Measurement of RF Emissions from an Model UAGTMA Rearview Mirror Transmitter

For	Gentex Corporation 380 Riley Street Zeeland, MI 49464
P.O. Number	2410472
Date Tested	March 29 through April 2, 2018 and June 12, 2018
Test Personnel	Richard E. King
Test Specification	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart B, for Receivers And FCC "Code of Federal Regulations" Title 47 Part 90, Subpart I RSS-137 RSS-GEN

Test Report By: Richard E. King

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Gentex Corporation

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REVISION HISTORY

Revision	Date	Description
—	25 April 2018	Initial release
A	26 April 2018 By Rick King	- Added Rev A to the report number on the cover and throughout the report. - Added RSS-137 specification throughout the report.
B	May 25, 2018 By Rick King	- Added Rev B to the report number on the cover and throughout the report. - Added Frequency Stability data throughout test report.
C	June 12, 2018 By Rick King	- Added Rev C to the report number on cover and throughout report. - Added minimum attenuation calculation and Changed Equivalent Antenna dB to Equivalent Antenna Gain to dBd on pages 32 and 33. - Corrected spurious emissions data to reflect data taken in a 100kHz RBW on pages 32 and 33. - Added frequency stability exemption for RSS-137 throughout report. - Added FCC ERP limit, 1MHz RBW, and corrected the typo from EIRP to ERP on page 25.
D	June 13, 2018 By Rick King	- Changed 1MHz RBW to 10MHz RBW on page 25.

Measurement of RF Emissions from a Rearview Mirror Transmitter, Model No. UAGTMA

1. INTRODUCTION

1.1. Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Gentex Corporation Rearview Mirror Transmitter, Model No. UAGTMA, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was manufactured and submitted for testing by Gentex Corporation located in Zeeland, MI.

The EUT contained a transmitter that was designed to transmit at 915MHz using an internal, non-removable antenna.

1.2. Purpose

The test series was performed to determine if the EUT would meet selected requirements of FCC Part 15, Subpart B and FCC Part 90, Subpart I, Sections 90.205, 90.209 and 90.210.

The test series was also performed to determine if the EUT would meet selected requirements of RSS-137, Sections 6.1, 6.4 and 6.5.

Testing was performed in accordance with IEEE C63.4-2014 and IEEE C63.26-2015.

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^{o}C and the relative humidity was 48%.

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 90, Subpart I, dated 1 October 2016
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2, dated 1 October 2016
-
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart B Section 236, dated 1 October 2016
- IEEE C63.26-2015 “American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services Accredited by the American National Standards Institute”
- Industry Canada Radio Standards Specification, RSS-Gen, “General Requirements and Information for the Certification of Radiocommunication Equipment”, Issue 4, November 2014

- Industry Canada Radio Standards Specification, RSS-137, "Location and Monitoring Service in the Band 902-928 MHz", Issue 2, February 2009

3. EUT SETUP AND OPERATION

3.1. General Description

The EUT is a Gentex Corporation, Rearview Mirror Transmitter, Model No. UAGTMA. A block diagram of the EUT setup is shown as Figure 1. A photograph of the EUT is shown as Figure 2.

3.1.1. Power Input

The EUT was powered by 13.5VDC from a DC power supply simulating an automotive battery.

3.1.2. Peripheral Equipment

No peripheral equipment was submitted with the EUT.

3.1.3. Signal Input/Output Leads

No interconnect cables were submitted with the EUT.

3.1.4. Grounding

The EUT was not grounded.

3.2. Operational Mode

All emissions tests were performed separately in the following modes:

Tx @ 915MHz
Rx @ 915MHz

3.3. EUT Modifications

The following modifications were performed to the EUT:

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 and CISPR 16 for site attenuation.

4.2. Test Instrumentation

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

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. FCC Part 15B Receiver Emissions

5.1.1.Requirements

All emanations from a receiver shall be below the levels shown on the following table.

RADIATION LIMITS FOR RECEIVER

Frequency MHz	Distance between EUT And Antenna in Meters	Field Strength uV/m	Field Strength dBuV/m
30-88	3	100	40
88-216	3	150	43.5
216-960	3	200	46
Above 960	3	500	54

Note: The tighter limit shall apply at the edge between the two frequency bands.

5.1.2.Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. 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.

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.

Since a quasi-peak detector and an average detector require(s) long integration times, it is not practical to automatically sweep through the quasi-peak and average levels. Therefore, radiated emissions from the EUT were first scanned using a peak detector and automatically plotted. The frequencies where significant emission levels were noted were then remeasured using the quasi-peak detector or average detector.

The broadband measuring antenna was positioned at a 3 meter distance from the EUT. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the bilog antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The frequency range from 1GHz to 5GHz was investigated using a peak detector function with

the double ridged waveguide antenna at several heights, horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels for each antenna polarization were plotted. The resultant field strength (FS) is a summation in decibels (dB) of the receiver meter reading (MTR), the antenna correction factor (AF), and the cable loss factor (CF). If an external pre-amplifier is used, the total is reduced by its gain (-PA). If a distance correction (DC) is required, it is added to the total.

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

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

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

Final radiated emissions were performed on all significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

1) Measurements from 30MHz to 1GHz were made using a quasi-peak detector and a broadband bilog antenna. Measurements above 1GHz were made using an average detector and a broadband double ridged waveguide antenna.

2) To ensure that maximum or worst case, emission levels were 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.

5.1.3.Results

The preliminary plots and final tabular data are presented on pages 19 through 24. The plots are presented for a reference only, and are not used to determine compliance. All emissions measured from the EUT were within the specification limit.

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

5.2. FCC RF Power Output Measurements

5.2.1.Requirements

5.2.1.1 FCC 90 Subpart I Section 90.205

The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

(l) *902-928 MHz* LMS systems operating pursuant to subpart M of this part in the 902-927.25 MHz band will be authorized a maximum of 30 watts ERP. LMS equipment operating in the 927.25-928 MHz band will be authorized a maximum of 300 watts ERP. ERP must be measured as peak envelope power. Antenna heights will be as specified in §90.353(h).

RSS-137 Section 6.4 - The output power shall be within ±1.0 dB of the manufacturer's rated value, and the e.r.p. shall not exceed 30 watts for the band 902-927.25 MHz and 300 watts for the band 927.25-928 MHz.

5.2.2.Procedures

5.2.2.1 ERP

The EUT was placed on a 1.5 meter high, non-conductive stand and set to transmit. A bilog antenna was placed at a test distance of 3 meters from the EUT. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The average power output was measured.

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 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, as required. The average power output was calculated.

5.2.3.Results

The ERP data are shown on page 25. The ERP readings from the EUT were within the 20% of the manufacturer's rated power and with the +/- 1dB of the manufacturers rated power.

5.3. Spurious Radiated Emissions

5.3.1.Requirements

5.3.1.1 FCC Part 90 Section 90.210

For all other transmitters authorized under subpart M that operate in the 902-928 MHz band, the peak power of any emission shall be attenuated below the power of the highest emission contained within the licensee's sub-band in accordance with the following schedule:

(i) On any frequency within the authorized bandwidth: Zero dB.

(ii) On any frequency outside the licensee's sub-band edges: 55 + 10 log(P) dB, where (P) is the highest emission (watts) of the transmitter inside the licensee's sub-band.

RSS-137 - In the band 902-928 MHz, mobile transponders with integral antennas (i.e. transmitters that respond only to a received radio signal) and intermittently operated hand-held transmitters shall not be required to comply with the above emission masks, provided that their 20 dB bandwidth does not exceed the maximum occupied bandwidth permitted. In addition, on any frequency distanced from the carrier frequency by more than 250% of the occupied bandwidth, the power of any emission shall be attenuated below the maximum permitted transmitter output power, P_{max}, by at least $43 + 10 \log_{10} P_{max}$ dB, measured in a bandwidth of 100 kHz.

5.3.2.Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with CISPR 16 for site attenuation.

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.

1. Preliminary radiated measurements were performed to determine the frequencies where the significant emissions might be found. The EUT was placed on a 1.5 meter high, non-conductive stand and set to transmit. With the EUT at one set position and the measurement antenna at a set height (i.e. without maximizing), the radiated emissions were measured using a peak detector and automatically plotted. The broadband measuring antenna was positioned at a 3 meter distance

from the EUT. This data was then automatically plotted up through the tenth harmonic of the transmit frequency of the EUT. All preliminary tests were performed separately with the EUT operating in the modes listed in paragraph 3.2.

2. All significant broadband and narrowband signals found in the preliminary sweeps were then maximized. For all measurements below 1GHz, a bilog antenna was used as the measurement antenna. For all measurements above 1GHz, a horn antenna was used as the measurement antenna. An average detector was used for all tests above 1GHz.

3. To ensure that maximum emission levels were 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 antennas are 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.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, another antenna was set in place of the EUT and connected to a calibrated signal generator. (A tuned dipole was used for all measurements below 1GHz and a double ridged waveguide antenna was used for all measurements above 1GHz.) 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 corrected to compensate for cable loss, as required, and for frequencies above 1GHz, increased by the gain of the waveguide.

5.3.3.Results

The plots of the peak preliminary spurious radiated emissions and the final tabular average spurious radiated emissions results are presented on pages 26 through 33. All spurious radiated emissions measured from the EUT were within the specification limits.

5.4. Occupied Bandwidth

5.4.1. FCC 90 Subpart I Section 90.209

The maximum authorized bandwidth shall be 12 MHz for non-multilateration LMS operations in the band 909.75-921.75 MHz and 2 MHz in the band 902.00-904.00 MHz. The maximum authorized bandwidth for multilateration LMS operations shall be 5.75 MHz in the 904.00-909.75 MHz band; 2 MHz in the 919.75-921.75 MHz band; 5.75 MHz in the 921.75-927.25 MHz band and its associated 927.25-927.50 MHz narrowband forward link; and 8.00 MHz if the 919.75-921.75 MHz and 921.75-927.25 MHz bands and their associated 927.25-927.50 MHz and 927.50-927.75 MHz narrowband forward links are aggregated.

Other transmitters. For all other transmitters authorized under subpart M that operate in the 902-928 MHz band, the peak power of any emission shall be attenuated below the power of the highest emission contained within the licensee's sub-band in accordance with the following schedule:

(i) On any frequency within the authorized bandwidth: Zero dB.

(ii) On any frequency outside the licensee's sub-band edges: 55 + 10 log(P) dB, where (P) is the highest emission (watts) of the transmitter inside the licensee's sub-band.

RSS-137:

Non-Multilateral LMS Systems

Non-Multilateral Systems	
Non-Multilateral LMS Sub-band (MHz)	Maximum Occupied Bandwidth Permitted (MHz)
902-904	2
909.75-921.75	12

5.4.2.Procedures

The EUT was placed on a 1.5 meter high, non-conductive stand and set to transmit. A bilog antenna was placed at a test distance of 3 meters from the EUT. 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.

