Electromagnetic Compatibility Tests on the Model No. Xeta1 12.5kHz Licensed Band Radio

For	:	XetaWave 1668 Valtec Lane Boulder, CO 60714
P.O. No.	:	44257
Dates Tested	:	May 20 – 23, 2013, Jan 8 2014
Test Personnel	:	Ian F Carnegie Dayne Putnam
Specification	:	FCC "Code of Federal Regulations" Title 47 Part 90

Test Report By :

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REPORT REVISION HISTORY

Revision	Date	Description
-	10 June 2013	Initial release
A	8 Jan 2014	Added Transient Frequency Behavior test

Electromagnetic Compatibility Tests on a 12.5kHz Licensed Band Radio, Model No. Xeta1

1. INTRODUCTION

1.1. Scope of Tests

This document presents the results of a series of electromagnetic compatibility (EMC) tests performed on a 12.5kHz Licensed Band Radio, Model No. Xeta1, (hereinafter referred to as the EUT). The EUT transmits in the 150–169.5 MHz band using an external antenna. Its power is rated at 1.5 W.

The EUT was manufactured and submitted for testing by XetaWave located in Boulder, CO.

1.2. Purpose

The test series was performed to determine if the EUT complies with the requirements of the Code of Federal Regulations, Title 47, Part 90.

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

The electromagnetic compatibility tests were performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois.

1.5. Laboratory Conditions

The temperature at the time of the test was 24°C and the relative humidity was 47%.

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, dated October 2012
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2, dated October 2012
- TIA-603-C-2004, “Land Mobile FM or PM Communications Equipment Measurement and Performance Standard”

3. EUT SETUP AND OPERATION

3.1. General Description

The EUT is a 12.5kHz Licensed Band Radio, Model No. Xeta1. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT was powered with 7.5VDC from an adjustable DC power supply.

3.1.2. Peripheral Equipment

The EUT was submitted with a support laptop that was used to program and communicate with the

EUT via a USB to Serial adapter.

3.1.3. Signal Input/Output Leads

The EUT was connected to the laptop via a USB to Serial adapter.

3.1.4. Grounding

The EUT was not grounded.

3.1.5. Frequency of EUT

For spurious radiated emissions measurements, the frequency spectrum shall be investigated up to at least the tenth harmonic of the highest fundamental frequency.

3.1.6. Software

The EUT ran on firmware build 1779. For all tests the EUT was controlled using the software called Terra Term version 4.73.

3.2. Operational Mode

Unless otherwise noted in the individual test procedure section, all testing was performed separately in the following transmitting modes:

12.5kHz Bandwidth:

- Tx @ 150.775 MHz
- Tx @ 169.5 MHz

Additionally, each of these frequencies was tests individually with each of the following modulations for Occupied Bandwidth and Antenna Port Spurious Emissions:

- 2FSK
- BPSK
- QPSK
- 8PSK
- 16QAM
- 32QAM

3.3. EUT Modifications

No modifications were required for compliance.

4. Test Facility and Test Instrumentation

4.1. Shielded Enclosure

The Field Strength of Spurious Emissions test was 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 C63.4-2009 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. 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:

Radiated Emission Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

5. TEST PROCEDURES

5.1. RF POWER OUTPUT MEASUREMENTS

5.1.1. Requirements

In accordance with paragraph 90.205(s), the output power shall not exceed by more than 20 percent the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

5.1.2. Procedures

With the EUT transmitting, the antenna port of the EUT was connected to a spectrum analyzer through a 50 dB attenuator. The resolution bandwidth of the spectrum analyzer was set wider than the bandwidth of the EUT. The output power of the item was then measured. This procedure was repeated separately with the EUT transmitting at the frequencies listed in paragraph 3.2.

5.1.3. Results

The output power measurements are shown in a tabular form on pages 19 through 20. As can be seen from the data, the power output at each frequency is below the maximum allowable power of up to 20% above the manufacturer's rated output power.

5.2. OCCUPIED BANDWIDTH MEASUREMENTS

5.2.1. Requirements

Per 90.210, for equipment with a 12.5 kHz channel bandwidth, any emissions must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.25(f_d - 2.88\text{kHz})$ dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz; At least 50 + 10log (P) dB or 70 dB whichever is the lesser attenuation:

5.2.2. Procedures

The EUT was set to transmit.

(a) The antenna port of the EUT was connected and transmitting @ 150.775MHz to a

spectrum analyzer through a 50 dB attenuator.

(b) The following spectrum analyzer settings were employed:
- trace 1 = on
- center frequency = transmit frequency of the EUT
- resolution bandwidth = 3 MHz
- video bandwidth > resolution bandwidth
- frequency span = 1 MHz
- sweep = Auto
- detector function = peak
- trace = max hold

(c) Several sweeps were made with the settings listed above.

(d) Trace 1 was changed from max hold to view and captured.

(e) Steps (a) through (d) were repeated with the EUT operated transmitting @ 169.5MHz.

(f) Trace 1 was reset and the EUT was set to transmit @ 150.775MHz. The following spectrum analyzer settings were employed:
- trace 1 = on
- resolution bandwidth = 100 Hz
- video bandwidth = 300 Hz
- sweep = 12s
- detector function = peak
- trace = max hold

(g) Several sweeps were made with the settings listed above.

(h) Steps (f) through (g) were repeated with the EUT set to transmit @ 169.5MHz.

5.2.3. Results

The emission mask measurements are presented on pages 21 through 34. As can be seen from the data, all EUT bandwidths meet the emission mask requirements.

5.3. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS

5.3.1. Requirements

Per 90.210, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz the emissions must be attenuated by at least 50 + 10log (P) dB or 70dB whichever is the lesser attenuation.

5.3.2. Procedures

The EUT was set to transmit at the low channel (150.775MHz) and a bandwidth of 5MHz.

a) The antenna port of the EUT was connected to a spectrum analyzer through a 50dB attenuator.
b) The resolution bandwidth of the spectrum analyzer was set to 100 kHz.
c) A sweep was made from 30 MHz to 1 GHz.
d) The resolution bandwidth of the spectrum analyzer was set to 1 MHz.
e) A sweep was made from 1 GHz to 11 GHz.
f) Steps (a) through (e) were repeated with the EUT set to transmit at the high channel (169.5MHz).

5.3.3. Results

The plots of the antenna conducted output measurements are presented on pages 35 through 46. The limits, shown on the plots, are referenced to the RF power output measurements made on the EUT. As can be seen from the data, the EUT did not produce spurious emissions in excess of the limit.

5.4. FIELD STRENGTH OF SPURIOUS EMISSIONS

5.4.1.Requirements

Per 90.210, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz the emissions must be attenuated by at least 50 + 10log (P) dB or 70dB whichever is the lesser attenuation.

5.4.2.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 2009 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. 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.

2. All significant broadband and narrowband signals found in the preliminary sweeps were then measured using a peak detector at a test distance of 3 meters. The measurements were made with a bilog antenna over the frequency range of 30MHz to 1GHz, and a double ridged waveguide or standard gain horn antenna was used for frequencies 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 or standard gain horn 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 antenna.

5.4.3.Results

The preliminary measurements are presented on pages 47 through 54.The final radiated levels are presented on pages 55 through 56. The radiated emissions were measured through the 10th harmonic. All emissions measured from the EUT were within the specification limits.

Photographs of the test setup are shown in Figure 2 through 4.

5.5. FREQUENCY STABILITY

5.5.1. Requirements

In accordance with paragraph 90.213(a), mobile stations operating at 2 watts or less with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm.

5.5.2. Procedures

The antenna port of the EUT was connected to a spectrum analyzer through a 50 dB attenuator. The EUT was then placed in a humidity temperature chamber.

a) The EUT was set to transmit at 150.775MHz and 169.5MHz with the transmitter bandwidth set to 12.5 kHz. The transmit frequency was measured and recorded at ambient temperature (23°C).
b) The temperature chamber was then set to -30ºC.
c) Once the temperature chamber had reached -30ºC, the EUT was allowed to soak for at least 30 minutes.
d) After soaking at -30ºC for thirty minutes, the EUT was turned on and set to transmit and the transmit frequency was measured and recorded.
e) Steps (b) through (d) were repeated at -20ºC.
f) Steps (b) through (d) were repeated at -10ºC.
g) Steps (b) through (d) were repeated at 0ºC.
h) Steps (b) through (d) were repeated at +10ºC.
i) Steps (b) through (d) were repeated at +20ºC.
j) Steps (b) through (d) were repeated at +30ºC.
k) Steps (b) through (d) were repeated at +40ºC.
l) Steps (b) through (d) were repeated at +50ºC.
m) The EUT was then removed from the temperature chamber and allowed to adjust to nominal room temperature.
n) The supply voltage was checked and adjusted to the nominal level (7.5 V). The EUT was turned on and set to transmit. The transmit frequency was measured and recorded at ambient temperature.
o) The supply voltage was then varied to 85% of its nominal level (6.4 V). The EUT was turned on and set to transmit. The transmit frequency was measured and recorded at ambient temperature.
p) The supply voltage was then varied to 115% of its nominal level (8.6 V). The EUT was turned on and set to transmit. The transmit frequency was measured and recorded at ambient temperature.

5.5.3. Results

The frequency stability measurements are presented on pages 57 and 58. As can be seen from the data, the frequency stability measurements are within the requirements.

5.6. Transient Frequency Behavior

5.6.1. Requirements

Per 90.214, transmitters with 12.5 kHz channel spacing must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals	Maximum Frequency Difference	Time (ms)
t_1 [4]	±12.5 kHz	5.0 ms
t_2	±6.25 kHz	20.0 ms
t_3 [4]	±12.5 kHz	5.0 ms

Where:

t_1 is the time period immediately following t_{on}

t_2 is the time period immediately following t_1

t_3 is the time period from the instant when the transmitter is turned off until t_{off}

5.6.2. Procedures

Two test signals were connected to the test discriminator via a combining network. The transmitter was connected to a 50 ohm power attenuator. The output of the power attenuator was connected to the test discriminator via one input of the combining network. A test signal was connected to the second input of the combining network.

(a) The test signal was adjusted to the nominal frequency of the transmitter.

(b) The test signal was modulated by a 1 kHz signal with a deviation equal to the value of the relevant channel separation (12.5 kHz).

(c) The test signal was adjusted to correspond to 0.5% of the power of the transmitter under test measured at the input of the test discriminator. This level was maintained throughout the measurement.

(d) The amplitude difference (ad) and the frequency difference (f_d) output of the test discriminator were connected to a storage oscilloscope.

(e) The storage oscilloscope was set to display the channel corresponding to the (f_d) input up to ±1 channel frequency difference, corresponding to the relevant channel separation, from the nominal frequency.

(f) The storage oscilloscope was set to a rate of 5 ms/div and set so that the triggering occurs at 1 div from the left edge of the display.

(g) The 1 kHz test signal was shown continuously. The storage oscilloscope was set to trigger on the channel corresponding to the amplitude difference (ad) input at a low input level, rising.

(h) The transmitter was then switched on, without modulation, to produce the trigger pulse and a picture on the display. The result of the change in the ratio of power between the test signal and the transmitter output produced two separate sides, one showing the 1 kHz test signal, the other the frequency difference of the transmitter versus time.

(i) The transmit signal suppresses the 1 kHz test signal and produces the start of the test or t_{on}. During this test time the frequency difference was measured and recorded verses time.

(j) The transmitter was then switched off to produce the trigger pulse and a picture of the display. The result of the change in the ratio of power between the test signal and the transmitter output produced two separate sides, one showing the frequency difference of the transmitter versus time and the other showing the 1 kHz test signal.

(k) The transmitter signal no longer suppresses the 1 kHz test signal and produces t_3

5.6.3. Results

The plots of the transient frequency behavior are shown on pages 59 and 60. As can be seen from the data, all transient frequencies were within the maximum frequency difference limits. A photograph of the test setup is shown on Figure 5.

6. OTHER TEST CONDITIONS

6.1. Test Personnel and Witnesses

All EMC 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 XetaWave upon completion of the tests.

7. CONCLUSION

It was found that the XetaWave, Model Xeta1 12.5kHz Licensed Band Radio complies with the technical requirements of the Code of Federal Regulations, Title 47, Part 90.

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 specification. The data presented in this test report pertains only 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.

9. ENDORSEMENT DISCLAIMER

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

EQUIPMENT LIST

Table 9-1

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
CDX7	COMPUTER	ELITE	WORKSTATION			N/A	
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
ETH4	THERMOTRON CONTROLLER SYSTEM	THERMOTRON	8800	37876	---	4/10/2013	4/10/2014
GBR6	SIGNAL GENERATOR	HEWLETT PACKARD	8648C	3642U02047	9KHZ-3000MHZ	2/20/2013	2/20/2014
GSD4	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMB100A	104455	9KHZ-6GHZ	9/3/2013	9/3/2014
MSP8	8 CHANNEL DIGITAL OSCILLOSCOPE	YOKOGAWA	DL708	7018FA058	---	3/4/2013	3/4/2014
NDP0	TUNED DIPOLE ANTENNA	EMCO	3121C-DB3	311	140-400MHZ	4/4/2013	4/4/2014
NTA3	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	2/15/2013	2/15/2014
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	11/6/2013	11/6/2014
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	3/18/2013	3/18/2014
RBA0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100145	20HZ-26.5GHZ	3/12/2013	3/12/2014
RBE0	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU26	100095	20Hz-26GHz	3/13/2013	3/13/2014
RYE0	MODULATION ANALYZER	HEWLETT PACKARD	8901B	3104A03410	0.15-1300MHZ	9/6/2013	9/6/2014
SMAH	POWER SUPPLY	MASTECH	HY3020EX	1014	30 Volt, 20 Amp	NOTE 1	
T1E1	10DB 25W ATTENUATOR	WEINSCHEL	46-10-43	AU1883	DC-18GHZ	8/5/2013	8/5/2014
T2D2	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-43	AV5815	DC-18GHZ	8/5/2013	8/5/2014
T2S3	20DB 25W ATTENUATOR	WEINSCHEL	46-20-34	BV3544	DC-18GHZ	11/7/2013	11/7/2014
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	

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.

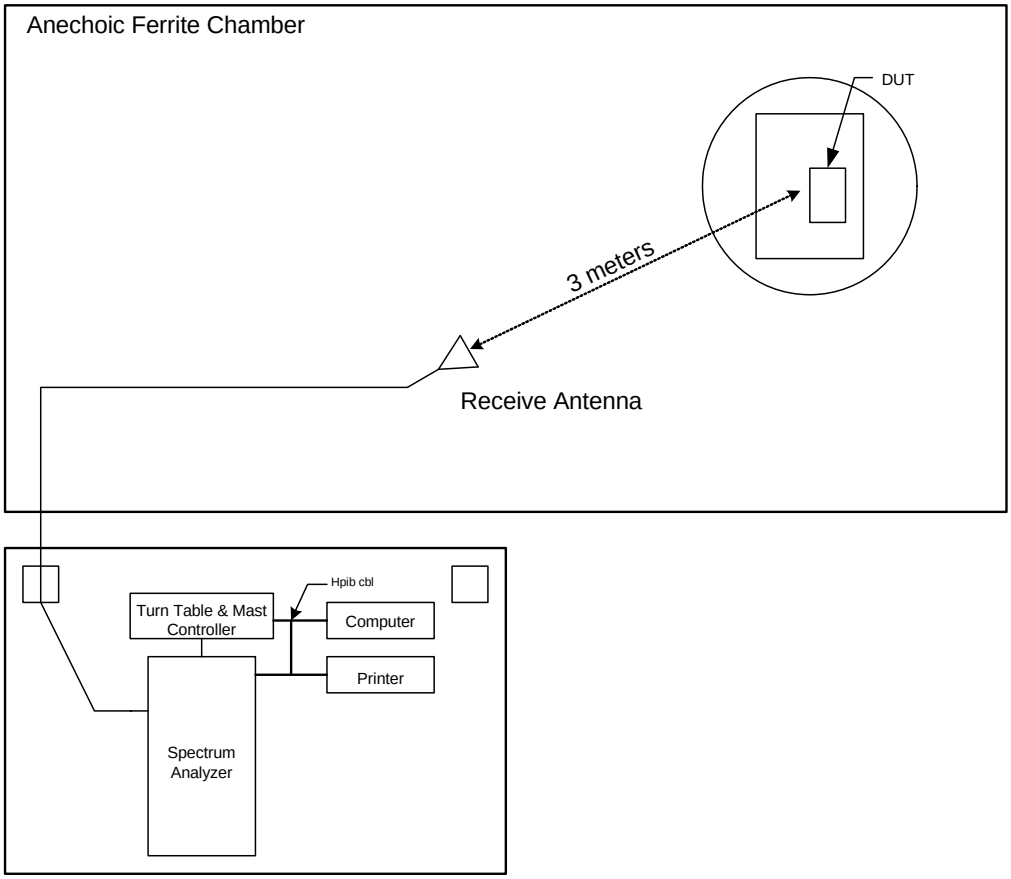
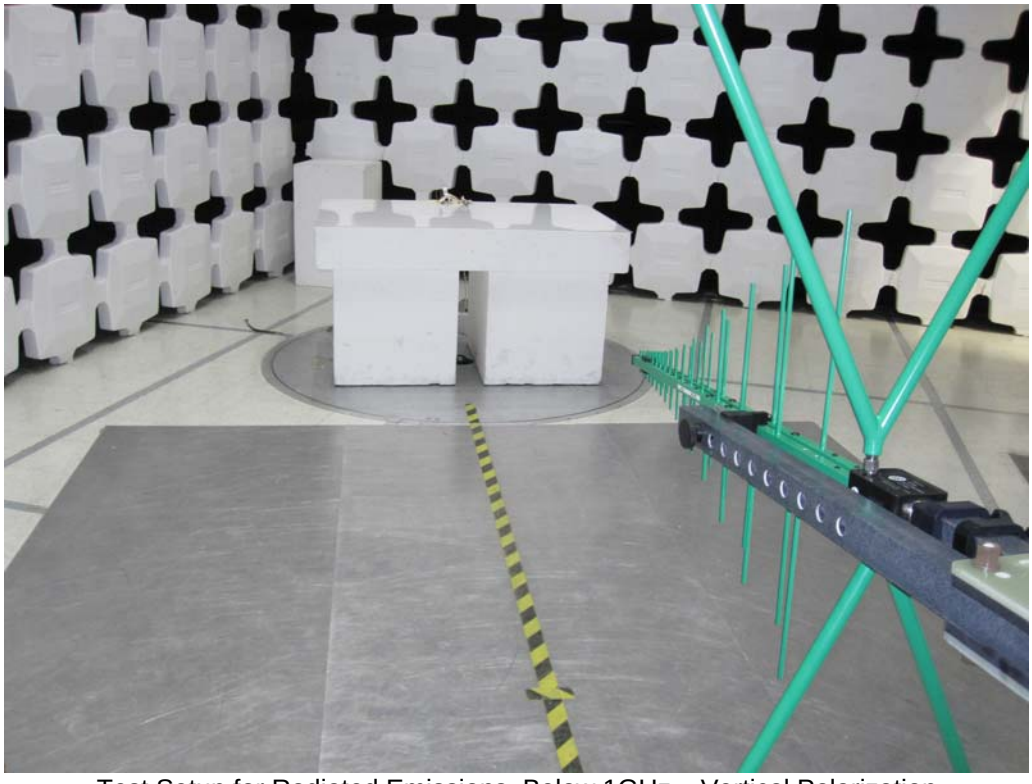


