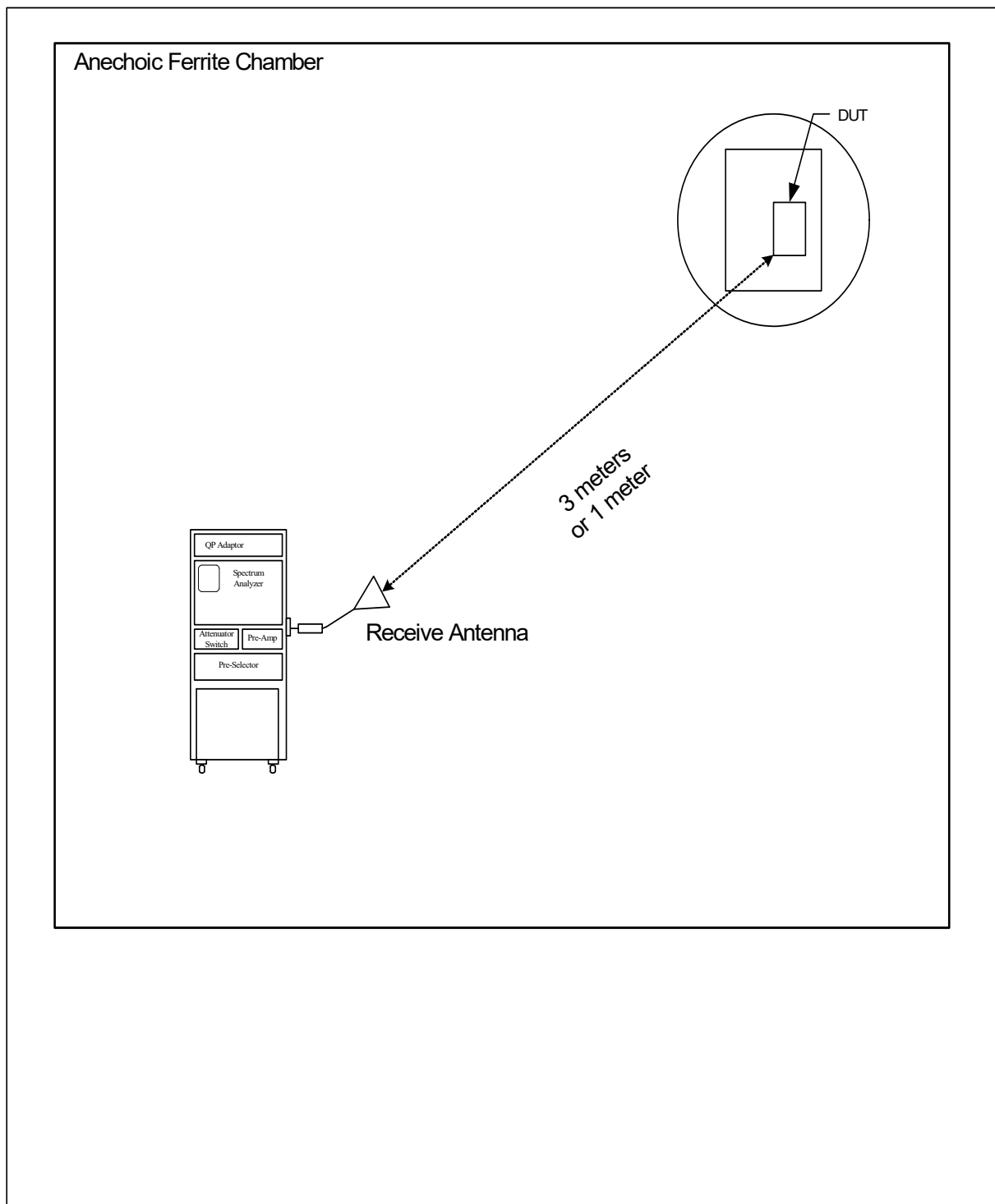


Figure 2: BLOCK DIAGRAM OF TEST SETUP FOR RADIATED EMISSIONS ABOVE 18GHZ

Figure 3



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

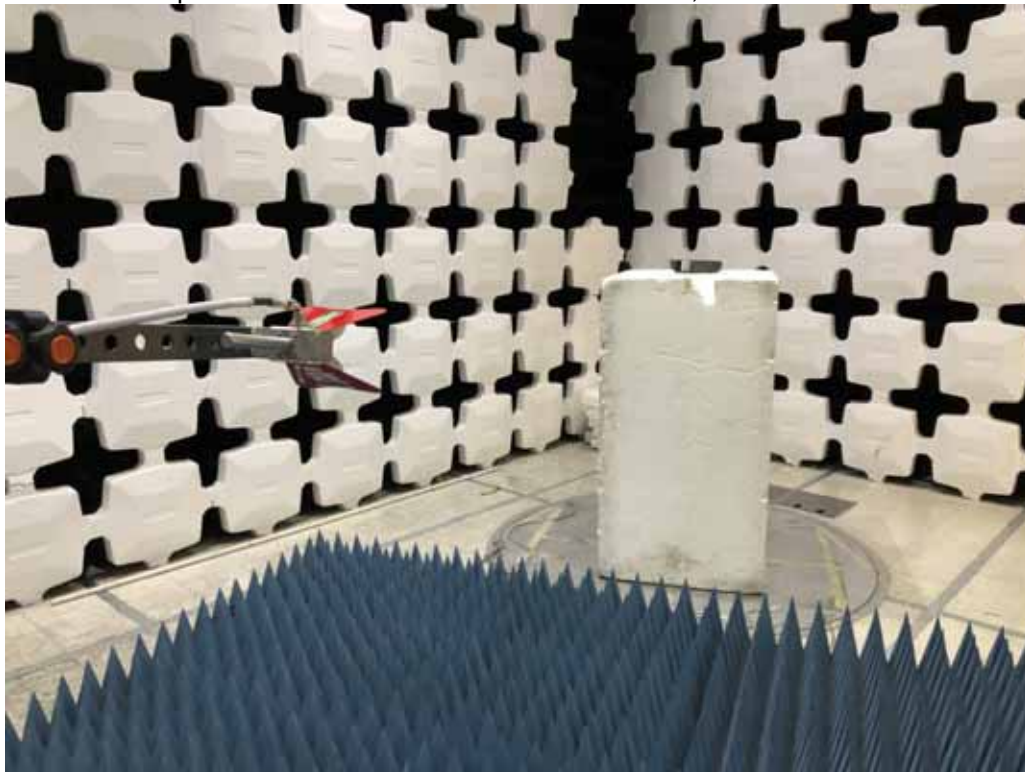


Test Setup for Radiated Emissions –30MHz to 1GHz, Vertical Polarization

Figure 4

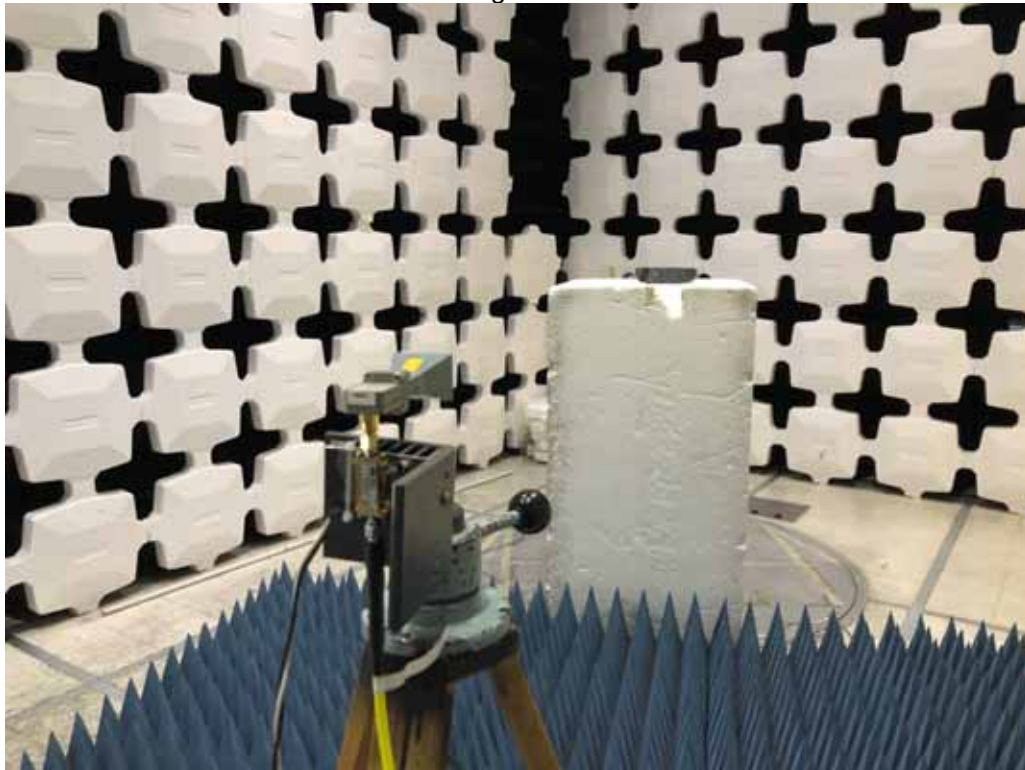


Test Setup for Radiated Emissions – 1GHz to 18GHz, Horizontal Polarization

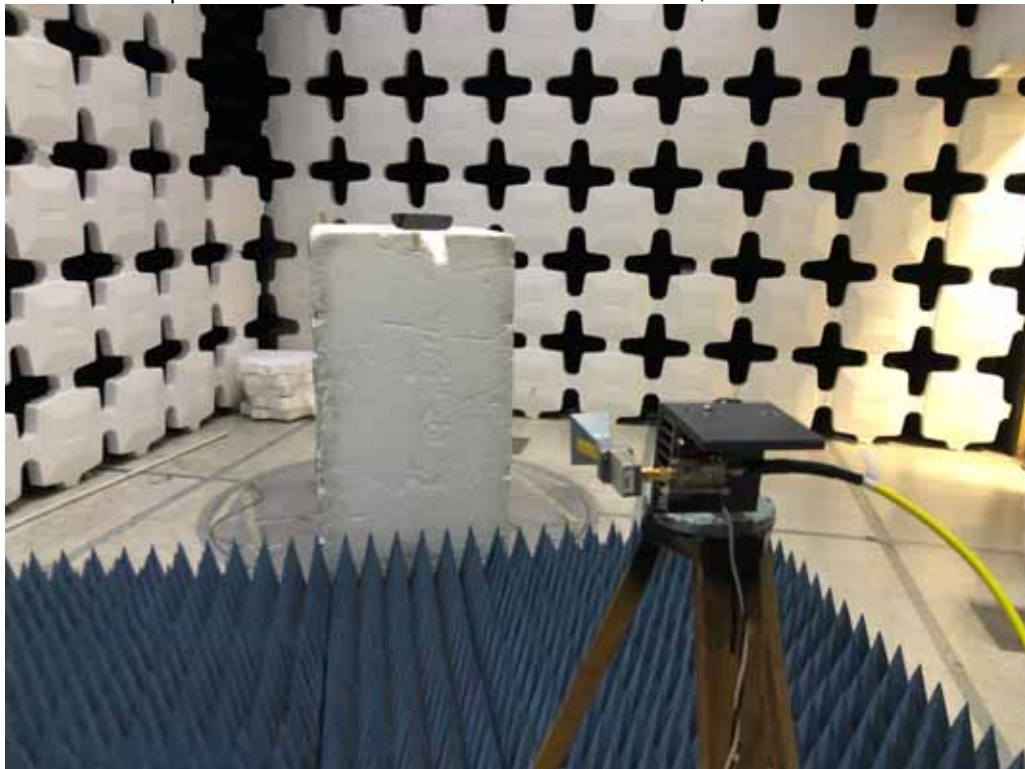


Test Setup for Radiated Emissions – 1GHz to 18GHz, Vertical Polarization

Figure 5

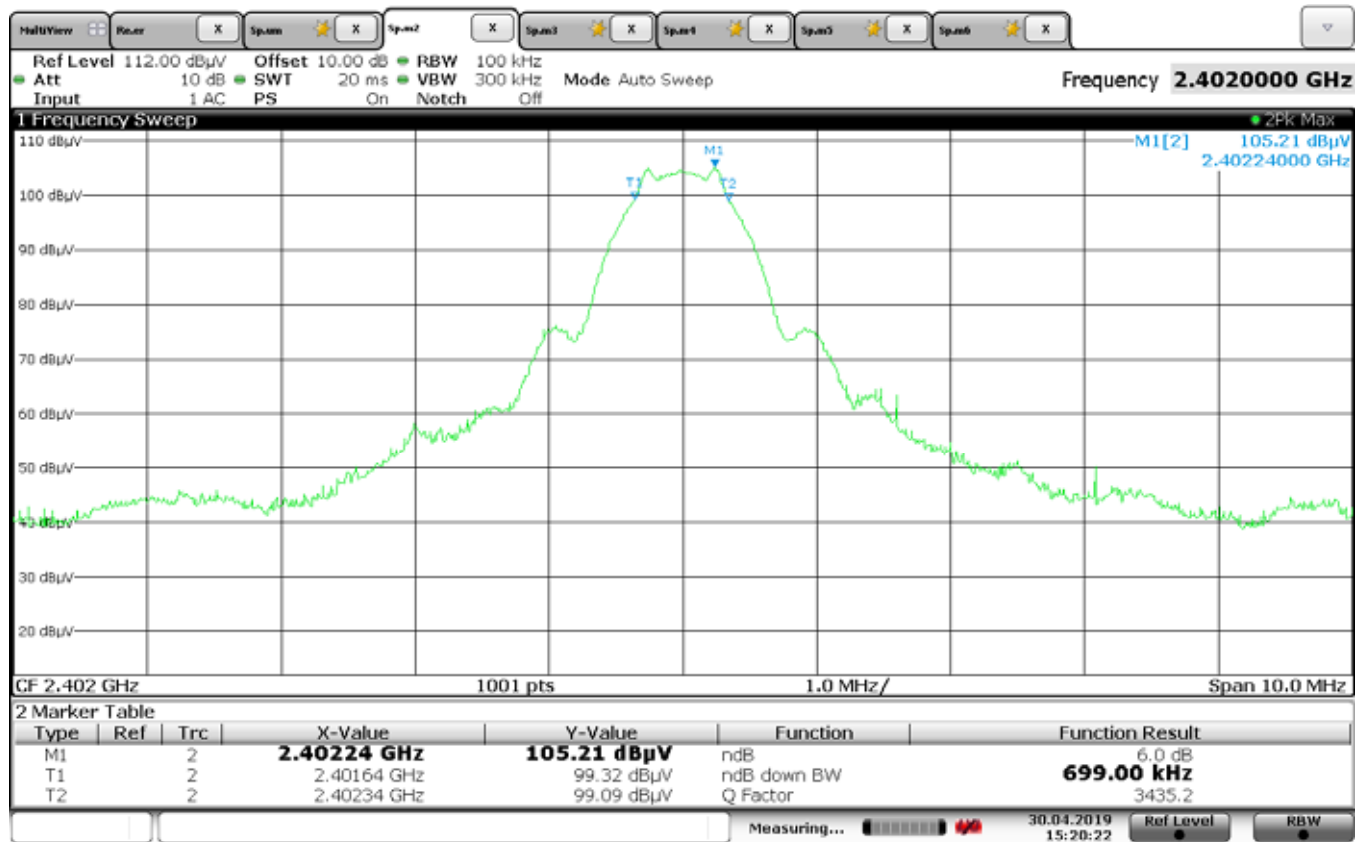


Test Setup for Radiated Emissions – 18GHz to 25GHz, Horizontal Polarization



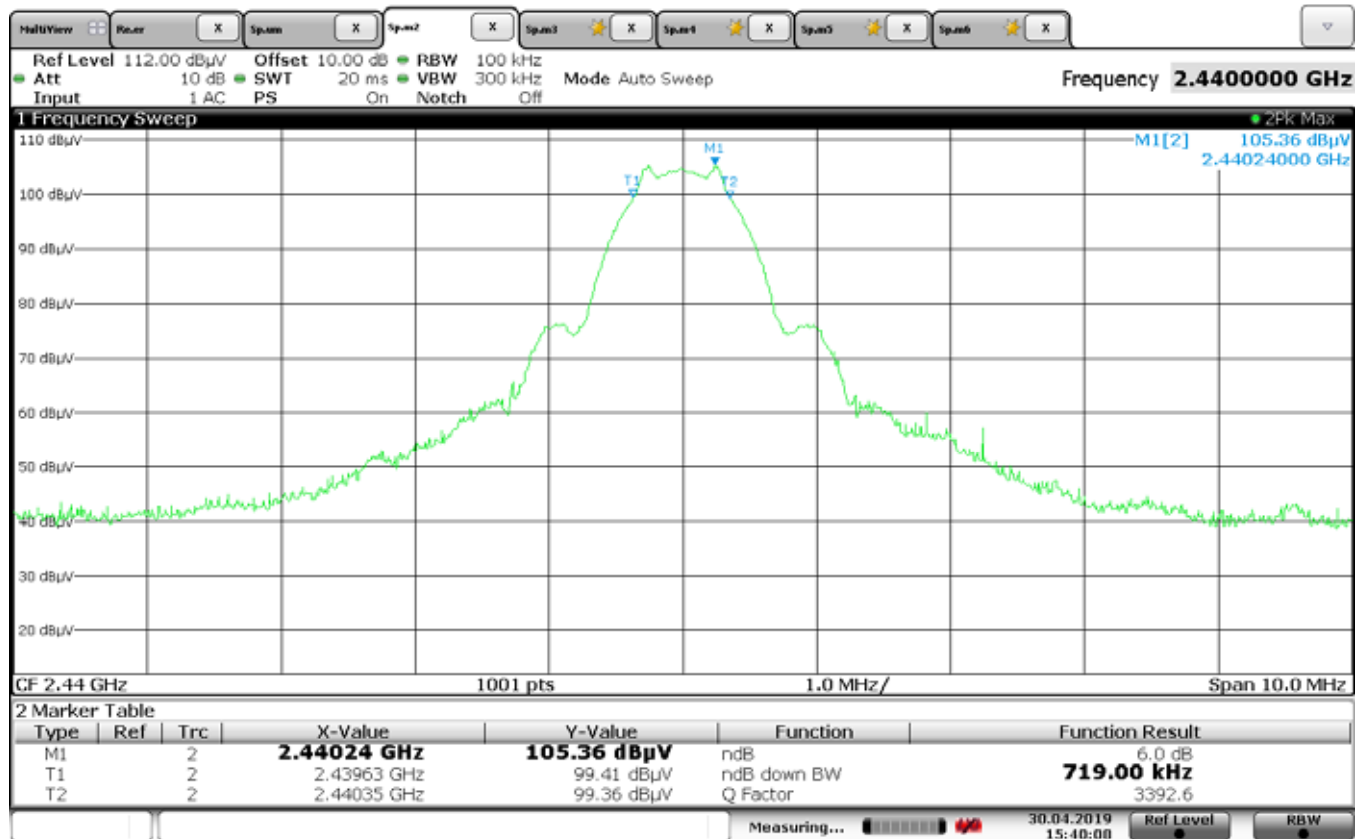
Test Setup for Radiated Emissions – 18GHz to 25GHz, Vertical Polarization