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 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, as required. The peak power output was calculated.

5.4.3.Results

A plot of the fundamental emission and the final tabular radiated emissions at the authorized 12MHz bandwidth results are presented on pages 34 and 35. The EUT emissions were within the specification limits. The 99% bandwidth was measured to be 4.02MHz.

5.5. Frequency Stability

5.5.1.Requirements

Per 90.213(a) Frequency stability, Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

MINIMUM FREQUENCY STABILITY

[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile Stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1 2 3]100	100	200
25-50	20	20	50
72-76	5		50
150-174	[5 11]5	[6]5	[4 6]50
216-220	1.0		1.0
220-222[12]	0.1	1.5	1.5
421-512	[7 11 14]2.5	[8]5	[8]5
806-809	[14]1.0	1.5	1.5

809-824	[14]1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	[14]0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928[13]	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1435	[9]300	300	300
Above 2450[10]			

[13]Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.

Per 2.1055(a)(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs 2.1055(a) (2) and (3) of this section.

RSS -137 Section 6.3:

Frequency Stability The carrier frequency shall not depart from the reference frequency in excess of ±2.5 ppm for any type of equipment unless indicated otherwise. Fixed N-LMS transmitters with an emission bandwidth located more than 40 kHz from the band edge, intermittently operated hand-held readers and mobile transponders are exempt from meeting the frequency stability limit.

5.5.2.Procedures

The EUT was connected to a frequency counter through the antenna output of each transmitter. The EUT was then placed in a temperature chamber.

a) The EUT was programmed to transmit with an unmodulated carrier.

b) The temperature chamber was set to +20ºC and allowed to soak for at least 1/2 hour.

c) The nominal frequency of the transmitter was measured and recorded.

d) The temperature chamber was then set to -30ºC.

e) Once the temperature had reached -30ºC, the EUT was allowed to soak for at least 1/2 hour.

f) After soaking at -30ºC for at least 1/2 hour, the EUT was turned on and the transmit frequency was measured and recorded.

g) Steps (b) through (e) were repeated for each temperature in 10ºC steps from -30ºC to +50ºC.

5.5.3.Results

The frequency tolerance data is shown on page 36. Since the EUT is exempt from the frequency tolerance requirement of 2.5ppm per note 13 and RSS-137 Section 6.3, the data shown is for informational purposes only.

6. OTHER TEST CONDITIONS

6.1. Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to Gentex Corporation upon completion of the tests.

7. CONCLUSIONS

The Gentex Corporation Rearview Mirror Transmitter, Model No. UAGTMA did fully meet the output power, frequency tolerance, and spurious emissions requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B for Receivers and FCC "Code of Federal Regulations" Title 47, Part 90, Subpart I when tested per IEEE C63.10-2014, and IEEE C63.26-2015.

The Gentex Corporation Rearview Mirror Transmitter, Model No. UAGTMA did fully meet the output power, frequency tolerance, and spurious emissions requirements of Industry Canada Radio Standards Specification, RSS-137 when tested per IEEE C63.10-2014, and IEEE C63.26-2015.

8. 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.

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
CDY0	WORKSTATION	ELITE	WORKSTATION		WINDOWS 7	N/A	
EMCE03	TEMPERATURE CHAMBER	TENNEY	BTRC	12024-18	-70 TO 180 C	9/21/2017	9/21/2018
GSD4	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMB100A	104455	9KHZ-6GHZ	9/13/2017	9/13/2018
MDC13	MULTIMUTER (R. KING)	FLUKE	179	34780079	I;VDC;VAC;R	2/21/2018	2/21/2019
NDQ0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	311	400-1000MHZ	4/19/2016	4/19/2018
NTA4	BILOG ANTENNA	TESEQ	6112D	46660	20-2000GHZ	8/18/2017	8/18/2018
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/10/2018	4/10/2020
NWQ2	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66659	1GHZ-18GHZ	3/22/2018	3/22/2020
RBG0	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101533	10HZ-44GHZ	12/7/2017	12/7/2018
RBG3	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101592	2HZ-44GHZ	2/20/2018	2/20/2019
SEK0	DC POWER SUPPLY	LABORNETZGERAT	L3205	94081001	0-32VDC;0-5A	NOTE 1	
XOL2	OPTICAL LIN TRANSCEIVER	SONTEC ELECTRONIC	OPTOLIN 2000	07/008LN	---	NOTE 1	
XOL3	OPTICAL LIN TRANSCEIVER	SONTEC ELECTRONIC	OPTOLIN 2000	07/005LN	---	NOTE 1	

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

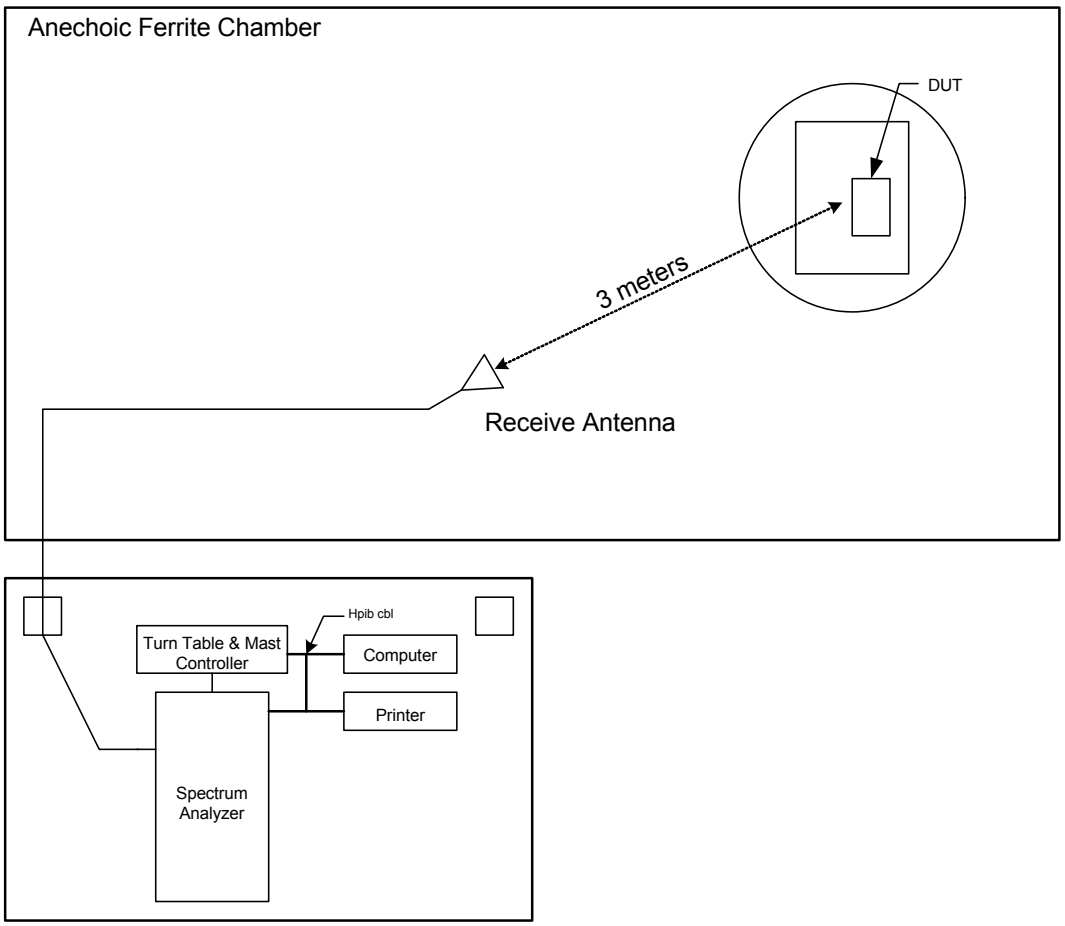
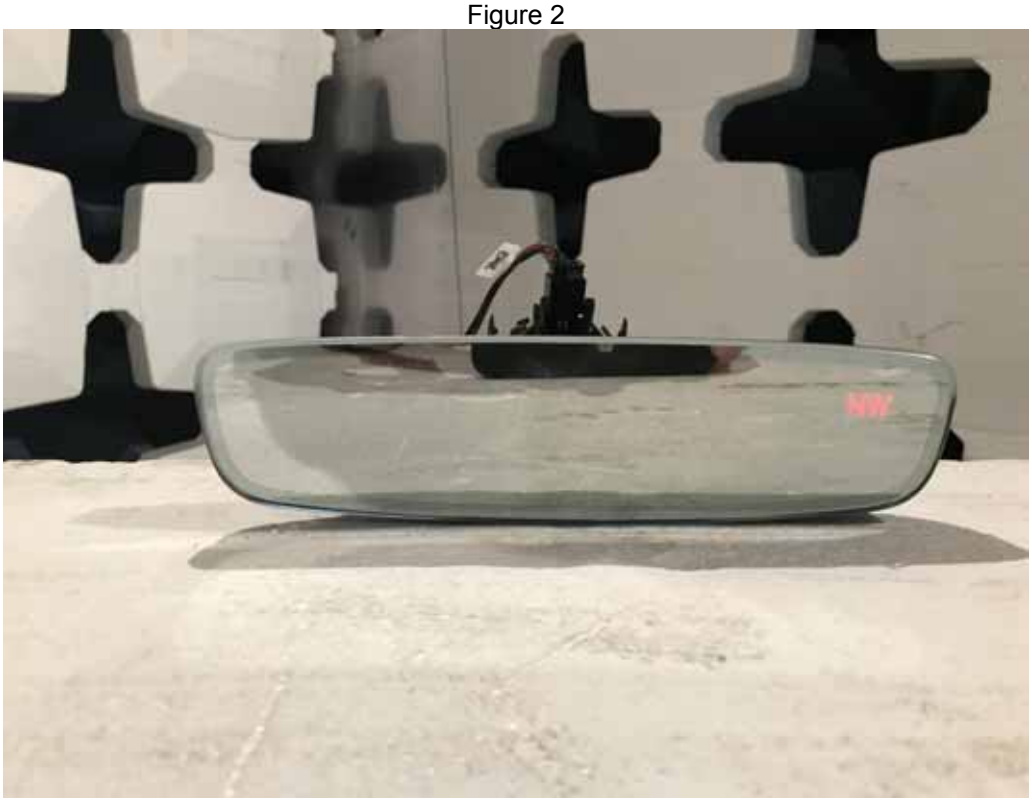