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

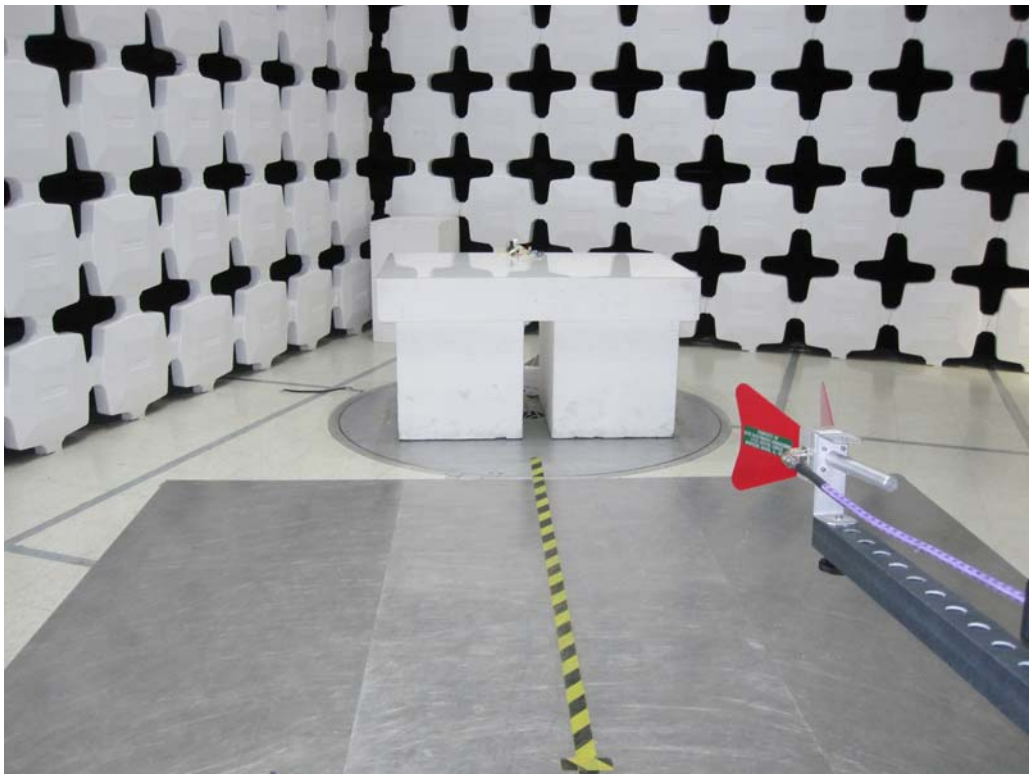
Figure 2

Test Setup for Radiated Emissions, Below 1GHz – Horizontal Polarization

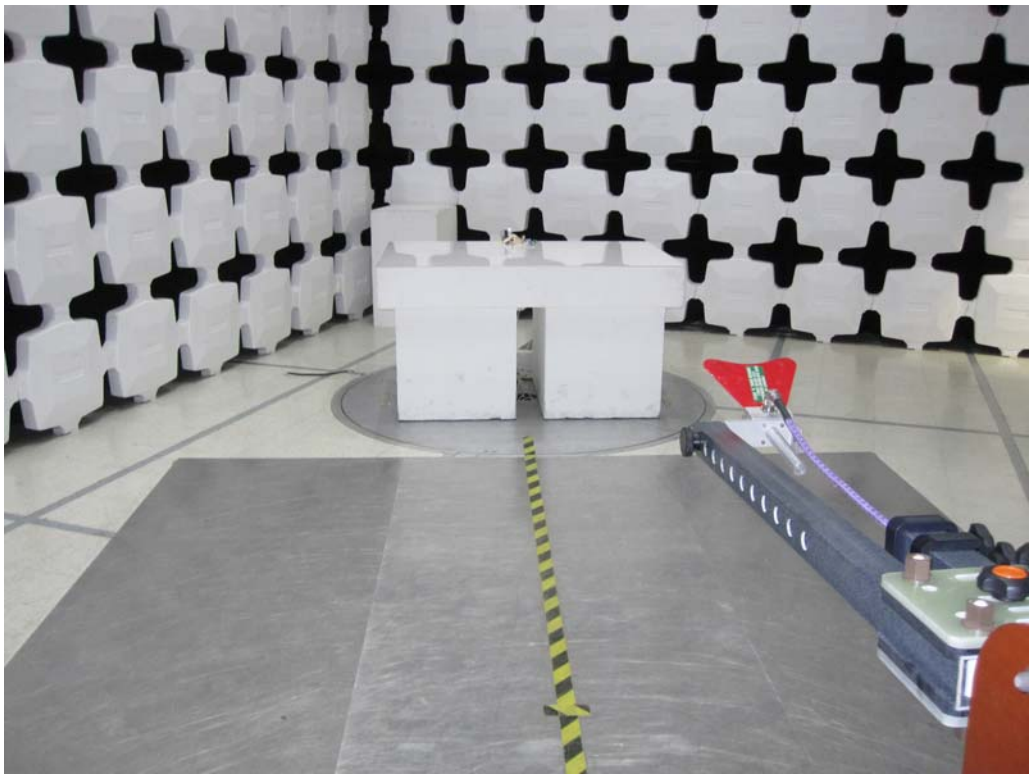


Test Setup for Radiated Emissions, Below 1GHz – Vertical Polarization

Figure 3

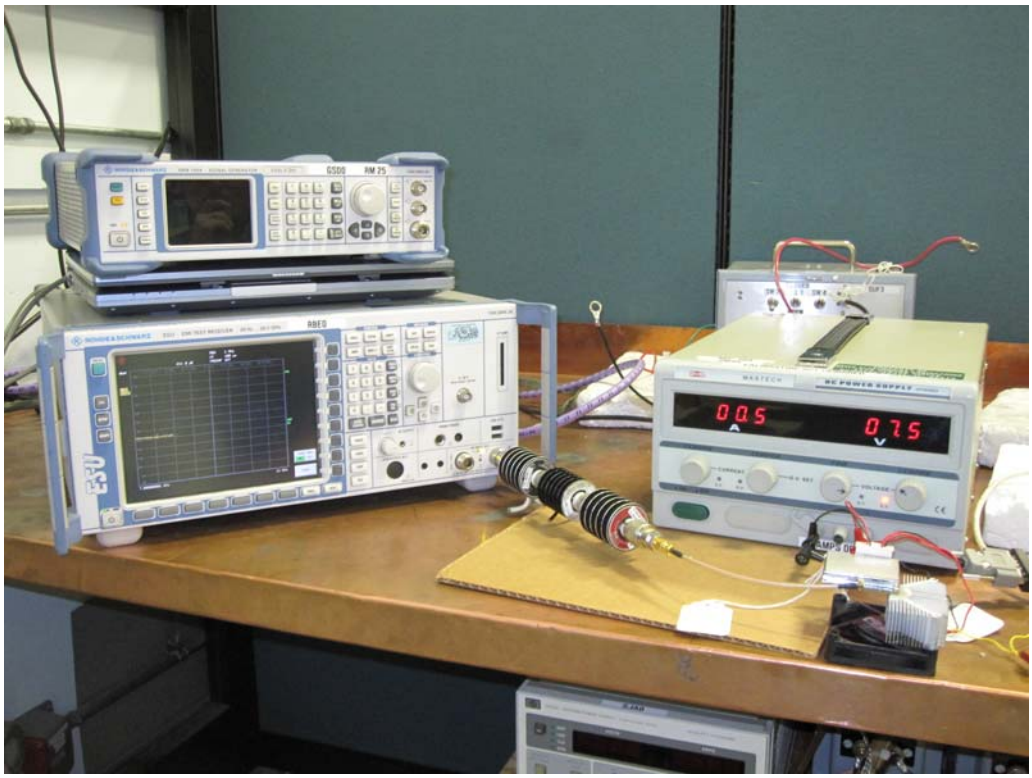


Test Setup for Radiated Emissions, Above 1GHz – Horizontal Polarization

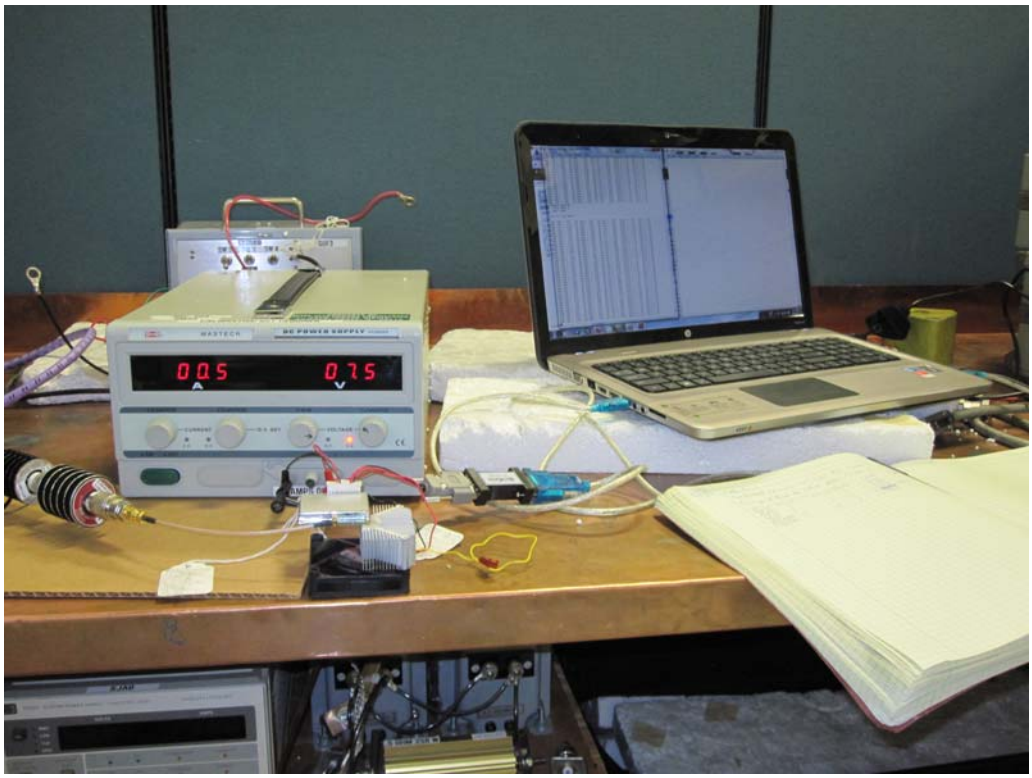


Test Setup for Radiated Emissions, Above 1GHz – Vertical Polarization

Figure 4



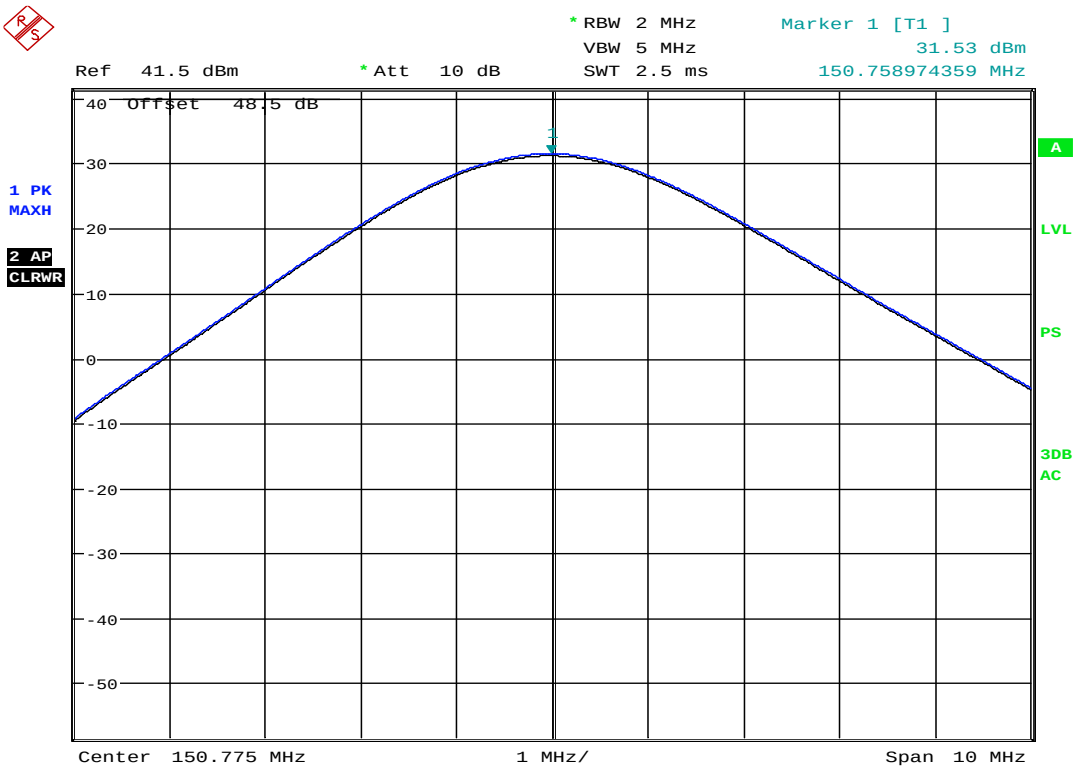
Antenna Port Test Setup – Test equipment