DTS (6dB) Bandwidth



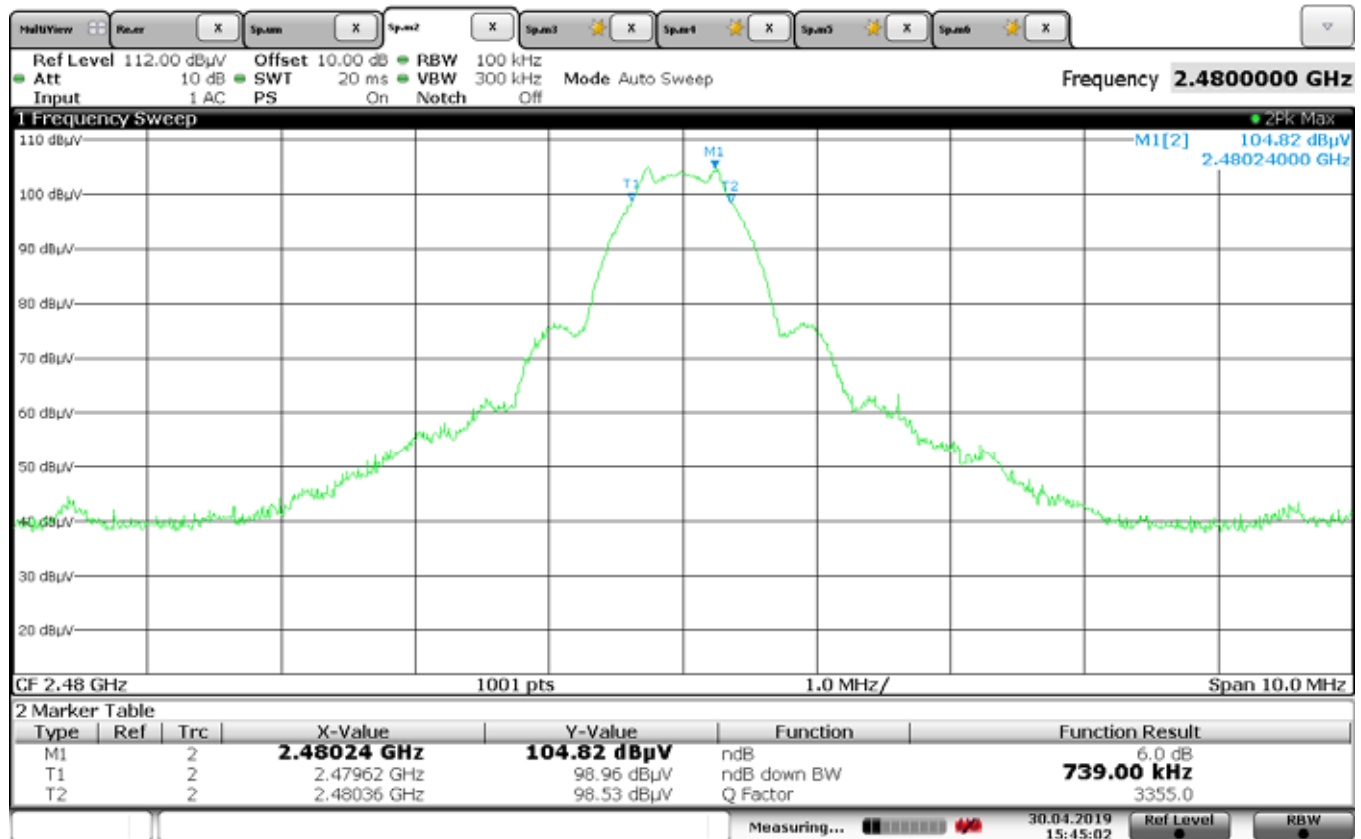
Date: 30.APR.2019 15:20:22

Manufacturer : Gentex Corporation
Model Number : UAHLC A
Serial Number : 905-6033-101561-3
Test : **DTS (6dB) Bandwidth**
Mode : Tx 2402MHz
Parameters : DTS Bandwidth = 699kHz
Date : April 30,2019
Notes : Bluetooth



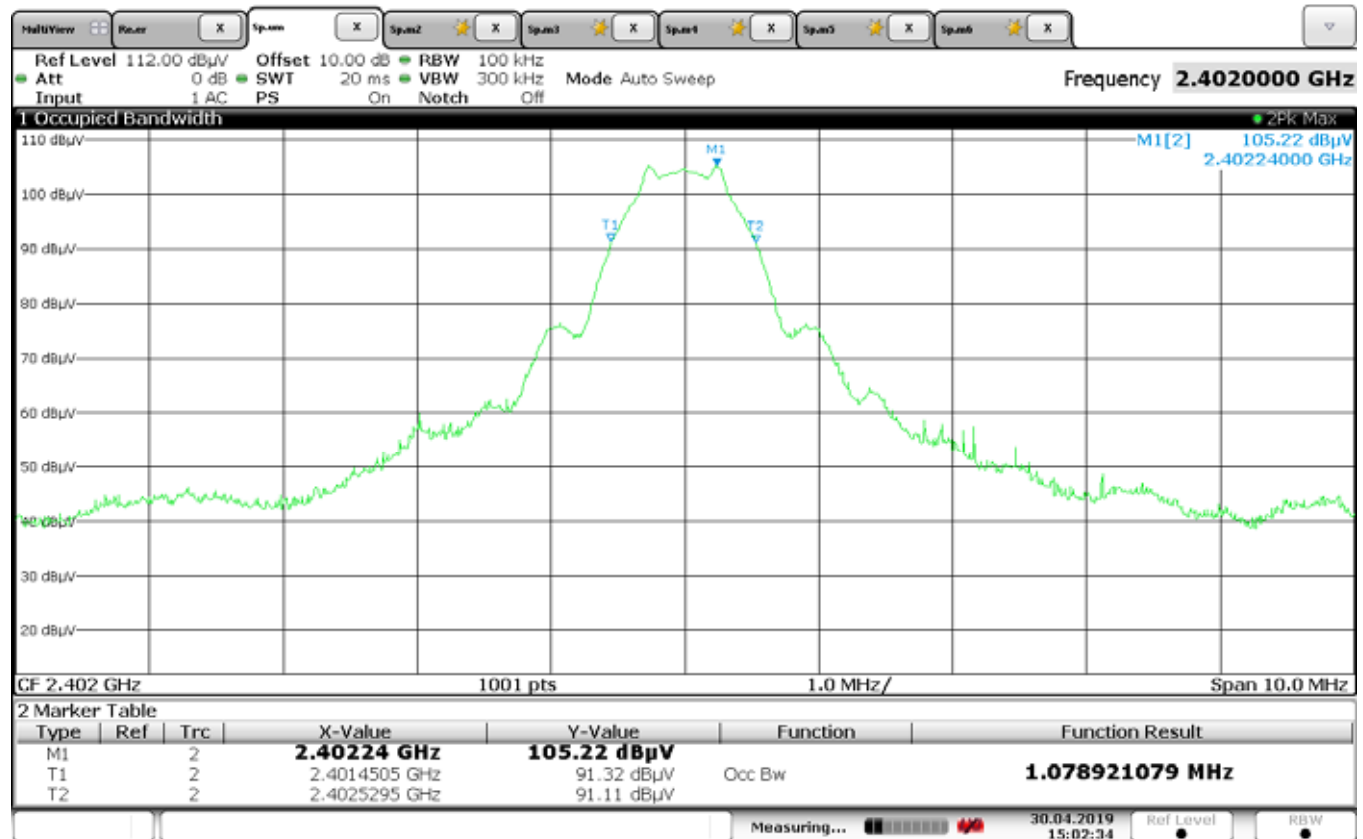
Date: 30 APR 2019 15:40:07

Manufacturer : Gentex Corporation
 Model Number : UAHLC A
 Serial Number : 905-6033-101561-3
 Test : **DTS (6dB) Bandwidth**
 Mode : Tx 2440MHz
 Parameters : DTS Bandwidth = 719kHz
 Date : April 30,2019
 Notes : Bluetooth



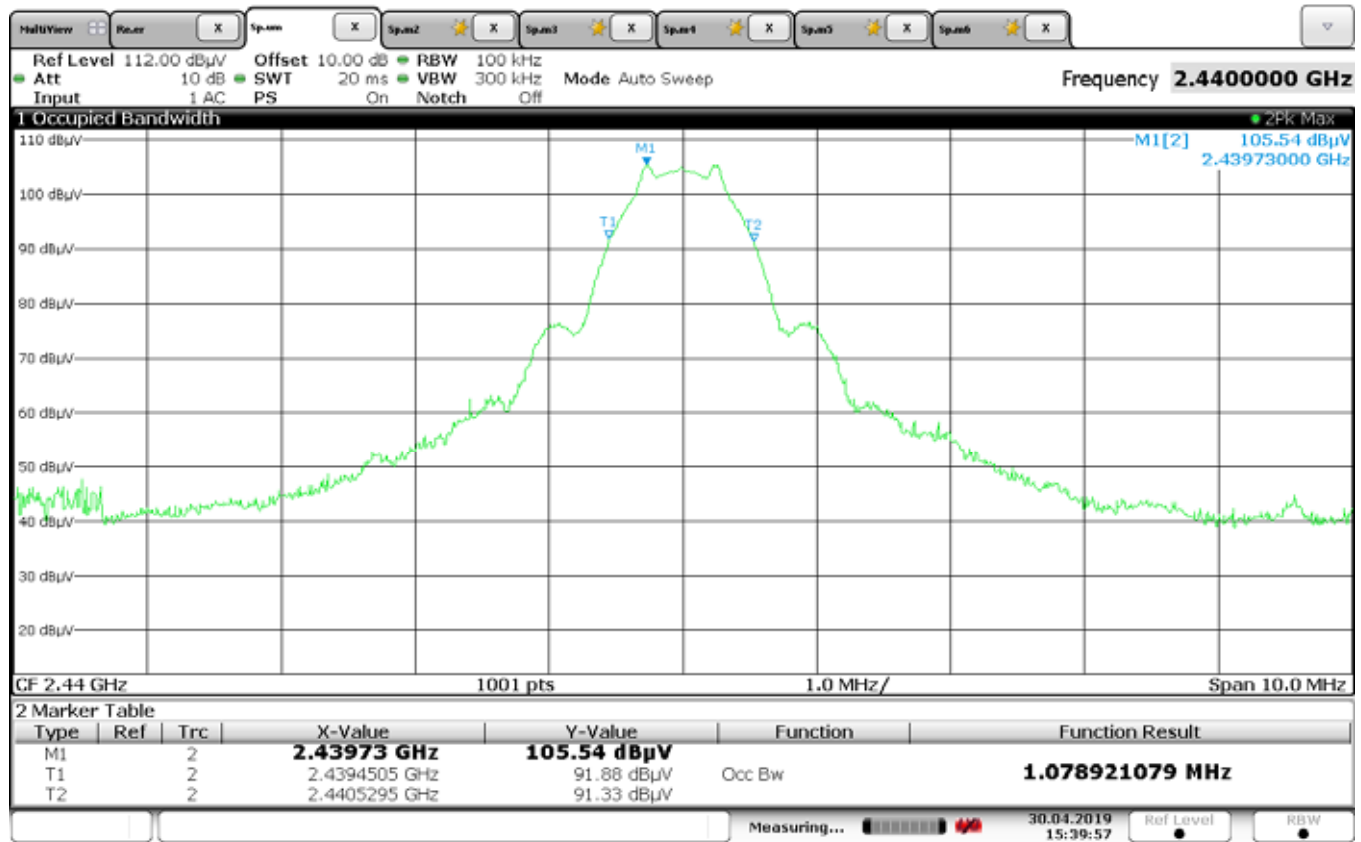
Date: 30 APR 2019 15:45:02

Manufacturer : Gentex Corporation
 Model Number : UAHLCA
 Serial Number : 905-6033-101561-3
 Test : **DTS (6dB) Bandwidth**
 Mode : Tx 2480MHz
 Parameters : DTS Bandwidth = 739kHz
 Date : April 30,2019
 Notes : Bluetooth



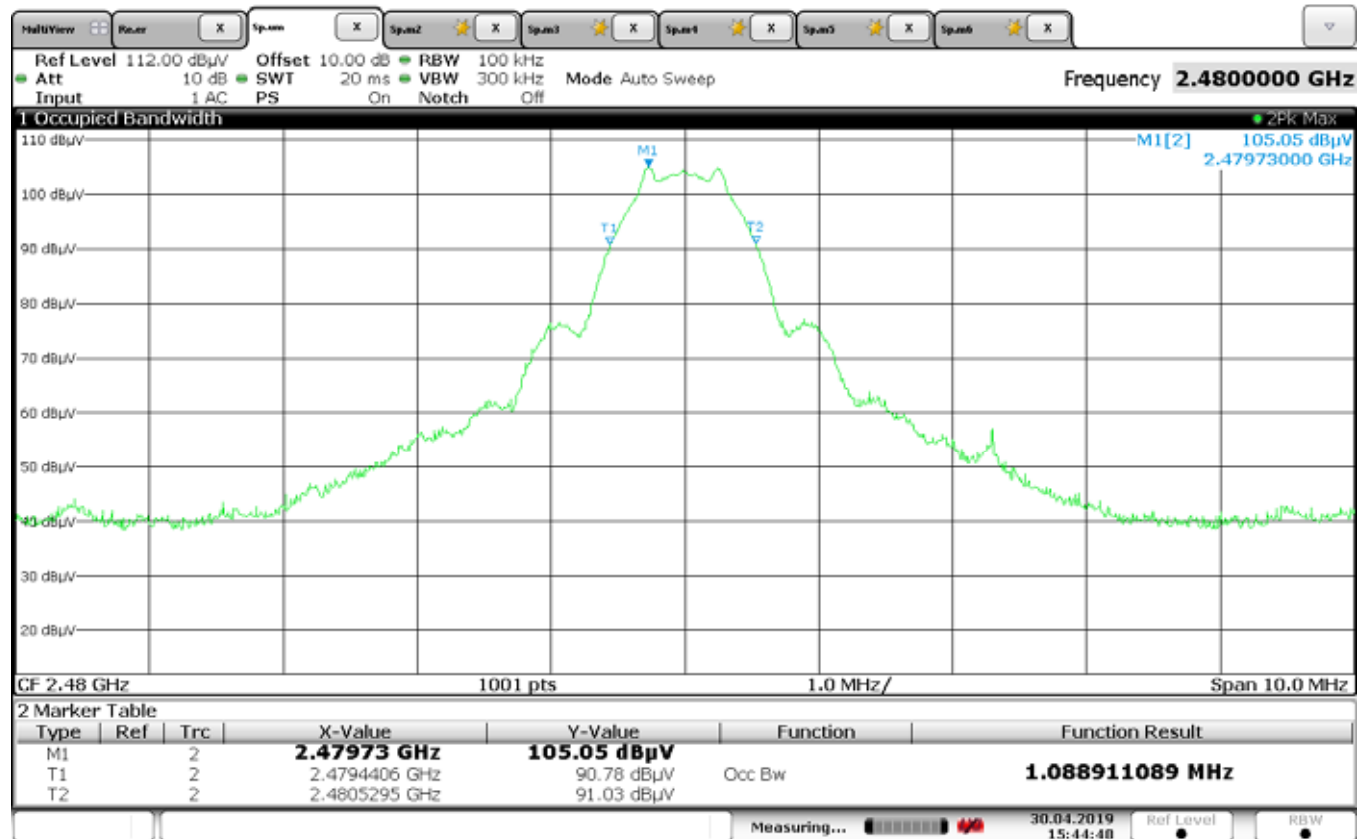
Date: 30 APR 2019 15:02:34

Manufacturer	: Gentex Corporation
Model Number	: UAHLCA
Serial Number	: 905-6033-101561-3
Test	: 99% Bandwidth
Mode	: Tx 2402MHz
Parameters	: 99% Bandwidth = 1.08MHz
Date	: April 30,2019
Notes	: Bluetooth



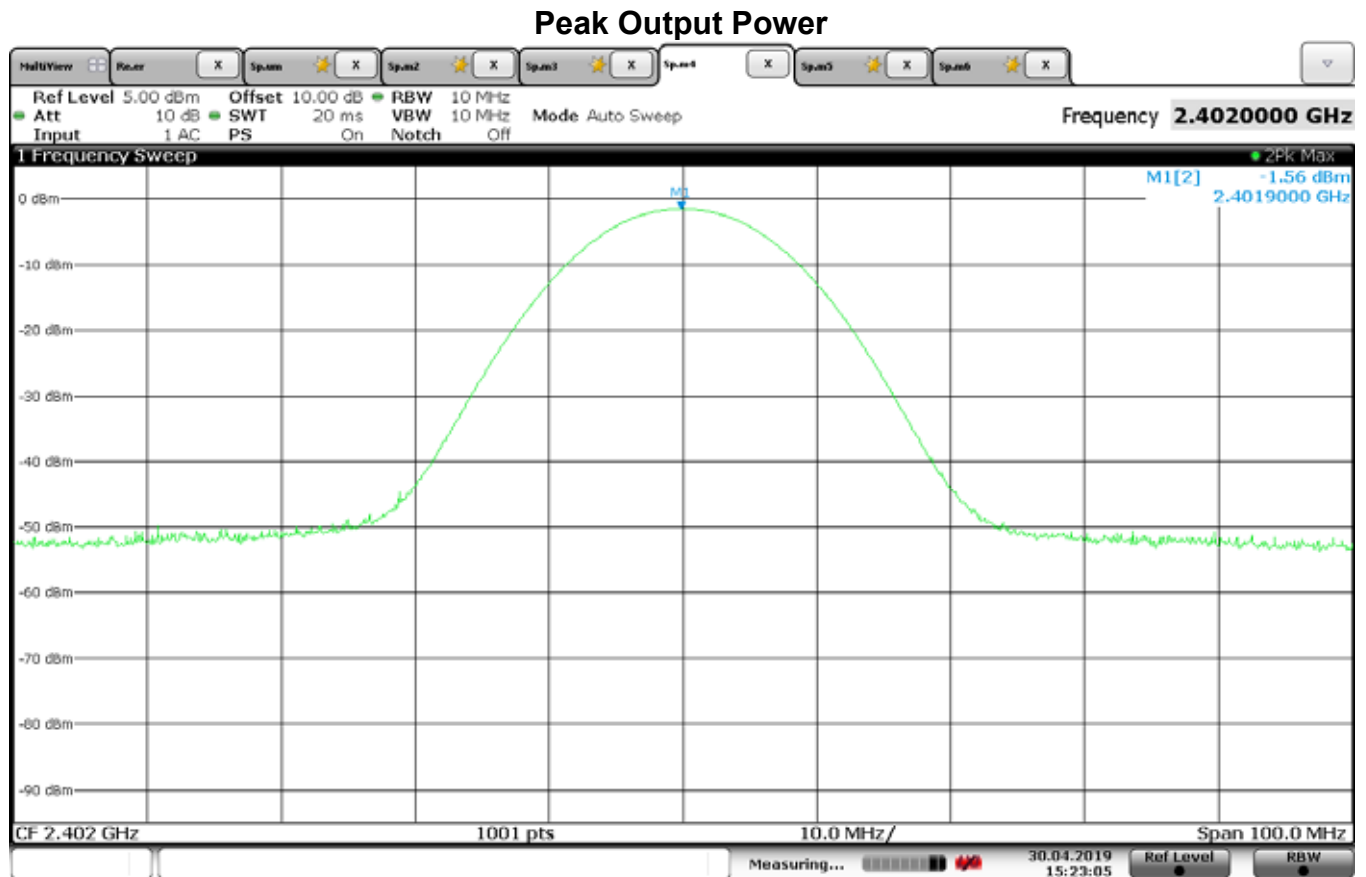
Date: 30 APR 2019 15:39:57

Manufacturer : Gentex Corporation
 Model Number : UAHLCA
 Serial Number : 905-6033-101561-3
 Test : **99% Bandwidth**
 Mode : Tx 2440MHz
 Parameters : 99% Bandwidth = 1.08MHz
 Date : April 30,2019
 Notes : Bluetooth



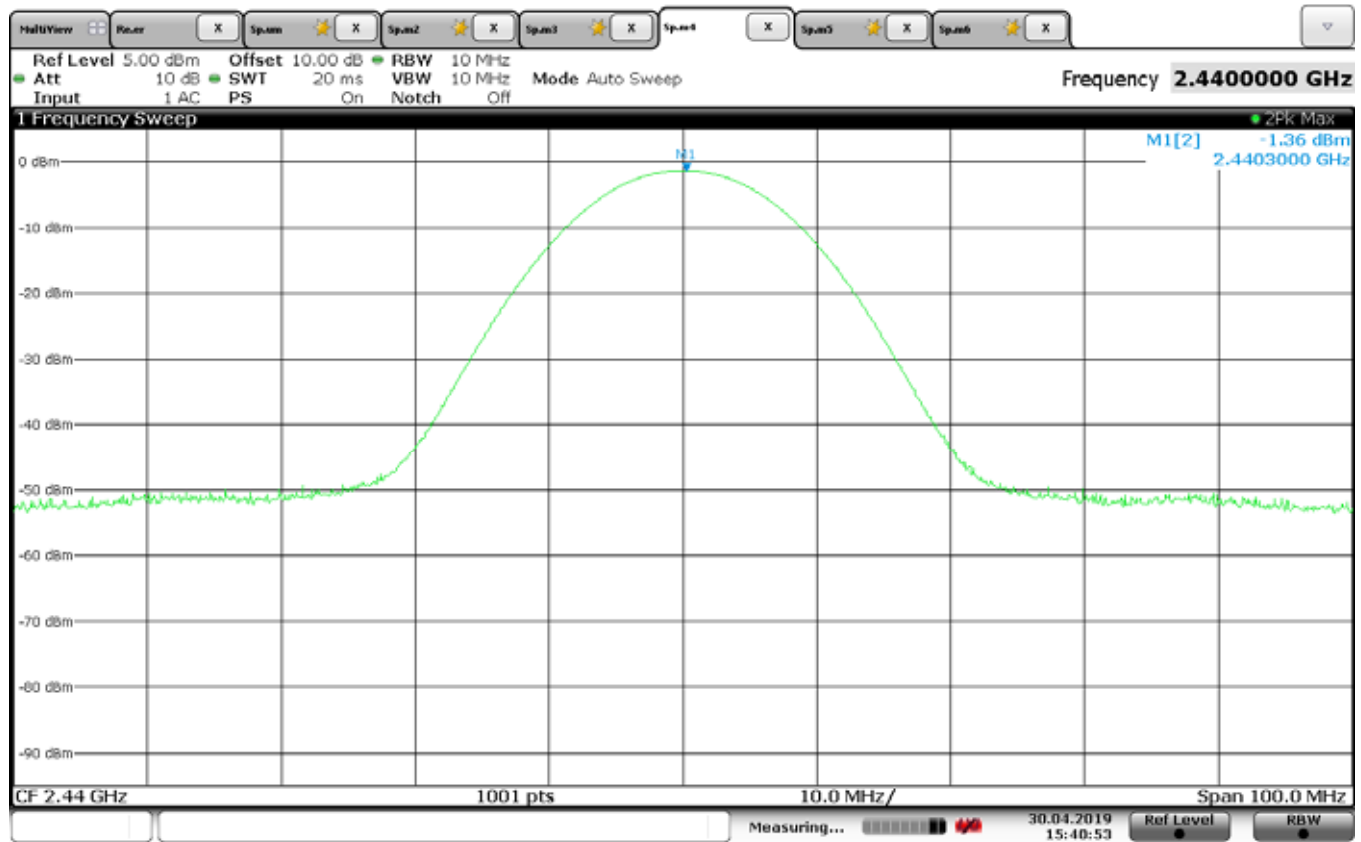
Date: 30 APR 2019 15:44:48

Manufacturer	: Gentex Corporation
Model Number	: UAHLCA
Serial Number	: 905-6033-101561-3
Test	: 99% Bandwidth
Mode	: Tx 2480MHz
Parameters	: 99% Bandwidth = 1.09MHz
Date	: April 30,2019
Notes	: Bluetooth