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 2



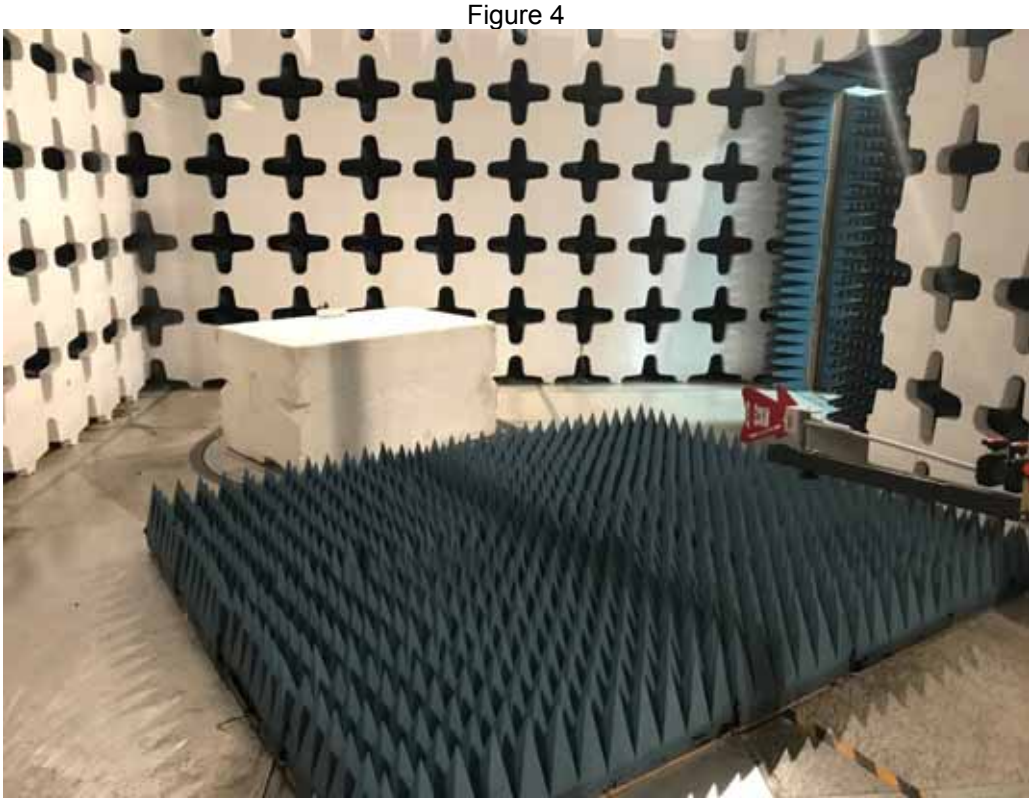
Photograph of the EUT

Figure 3

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

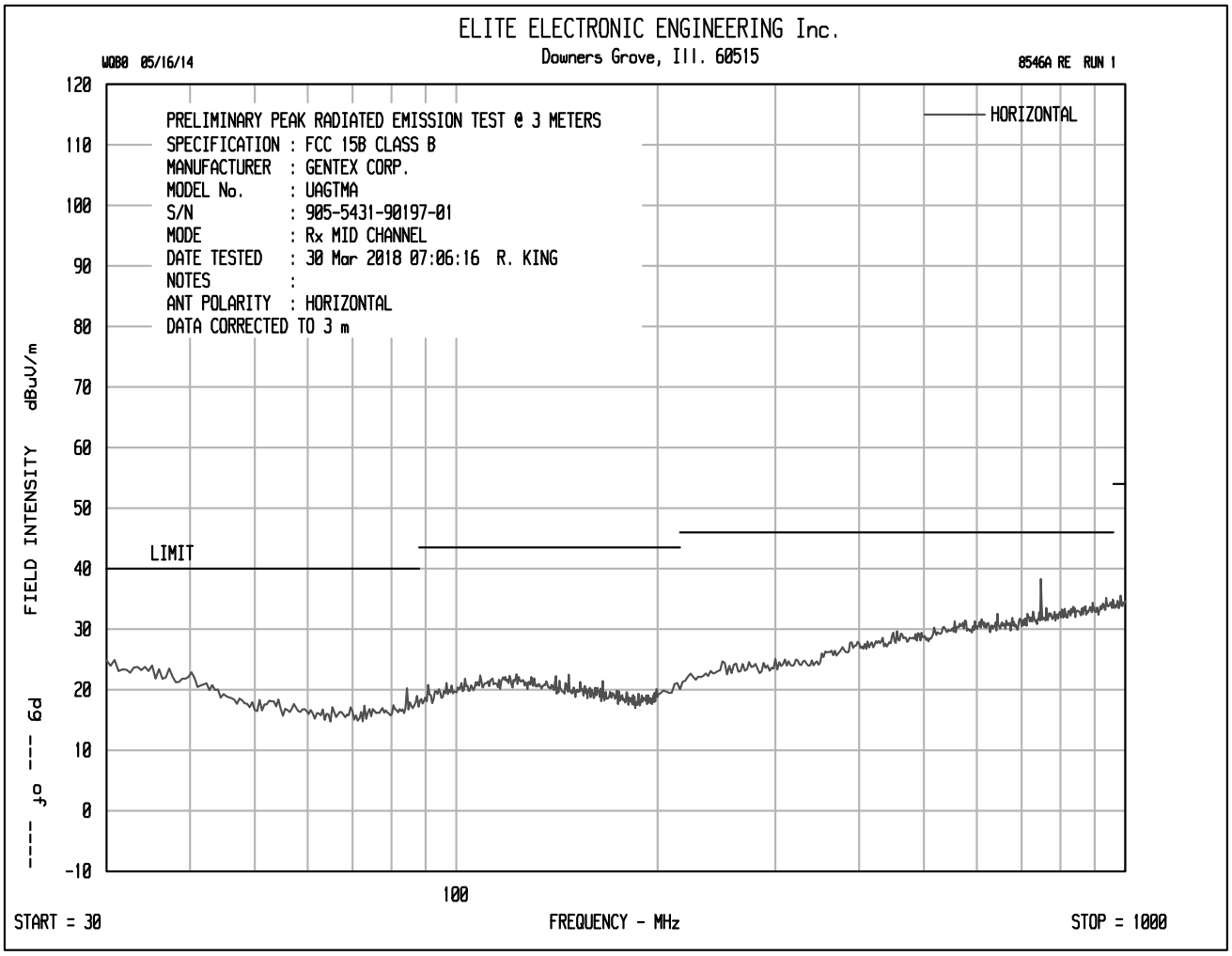
Test Setup for Radiated Emissions, 30MHz to 1GHz – Vertical Polarization