Antenna Port Test Setup – With support laptop

Figure 5

Transient Freq Response Test Setup – With support laptop

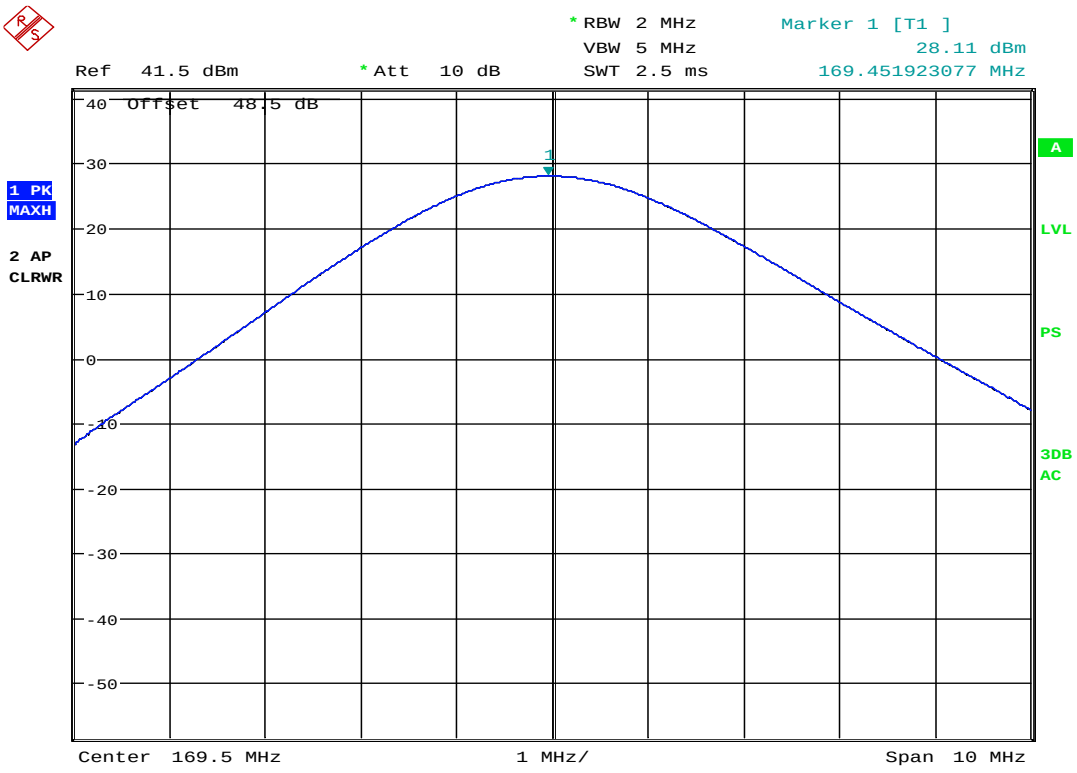


Date: 21.MAY.2013 15:02:53

FCC Part 90 – Peak Power Out

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 150.775MHz (Unmodulated)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES



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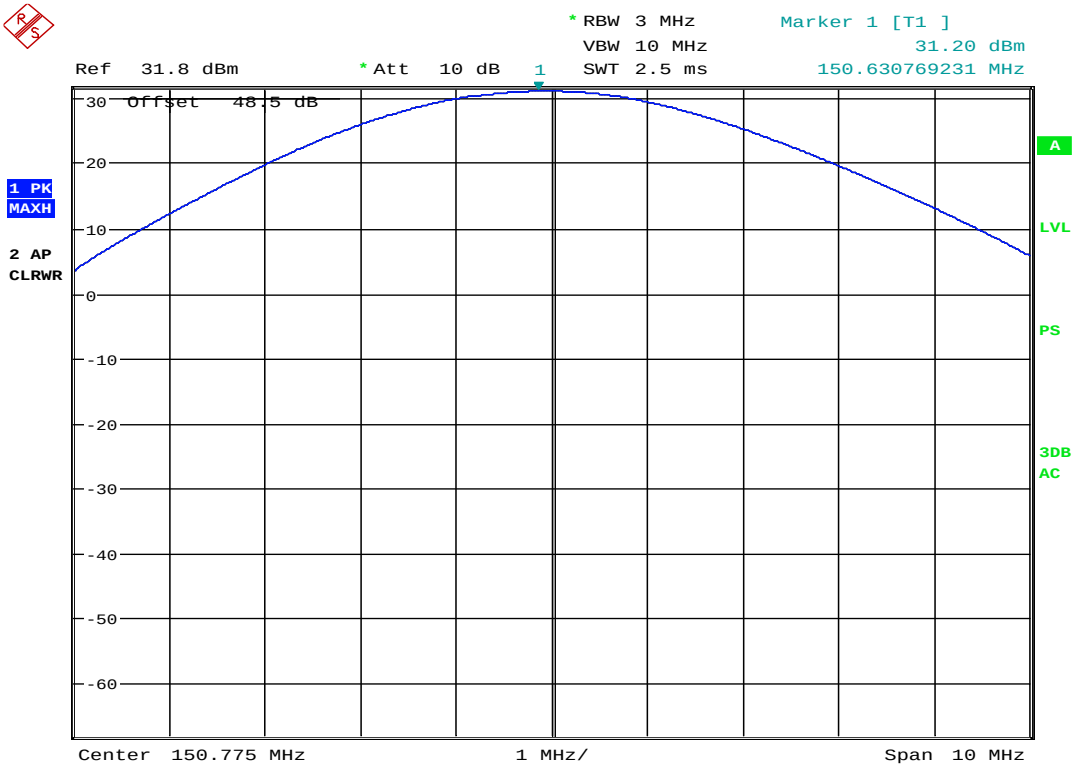
FCC Part 90 – Peak Power Out

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 169. 5MHz (Unmodulated)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES



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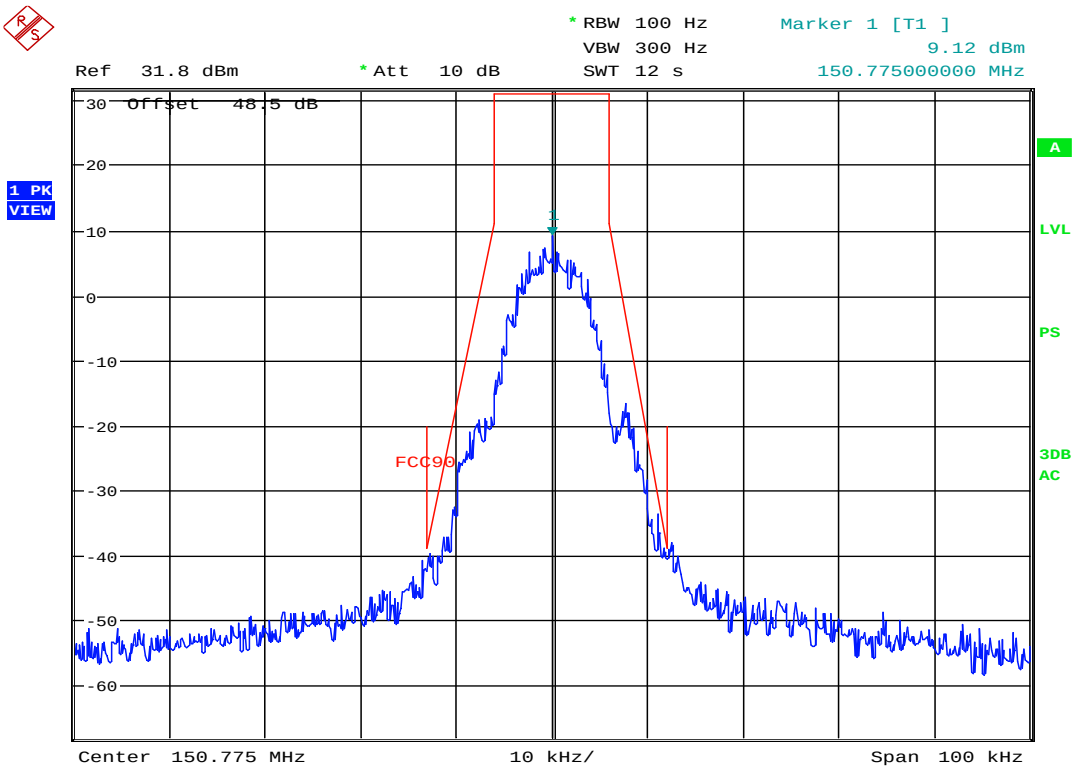
FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 150.775MHz (Unmodulated)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES



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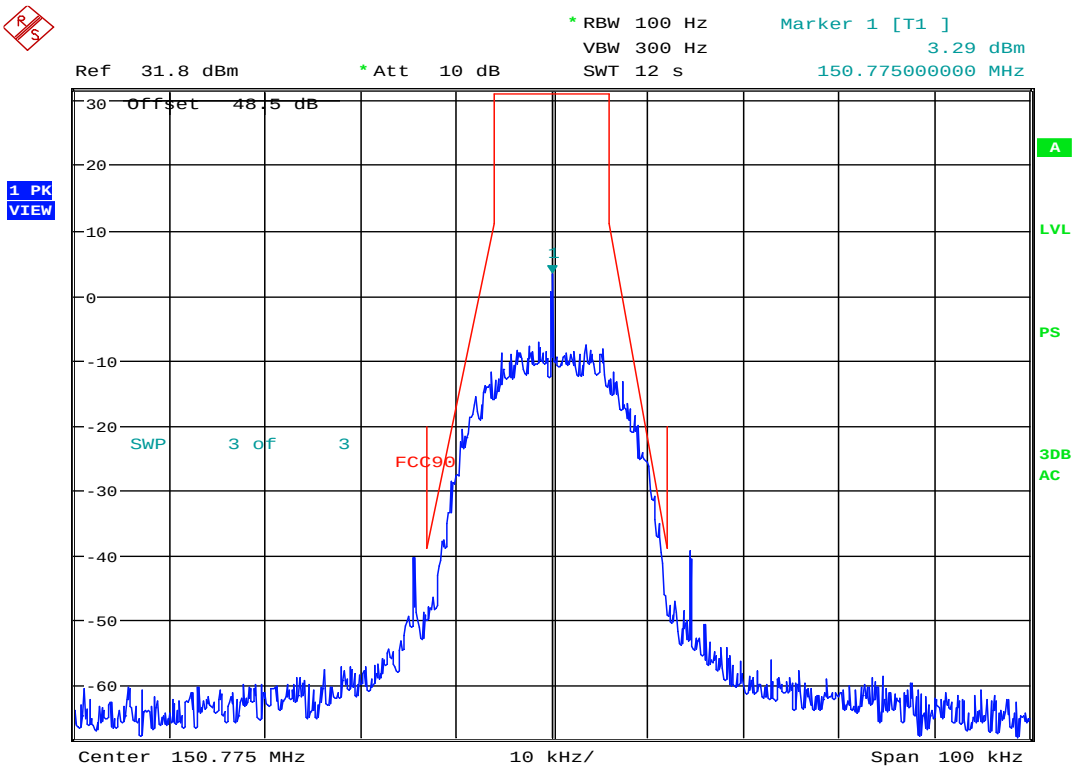
FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 150.775MHz (2FSK Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES



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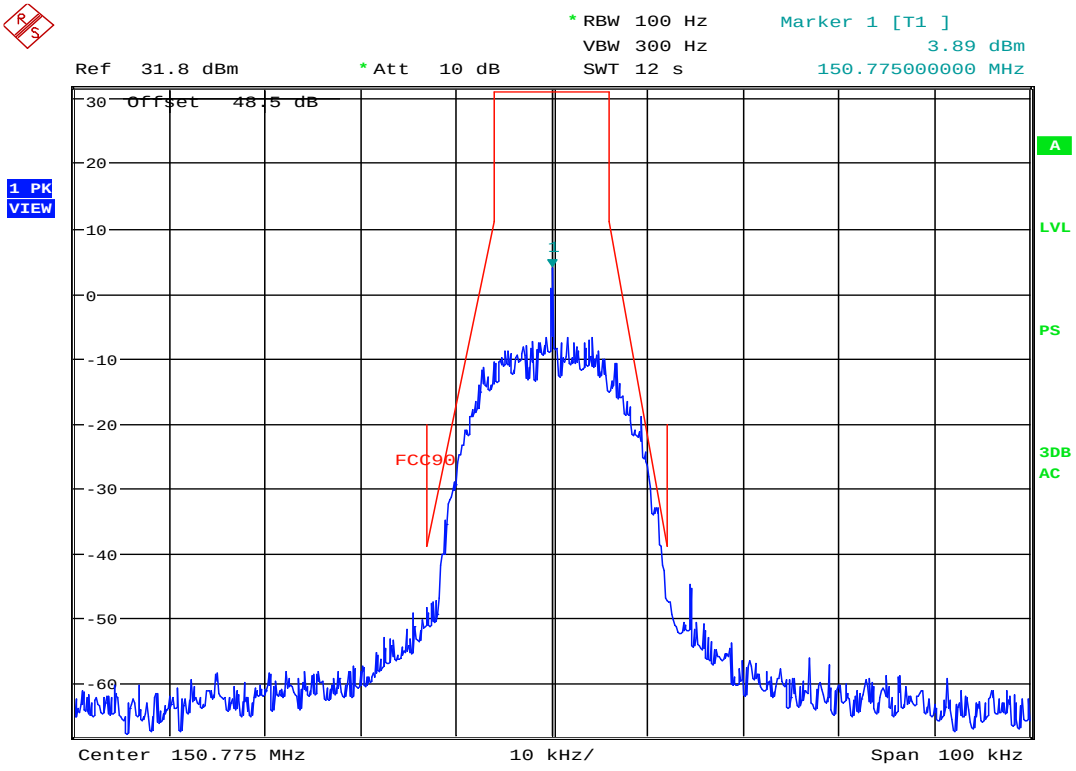
FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 150.775MHz (BPSK Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES



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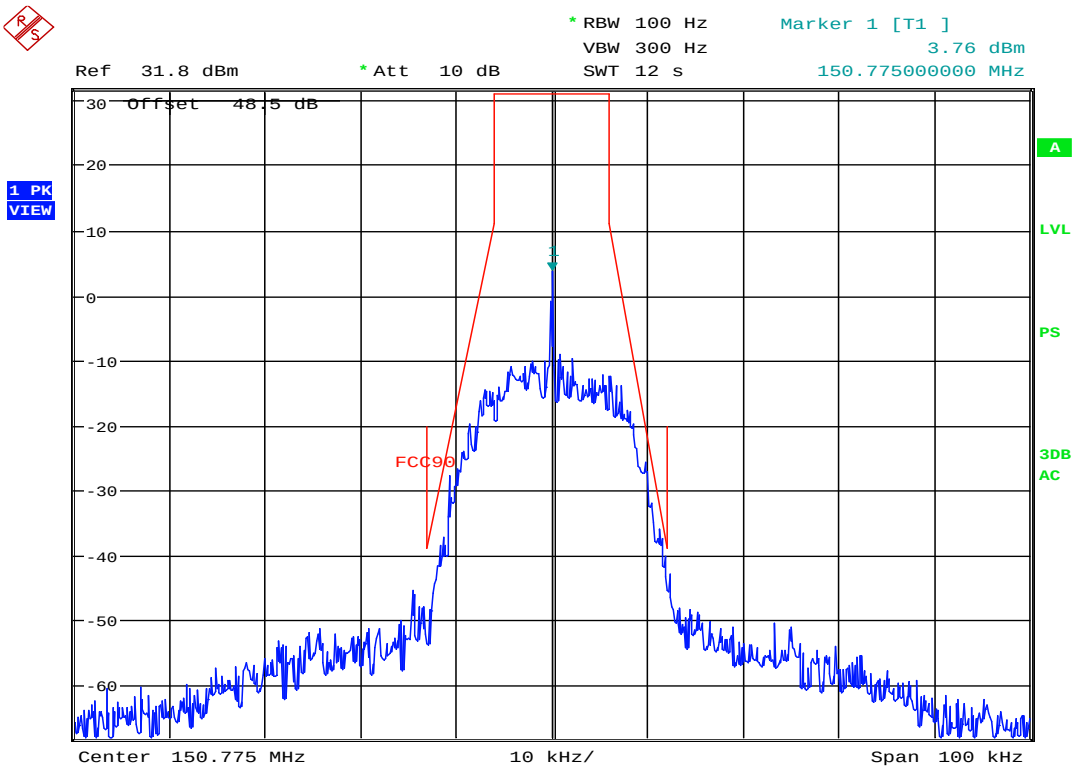
FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 150.775MHz (QPSK Modulation)
TEST PARAMETERS : 1.5W
EQUIPMENT USED : RBE0

NOTES



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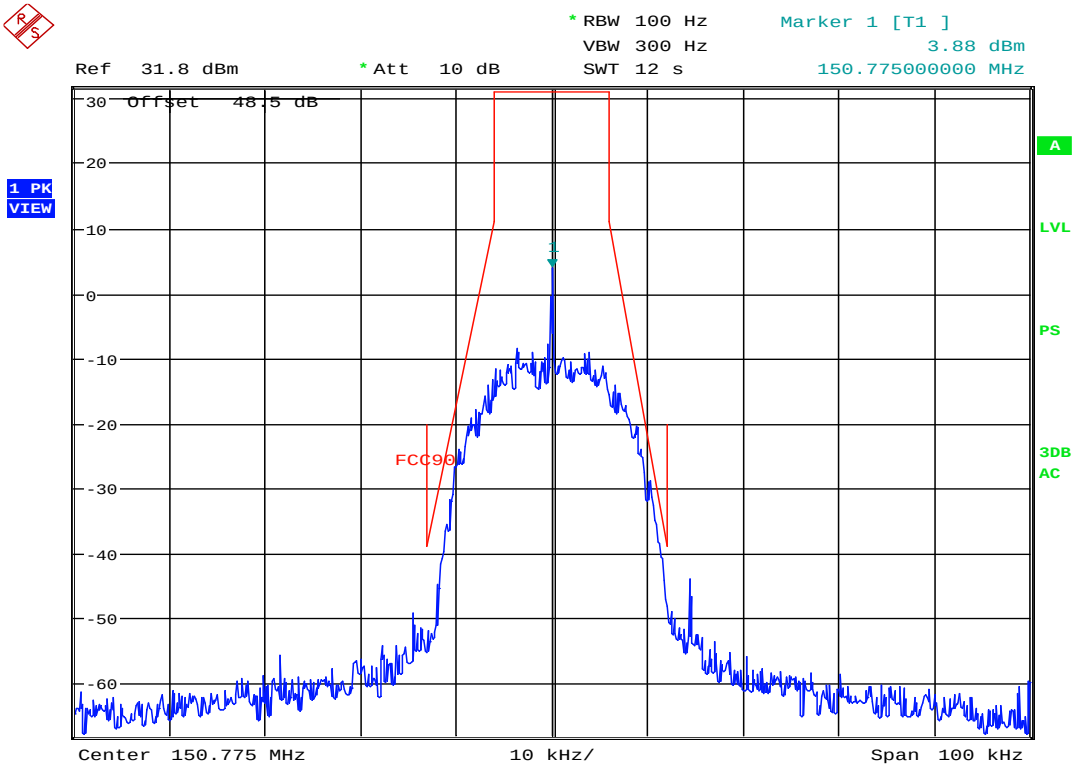
FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 150.775MHz (8PSK Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