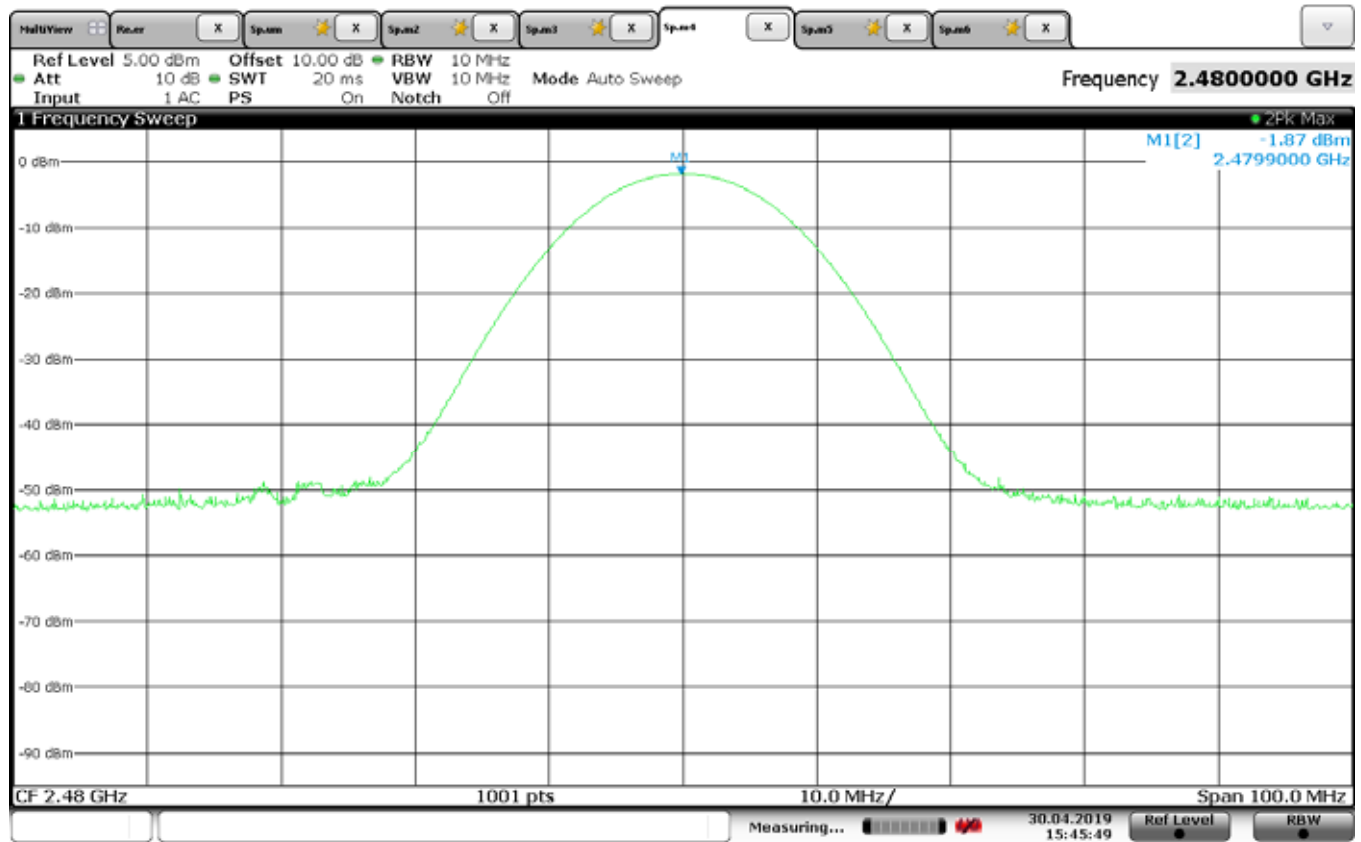
Date: 30.APR.2019 15:23:05

Manufacturer : Gentex Corporation
Model Number : UAHLC A
Serial Number : 905-6033-101561-3
Test : **Conducted Peak Output Power**
Mode : Tx 2402MHz
Parameters : Peak Output Power = -1.56dBm
Date : April 30,2019
Notes : Bluetooth



Date: 30 APR 2019 15:40:53

Manufacturer : Gentex Corporation
 Model Number : UAHLCA
 Serial Number : 905-6033-101561-3
 Test : **Conducted Peak Output Power**
 Mode : Tx 2440MHz
 Parameters : Peak Output Power = -1.36dBm
 Date : April 30,2019
 Notes : Bluetooth



Date: 30 APR 2019 15:45:49

Manufacturer : Gentex Corporation
 Model Number : UAHLCA
 Serial Number : 905-6033-101561-3
 Test : **Conducted Peak Output Power**
 Mode : Tx 2480MHz
 Parameters : Peak Output Power = -1.87dBm
 Date : April 30,2019
 Notes : Bluetooth



Freq.	Ant	Wide BW Meter Reading	Matched Sig. Gen. Reading	Equivalent Antenna Gain	Cable Loss	EIRP	Limit	Margin
(MHz)	Pol	(dBuV)	(dBm)	(dB)	(dB)	(dBm)	(dBm)	(dB)
2402.00	H	48.6	-14.1	4.2	3.4	-13.3	36.0	-49.3
2402.00	V	51.2	-12.1	4.2	3.4	-11.3	36.0	-47.3

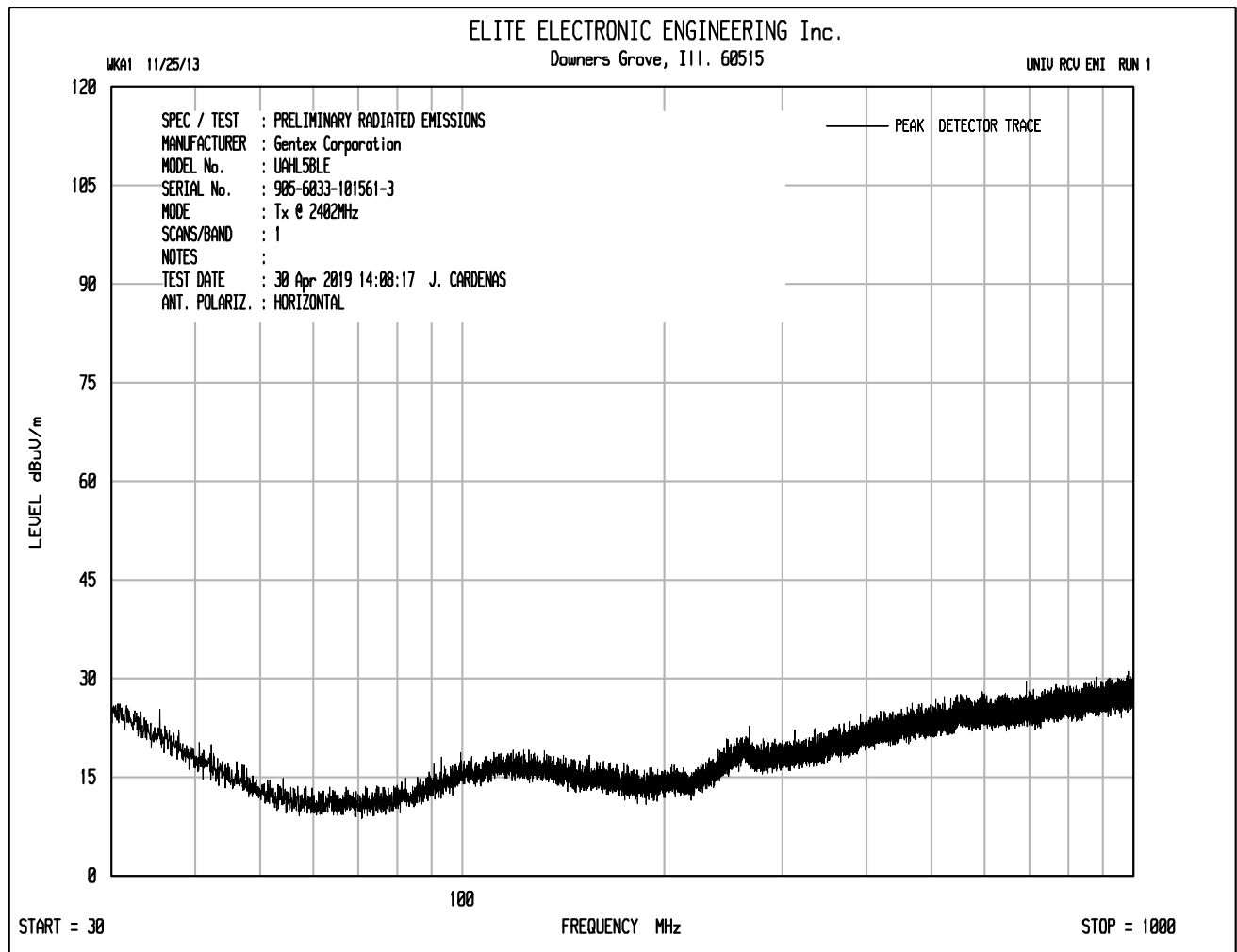
Manufacturer : Gentex Corporation
Model Number : UAHLC A
Serial Number : 905-6033-101561-3
Test : **EIRP**
Mode : Tx 2402MHz
Date : April 30,2019
Notes : Bluetooth

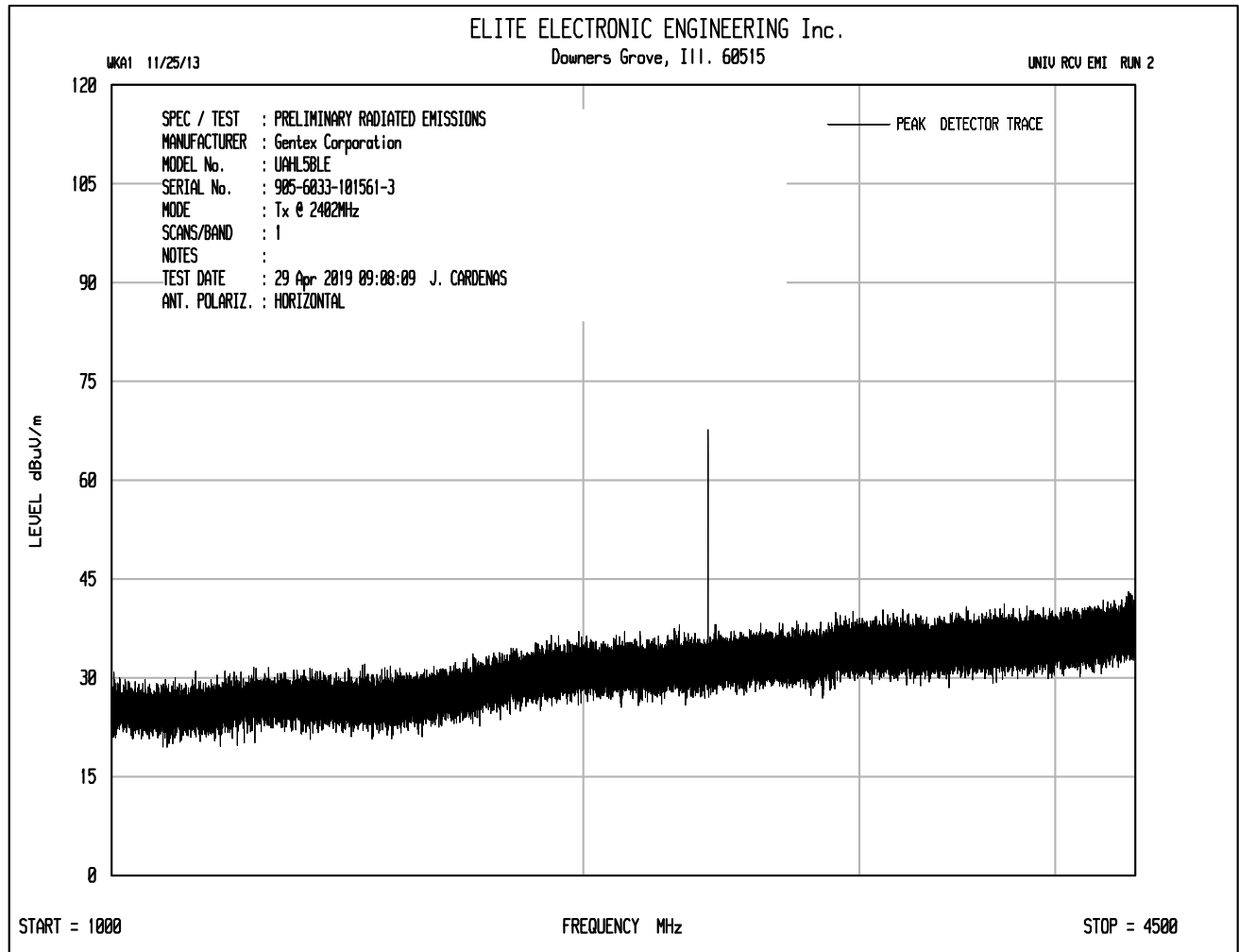
Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2440.00	H	52.4	-10.0	4.4	3.5	-9.1	36.0	-45.1
2440.00	V	49.0	-14.5	4.4	3.5	-13.6	36.0	-49.6

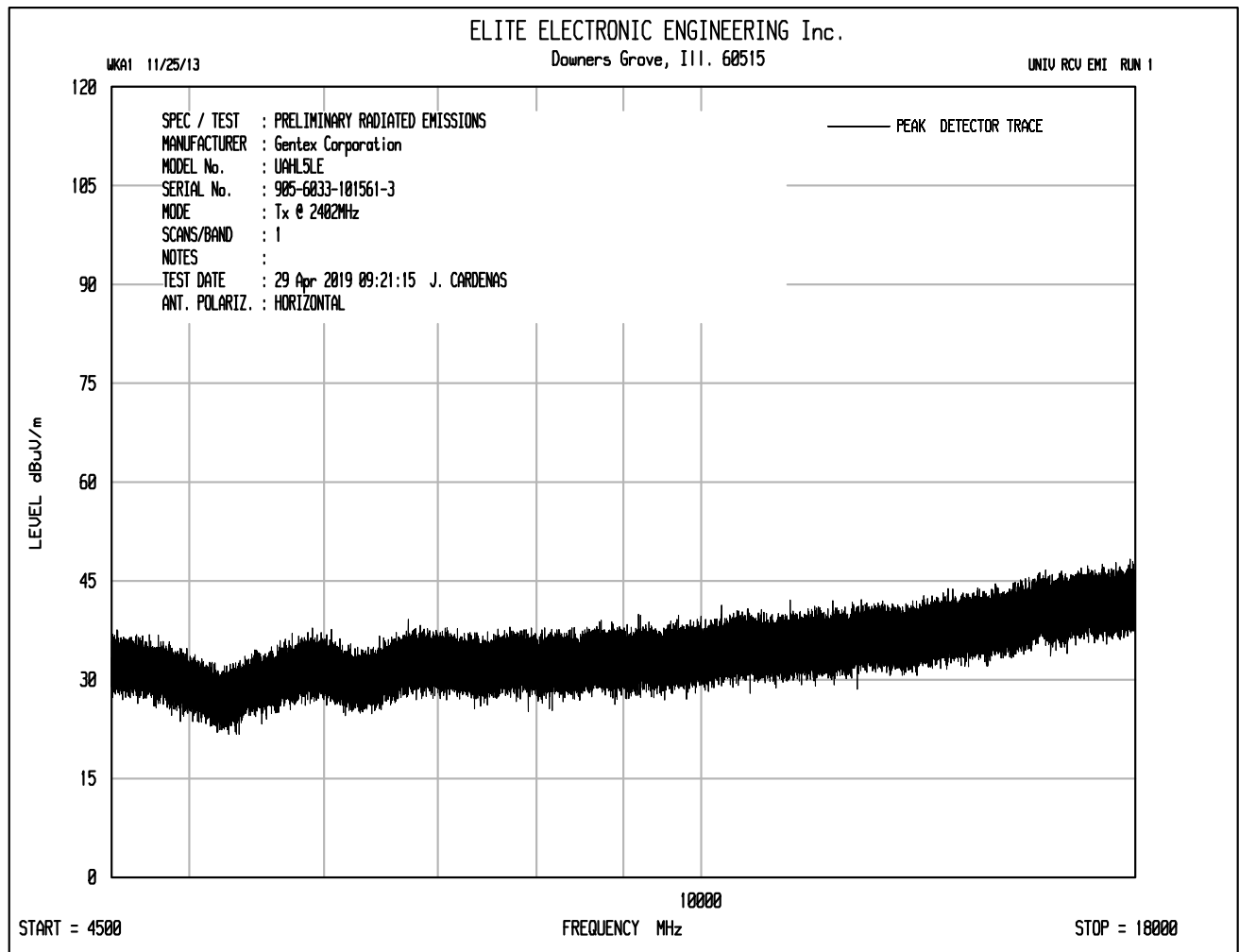
Manufacturer : Gentex Corporation
Model Number : UAHLC A
Serial Number : 905-6033-101561-3
Test : **EIRP**
Mode : Tx 2440MHz
Date : April 30,2019
Notes : Bluetooth

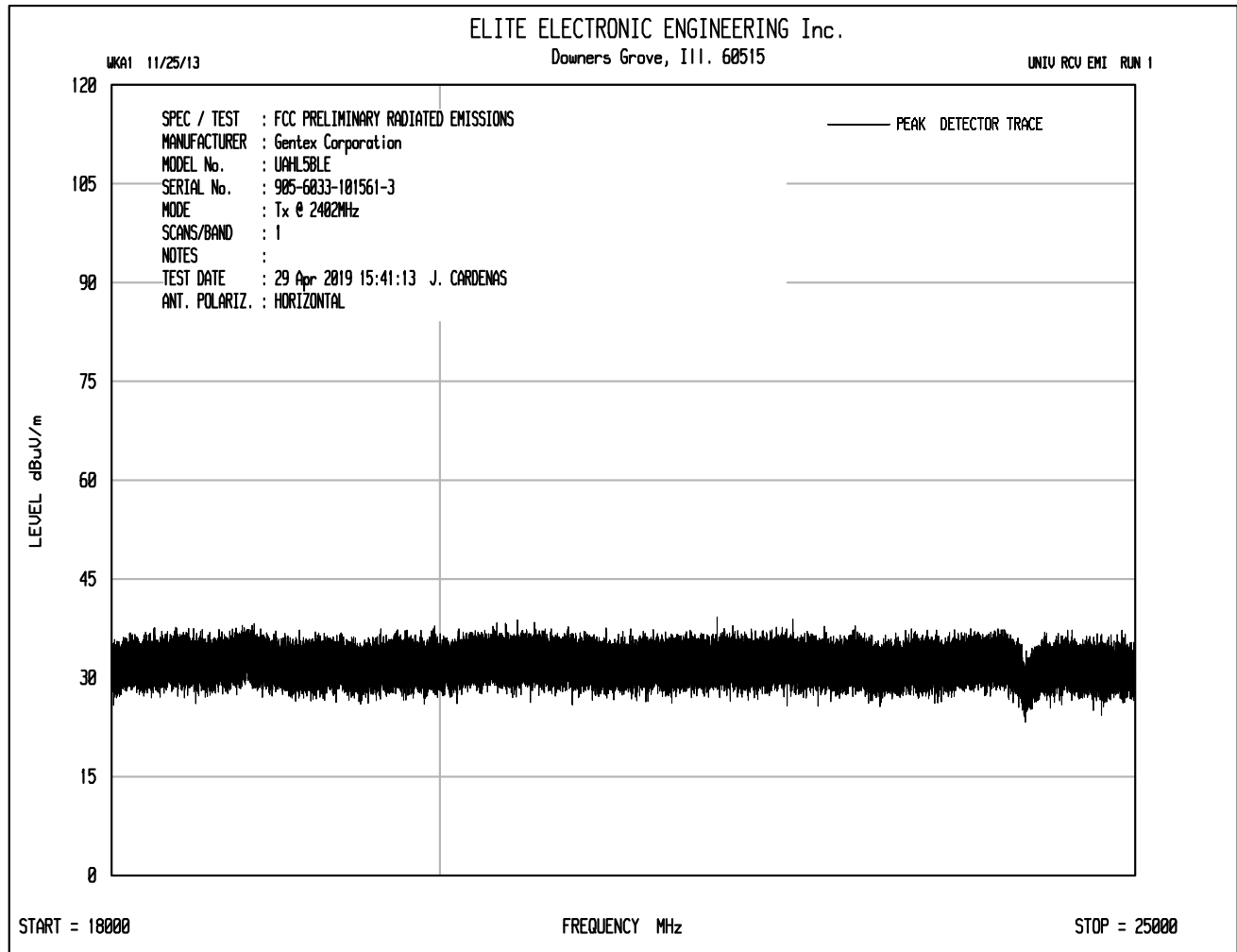
Freq. (MHz)	Ant Pol	Wide BW Meter Reading (dBuV)	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
2480.00	H	51.2	-10.5	4.5	3.5	-9.5	36.0	-45.5
2480.00	V	47.5	-17.4	4.5	3.5	-16.4	36.0	-52.4