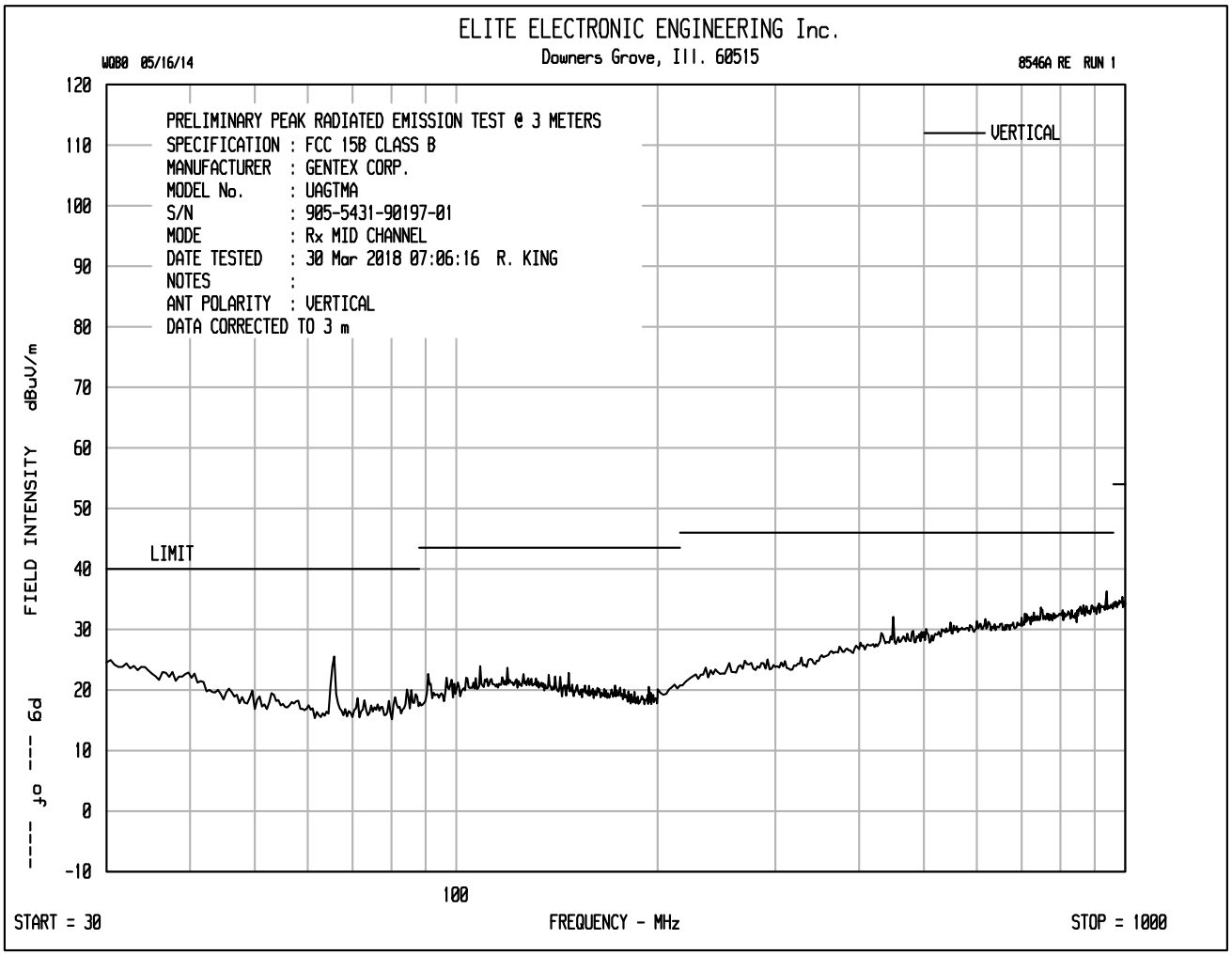
Figure 4

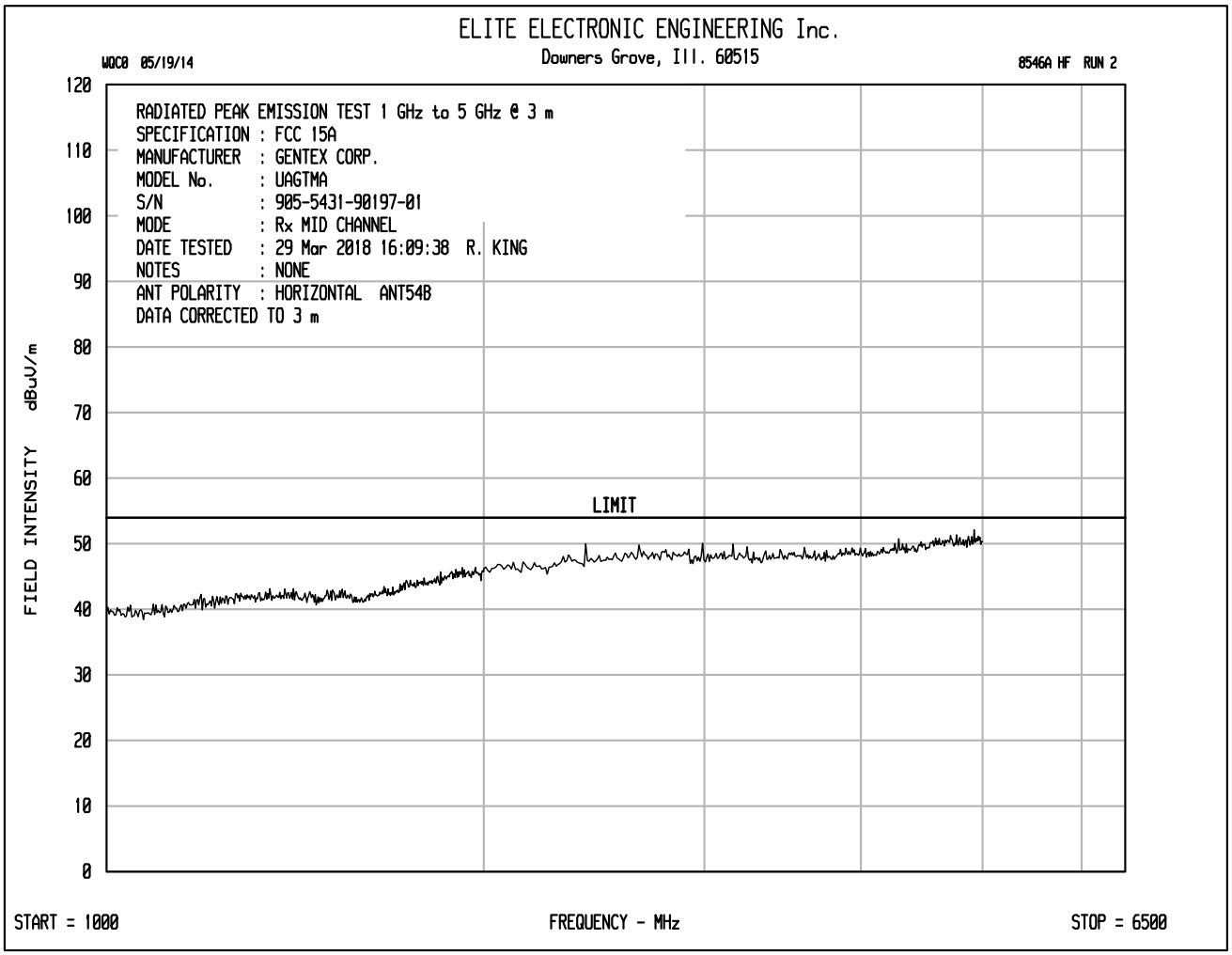


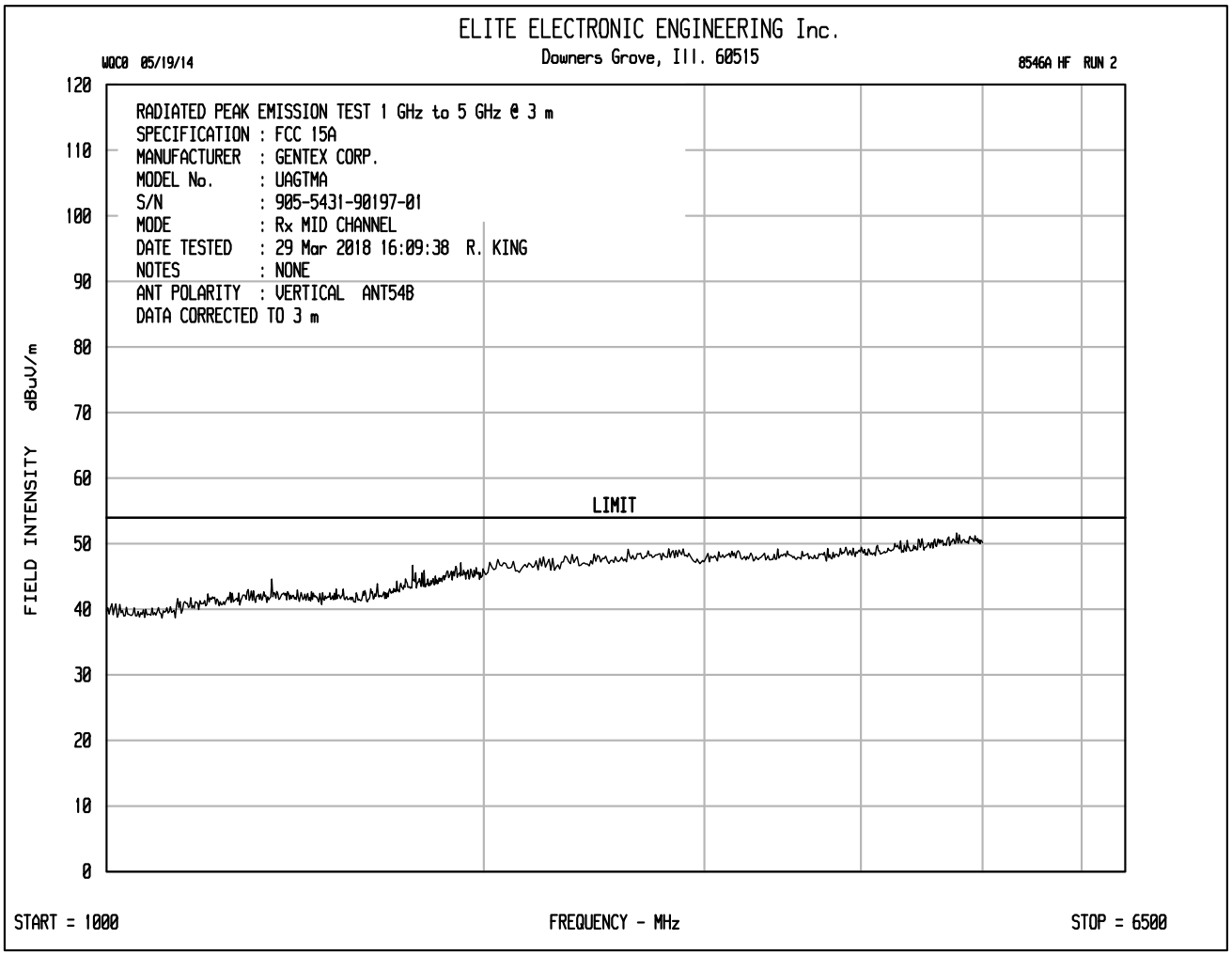
Test Setup for Radiated Emissions above 1GHz – Horizontal Polarization

Test Setup for Radiated Emissions above 1GHz – Vertical Polarization


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
W080 05/16/14
8546A RE RUN 1
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
S/N : 905-5431-90197-01
MODE : Rx MID CHANNEL
DATE TESTED : 30 Mar 2018 07:06:16 R. KING
NOTES :
ANT POLARITY : HORIZONTAL
DATA CORRECTED TO 3 m
HORIZONTAL
LIMIT
FIELD INTENSITY dBuV/m
---- uo --- 6d
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
100
START = 30
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQB0 05/16/14
8546A RE RUN 1
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
S/N : 905-5431-90197-01
MODE : Rx MID CHANNEL
DATE TESTED : 30 Mar 2018 07:06:16 R. KING
NOTES :
ANT POLARITY : VERTICAL
DATA CORRECTED TO 3 m
VERTICAL
LIMIT
FIELD INTENSITY dBuV/m
---- to --- 6d
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
100
START = 30
FREQUENCY - MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC8 05/19/14
8546A HF RUN 2
RADIATED PEAK EMISSION TEST 1 GHz to 5 GHz @ 3 m
SPECIFICATION : FCC 15A
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
S/N : 905-5431-90197-01
MODE : Rx MID CHANNEL
DATE TESTED : 29 Mar 2018 16:09:38 R. KING
NOTES : NONE
ANT POLARITY : HORIZONTAL ANT54B
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC8 05/19/14
8546A HF RUN 2
RADIATED PEAK EMISSION TEST 1 GHz to 5 GHz @ 3 m
SPECIFICATION : FCC 15A
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
S/N : 905-5431-90197-01
MODE : Rx MID CHANNEL
DATE TESTED : 29 Mar 2018 16:09:38 R. KING
NOTES : NONE
ANT POLARITY : VERTICAL ANT54B
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500

ETR No. 8546A
DATA SHEET TEST NO. 1

RADIATED QP EMISSION MEASUREMENTS in a 3 m SEMI-ANECHOIC ROOM
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : GENTEX CORP.
MODEL NO. : UAGTMA
SERIAL NO. : 905-5431-90197-01
TEST MODE : Rx MID CHANNEL
NOTES :
TEST DATE : 30 Mar 2018 07:06:16
TEST DISTANCE : 3 m

FREQUENCY MHz	QP READING dBuV	ANT FAC dB	CBL FAC dB	EXT ATTN dB	DIST FAC dB	TOTAL dBuV/m	QP LIMIT dBuV/m	AZ deg	ANT HT cm	ANT POL
66.53	-4.9	12.3	.7	0.0	0.0	8.0	40.0	135	120	V
83.99	-4.7	13.8	.7	0.0	0.0	9.8	40.0	270	340	H
107.94	-2.3	17.8	.8	0.0	0.0	16.3	43.5	135	200	V
124.11	-6.6	18.1	.9	0.0	0.0	12.4	43.5	45	120	V
146.43	-.5	16.8	1.0	0.0	0.0	17.3	43.5	225	200	V
174.57	-6.5	15.2	1.2	0.0	0.0	9.9	43.5	90	340	V
257.05	-5.3	18.5	1.4	0.0	0.0	14.6	46.0	135	340	H
358.57	-5.4	20.5	1.7	0.0	0.0	16.8	46.0	45	200	H
448.03	-1.9	22.6	1.8	0.0	0.0	22.5	46.0	135	340	V
580.03	-5.7	24.5	2.0	0.0	0.0	20.8	46.0	-0	200	H
644.54	-5.9	24.8	2.1	0.0	0.0	20.9	46.0	-0	200	H
742.53	7.5	25.5	2.2	0.0	0.0	35.2	46.0	315	120	H
894.57	-4.3	26.3	2.5	0.0	0.0	24.4	46.0	270	200	H
942.21	-4.6	26.7	2.5	0.0	0.0	24.7	46.0	135	340	V