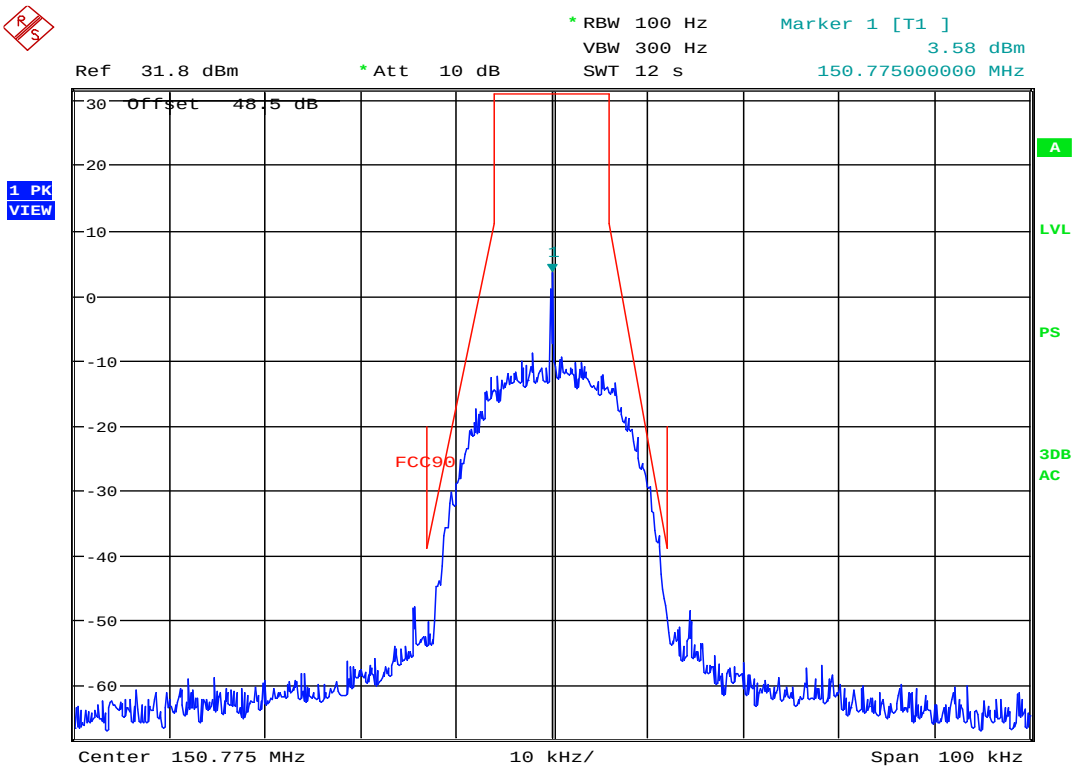


Date: 21.MAY.2013 16:44:11

FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 150.775MHz (16QAM Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

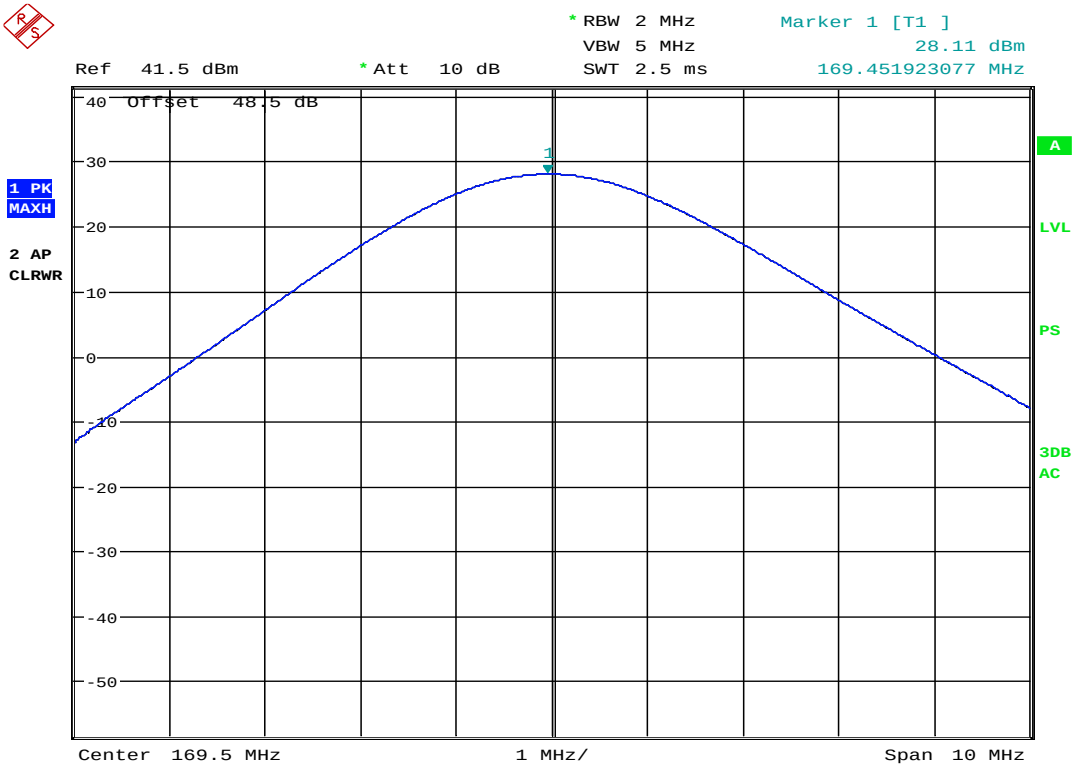


Date: 21.MAY.2013 16:46:24

FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 150.775MHz (32QAM Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

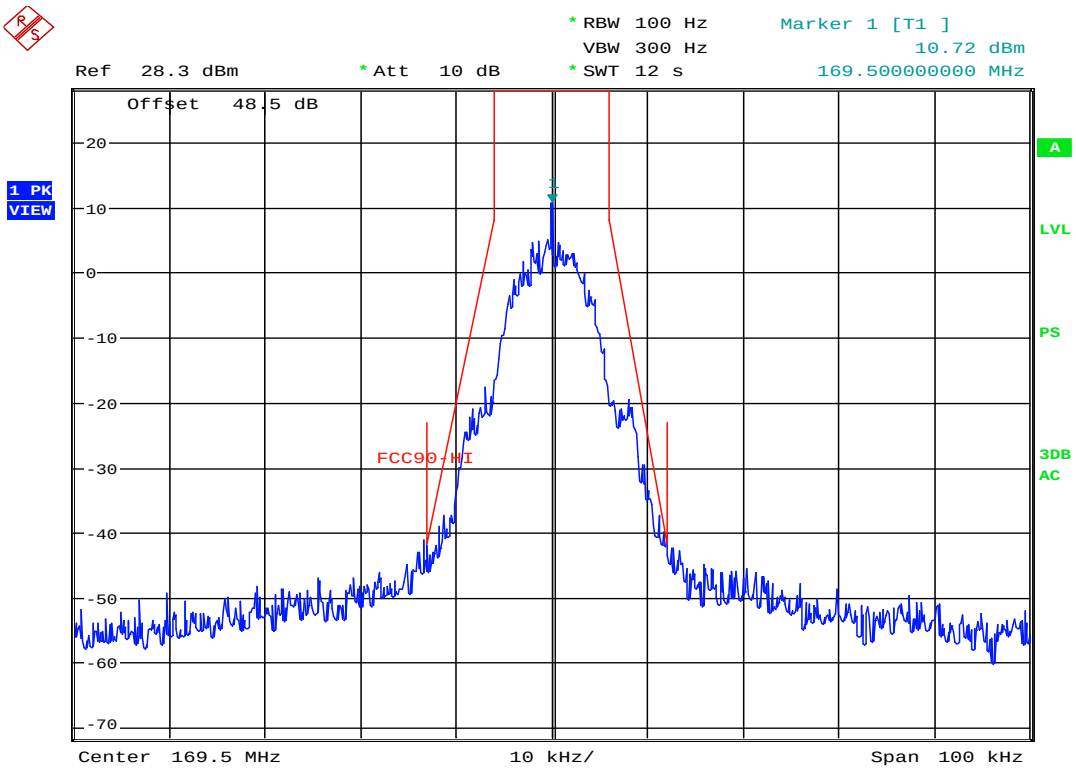


Date: 21.MAY.2013 15:15:05

FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 169. 5MHz (Unmodulated)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

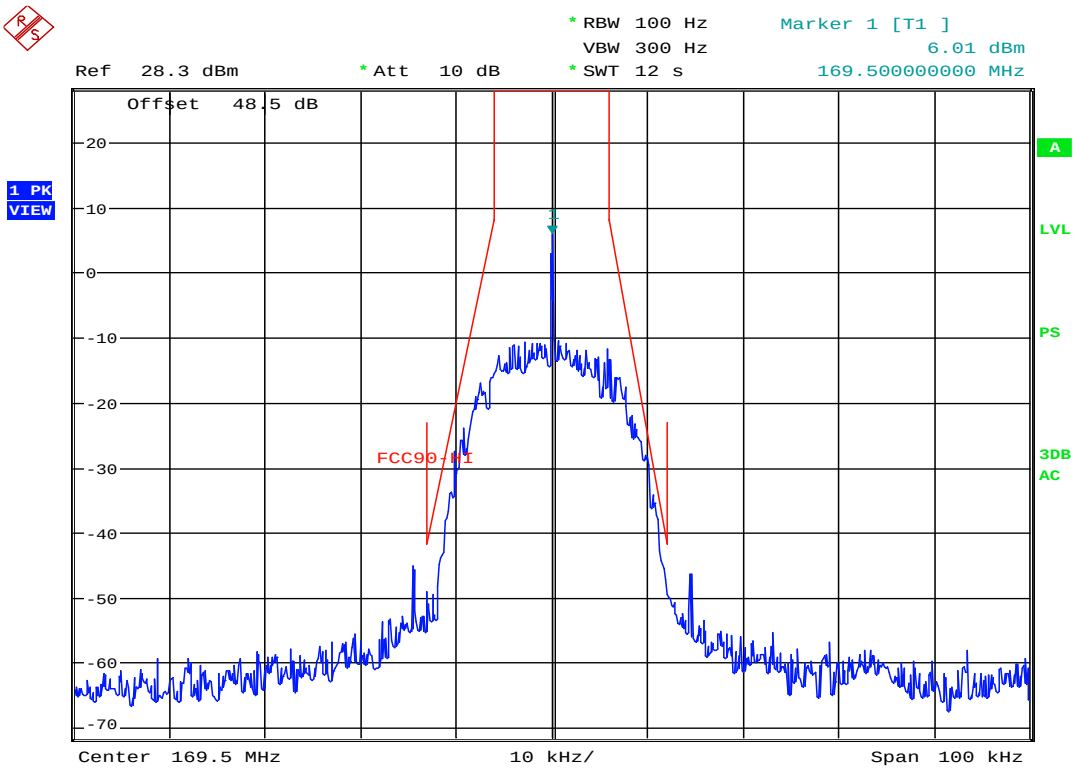


Date: 22.MAY.2013 09:59:28

FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 169.5MHz (2FSK Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

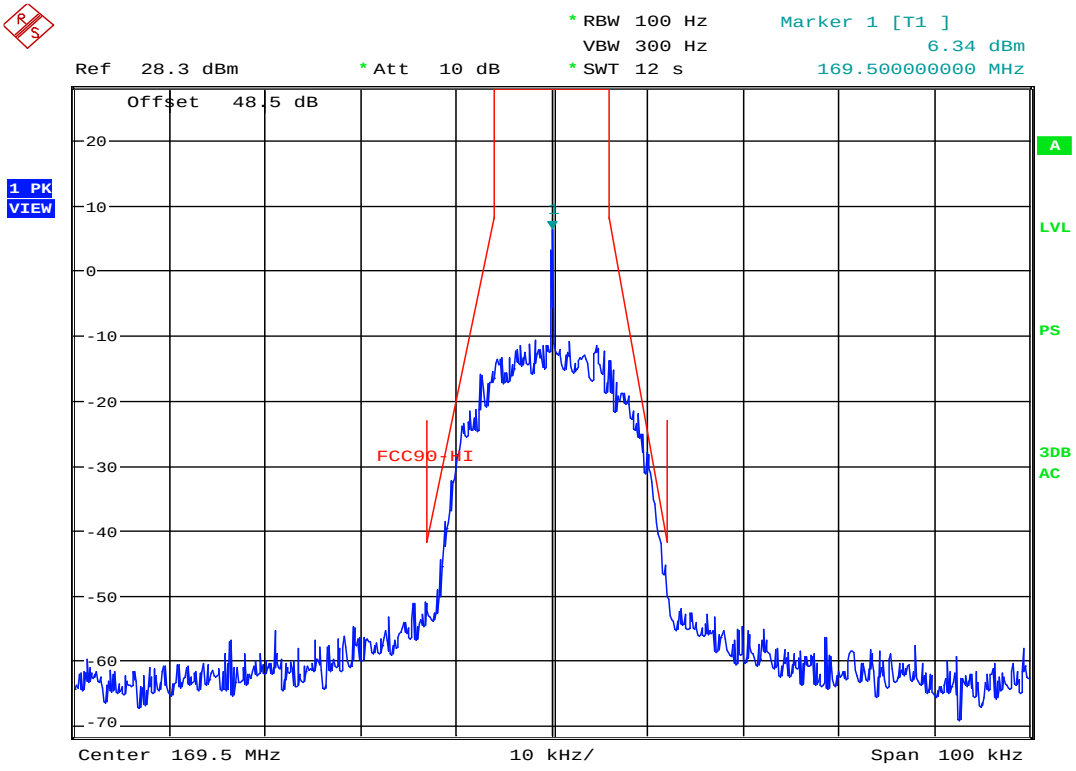


Date: 22.MAY.2013 10:02:10

FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 169.5MHz (BPSK Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

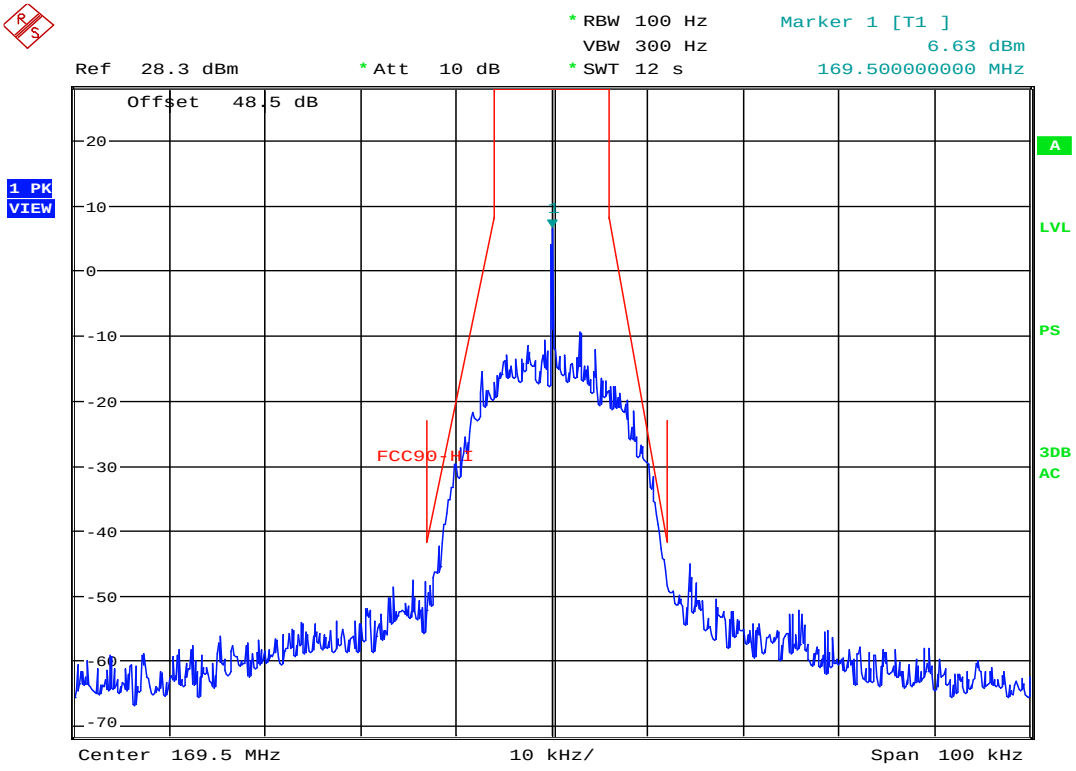


Date: 22.MAY.2013 10:03:42

FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 169.5MHz (QPSK Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