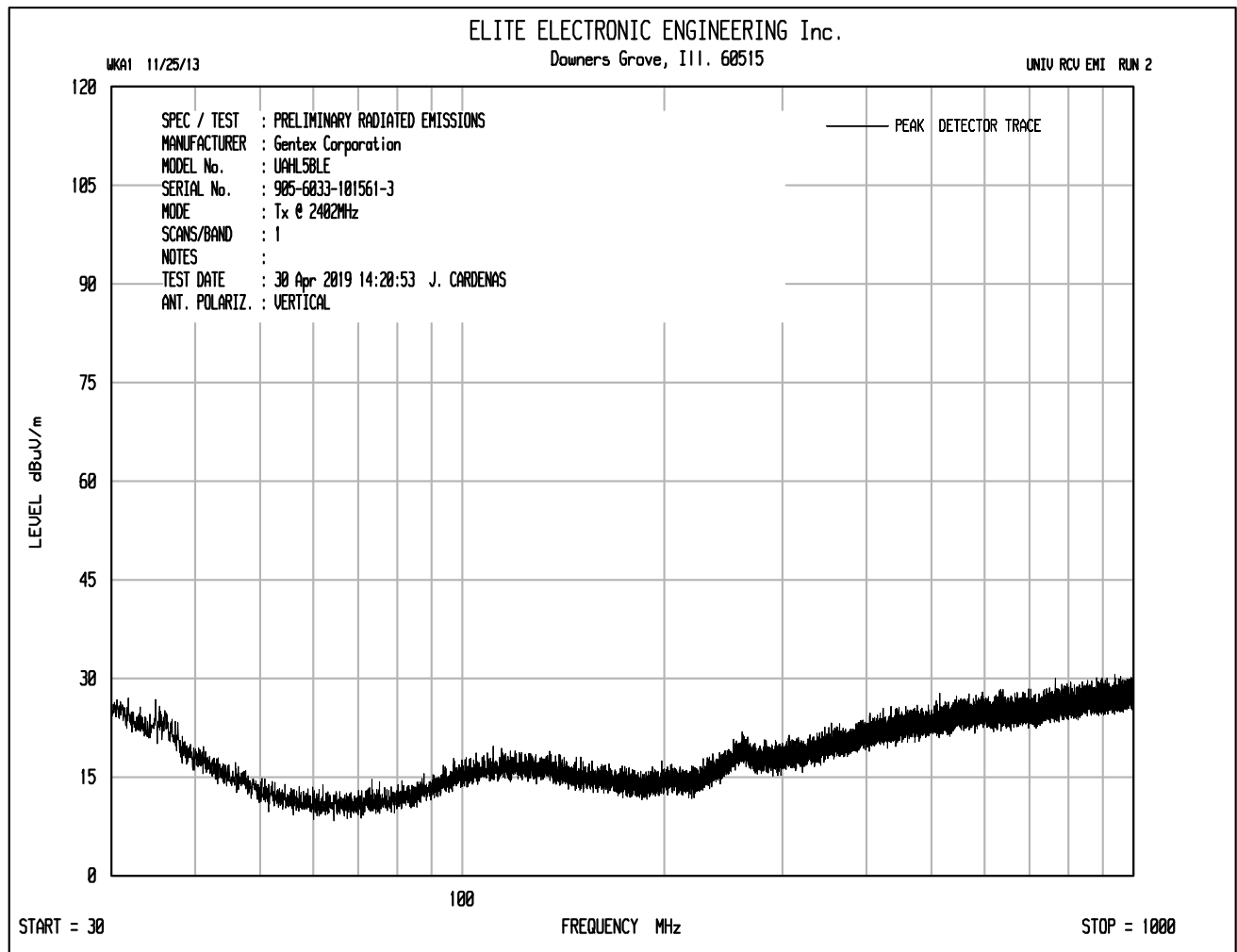
Manufacturer : Gentex Corporation
Model Number : UAHLC A
Serial Number : 905-6033-101561-3
Test : **EIRP**
Mode : Tx 2480MHz
Date : April 30,2019
Notes : Bluetooth