Checked BY Richard E. King :

Richard E. King

DATA SHEET HF TEST NO. 2

RADIATED AVG EMISSION MEASUREMENTS >=1000 MHz in a 3 m ANECHOIC ROOM

SPECIFICATION : FCC 15B
MANUFACTURER : GENTEX CORP.
MODEL NO. : UAGTMA
SERIAL NO. : 905-5431-90197-01
TEST MODE : Rx MID CHANNEL
NOTES : NONE
TEST DATE : 29 Mar 2018 16:09:38
TEST DISTANCE : 3 m
ANTENNA : ANT54B

FREQUENCY	AVG READING	ANT FAC	CBL FAC	DIST FAC	TOTAL	AVG LIMIT	PASS/ FAIL	AZ	ANT HT	POLAR
MHz	dBuV	dB	dB	dB	dBuV/m	dBuV/m		deg	cm	
1025.26	-2.9	27.0	2.0	0.0	26.1	54.0		0	340	V
1283.98	-3.9	29.1	2.4	0.0	27.6	54.0		0	200	V
1368.37	-.9	29.0	2.5	0.0	30.6	54.0		315	200	V
1390.44	-3.0	29.0	2.5	0.0	28.4	54.0		225	200	H
1637.09	-3.3	28.8	2.7	0.0	28.2	54.0		180	340	V
1777.21	-2.7	30.3	2.8	0.0	30.5	54.0		45	200	V
1905.63	-3.0	31.6	2.9	0.0	31.5	54.0		315	340	V
2206.36	-2.3	31.6	3.2	0.0	32.6	54.0		315	200	V
2412.71	7.6	32.2	3.4	0.0	43.2	54.0		180	340	H
2991.44	-3.9	32.6	3.9	0.0	32.6	54.0		0	340	H
3156.97	-3.2	32.9	4.0	0.0	33.7	54.0		315	120	H
3591.64	-4.2	33.2	4.3	0.0	33.3	54.0		315	340	H
4113.93	-4.7	33.6	4.6	0.0	33.5	54.0		180	340	V
4609.71	-4.0	34.4	4.8	0.0	35.3	54.0		45	200	H
4931.75	-4.1	34.8	5.0	0.0	35.7	54.0		225	200	H

Checked BY Richard E. King :

Richard E. King

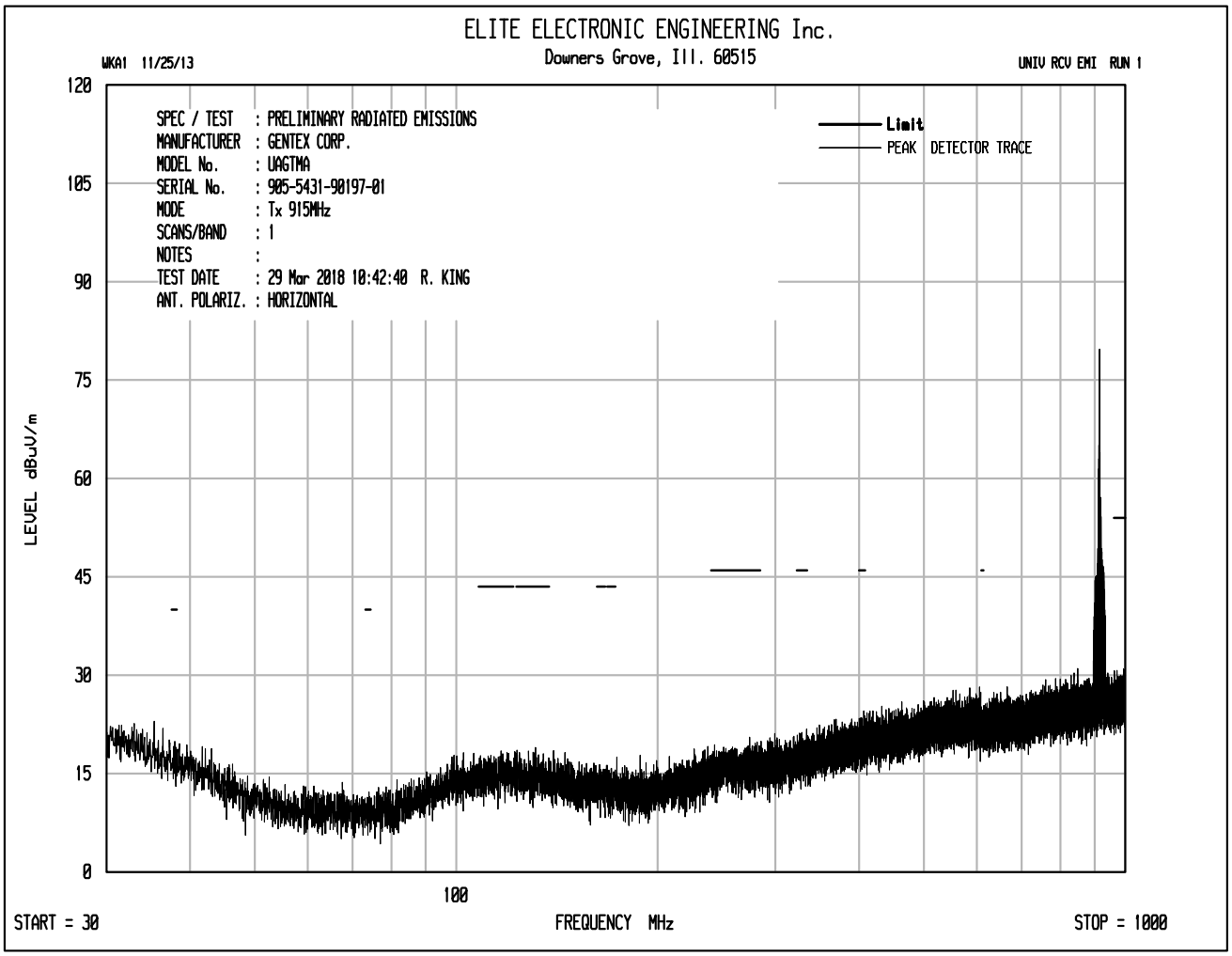
MANUFACTURER : Gentex Corporation
MODEL NO. : UAGTMA
SERIAL NO. : 905-5431-87656-01
SPECIFICATION : FCC 90 Subpart I
DATE : March 30, 2018
MODE : See Below
NOTES : 3.3mW rated power
NOTES : Output power was measured in 10MHz RBW

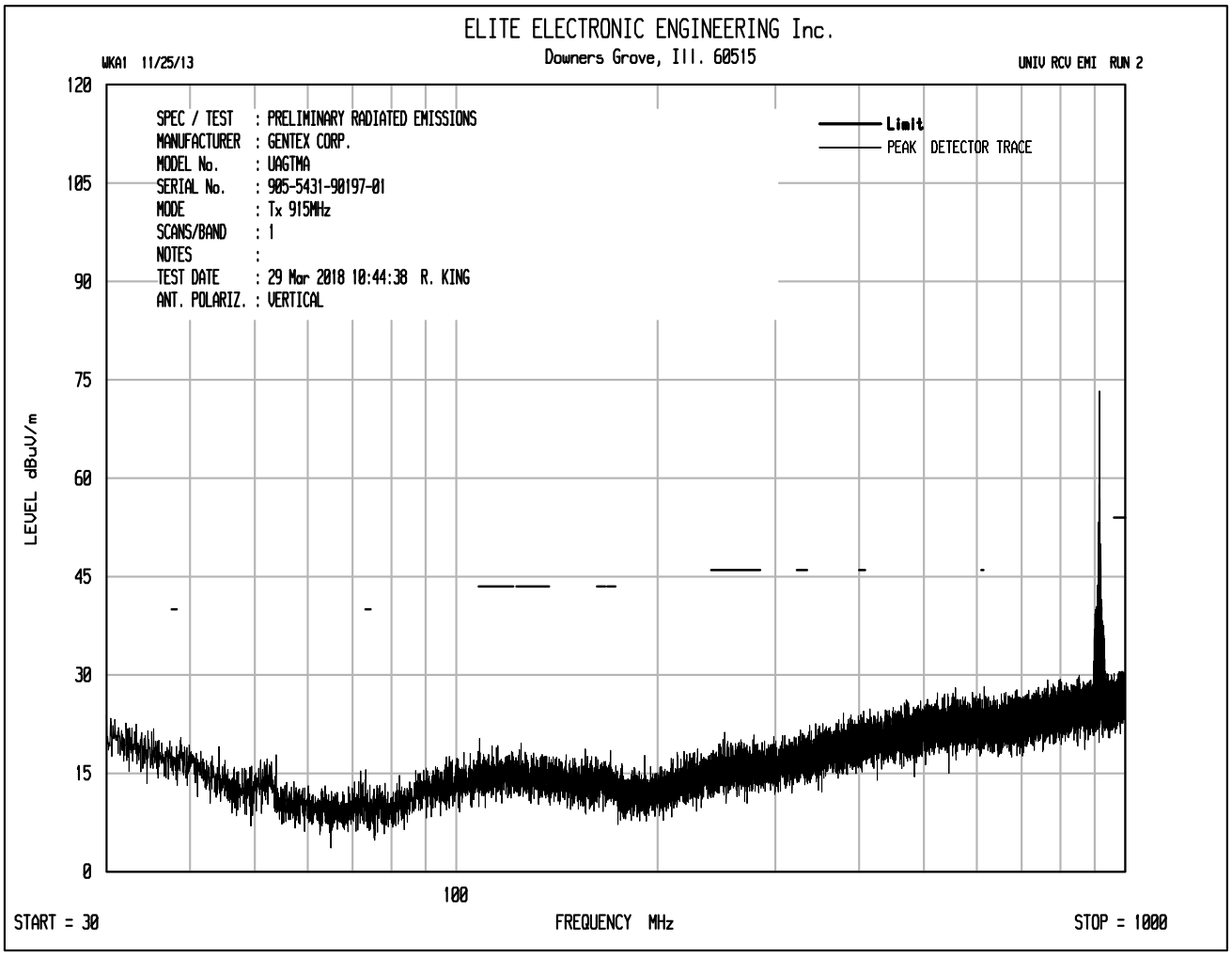
Frequency MHz	Ant Pol	Meter Reading (dBuV)	Amb	Matched Signal Generator Reading (dBm)	Equivalent Antenna Gain (dBd)	Cable Loss (dB)	ERP Total (dBm)	ERP Total (mW)	ERP Limit (mW) 20%	ERP Limit (W)
915.00	H	75.8		6.8	0.0	1.6	5.2	3.31	3.96	30
915.00	V	67.1		-2.2	0.0	1.6	-3.8	0.47	3.96	30