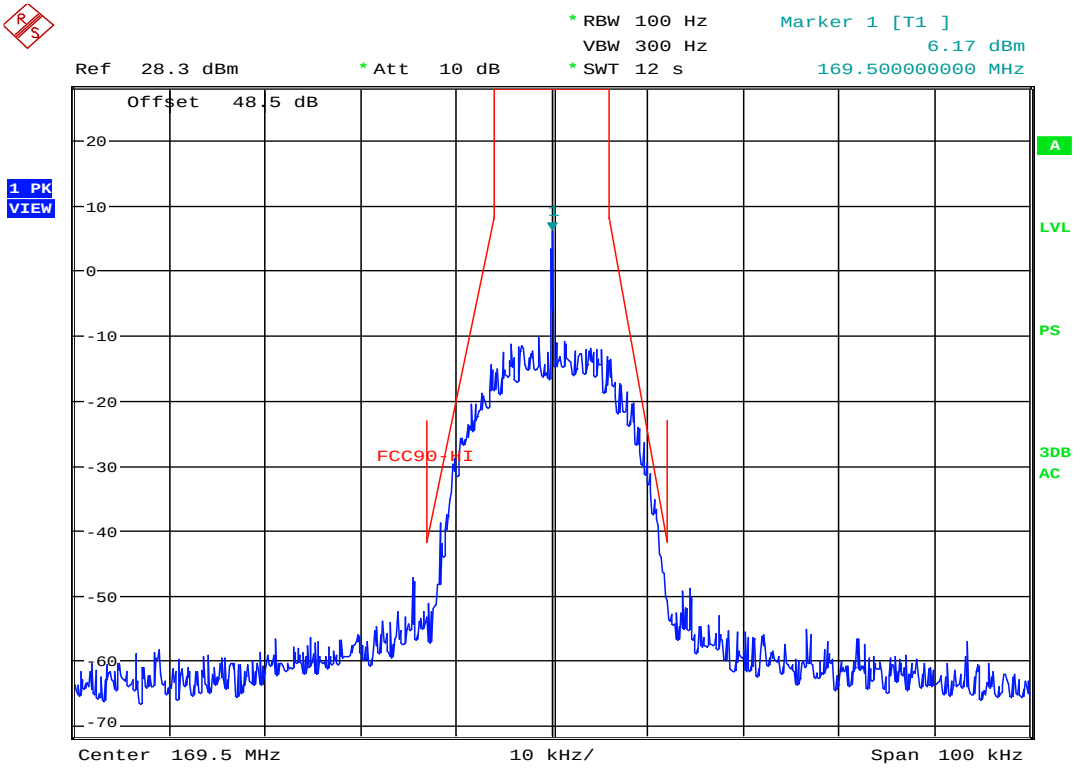


Date: 22.MAY.2013 10:07:16

FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 169.5MHz (8PSK Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

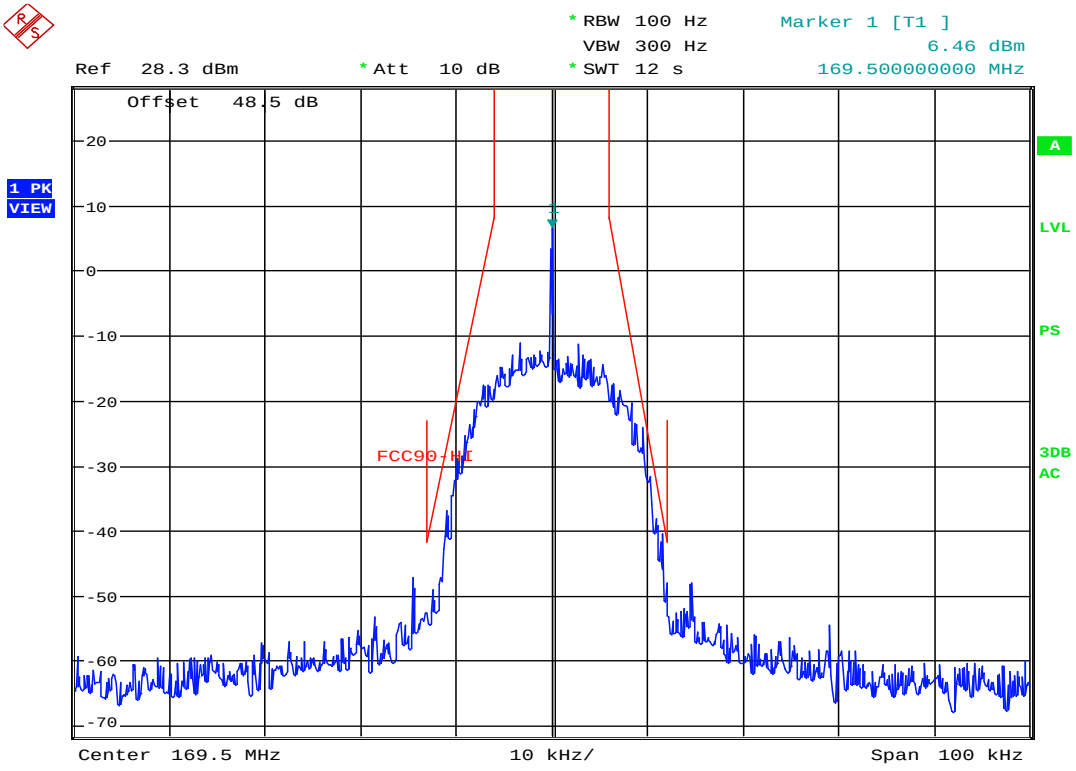


Date: 22.MAY.2013 10:09:34

FCC 90: Occupied Bandwidth

MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 169.5MHz (16QAM Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