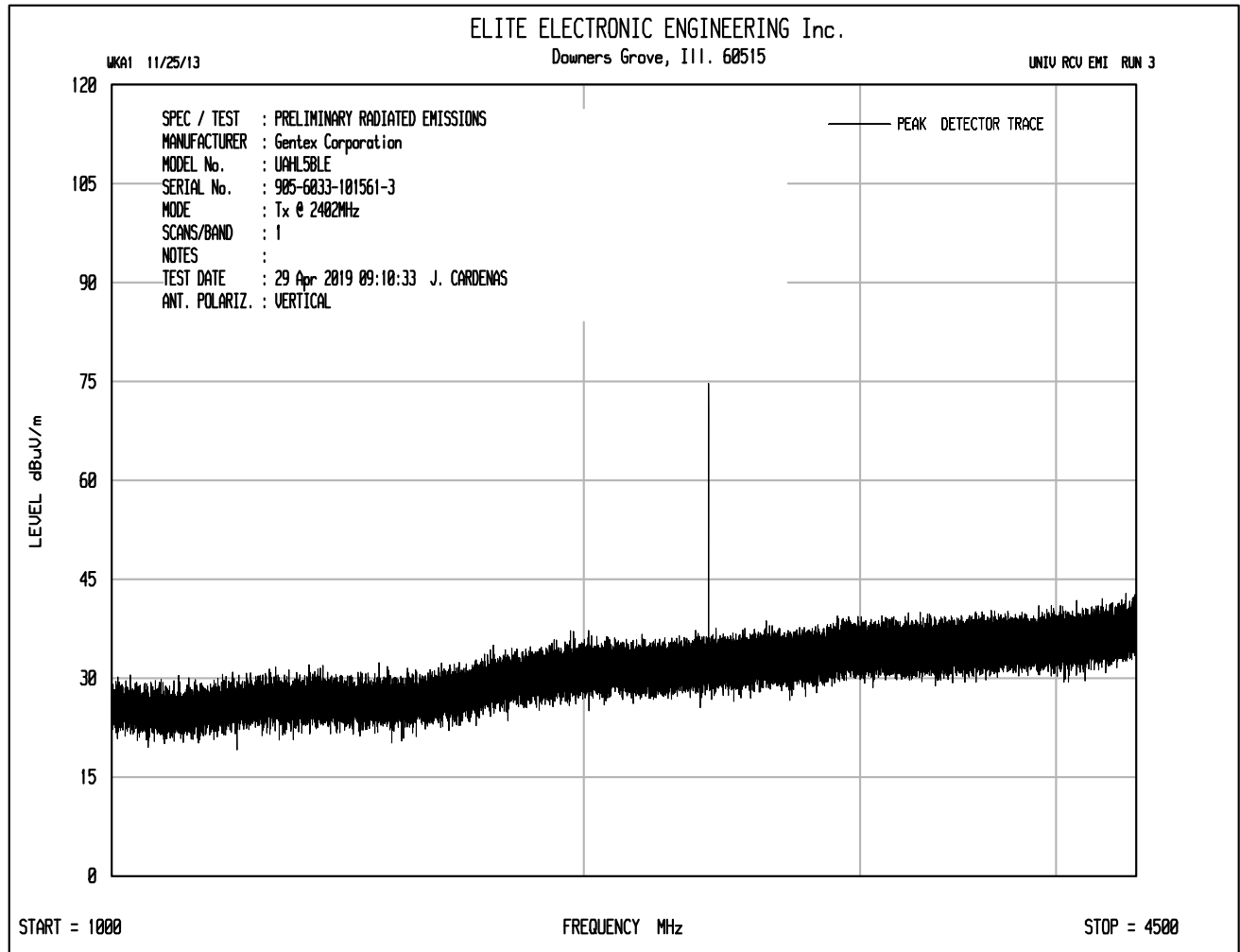


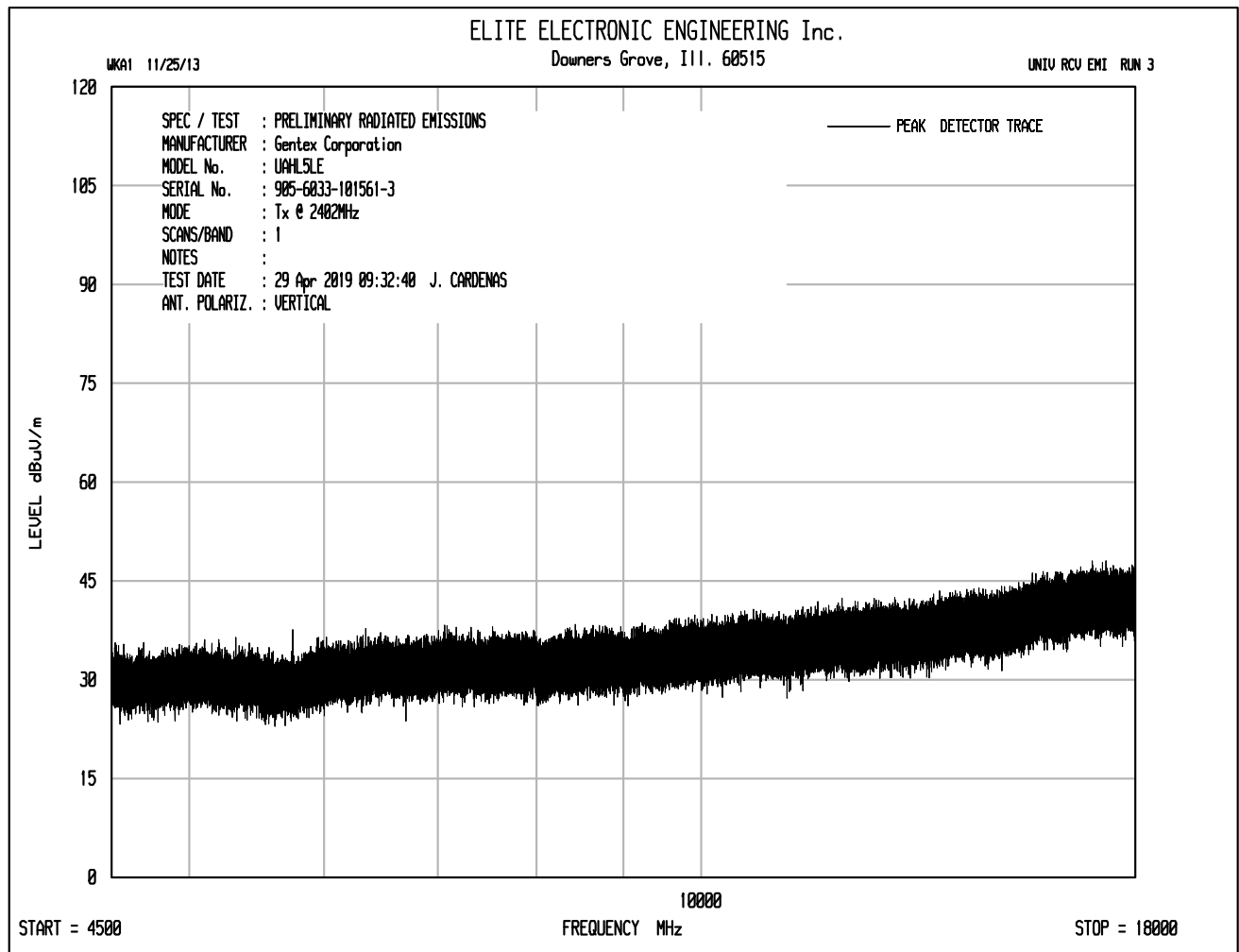


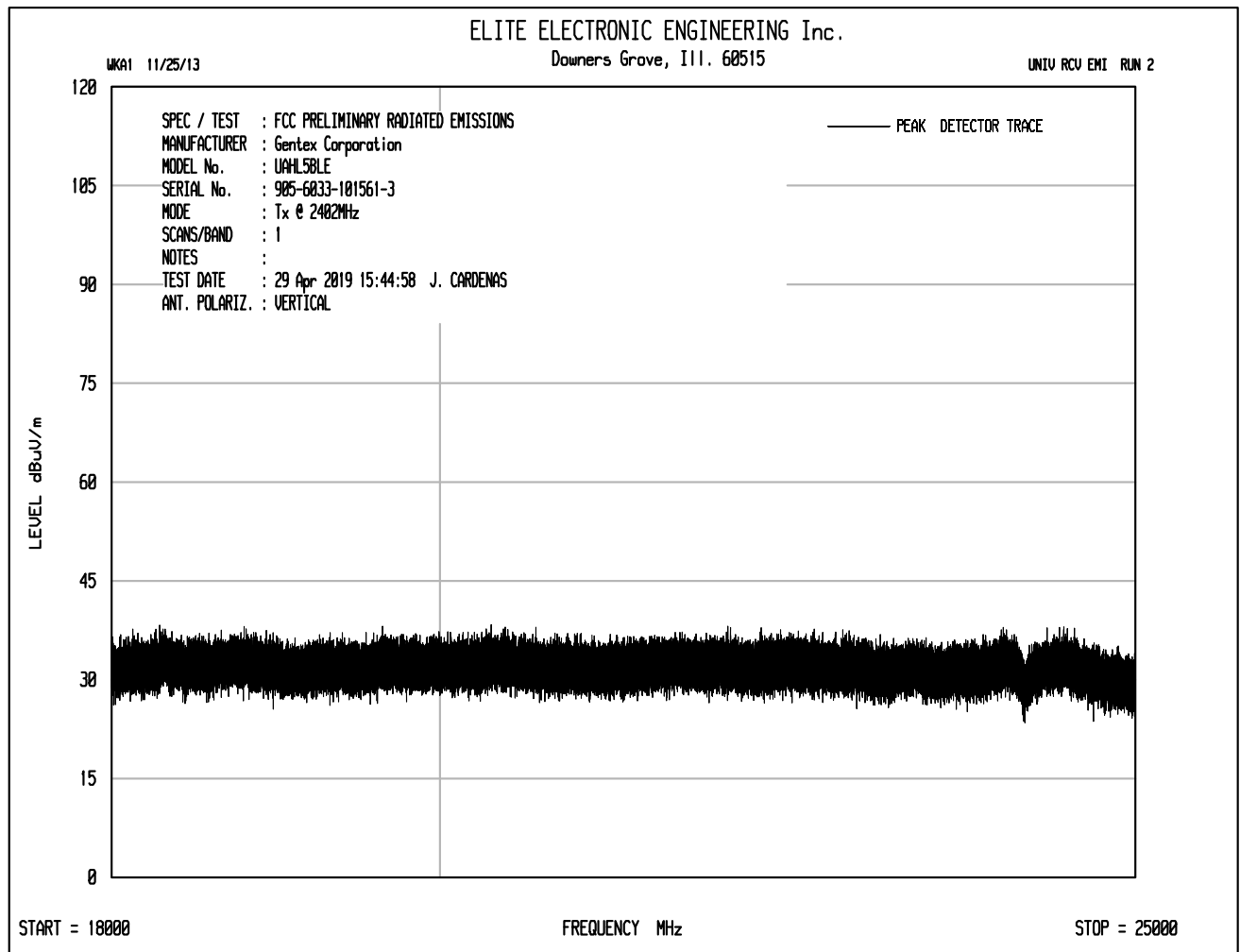


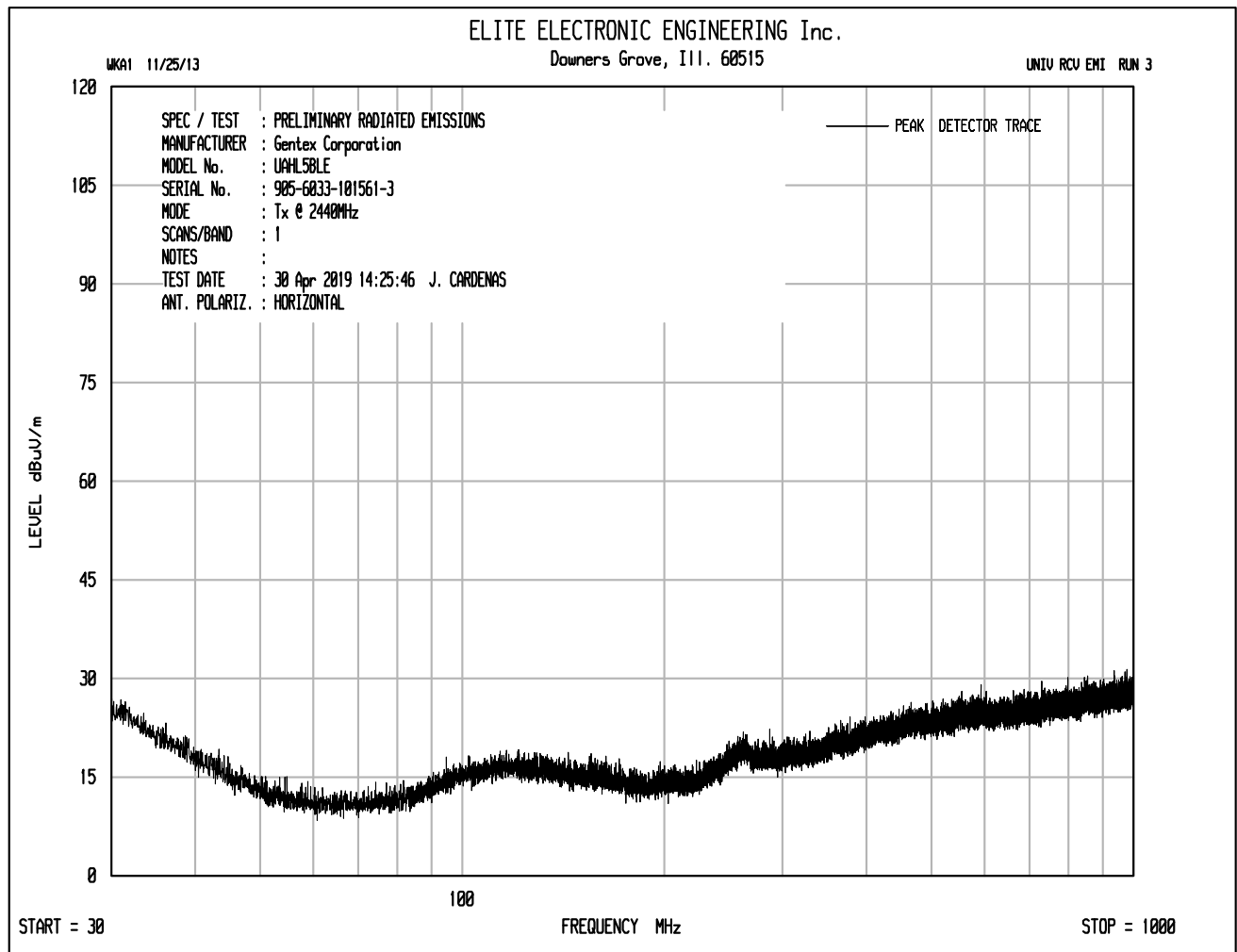


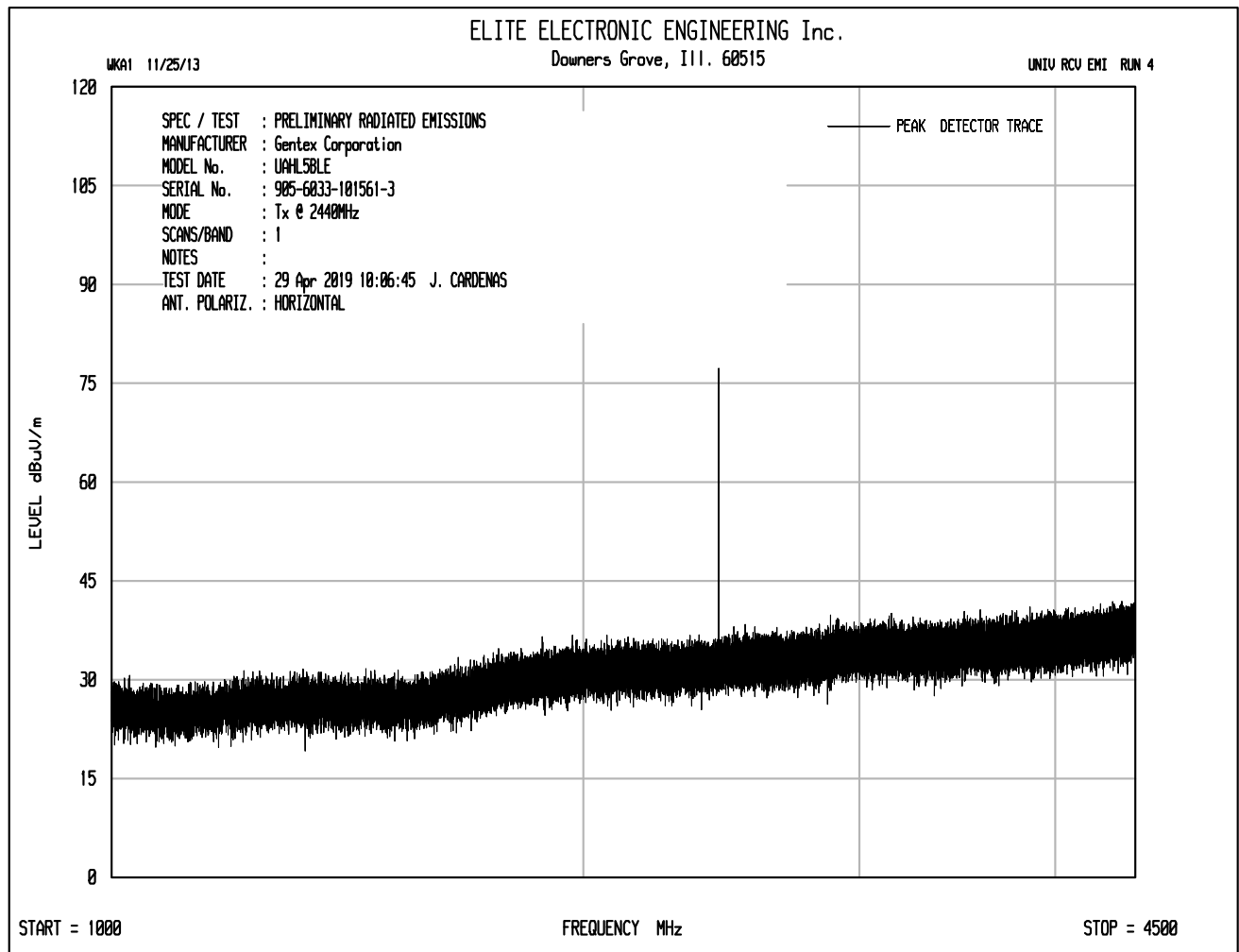


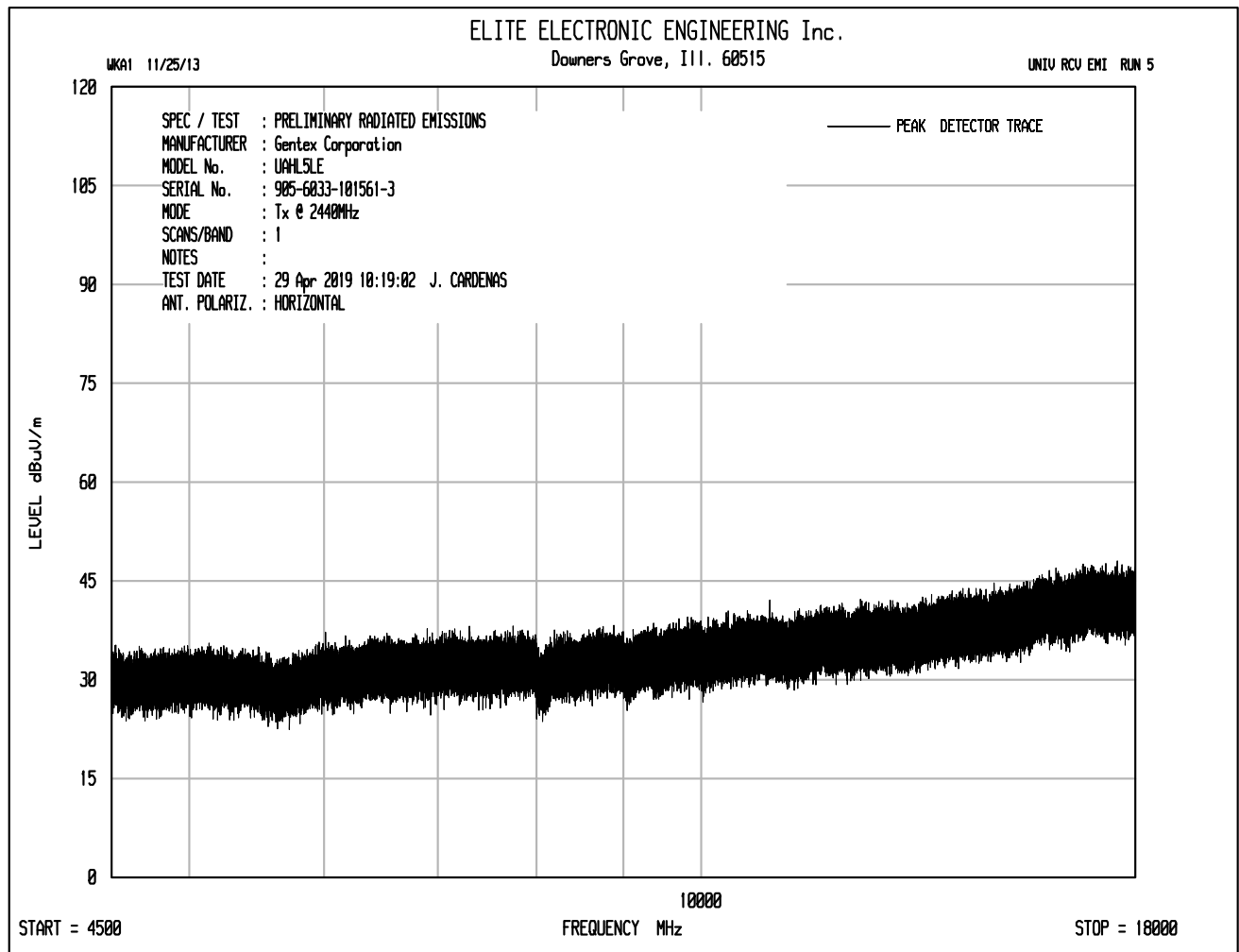


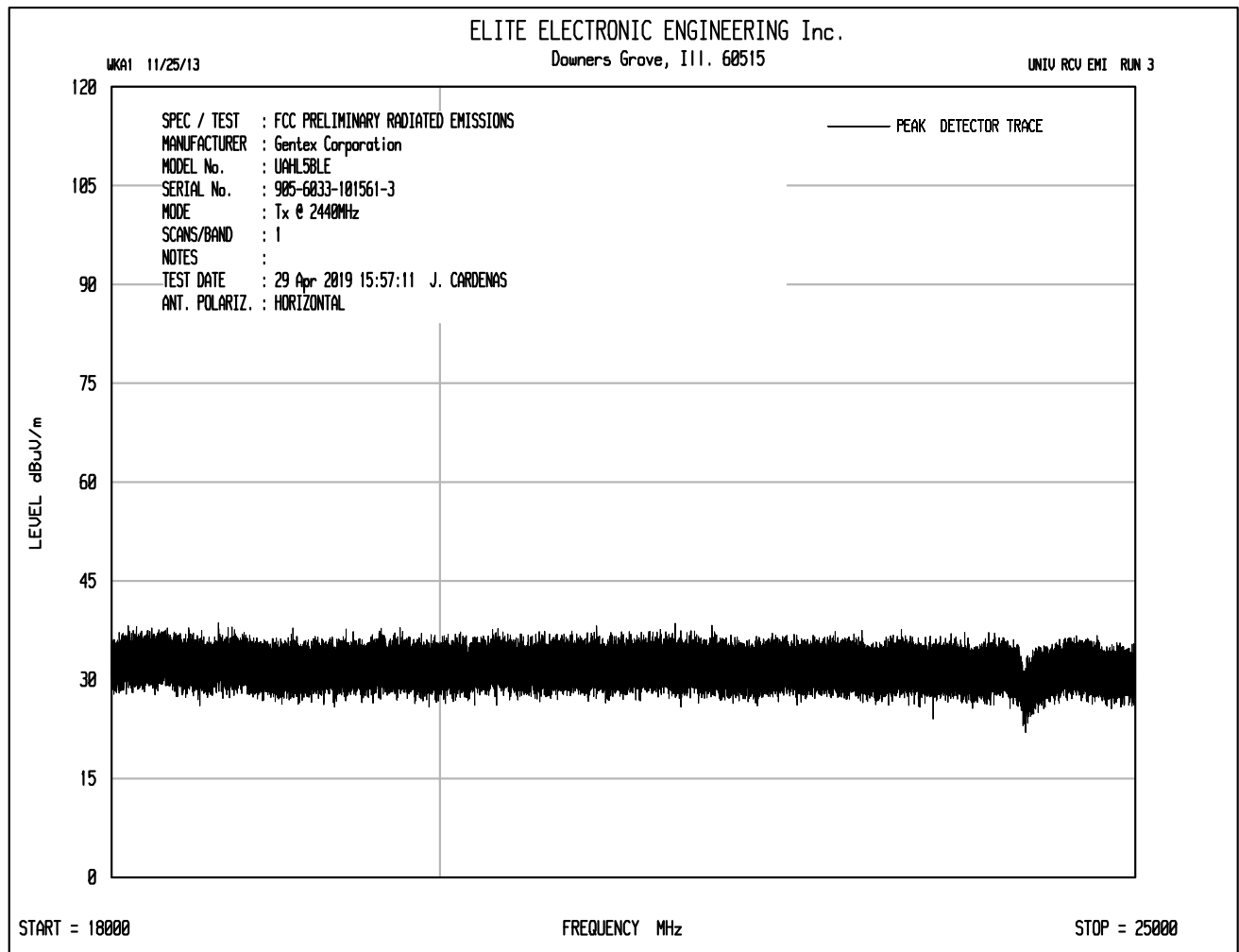


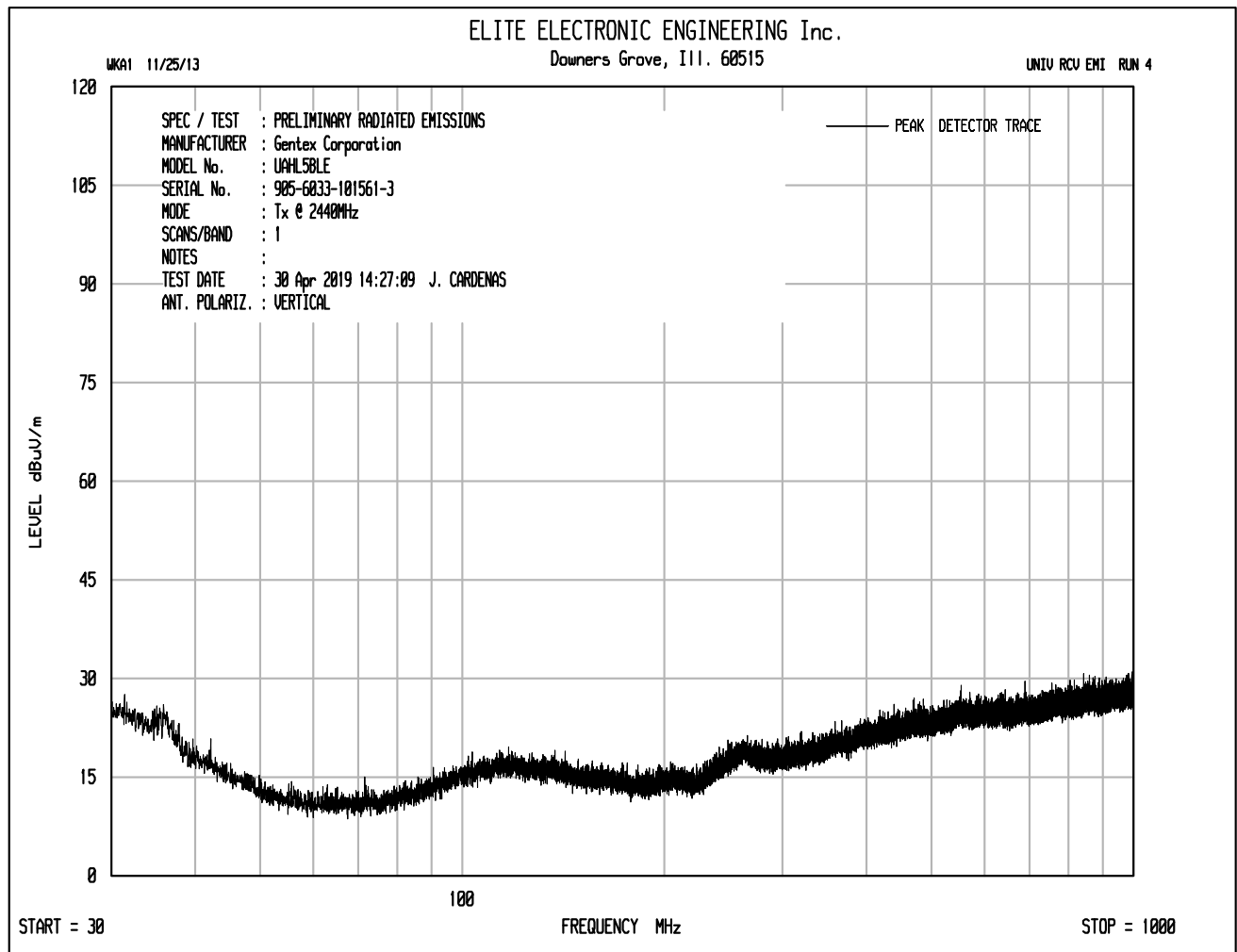


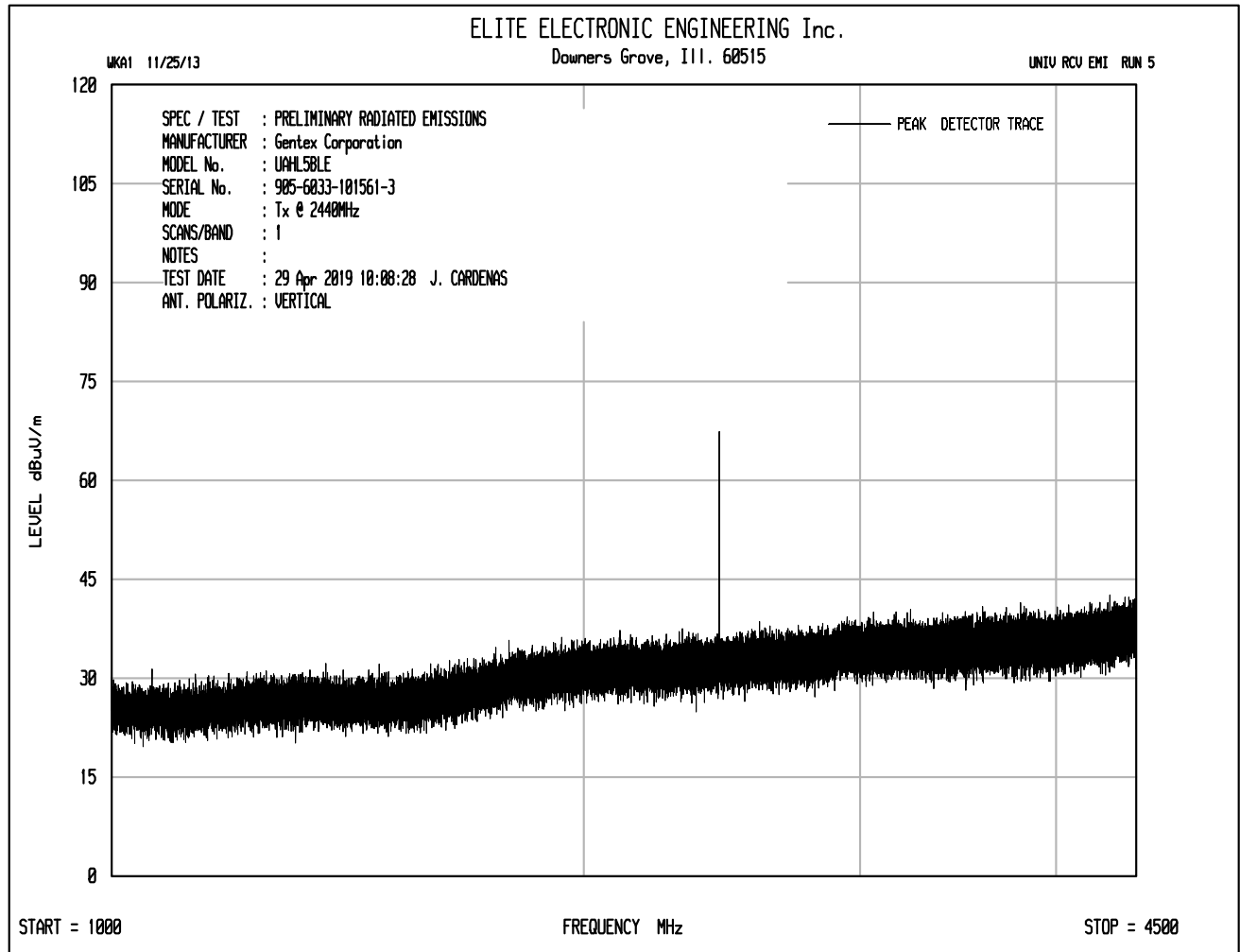


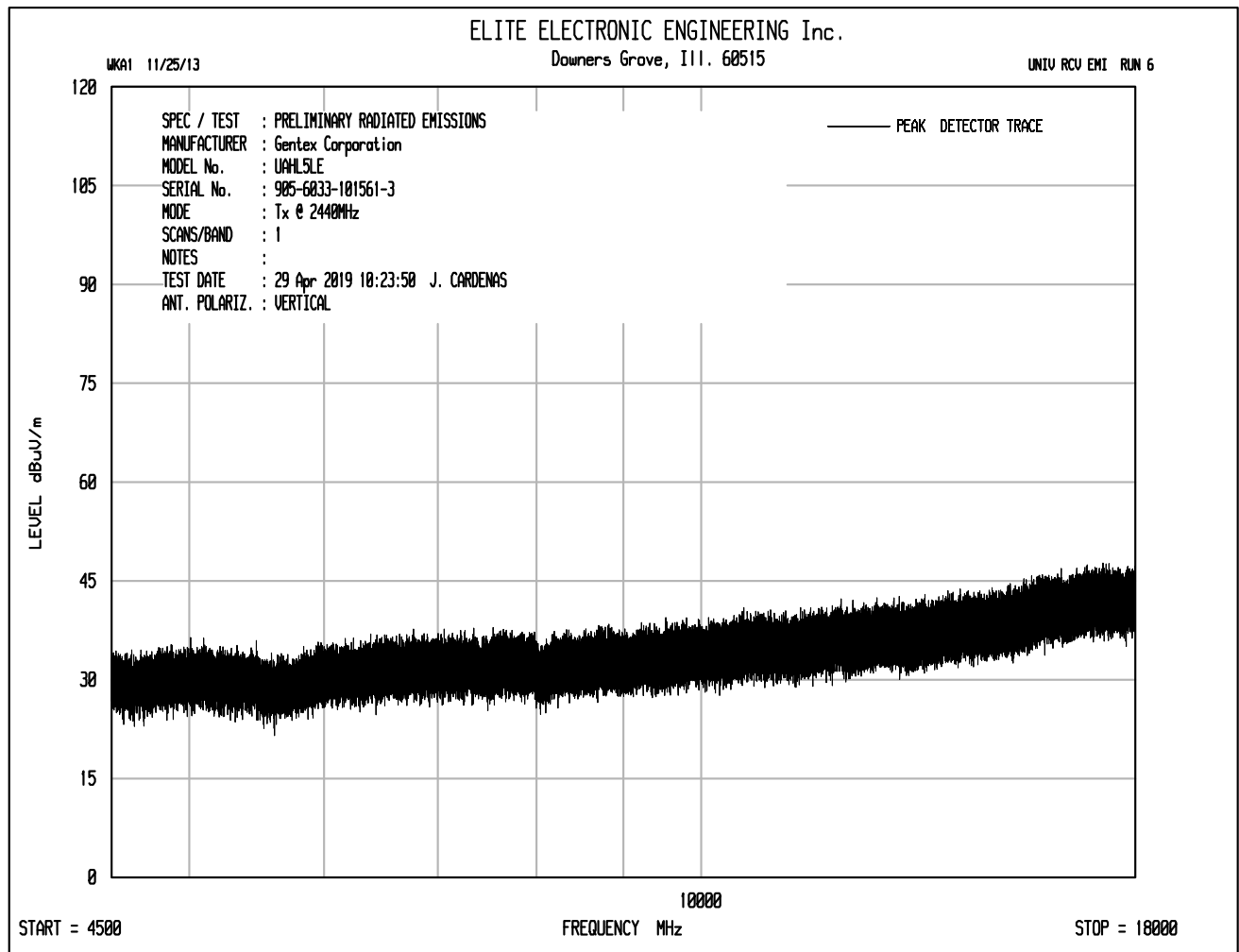


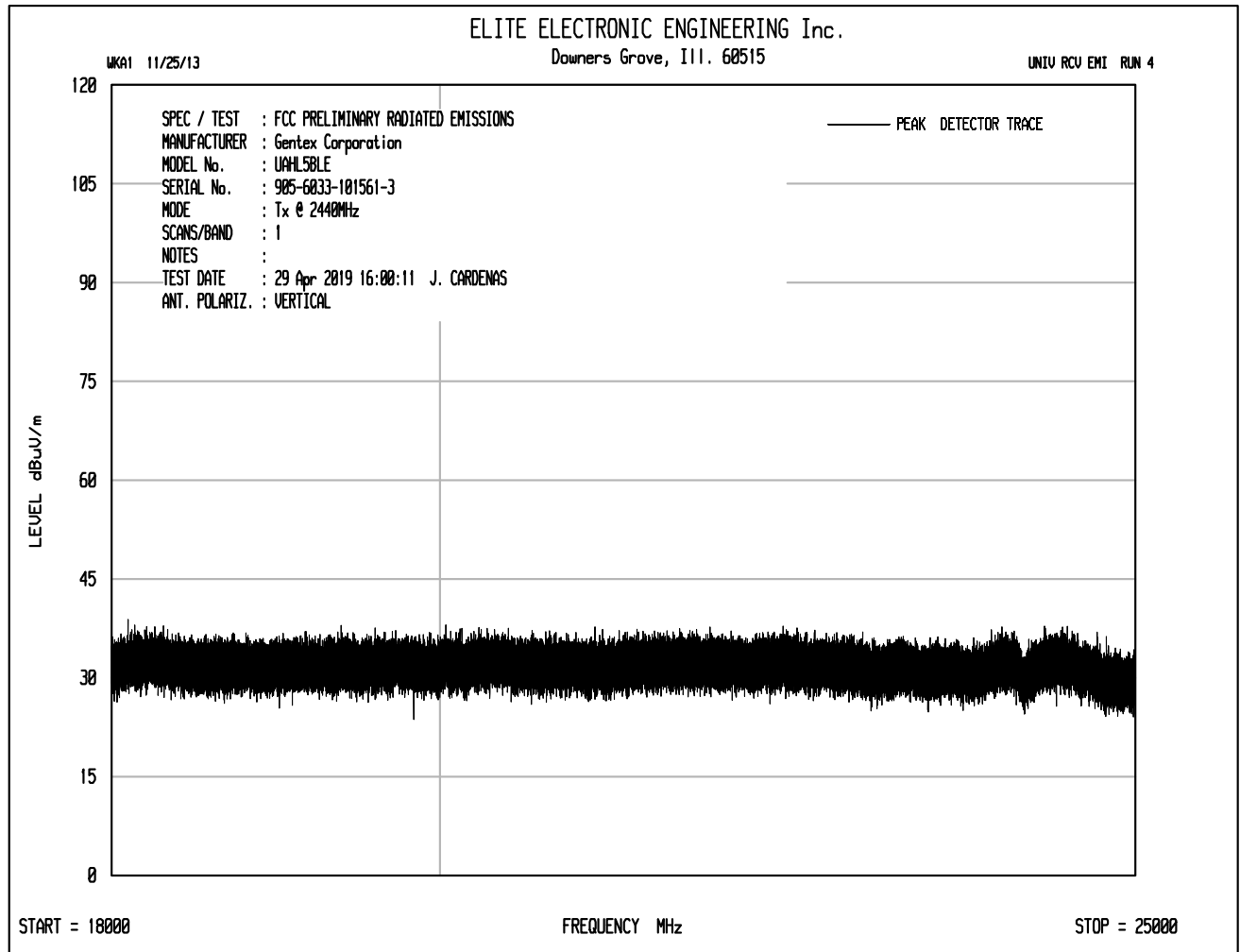


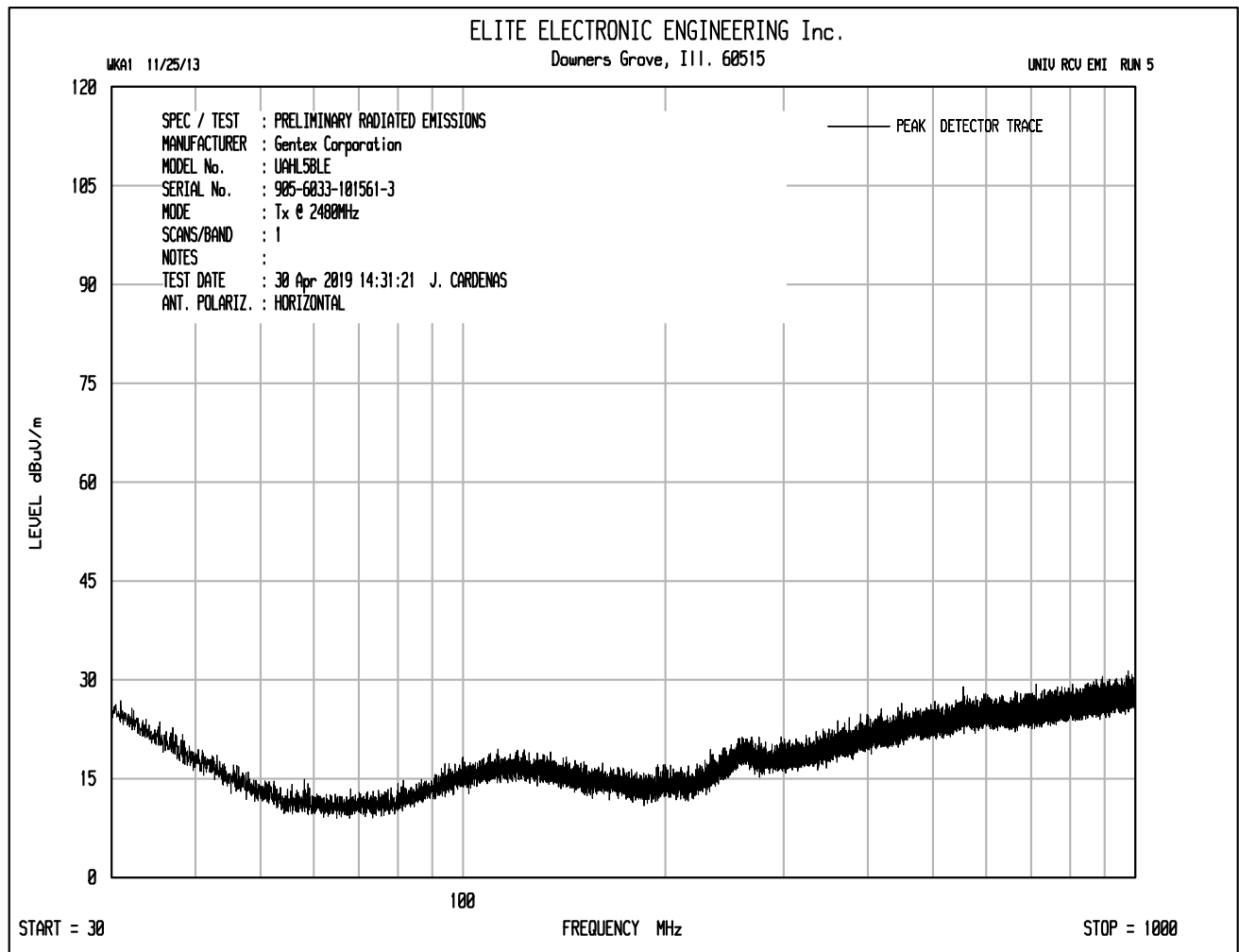


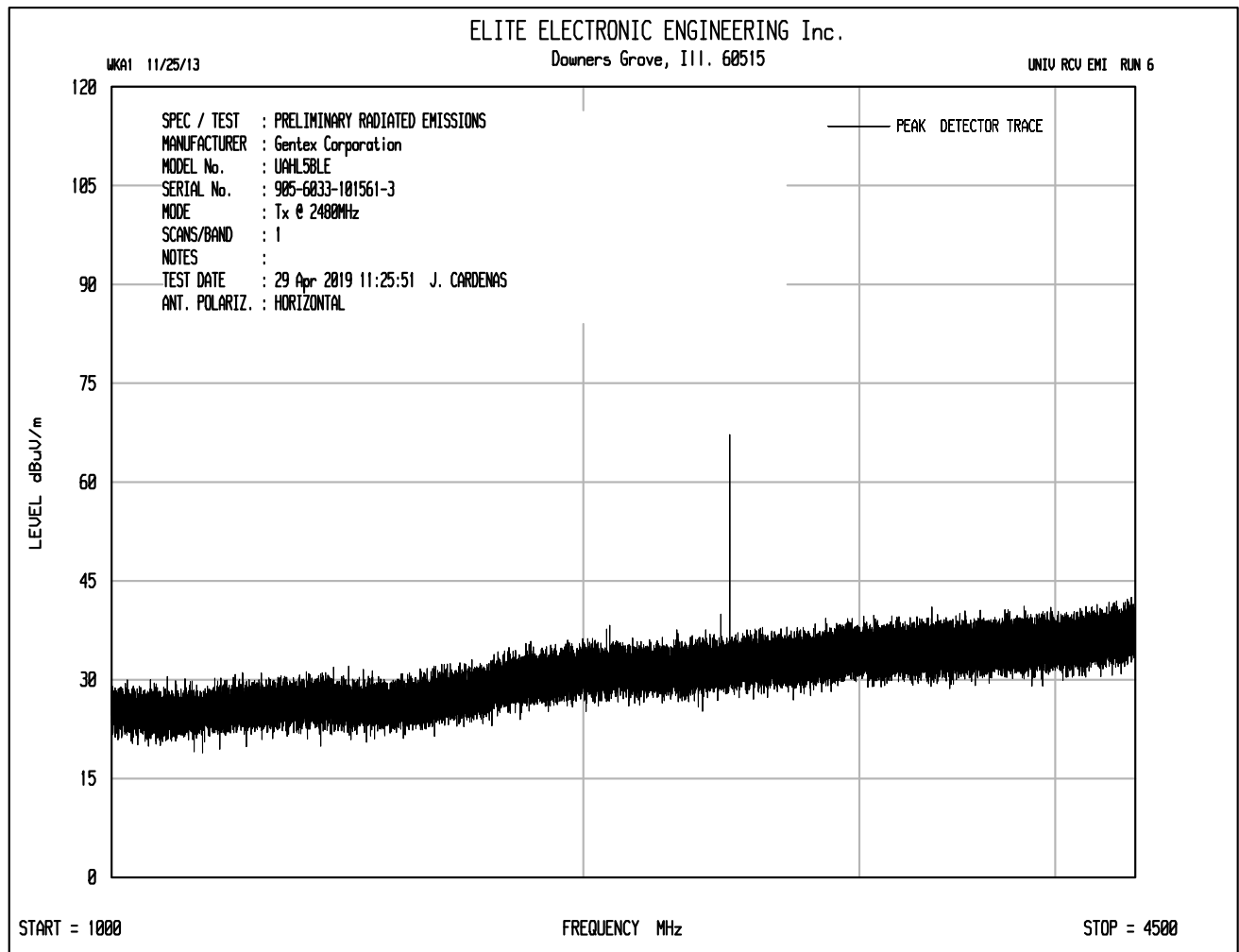


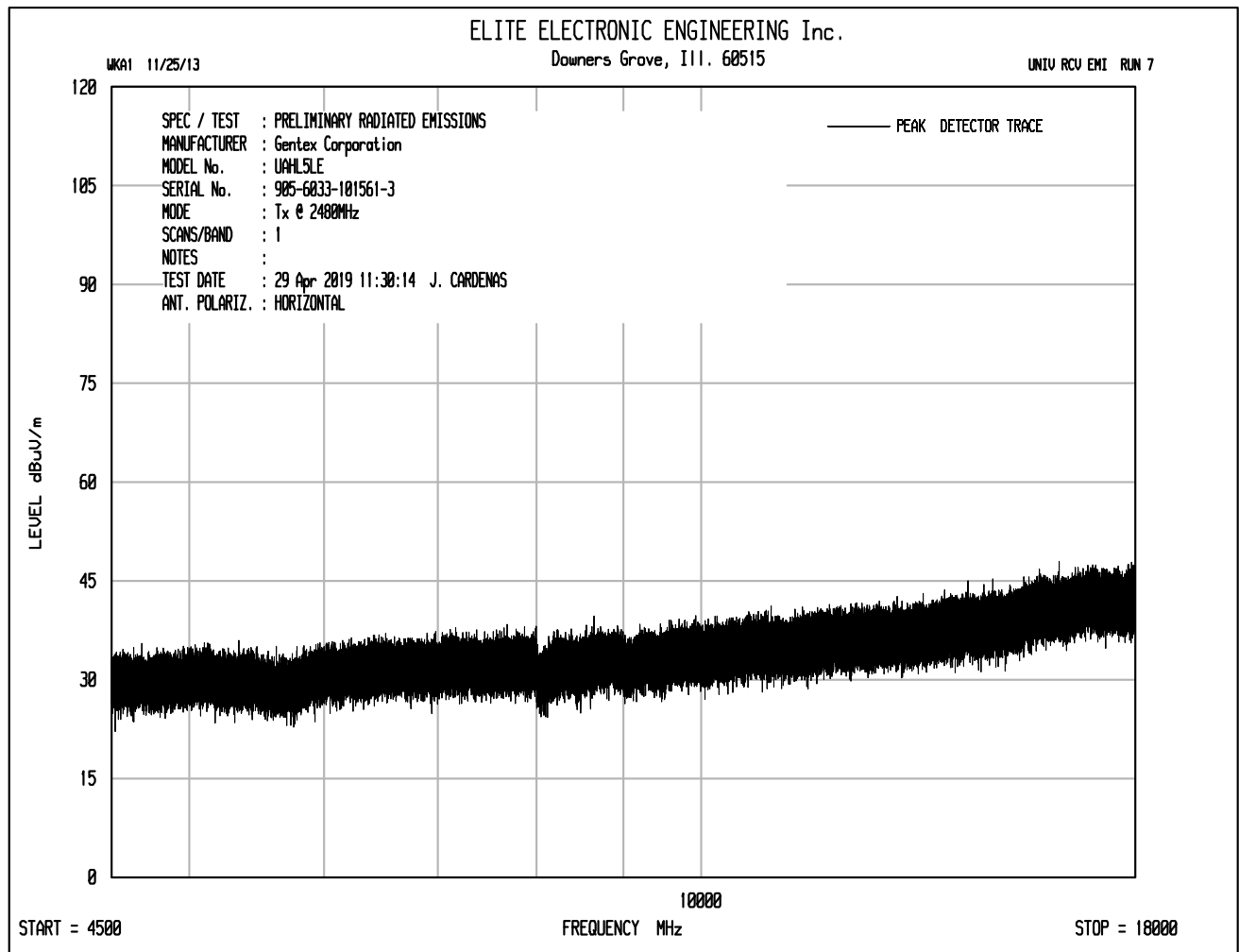


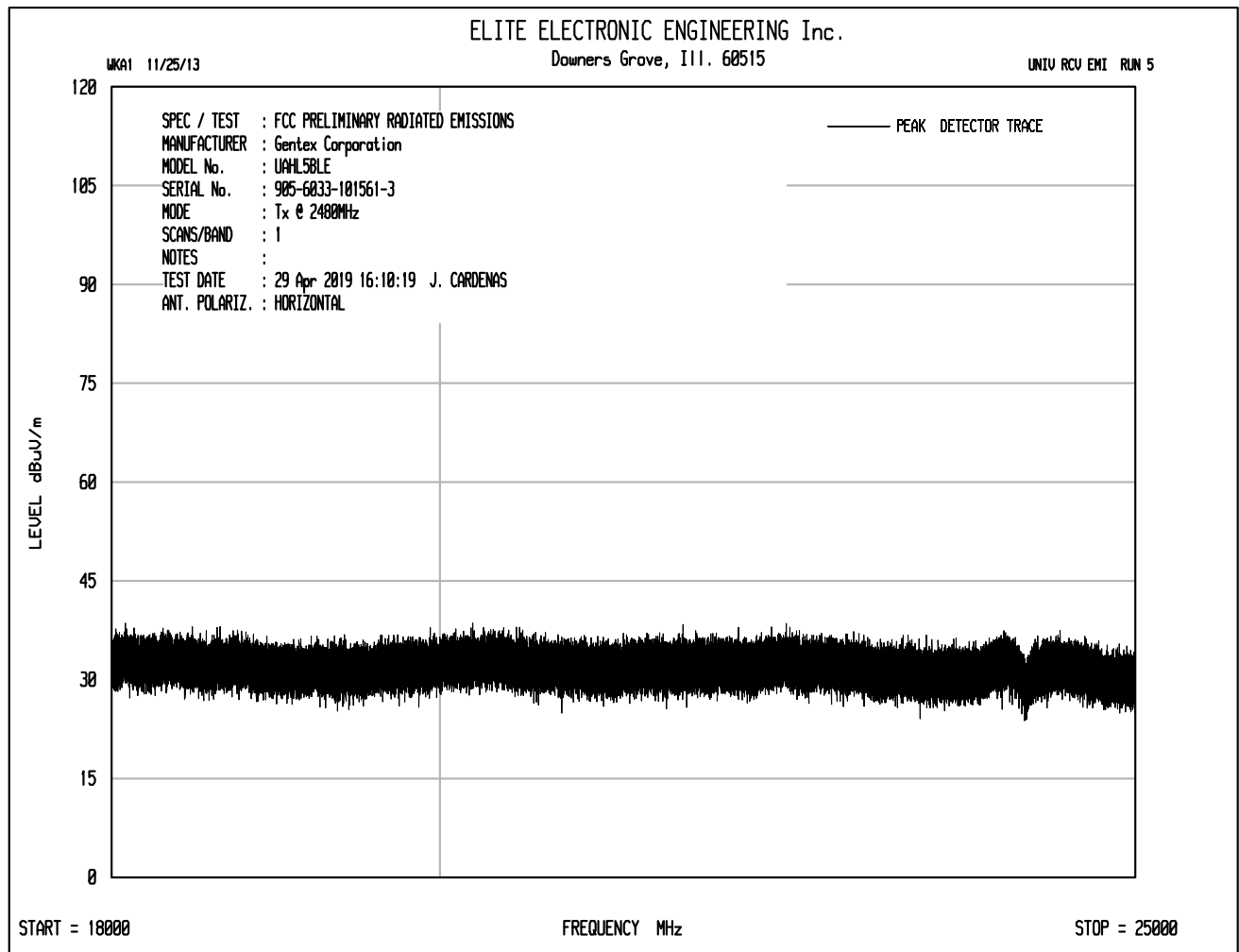


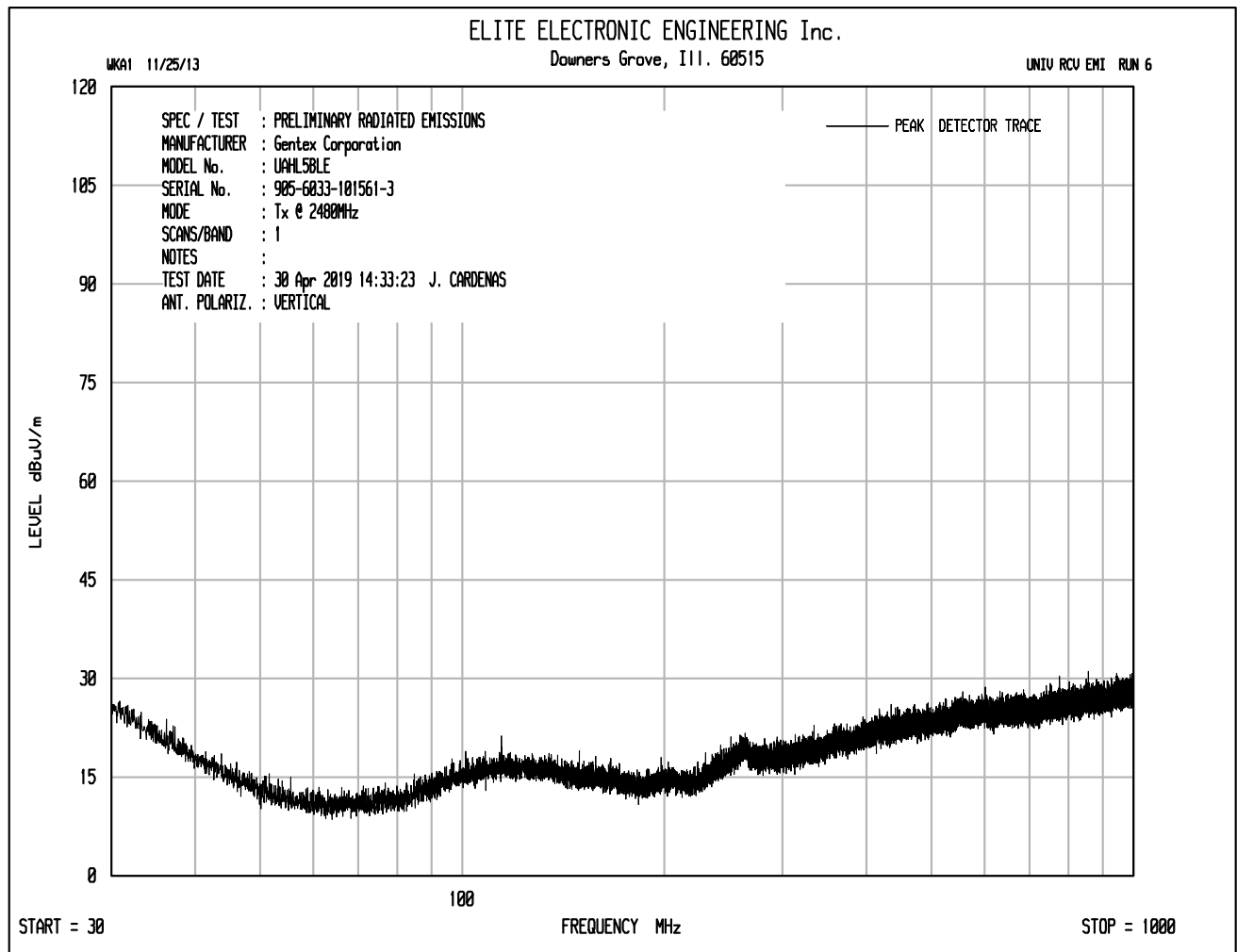


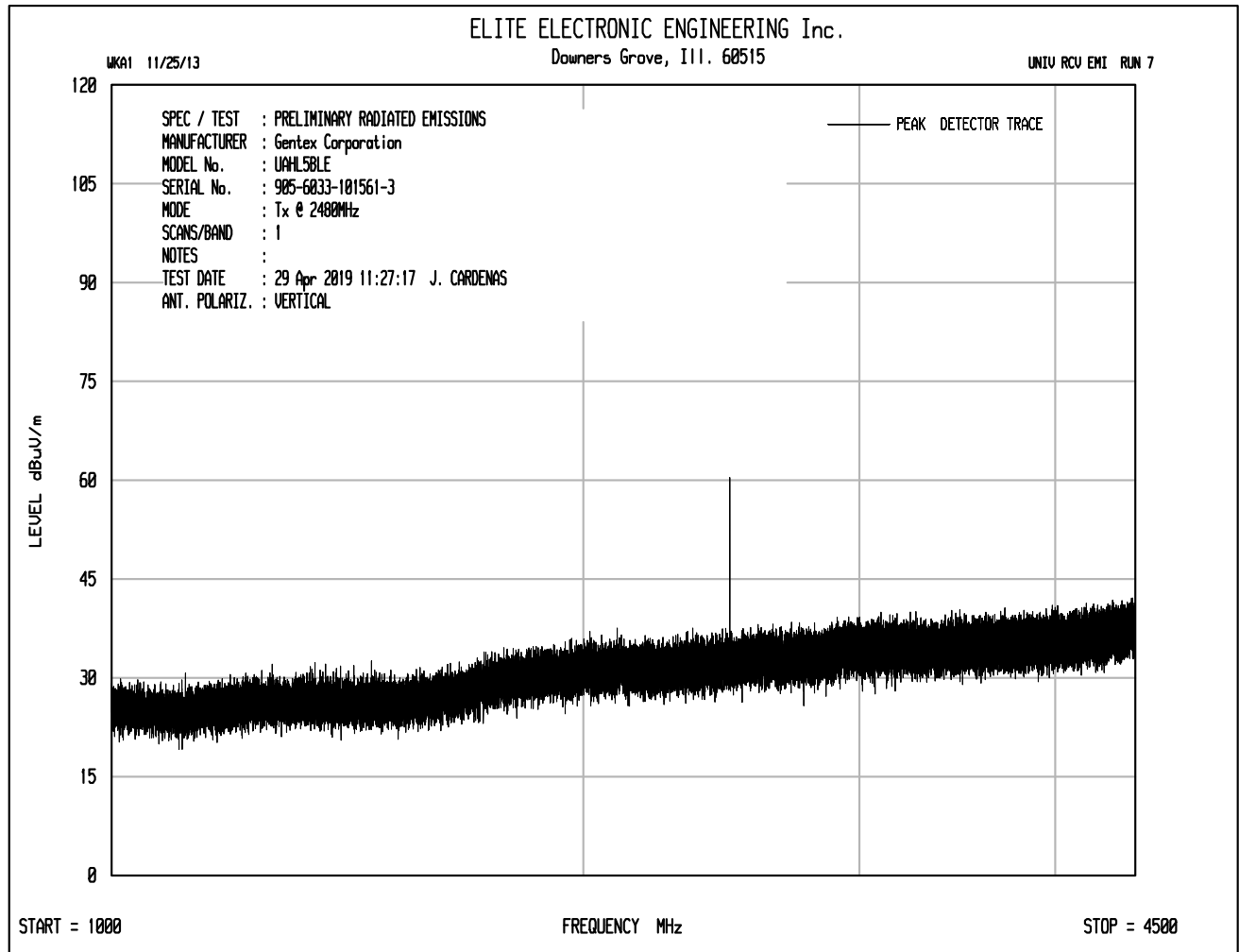


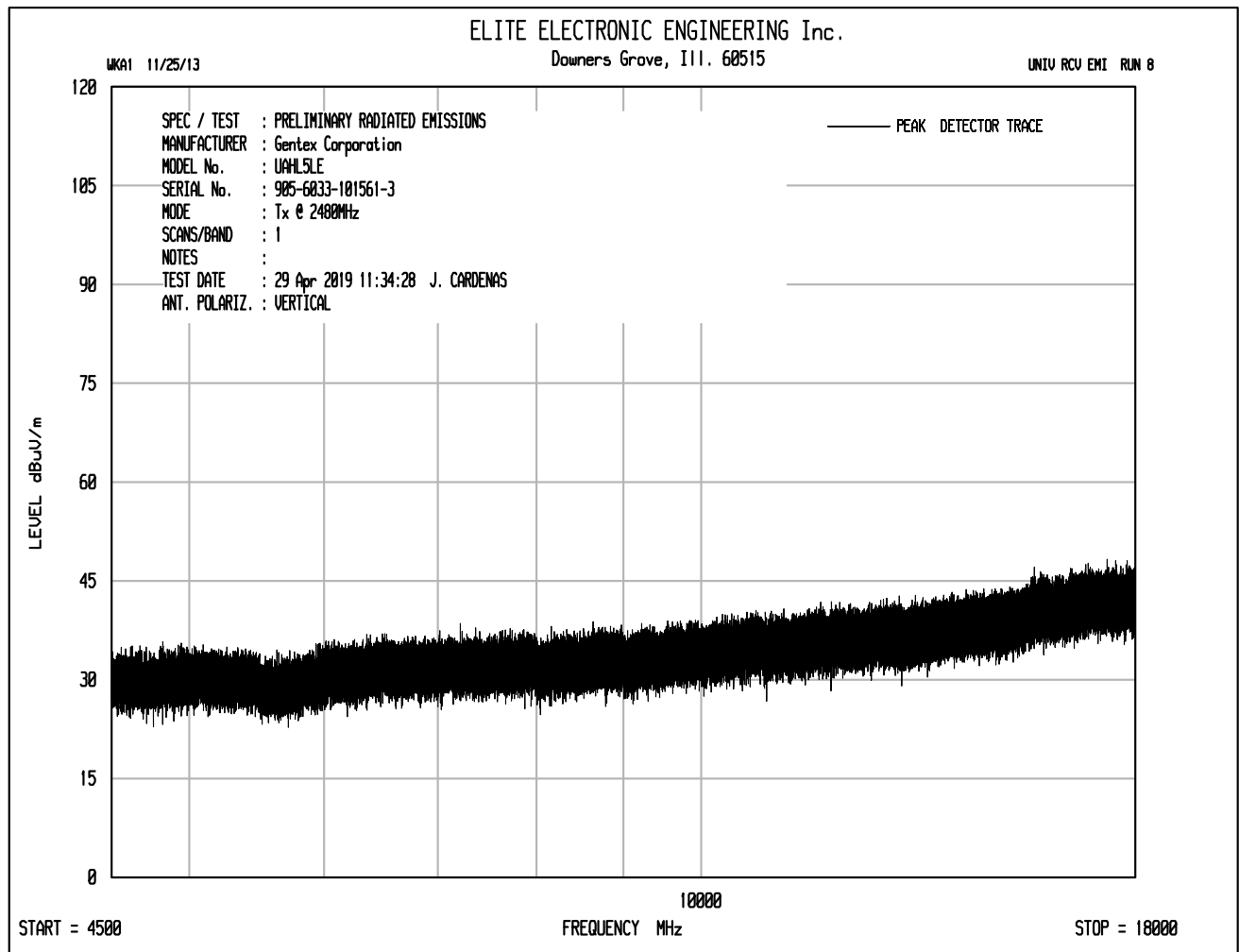


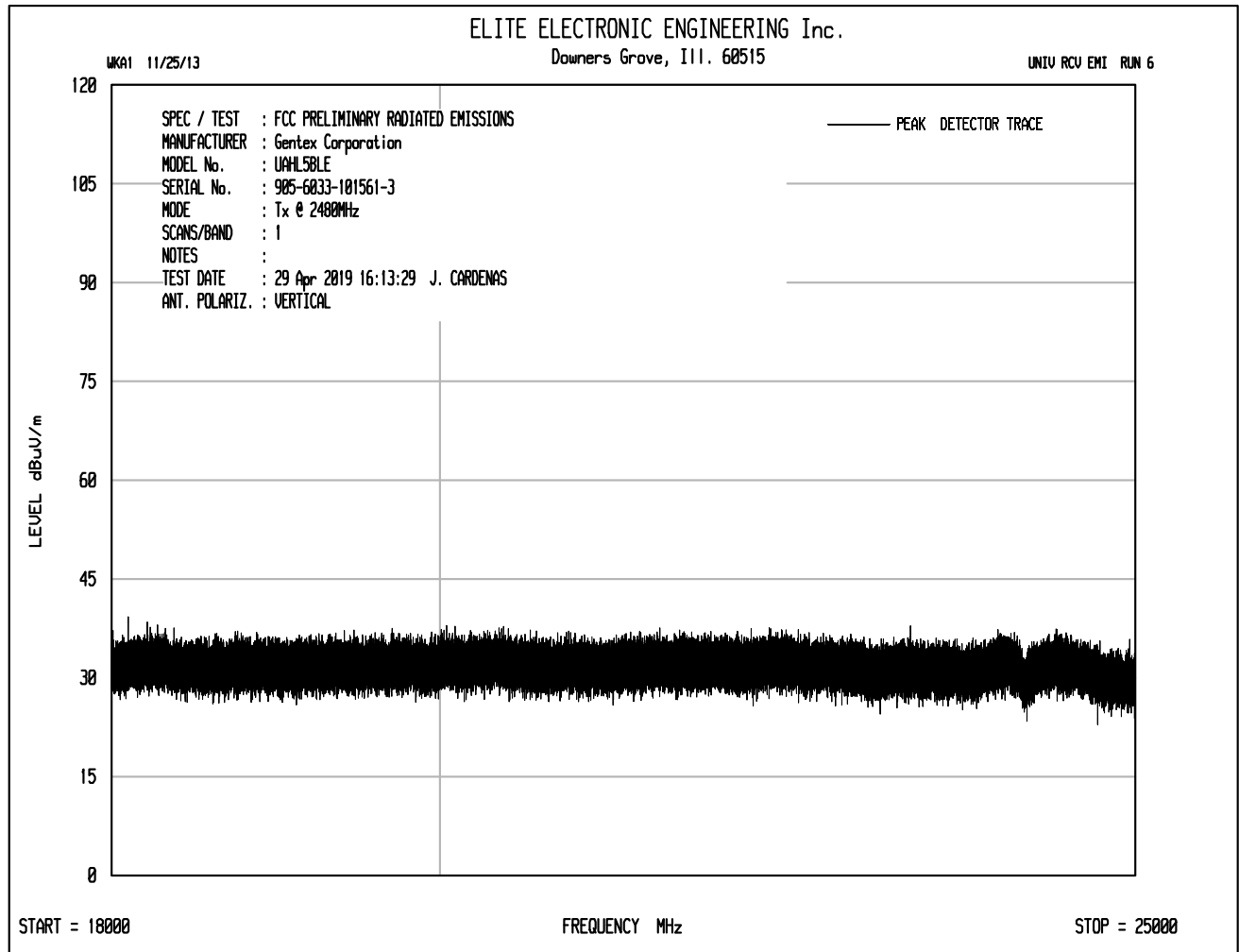














Manufacturer : Gentex Corporation
Test Item : Rear View Mirror
Model No. : UAHLC A
Serial No. : 905-6033-101561-3
Mode : Transmitting at 2402MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : April 29,2019
Test Distance : 3 meters
Notes : Peak Detector with 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	50.0		3.7	34.2	-39.3	48.5	266.7	5000.0	-25.5
4804.00	V	50.6		3.7	34.2	-39.3	49.1	285.1	5000.0	-24.9
12010.00	H	48.9	*	6.1	38.7	-39.2	54.5	529.3	5000.0	-19.5
12010.00	V	49.5	*	6.1	38.7	-39.2	55.1	570.4	5000.0	-18.9
19216.00	H	36.3	*	2.2	40.4	-28.2	50.7	341.3	5000.0	-23.3
19216.00	V	36.4	*	2.2	40.4	-28.2	50.8	345.3	5000.0	-23.2

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



Manufacturer : Gentex Corporation
Test Item : Rear View Mirror
Model No. : UAHLC A
Serial No. : 905-6033-101561-3
Mode : Transmitting at 2402MHz
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : April 29,2019
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)	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)