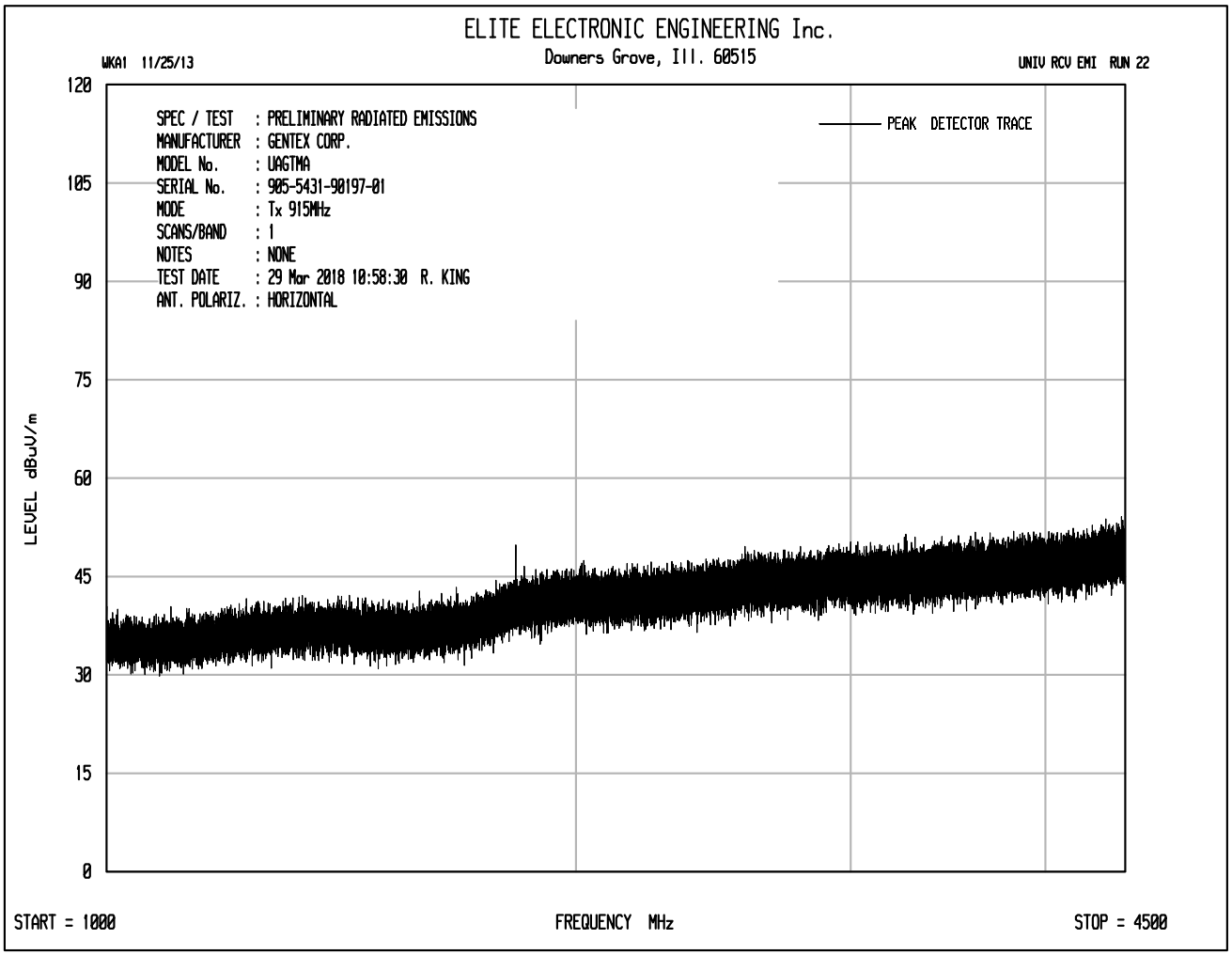
ERP (dBm) = Matched Sig. Gen. Reading (dBm) + Equivalent Antenna Gain (dBd) – Cable Loss (dB)

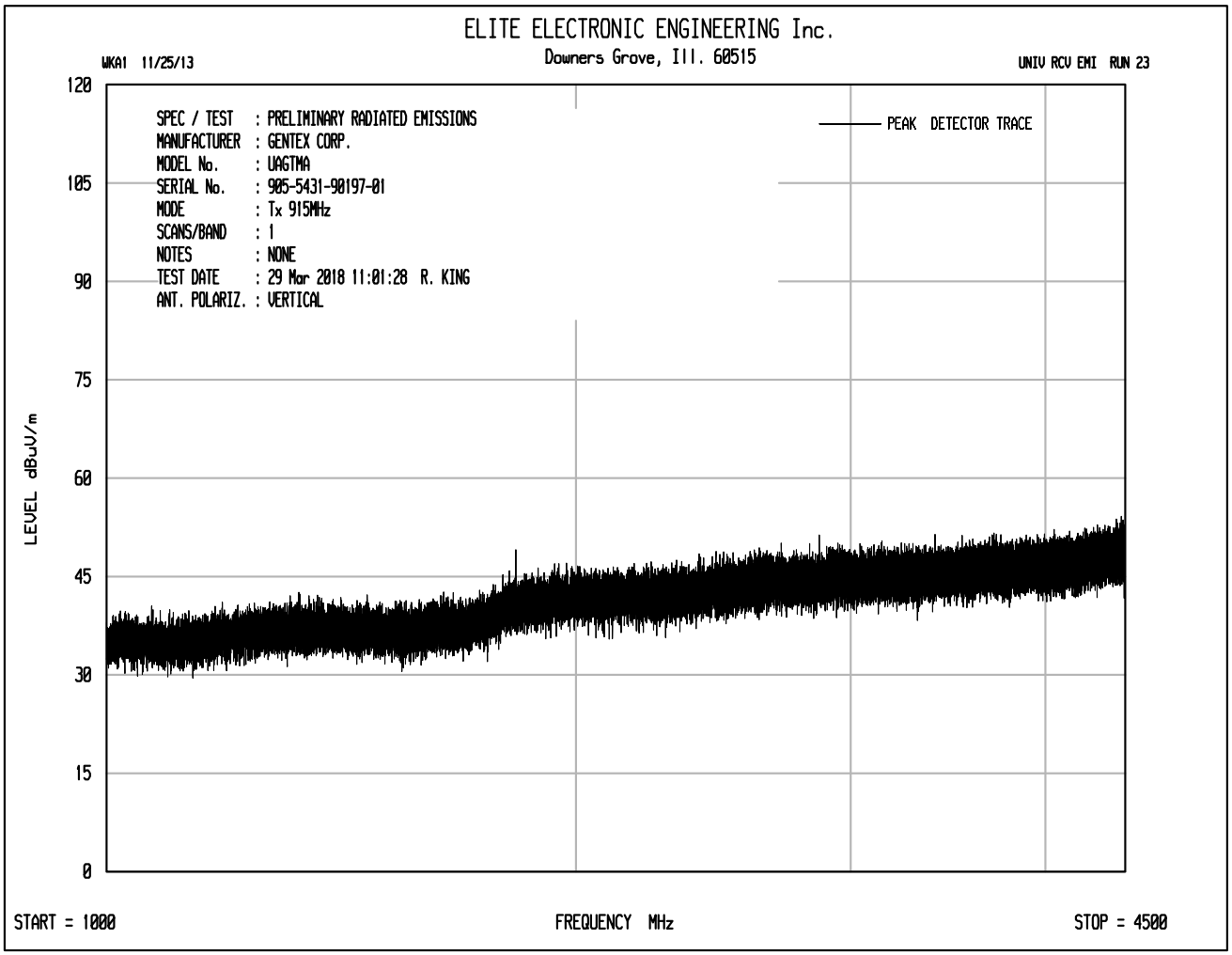
Checked BY Richard E. King :