NOTES

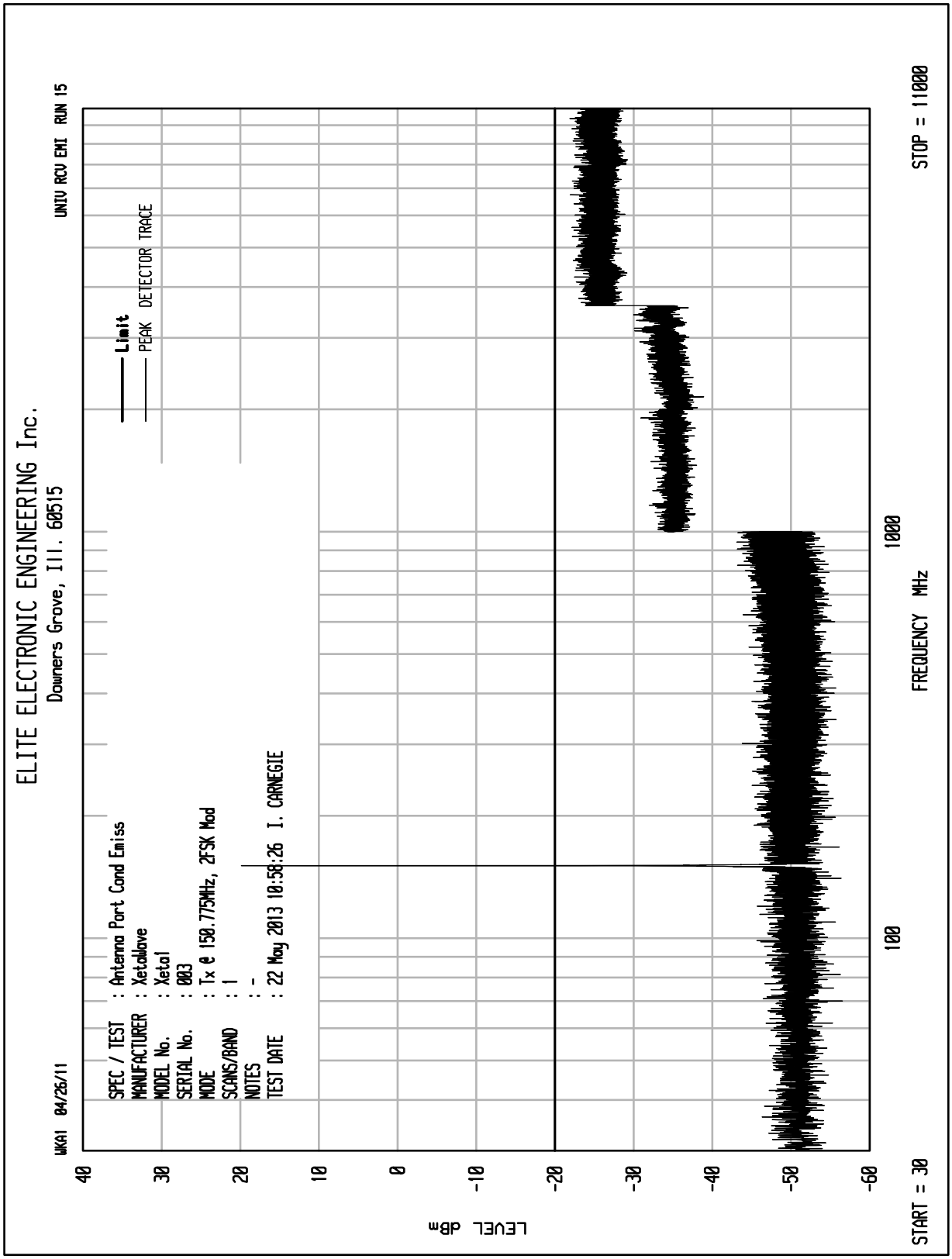


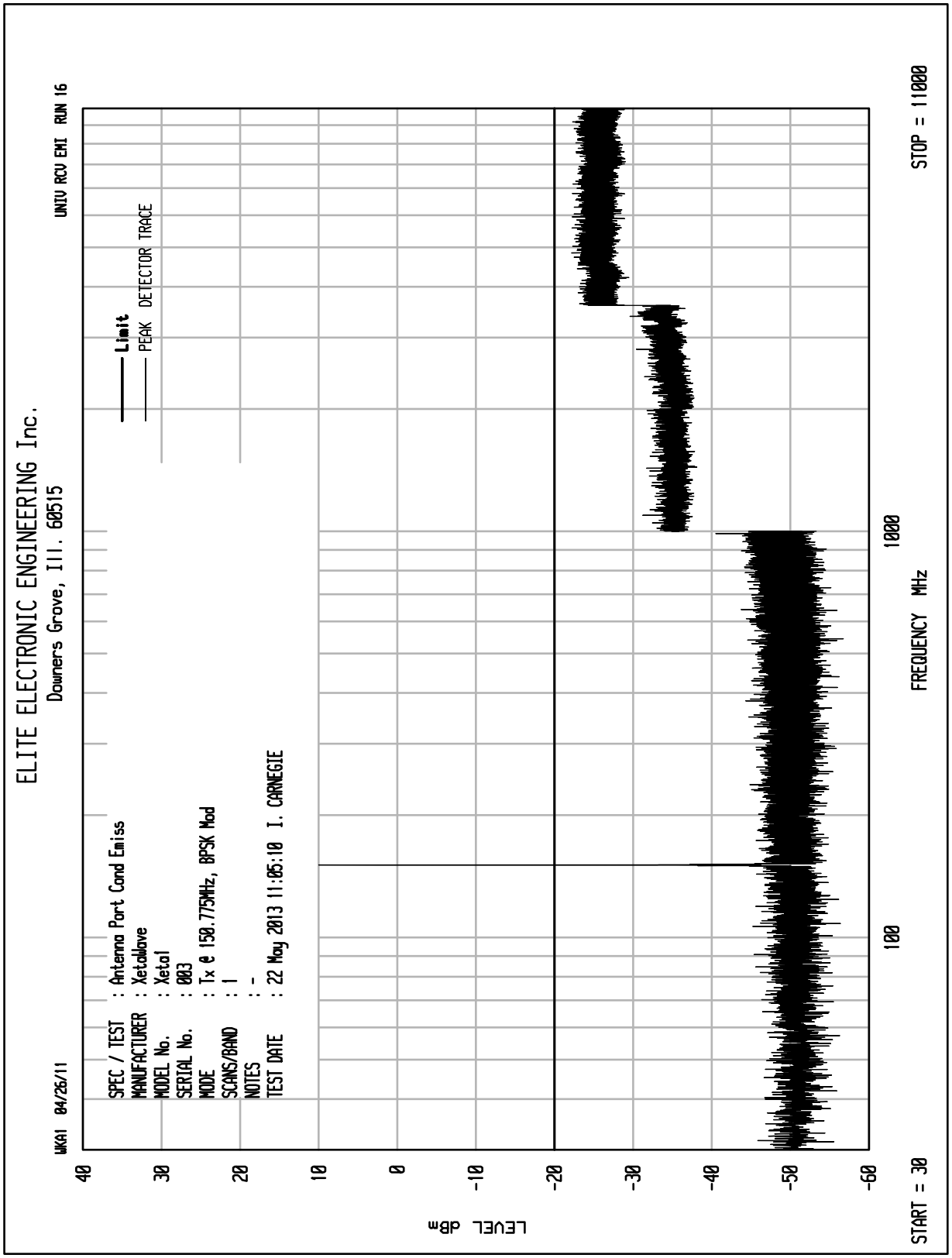
Date: 22.MAY.2013 10:10:36

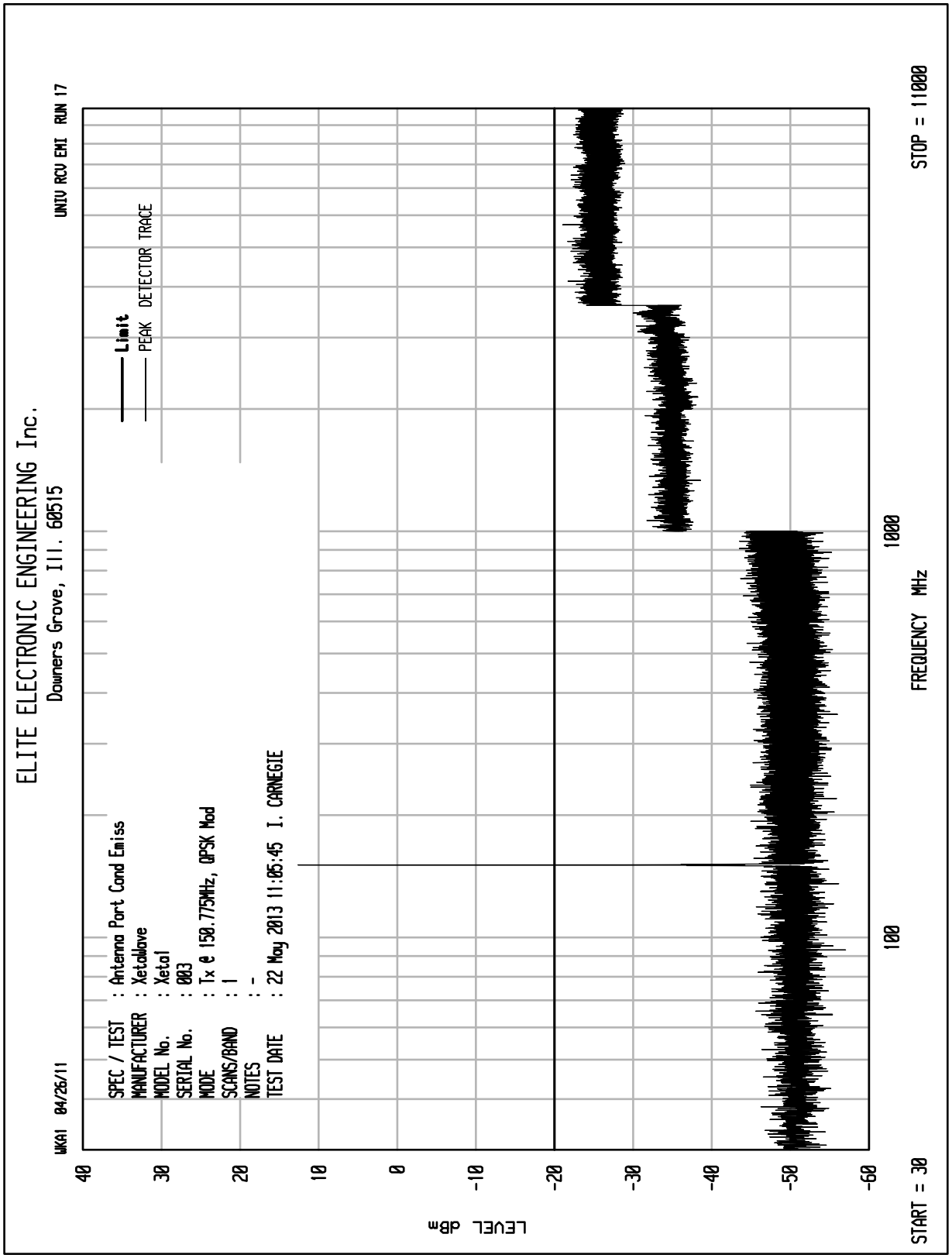
FCC 90: Occupied Bandwidth

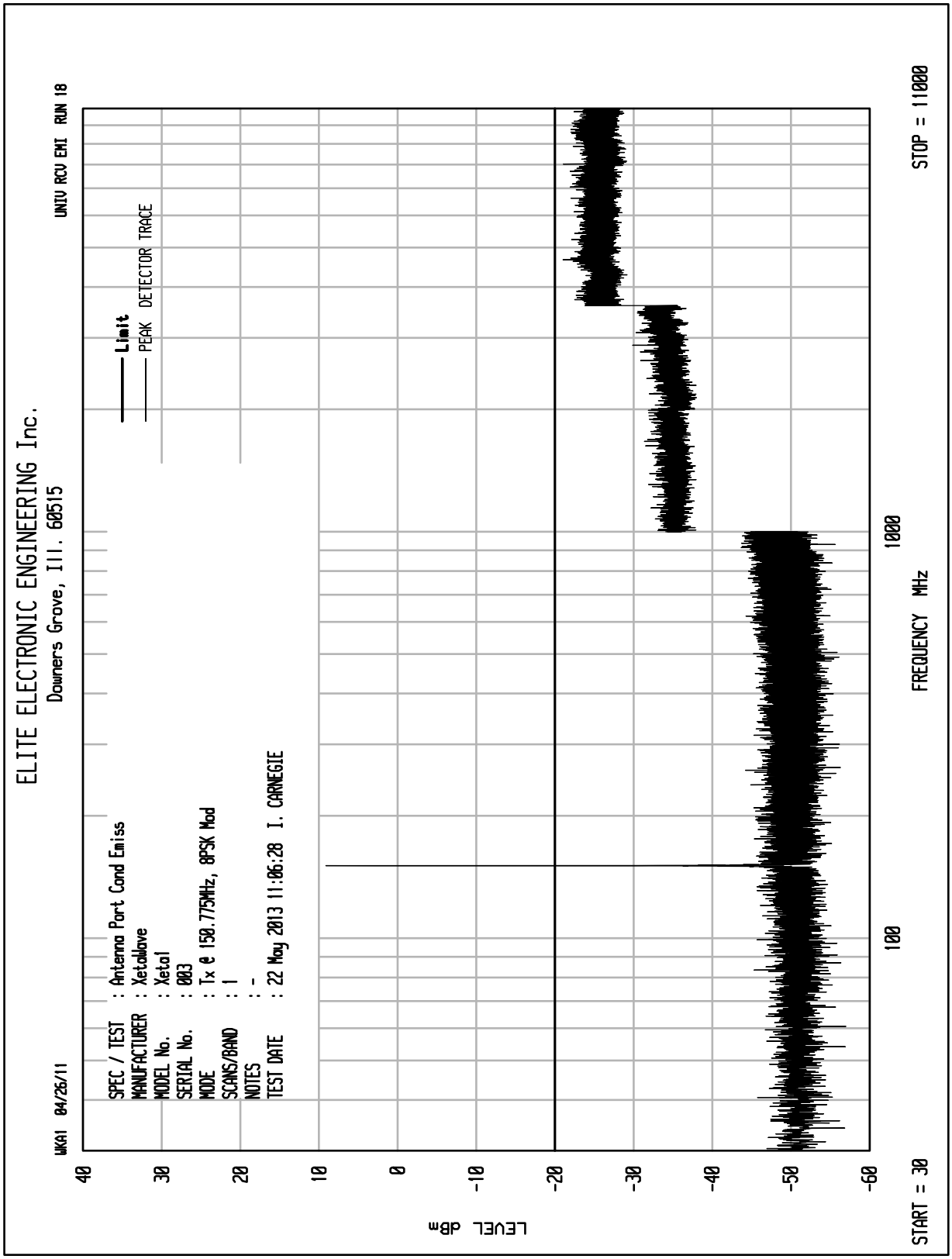
MANUFACTURER : XetaWave
MODEL NUMBER : Xeta1
SERIAL NUMBER : 003
TEST MODE : Tx @ 169.5MHz (32QAM Modulation)
TEST PARAMETERS : 1.5W (31.8dBm)
EQUIPMENT USED : RBE0

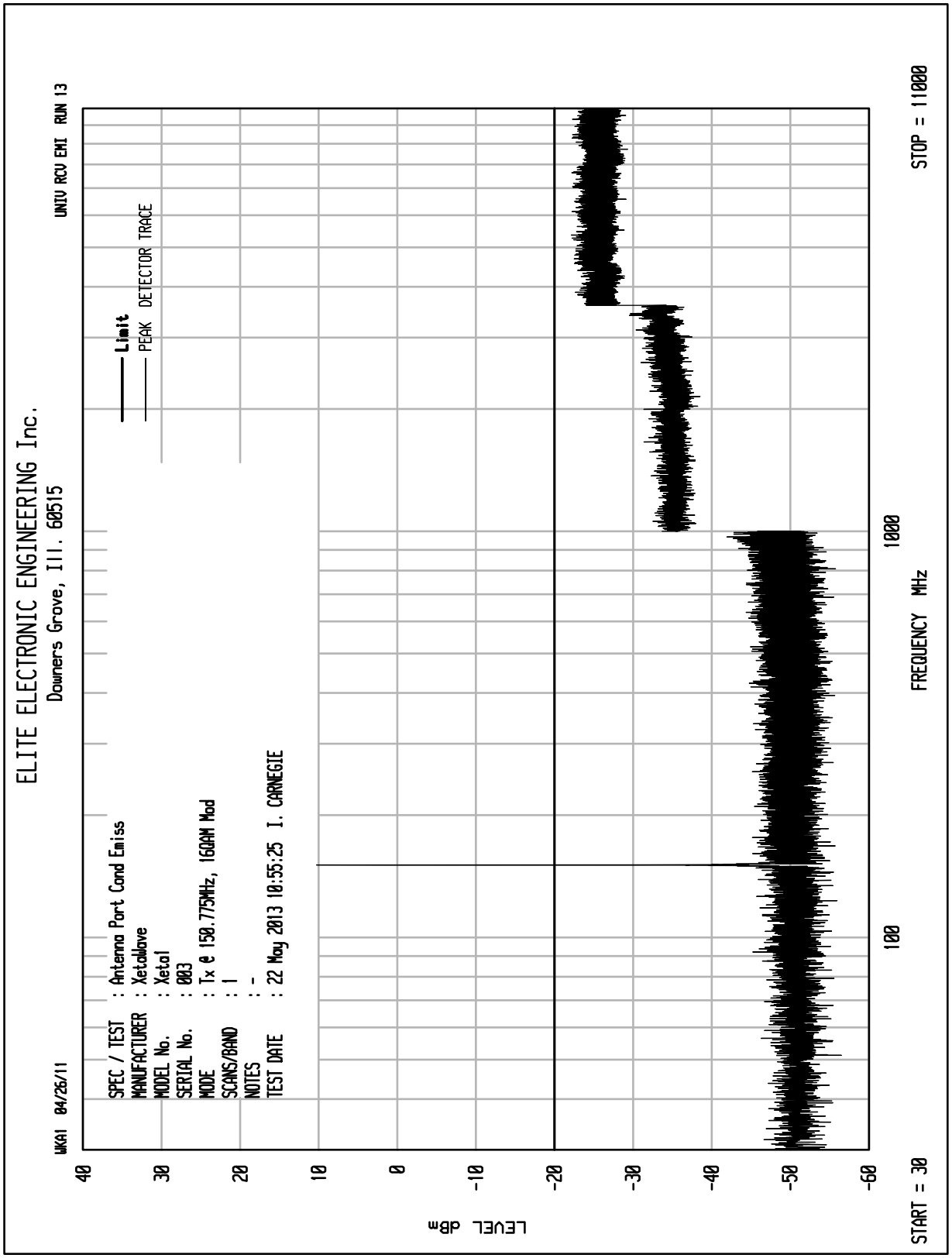
NOTES

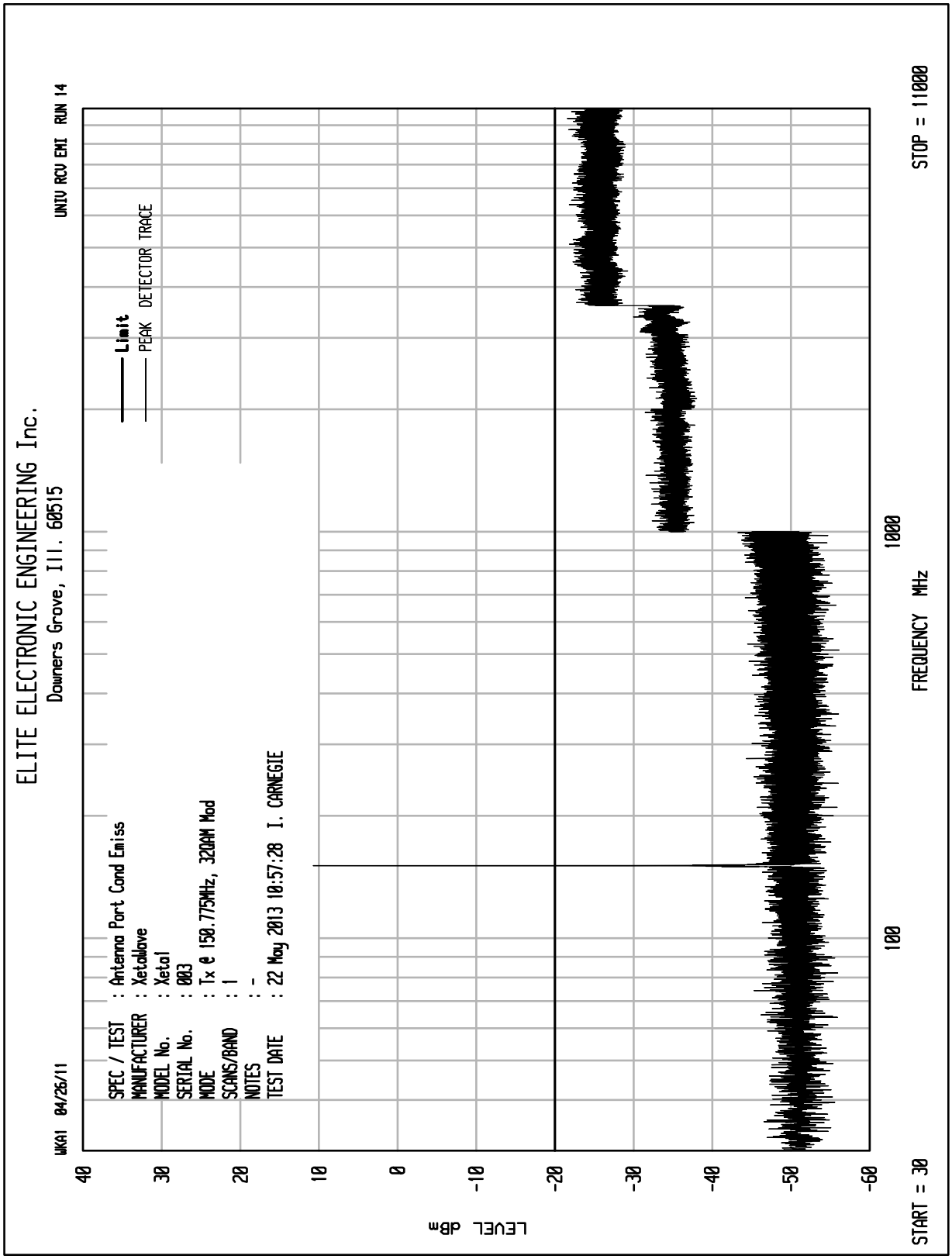

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 15
UKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz, 2FSK Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 10:58:26 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
FREQUENCY MHz
STOP = 11000

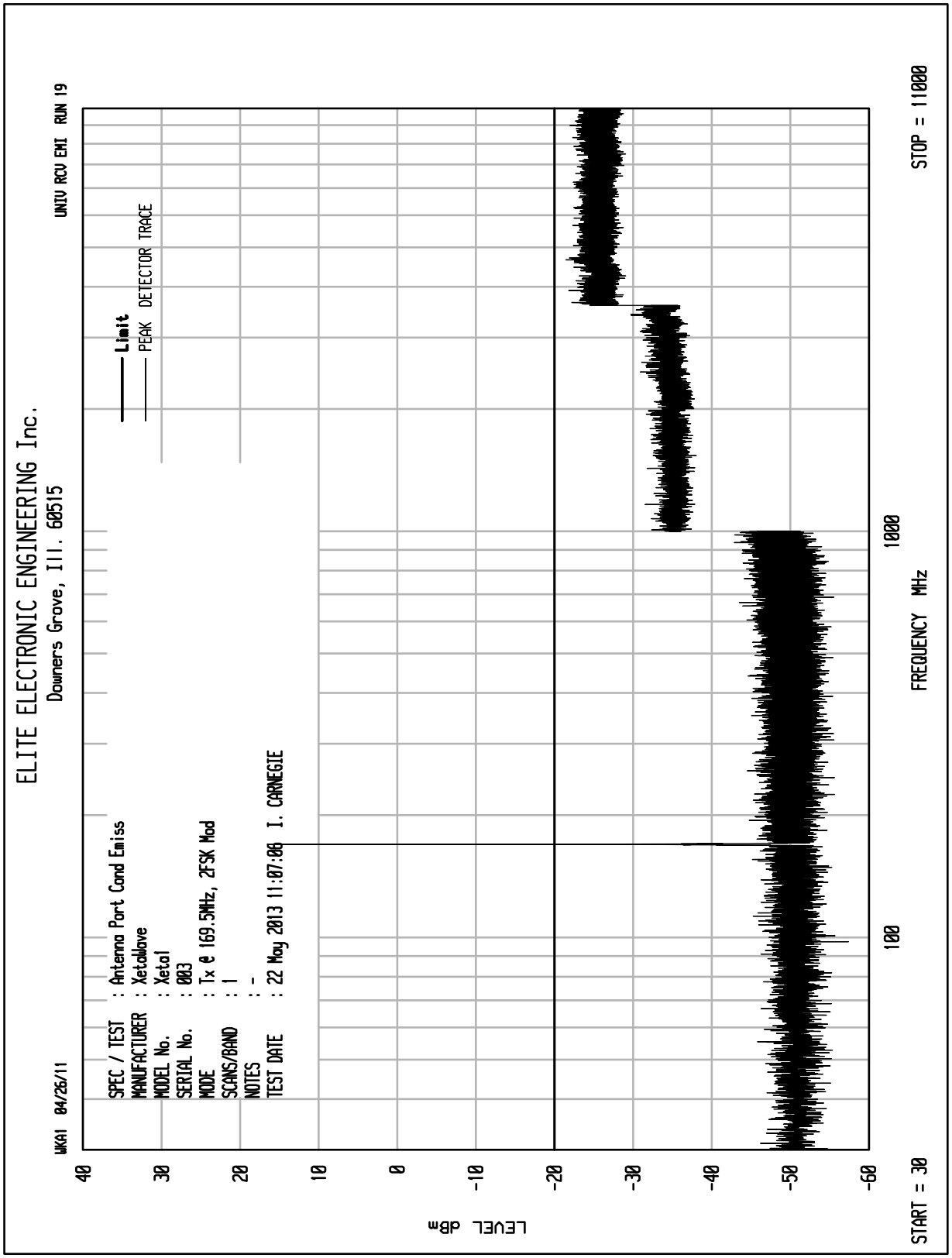

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 16
WKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz, BPSK Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:05:10 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
FREQUENCY MHz
STOP = 11000