4804.00	H	35.1		3.7	34.2	-39.3	0.0	33.6	48.1	500.0	-20.3
4804.00	V	36.4		3.7	34.2	-39.3	0.0	35.0	56.0	500.0	-19.0
12010.00	H	33.8	*	6.1	38.7	-39.2	0.0	39.4	93.4	500.0	-14.6
12010.00	V	33.9	*	6.1	38.7	-39.2	0.0	39.5	94.2	500.0	-14.5
19216.00	H	21.0	*	2.2	40.4	-28.2	0.0	35.4	58.6	500.0	-18.6
19216.00	V	21.4	*	2.2	40.4	-28.2	0.0	35.8	61.4	500.0	-18.2

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



Manufacturer : Gentex Corporation
Test Item : Rear View Mirror
Model No. : UAHLC A
Serial No. : 905-6033-101561-3
Mode : Transmitting at 2402MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : April 29/2019
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	48.0		2.6	32.2	0.0	82.8	13747.3		
2402.00	V	50.5		2.6	32.2	0.0	85.3	18311.2		
7206.00	H	41.6		4.6	35.9	-39.4	42.7	137.0	5000.0	-31.2
7206.00	V	44.3		4.6	35.9	-39.4	45.4	187.0	5000.0	-28.5
9608.00	H	38.1	*	5.2	36.8	-39.3	40.8	110.1	5000.0	-33.1
9608.00	V	39.2	*	5.2	36.8	-39.3	41.9	124.8	5000.0	-32.1
14412.00	H	38.3	*	6.6	39.6	-38.3	46.1	202.7	5000.0	-27.8
14412.00	V	38.2	*	6.6	39.6	-38.3	46.1	201.5	5000.0	-27.9
16814.00	H	38.8	*	7.2	42.0	-37.5	50.4	331.1	5000.0	-23.6
16814.00	V	38.5	*	7.2	42.0	-37.5	50.1	319.8	5000.0	-23.9



Manufacturer : Gentex Corporation
Test Item : Rear View Mirror
Model No. : UAHLC A
Serial No. : 905-6033-101561-3
Mode : Transmitting at 2440MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
Date : April 29,2019
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	51.5		3.7	34.1	-39.3	50.0	317.6	5000.0	-23.9
4880.00	V	50.5		3.7	34.1	-39.3	49.0	283.4	5000.0	-24.9
7320.00	H	49.8		4.7	35.9	-39.4	50.9	352.0	5000.0	-23.0
7320.00	V	50.5		4.7	35.9	-39.4	51.7	382.9	5000.0	-22.3
12200.00	H	46.5		6.1	38.7	-39.1	52.2	408.3	5000.0	-21.8
12200.00	V	47.8		6.1	38.7	-39.1	53.5	473.7	5000.0	-20.5
19520.00	H	34.5	*	2.2	40.4	-28.2	48.9	279.3	5000.0	-25.1