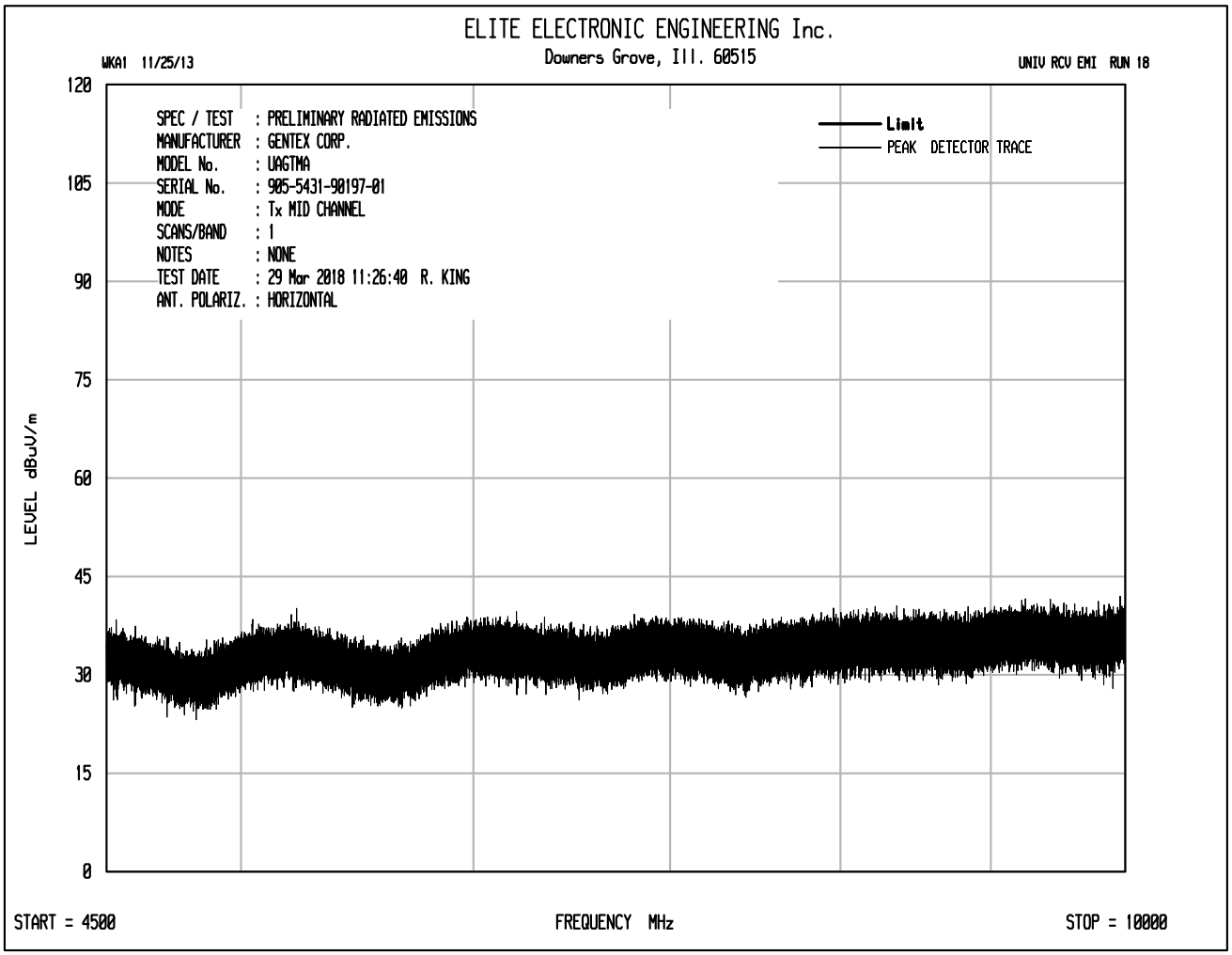
Richard E. King

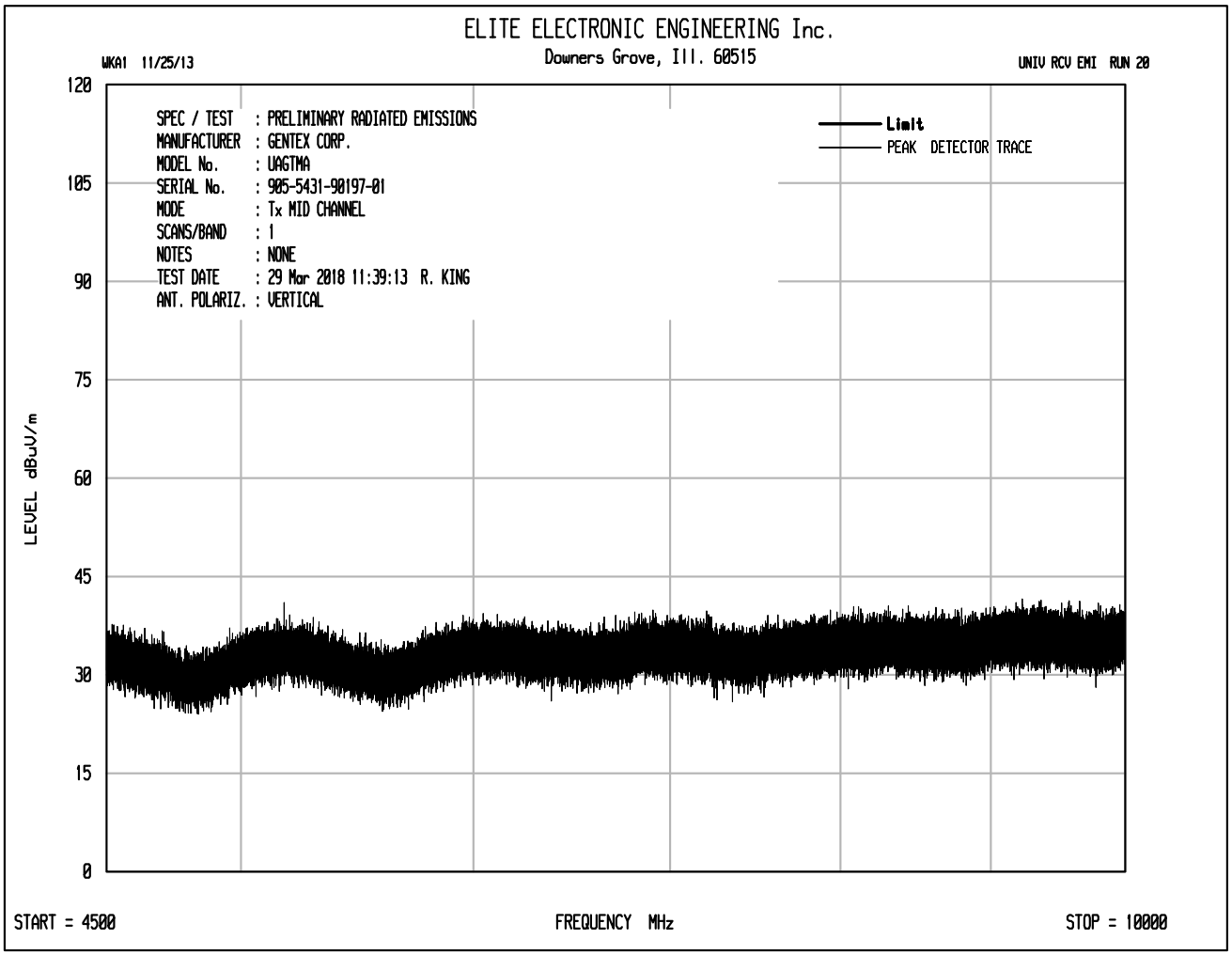

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 1
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
SERIAL No. : 905-5431-90197-01
MODE : Tx 915MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 29 Mar 2018 10:42:40 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
SERIAL No. : 985-5431-90197-01
MODE : Tx 915MHz
SCANS/BAND : 1
NOTES :
TEST DATE : 29 Mar 2018 10:44:38 R. KING
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 22
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
SERIAL No. : 985-5431-90197-01
MODE : Tx 915MHz
SCANS/BAND : 1
NOTES : NONE
TEST DATE : 29 Mar 2018 10:58:30 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 23
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
SERIAL No. : 985-5431-90197-01
MODE : Tx 915MHz
SCANS/BAND : 1
NOTES : NONE
TEST DATE : 29 Mar 2018 11:01:28 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 18
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
SERIAL No. : 985-5431-90197-01
MODE : Tx MID CHANNEL
SCANS/BAND : 1
NOTES : NONE
TEST DATE : 29 Mar 2018 11:26:40 R. KING
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 4500
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 20
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : GENTEX CORP.
MODEL No. : UAGTMA
SERIAL No. : 985-5431-90197-01
MODE : Tx MID CHANNEL
SCANS/BAND : 1
NOTES : NONE
TEST DATE : 29 Mar 2018 11:39:13 R. KING
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 4500
FREQUENCY MHz
STOP = 10000

MANUFACTURER : Gentex Corporation
MODEL NO. : UAGTMA
SERIAL NO. : 905-5431-87656-01
SPECIFICATION : FCC Part 90 Spurious Radiated Emissions
DATE : March 13, 2018
MODE : Transmit at 915MHz
NOTES : 3.3mW nominal power
NOTES : Spurious emissions meausred in a 100kHz RBW

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dBd)	Cable Loss (dB)	ERP (dBm)	Attenuation Below Output Power (dB)	Minimum Attenuation (dB)
1830.00	H	50.8	*	-73.8	2.7	2.4	-73.5	78.7	30.2
1830.00	V	49.3	*	-72.1	2.7	2.4	-71.8	77.0	30.2
2745.00	H	47.5	*	-70.7	4.3	3.0	-69.4	74.6	30.2
2745.00	V	48.7	*	-72.4	4.3	3.0	-71.1	76.3	30.2
3660.00	H	51.7	*	-63.8	6.4	3.4	-60.9	66.1	30.2
3660.00	V	52.7	*	-63.2	6.4	3.4	-60.2	65.4	30.2
4575.00	H	51.3	*	-63.7	7.1	3.8	-60.4	65.6	30.2
4575.00	V	50.8	*	-62.8	7.1	3.8	-59.5	64.7	30.2
5490.00	H	48.3	*	-62.3	8.3	4.1	-58.2	63.3	30.2
5490.00	V	48.9	*	-64.1	8.3	4.1	-60.0	65.2	30.2
6405.00	H	50.0	*	-61.1	8.7	4.5	-57.0	62.1	30.2
6405.00	V	49.4	*	-60.4	8.7	4.5	-56.2	61.4	30.2
7320.00	H	49.6	*	-57.7	9.7	4.9	-52.9	58.1	30.2
7320.00	V	48.9	*	-58.0	9.7	4.9	-53.2	58.4	30.2
8235.00	H	39.2	*	-58.0	10.7	5.2	-52.5	57.7	30.2
8235.00	V	40.2	*	-47.3	10.7	5.2	-41.8	47.0	30.2
9150.00	H	50.3	*	-55.0	11.2	5.3	-49.1	54.3	30.2
9150.00	V	50.9	*	-57.1	11.2	5.3	-51.1	56.3	30.2

ERP(dBm) = Matched Sig. Gen. Reading (dBm) + Equivalent Antenna Gain (dBd) – Cable Loss (dB)
Minimum Attenuation = 55+10log(.0033W)= 30.2dB

Checked BY Richard E. King :

Richard E. King

MANUFACTURER : Gentex Corporation
MODEL NO. : UAGTMA
SERIAL NO. : 905-5431-87656-01
SPECIFICATION : RSS-137 Section 6.5 Spurious Radiated Emissions
DATE : March 13, 2018
MODE : Transmit at 915MHz
NOTES : 3.3mW nominal power
NOTES : Spurious emissions meausred in a 100kHz RBW