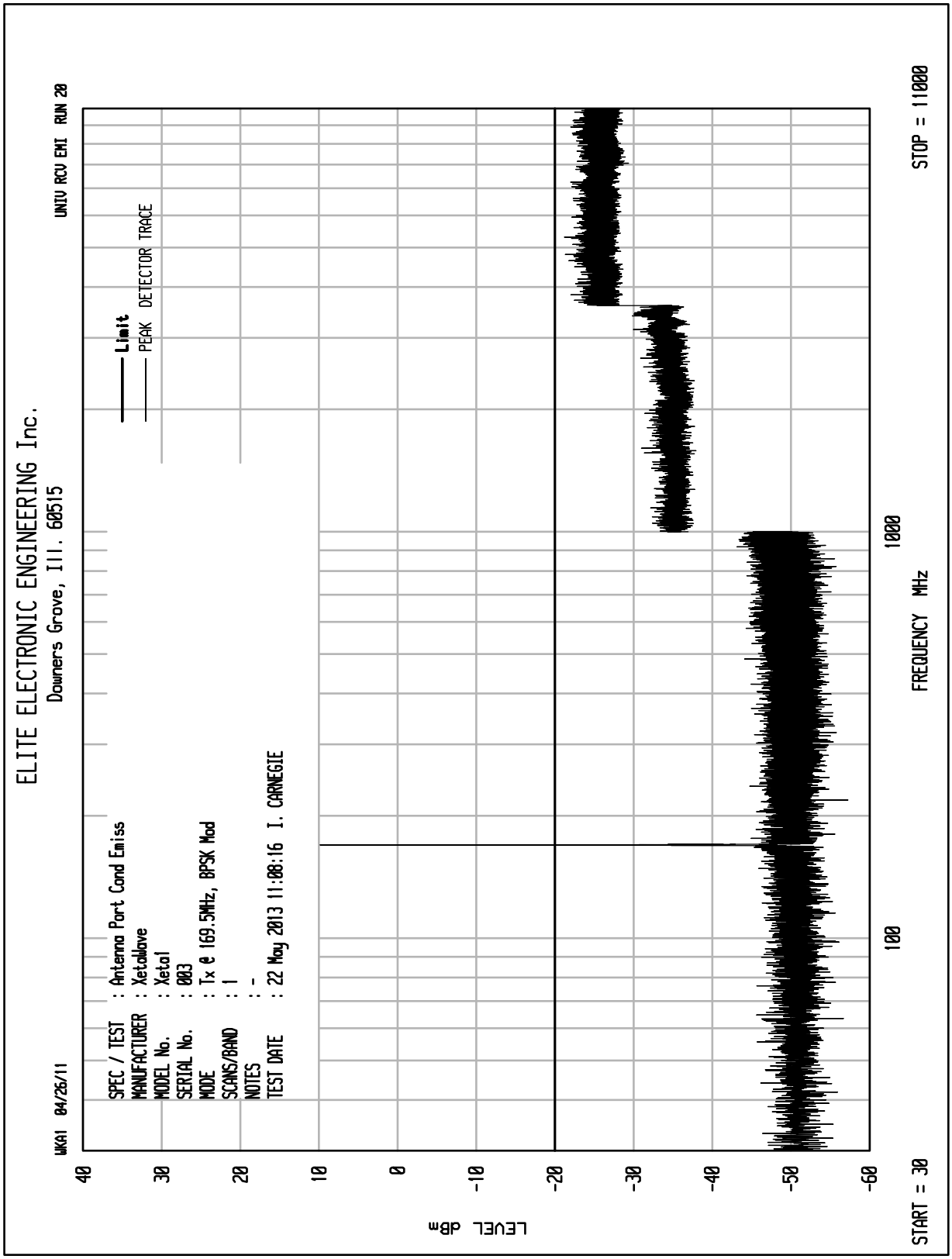

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 17
WKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz, QPSK Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:05:45 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
STOP = 11000
FREQUENCY MHz

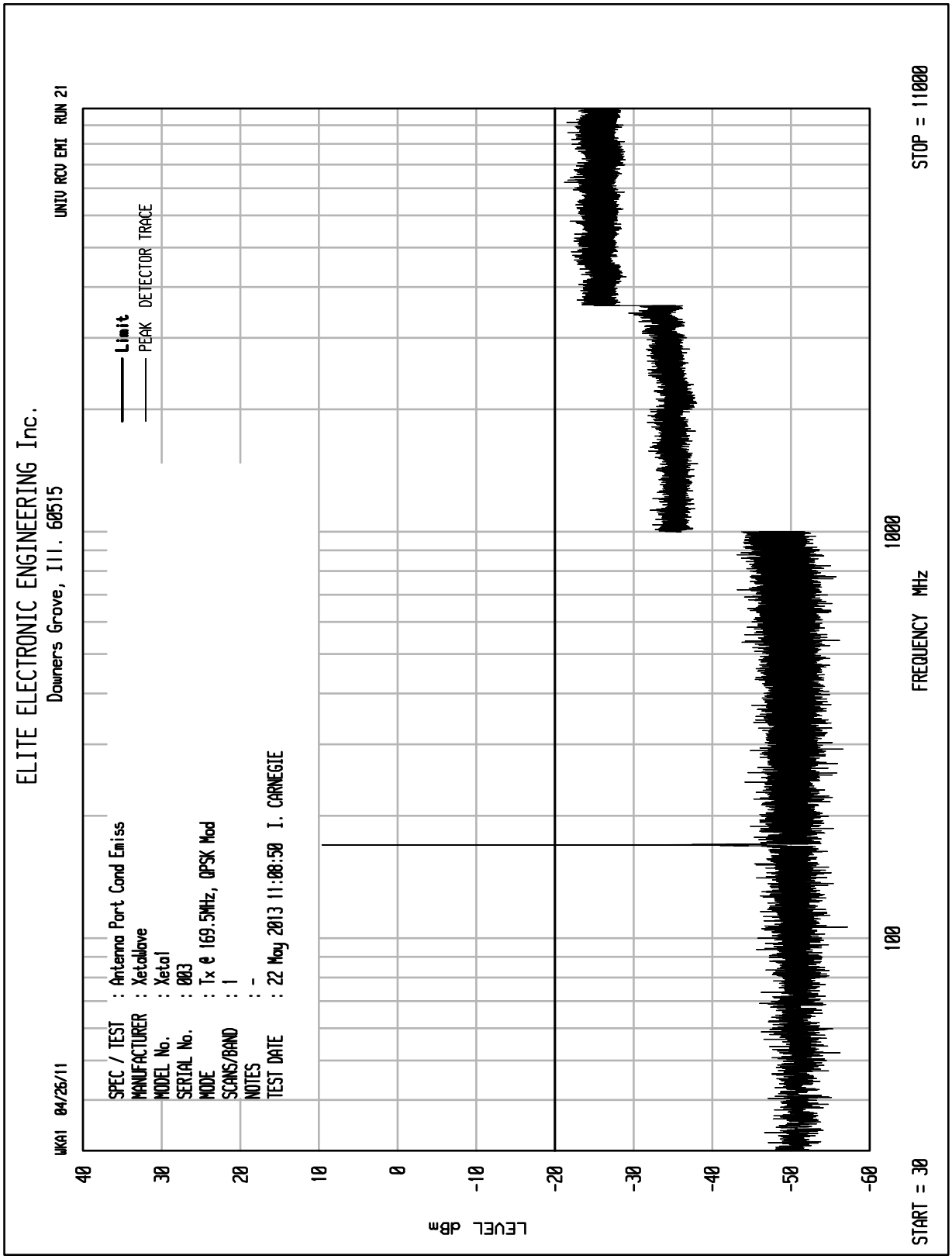

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 18
UKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz, 8PSK Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:06:28 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
FREQUENCY MHz
STOP = 11000

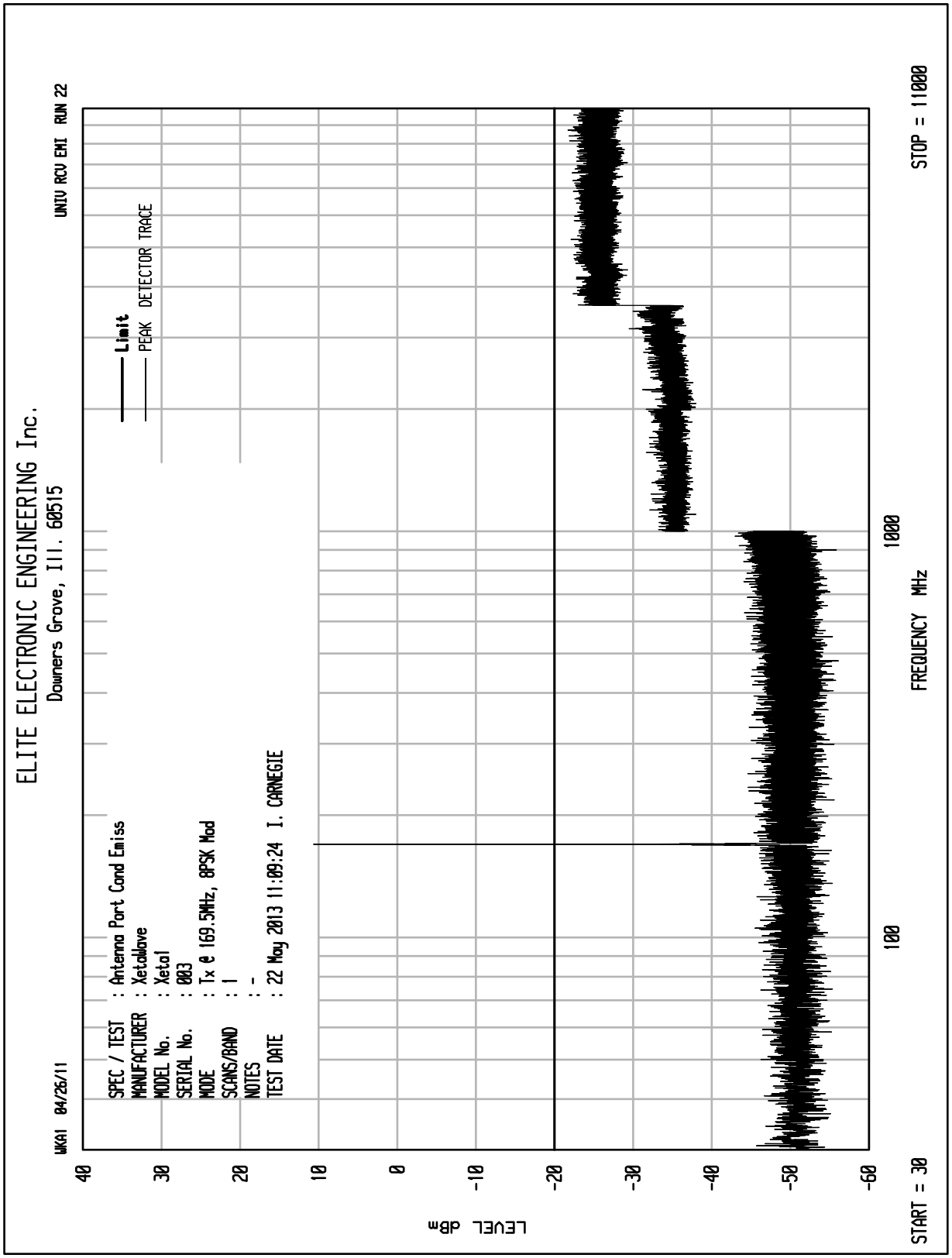

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 13
WKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz, 16QAM Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 10:55:25 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
STOP = 11000
FREQUENCY MHz

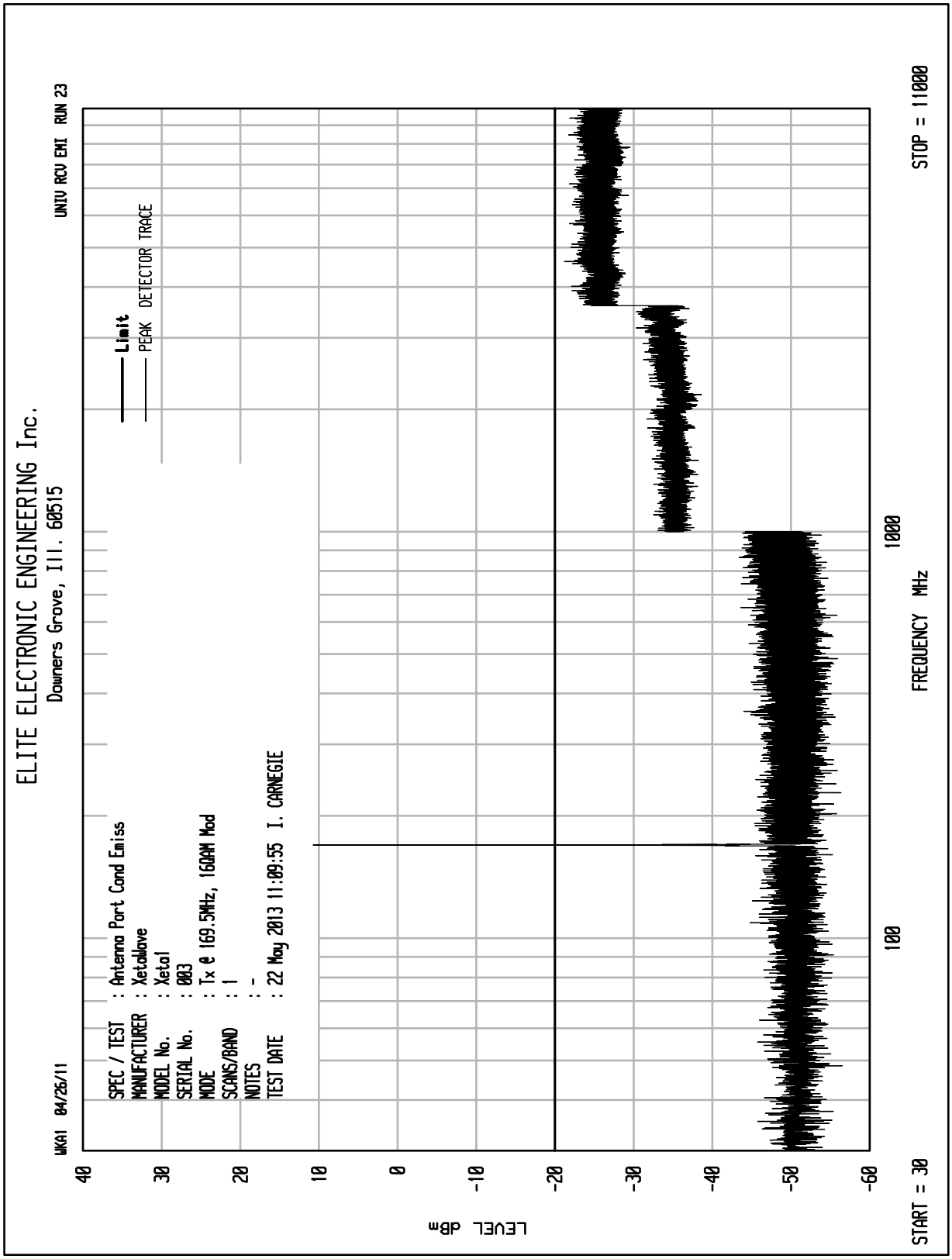

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 14
WKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz, 32DAM Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 10:57:28 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
STOP = 11000
FREQUENCY MHz

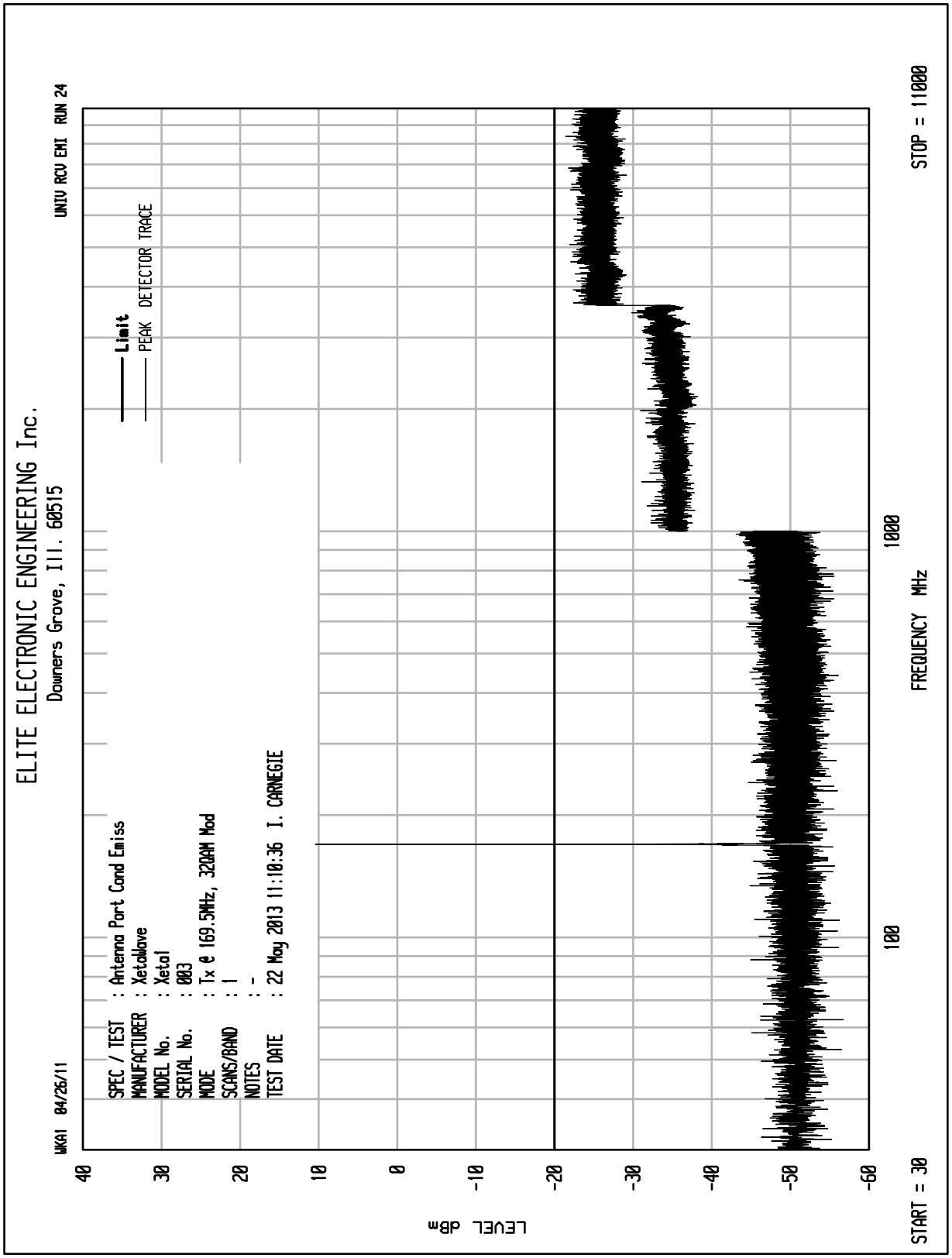

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 19
WKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz, 2FSK Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:07:08 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
FREQUENCY MHz
STOP = 11000