19520.00	V	35.3	*	2.2	40.4	-28.2	49.8	307.3	5000.0	-24.2

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

Manufacturer : Gentex Corporation
 Test Item : Rear View Mirror
 Model No. : UAHLC A
 Serial No. : 905-6033-101561-3
 Mode : Transmitting at 2440MHz
 Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
 Date : April 29,2019
 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)	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	41.1		3.7	34.1	-39.3	0.0	39.6	96.0	500.0	-14.3
4880.00	V	36.1		3.7	34.1	-39.3	0.0	34.6	53.4	500.0	-19.4
7320.00	H	35.68		4.7	35.9	-39.4	0.0	36.8	69.4	500.0	-17.1
7320.00	V	37.1		4.7	35.9	-39.4	0.0	38.2	81.7	500.0	-15.7
12200.00	H	33.0		6.1	38.7	-39.1	0.0	38.7	86.0	500.0	-15.3
12200.00	V	33.6		6.1	38.7	-39.1	0.0	39.2	91.6	500.0	-14.7
19520.00	H	20.3	*	2.2	40.4	-28.2	0.0	34.8	54.8	500.0	-19.2
19520.00	V	20.8	*	2.2	40.4	-28.2	0.0	35.2	57.8	500.0	-18.7

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



Manufacturer : Gentex Corporation
Test Item : Rear View Mirror
Model No. : UAHLC A
Serial No. : 905-6033-101561-3
Mode : Transmitting at 24440MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : April 29/2019
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	52.3		2.6	32.3	0.0	87.2	22942.7		
2440.00	V	48.8		2.6	32.3	0.0	83.7	15298.4		
9760.00	H	38.7	*	5.2	37.0	-39.3	41.6	120.9	5000.0	-32.3
9760.00	V	38.2	*	5.2	37.0	-39.3	41.2	114.4	5000.0	-32.8
14640.00	H	38.3	*	6.7	39.7	-38.2	46.5	210.8	5000.0	-27.5
14640.00	V	37.6	*	6.7	39.7	-38.2	45.8	194.2	5000.0	-28.2
17080.00	H	37.9	*	7.3	41.8	-37.6	49.4	294.9	5000.0	-24.6
17080.00	V	38.1	*	7.3	41.8	-37.6	49.6	302.5	5000.0	-24.4
21960.00	H	26.0	*	2.2	40.6	-28.9	39.9	98.7	5000.0	-34.1
21960.00	V	25.9	*	2.2	40.6	-28.9	39.8	97.9	5000.0	-34.2
24400.00	H	26.8	*	2.2	40.6	-29.1	40.5	106.5	5000.0	-33.4
24400.00	V	27.1	*	2.2	40.6	-29.1	40.8	109.5	5000.0	-33.2