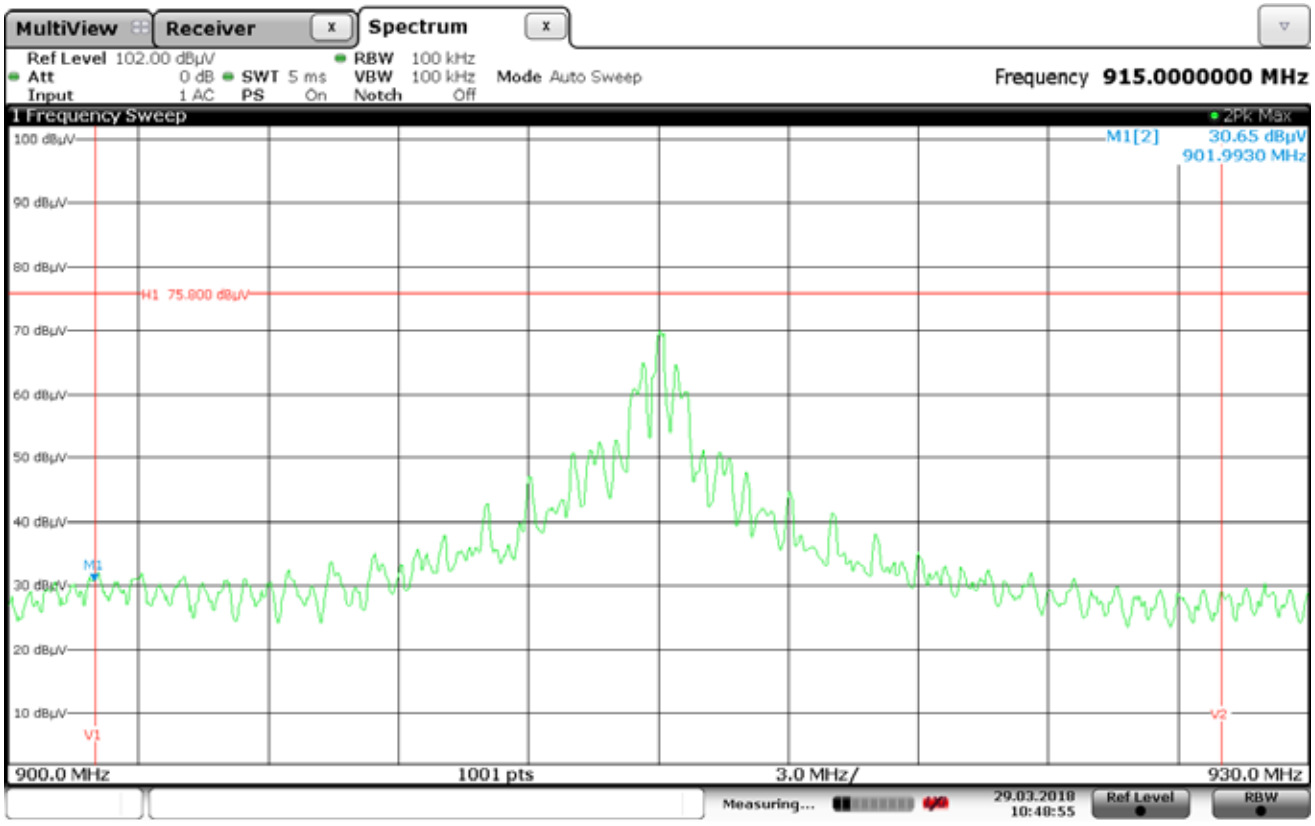
Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dBd)	Cable Loss (dB)	ERP (dBm)	Attenuation Below Output Power (dB)	RSS-137 Minimum Attenuation (dB)
1830.00	H	50.8	*	-73.8	2.7	2.4	-73.5	78.7	18.2
1830.00	V	49.3	*	-72.1	2.7	2.4	-71.8	77.0	18.2
2745.00	H	47.5	*	-70.7	4.3	3.0	-69.4	74.6	18.2
2745.00	V	48.7	*	-72.4	4.3	3.0	-71.1	76.3	18.2
3660.00	H	51.7	*	-63.8	6.4	3.4	-60.9	66.1	18.2
3660.00	V	52.7	*	-63.2	6.4	3.4	-60.2	65.4	18.2
4575.00	H	51.3	*	-63.7	7.1	3.8	-60.4	65.6	18.2
4575.00	V	50.8	*	-62.8	7.1	3.8	-59.5	64.7	18.2
5490.00	H	48.3	*	-62.3	8.3	4.1	-58.2	63.3	18.2
5490.00	V	48.9	*	-64.1	8.3	4.1	-60.0	65.2	18.2
6405.00	H	50.0	*	-61.1	8.7	4.5	-57.0	62.1	18.2
6405.00	V	49.4	*	-60.4	8.7	4.5	-56.2	61.4	18.2
7320.00	H	49.6	*	-57.7	9.7	4.9	-52.9	58.1	18.2
7320.00	V	48.9	*	-58.0	9.7	4.9	-53.2	58.4	18.2
8235.00	H	39.2	*	-58.0	10.7	5.2	-52.5	57.7	18.2
8235.00	V	40.2	*	-47.3	10.7	5.2	-41.8	47.0	18.2
9150.00	H	50.3	*	-55.0	11.2	5.3	-49.1	54.3	18.2
9150.00	V	50.9	*	-57.1	11.2	5.3	-51.1	56.3	18.2

ERP(dBm) = Matched Sig. Gen. Reading (dBm) + Equivalent Antenna Gain (dBd) – Cable Loss (dB)
Minimum Attenuation = 43+10log(.0033W)= 18.2dB

Checked BY Richard E. King :

Richard E. King

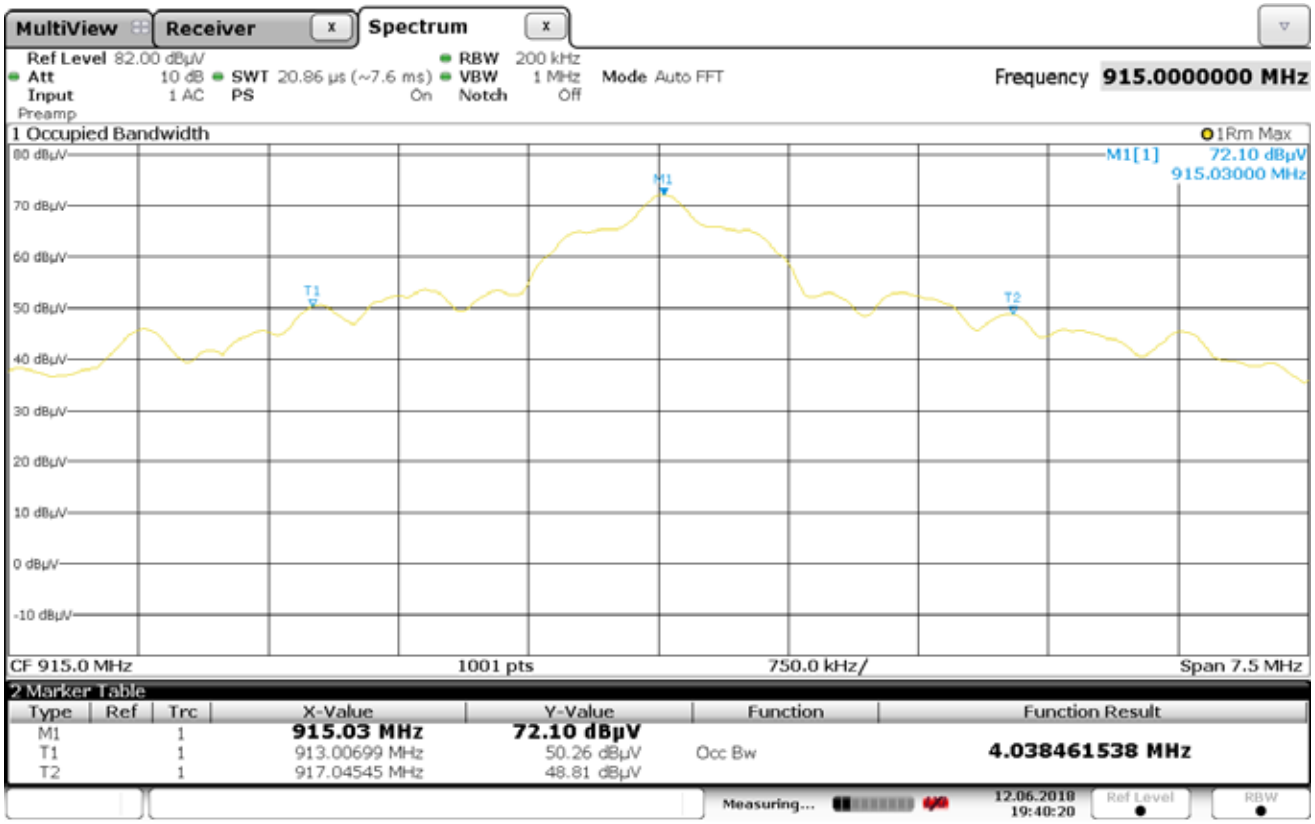
MANUFACTURER : Gentex Corporation
MODEL NO. : UAGTMA
SPECIFICATION : FCC Part 90
DATE : March 30, 2018
MODE : Transmit at 915MHz
NOTES : 3.3mW nominal power



Date: 29.MAR.2018 10:48:56

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	Matched Sig. Gen. Reading (dBm)	Equivalent Antenna Gain (dB)	Cable Loss (dB)	ERP (dBm)	Attenuation Below Output Power (dB)	Minimum Attenuation (dB)
909.00	H	32.0		-37.8	0.0	1.6	-39.4	44.6	30.2
921.00	H	32.2		-39.8	0.0	1.6	-41.4	46.6	30.2

MANUFACTURER : Gentex Corporation
MODEL NO. : UAGTMA
SPECIFICATION : 99% Bandwidth
DATE : June 12, 2018
MODE : Transmit at 915MHz
NOTES : 99% bandwidth = 4.03MHz



Date: 12.JUN.2018 19:40:20

MANUFACTURER : Gentex Corporation
MODEL NO. : UAGTMA
SPECIFICATION : FCC 90 Frequency Tolerance
DATE : April 2, 2018
MODE : Transmit at 915MHz
NOTES :

Temperature °C	Input Voltage	Nominal Frequency Hz	Measured Frequency Hz	Frequency Variation in ppm Measured Variation ppm
-30	12.0	915,027,480	914,948,060	-86.795208
-30	10.2	915,027,480	914,946,060	-88.980934
-30	13.8	915,027,480	914,949,060	-85.702344
-20	12.0	915,027,480	914,928,080	-108.630617
-20	10.2	915,027,480	914,921,090	-116.269732
-20	13.8	915,027,480	914,929,580	-106.991322
-10	12.0	915,027,480	914,955,050	-79.156093
-10	10.2	915,027,480	914,960,505	-73.194523
-10	13.8	915,027,480	914,959,050	-74.784639
0	12.0	915,027,480	914,975,530	-56.774251
0	10.2	915,027,480	914,974,530	-57.867115
0	13.8	915,027,480	914,976,530	-55.681388
+10	12.0	915,027,480	914,998,510	-31.660251
+10	10.2	915,027,480	914,999,010	-31.113820
+10	13.8	915,027,480	914,998,010	-32.206683
+20	12.0	915,027,480	915,027,480	0.000000
+20	10.2	915,027,480	915,026,980	-0.546432
+20	13.8	915,027,480	915,026,980	-0.546432
+30	12.0	915,027,480	915,012,490	-16.382022
+30	10.2	915,027,480	915,011,000	-18.010388
+30	13.8	915,027,480	915,012,990	-15.835590
+40	12.0	915,027,480	915,030,950	3.792236
+40	10.2	915,027,480	915,031,480	4.371453
+40	13.8	915,027,480	915,030,480	3.278590
+50	12.0	915,027,480	915,032,970	5.999820
+50	10.2	915,027,480	915,033,470	6.546251
+50	13.8	915,027,480	915,032,970	5.999820