Manufacturer : Gentex Corporation
 Test Item : Rear View Mirror
 Model No. : UAHLC A
 Serial No. : 905-6033-101561-3
 Mode : Transmitting at 2480MHz
 Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions in Restricted Bands
 Date : April 29,2019
 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	51.7		3.7	34.1	-39.3	50.3	325.5	5000.0	-23.7
4960.00	V	51.4		3.7	34.1	-39.3	49.9	314.1	5000.0	-24.0
7440.00	H	50.1		4.7	35.8	-39.4	51.2	364.8	5000.0	-22.7
7440.00	V	49.7		4.7	35.8	-39.4	50.8	344.8	5000.0	-23.2
12400.00	H	48.5	*	6.1	38.6	-39.0	54.2	514.5	5000.0	-19.8
12400.00	V	49.0	*	6.1	38.6	-39.0	54.7	545.0	5000.0	-19.3
19840.00	H	36.0	*	2.2	40.4	-28.4	50.2	324.7	5000.0	-23.8
19840.00	V	35.6	*	2.2	40.4	-28.4	49.8	310.1	5000.0	-24.2
22320.00	H	36.2	*	2.2	40.6	-29.0	50.0	317.8	5000.0	-23.9
22320.00	V	36.9	*	2.2	40.6	-29.0	50.7	342.1	5000.0	-23.3

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



Manufacturer : Gentex Corporation
Test Item : Rear View Mirror
Model No. : UAHLC A
Serial No. : 905-6033-101561-3
Mode : Transmitting at 2480MHz
Test Specification : FCC-15.247, RSS-247 Average Radiated Emissions in Restricted Bands
Date : April 29,2019
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)	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)
4960.00	H	39.9		3.7	34.1	-39.3	0.0	38.4	82.9	500.0	-15.6
4960.00	V	38.9		3.7	34.1	-39.3	0.0	37.4	73.8	500.0	-16.6
7440.00	H	36.37		4.7	35.8	-39.4	0.0	37.5	74.7	500.0	-16.5
7440.00	V	34.2		4.7	35.8	-39.4	0.0	35.3	57.9	500.0	-18.7
12400.00	H	33.7	*	6.1	38.6	-39.0	0.0	39.4	93.4	500.0	-14.6
12400.00	V	33.9	*	6.1	38.6	-39.0	0.0	39.5	94.9	500.0	-14.4
19840.00	H	21.0	*	2.2	40.4	-28.4	0.0	35.2	57.9	500.0	-18.7
19840.00	V	21.1	*	2.2	40.4	-28.4	0.0	35.3	58.4	500.0	-18.7
22320.00	H	22.0	*	2.2	40.6	-29.0	0.0	35.8	61.5	500.0	-18.2
22320.00	V	22.1	*	2.2	40.6	-29.0	0.0	36.0	62.8	500.0	-18.0

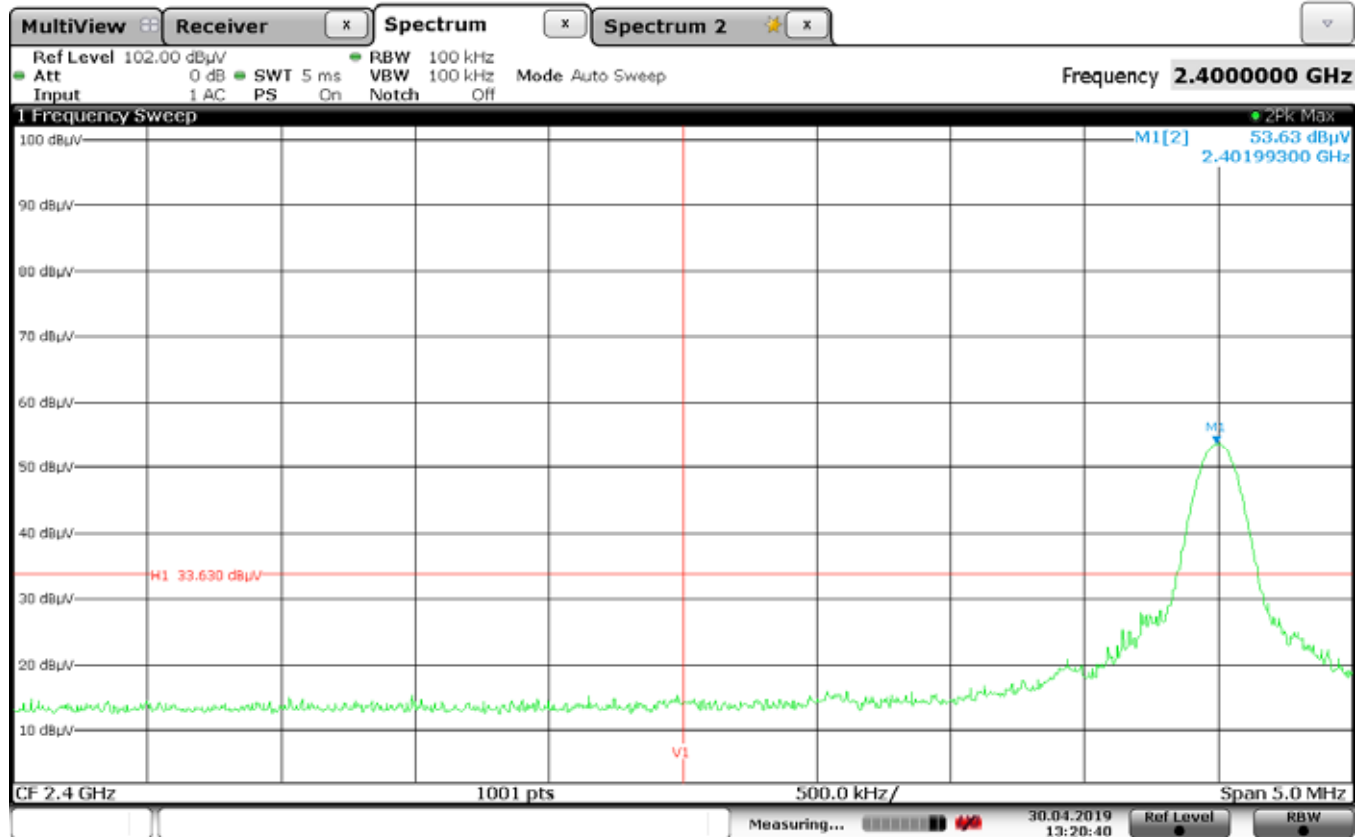
Total (dBuV/m) = Meter Reading + CBL FAC + Ant Fac + Pre Amp + Duty Cycle



Manufacturer : Gentex Corporation
Test Item : Rear View Mirror
Model No. : UAHLC A
Serial No. : 905-6033-101561-3
Mode : Transmitting at 24480MHz
Test Specification : FCC-15.247, RSS-247 Peak Radiated Emissions not in Restricted Bands
Date : April 29/2019
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	50.4		2.7	32.3	0.0	85.4	18654.5		
2480.00	V	46.5		2.7	32.3	0.0	81.5	11920.2		
9920.00	H	38.1	*	5.3	37.1	-39.2	41.3	116.5	5000.0	-32.7
9920.00	V	38.1	*	5.3	37.1	-39.2	41.3	115.7	5000.0	-32.7
14880.00	H	39.0	*	6.8	39.8	-38.2	47.4	233.2	5000.0	-26.6
14880.00	V	39.1	*	6.8	39.8	-38.2	47.5	237.3	5000.0	-26.5
17360.00	H	38.8	*	7.4	41.7	-37.7	50.1	320.6	5000.0	-23.9
17360.00	V	38.2	*	7.4	41.7	-37.7	49.5	299.9	5000.0	-24.4
24800.00	H	24.8	*	2.2	40.6	-29.2	38.5	83.7	5000.0	-35.5
24800.00	V	25.8	*	2.2	40.6	-29.2	39.5	93.9	5000.0	-34.5

Band Edge Compliance



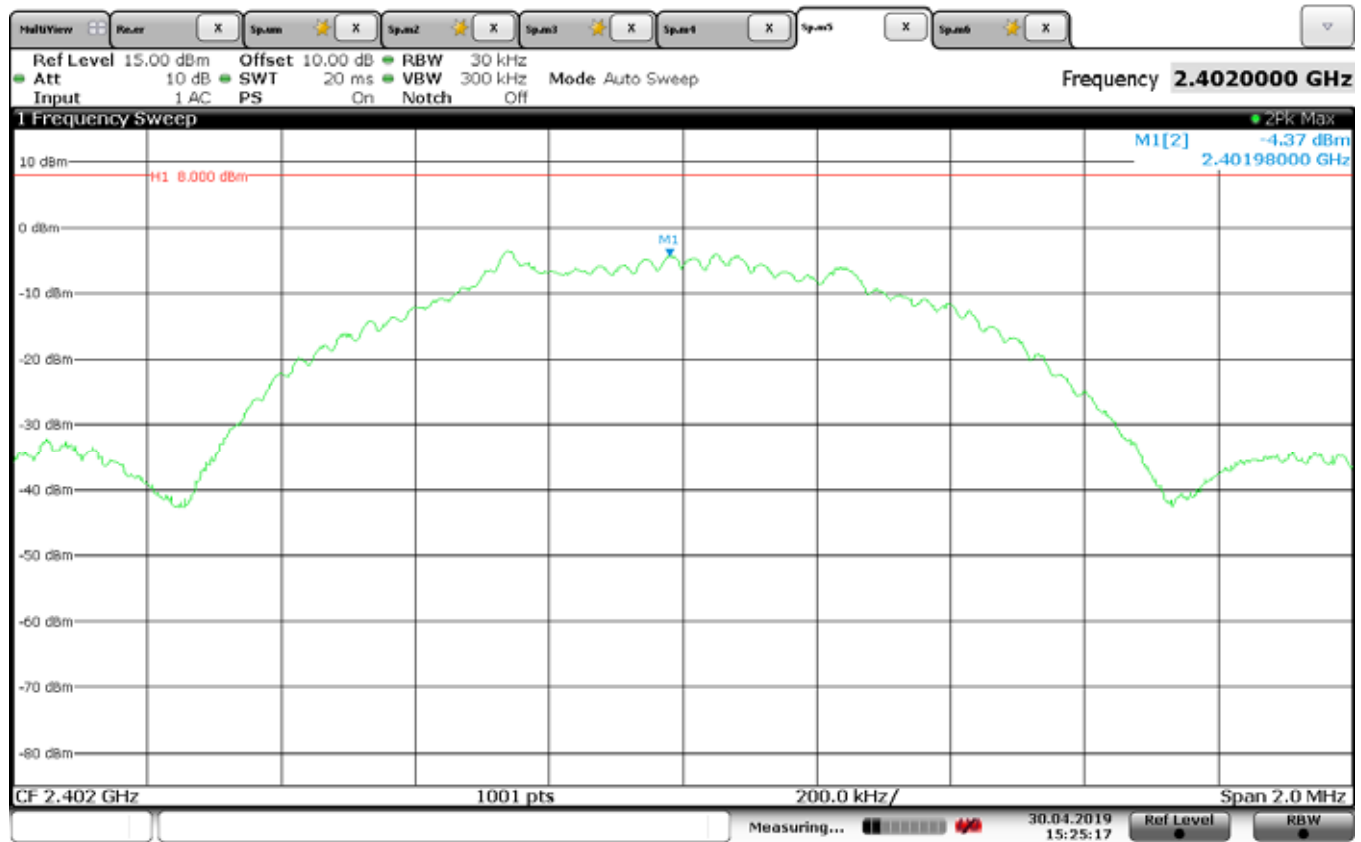
Date: 30.APR.2019 13:20:40

Manufacturer : Gentex Corporation
Model Number : UAHLCA
Serial Number : 905-6033-101561-3
Test : **Low Band Edge**
Mode : Tx 2402MHz
Date : April 30,2019
Notes : Bluetooth

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	25.6	*	2.7	32.3	0.0	60.6	1067.0	5000.0	-13.4
2483.50	V	25.4	*	2.7	32.3	0.0	60.4	1046.3	5000.0	-13.6

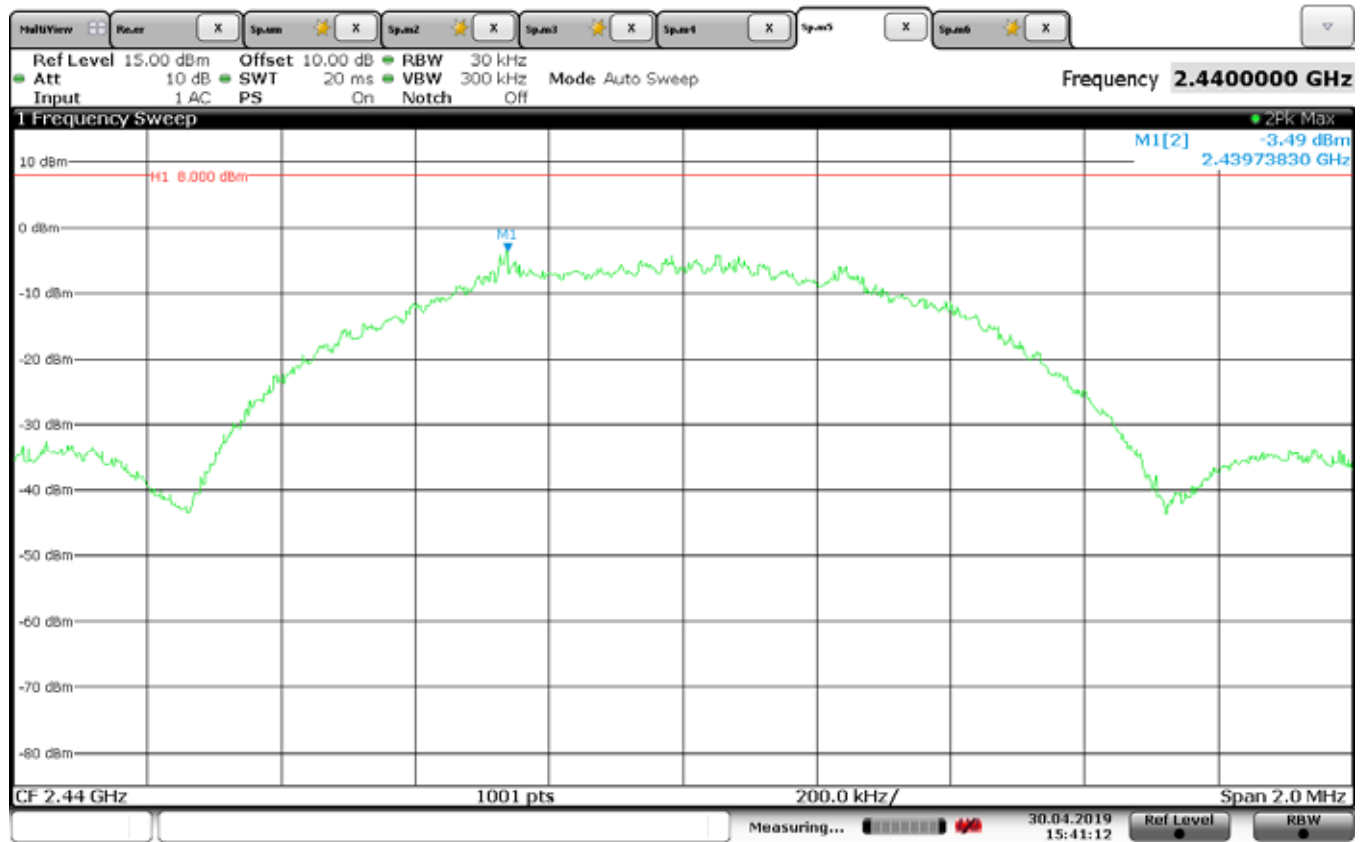
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Average Total dBuV/m at 3m	Average Total uV/m at 3 m	Average Limit uV/m at 3 m	Margin (dB)
2483.50	H	7.6	*	2.7	32.3	0.0	0.0	42.6	134.6	500.0	-11.4
2483.50	V	6.8	*	2.7	32.3	0.0	0.0	41.8	122.7	500.0	-12.2

Manufacturer : Gentex Corporation
 Model Number : UAHLC A
 Serial Number : 905-6033-101561-3
 Test : **High Band Edge**
 Mode : Tx 2402MHz
 Date : April 30,2019
 Notes : Bluetooth



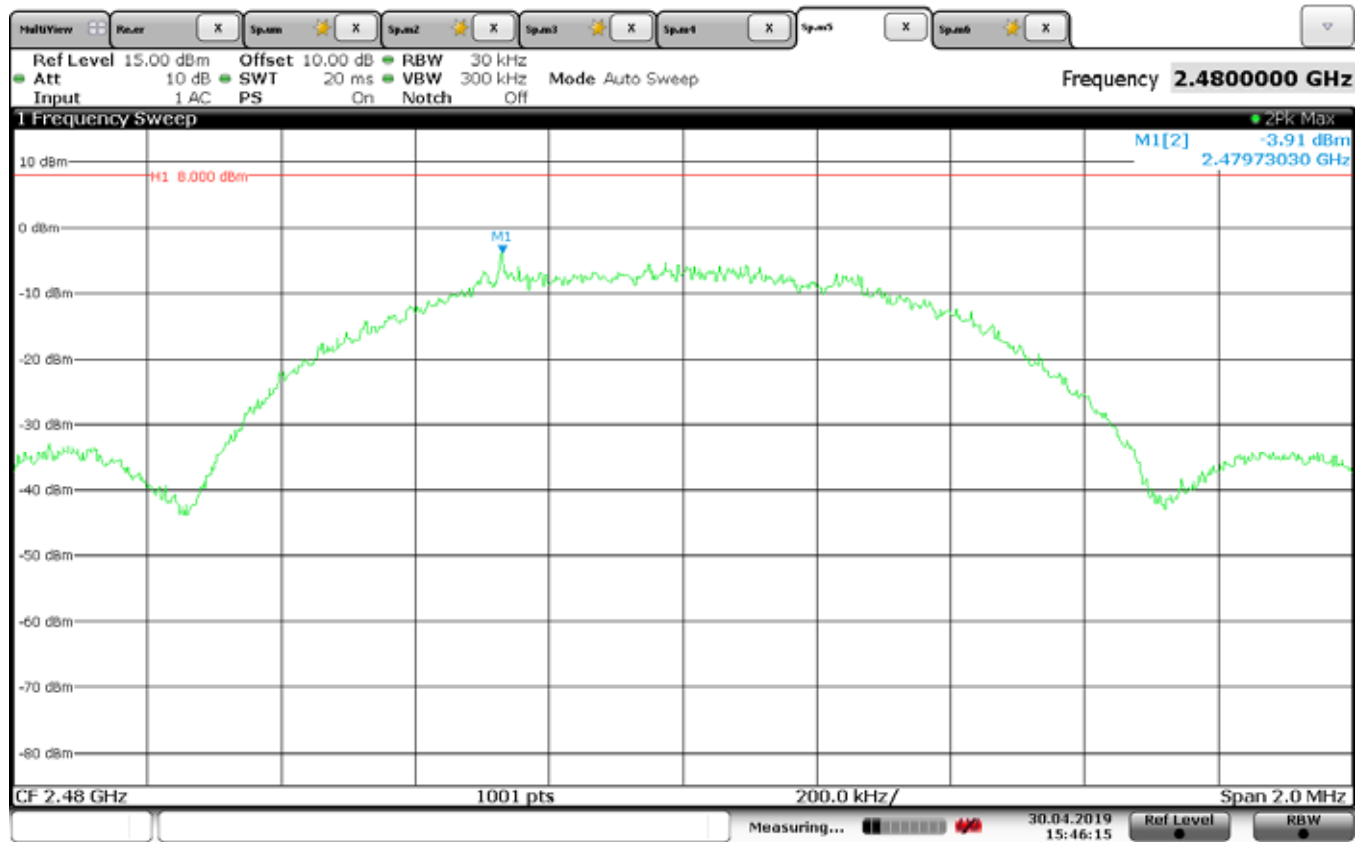
Date: 30 APR 2019 15:25:17

Manufacturer : Gentex Corporation
Model Number : UAHLC A
Serial Number : 905-6033-101561-3
Test : **Power Spectral Density**
Mode : Tx 2402MHz
Parameters : PSD Bandwidth = -4.37dBm
Date : April 30,2019
Notes : Bluetooth



Date: 30 APR 2019 15:41:12

Manufacturer : Gentex Corporation
 Model Number : UAHLC A
 Serial Number : 905-6033-101561-3
 Test : **Power Spectral Density**
 Mode : Tx 2440MHz
 Parameters : PSD Bandwidth = -3.49dBm
 Date : April 30,2019
 Notes : Bluetooth



Date: 30 APR 2019 15:46:15

Manufacturer : Gentex Corporation
 Model Number : UAHLC A
 Serial Number : 905-6033-101561-3
 Test : **Power Spectral Density**
 Mode : Tx 2480MHz
 Parameters : PSD Bandwidth = -3.91dBm
 Date : April 30,2019
 Notes : Bluetooth