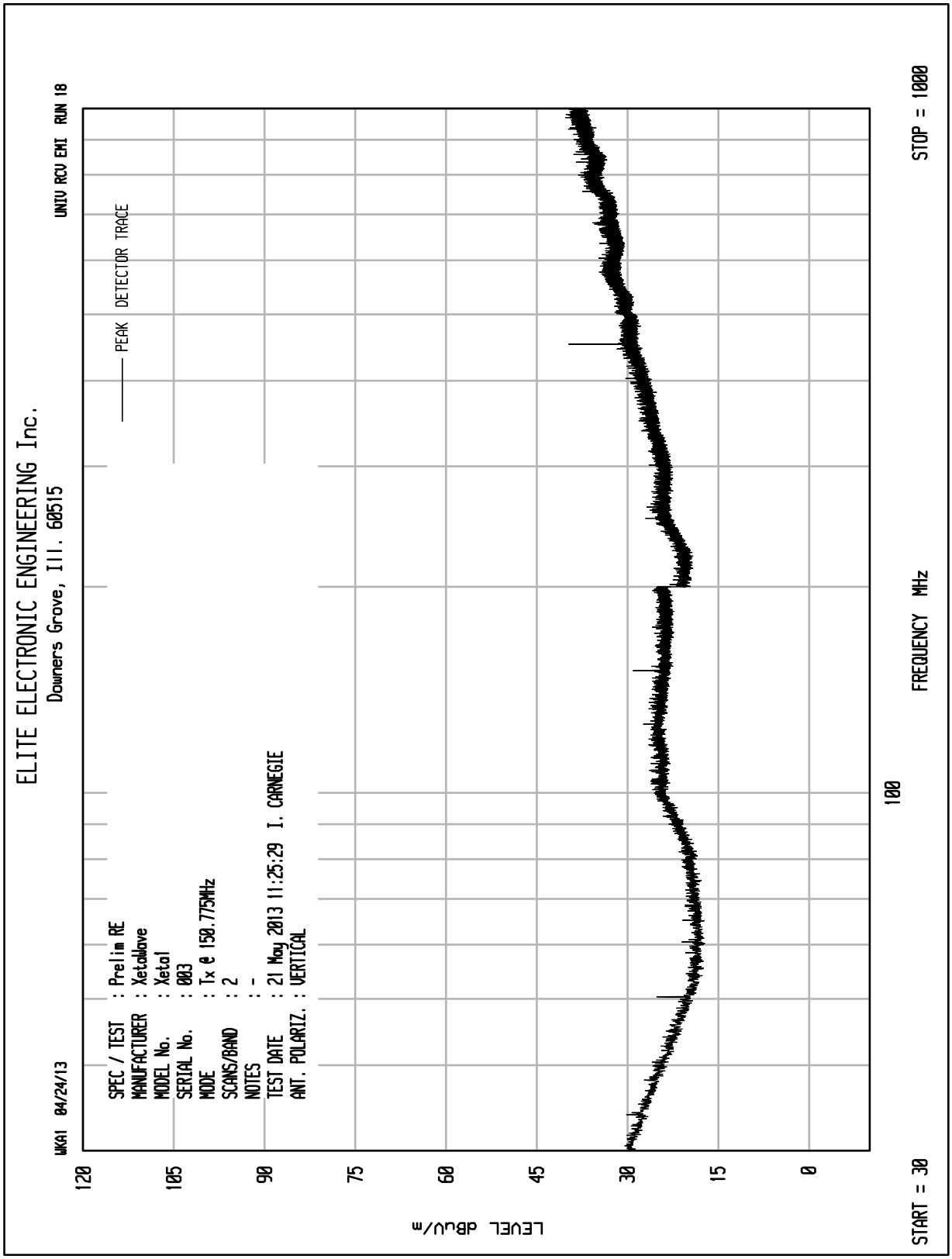

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 20
WKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz, BPSK Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:08:16 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
FREQUENCY MHz
STOP = 11000

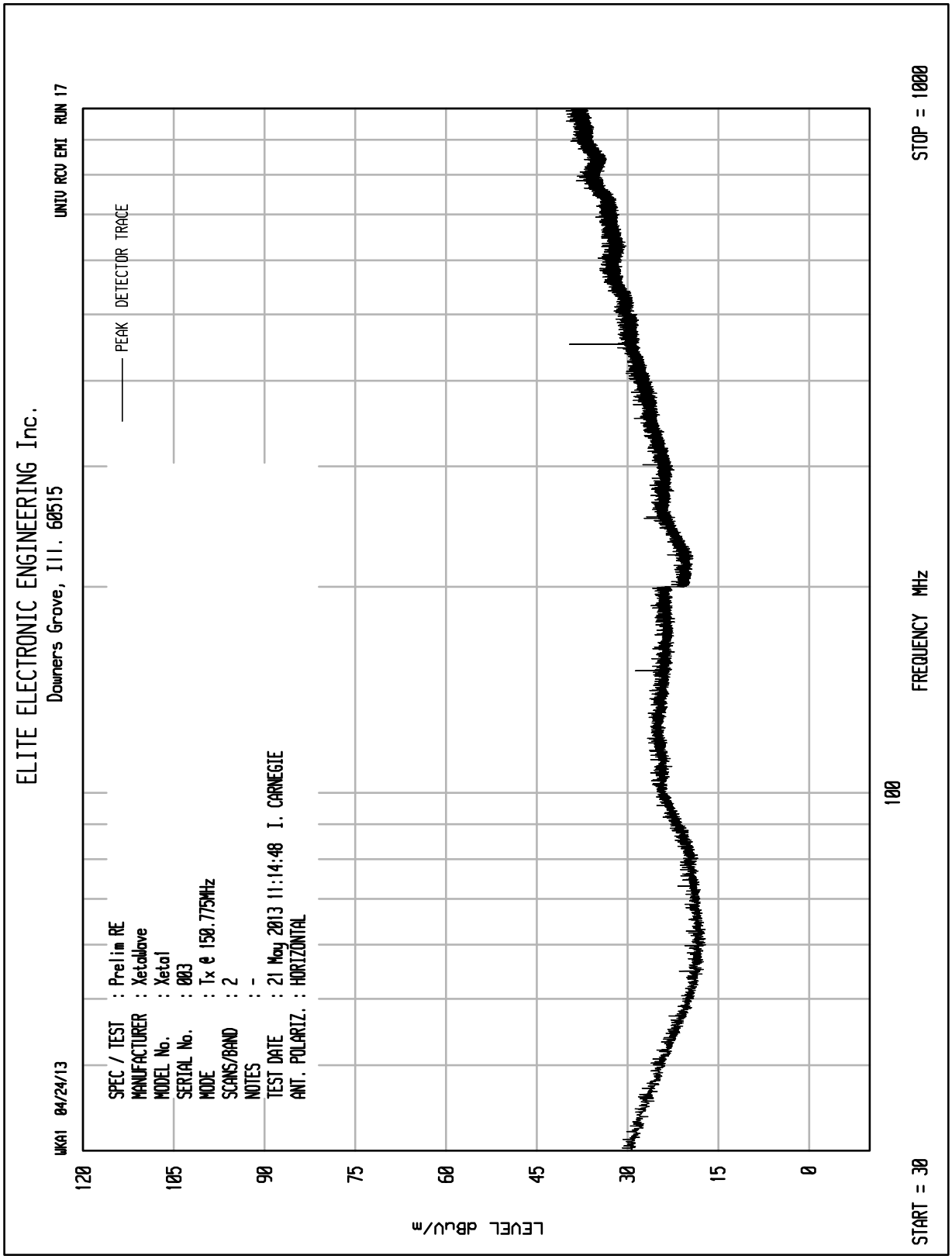

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 21
WKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz, QPSK Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:00:50 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
FREQUENCY MHz
STOP = 11000

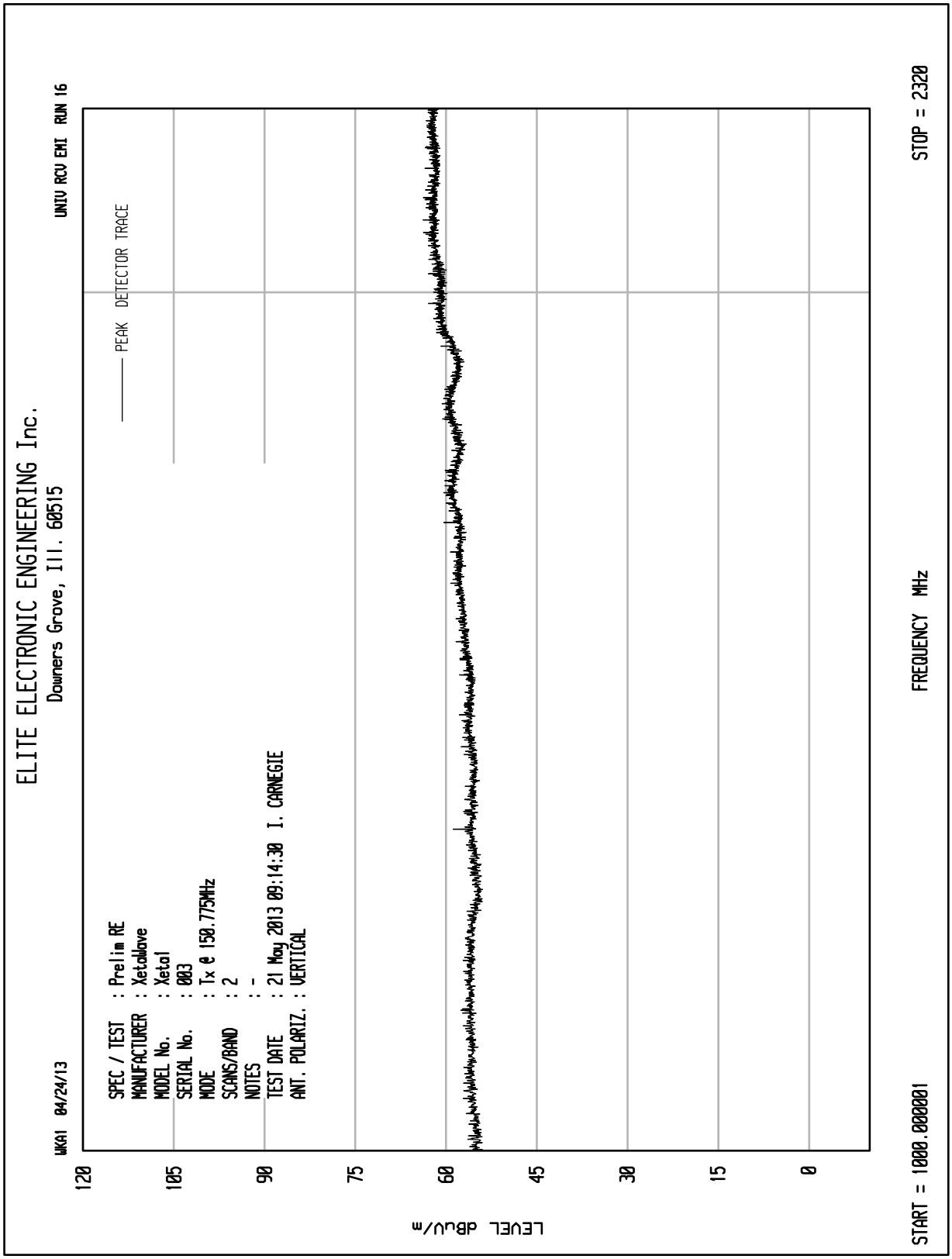

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 22
WKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz, 8PSK Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:09:24 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
STOP = 11000
FREQUENCY MHz

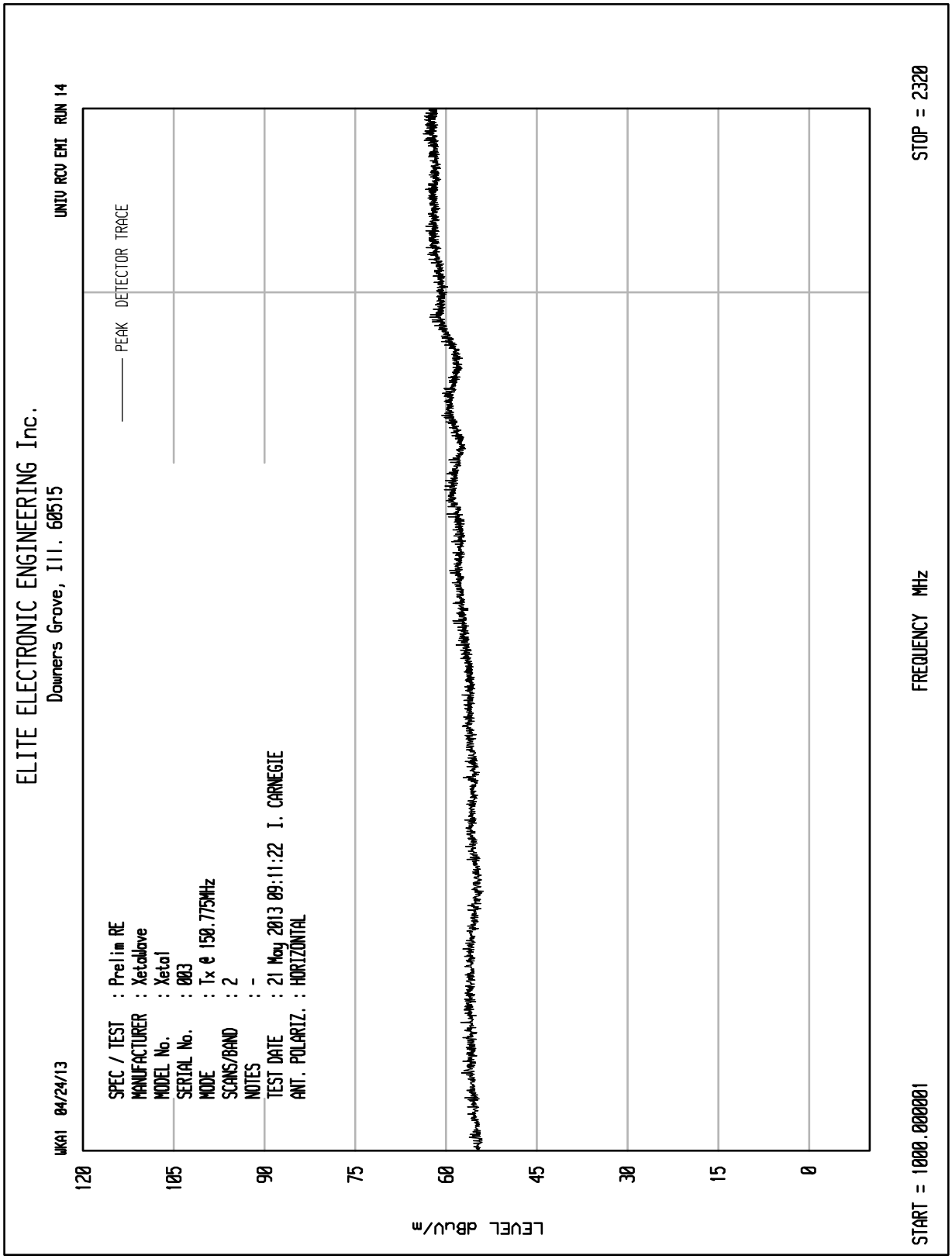

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 23
UKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz, 16QAM Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:09:55 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
FREQUENCY MHz
STOP = 11000

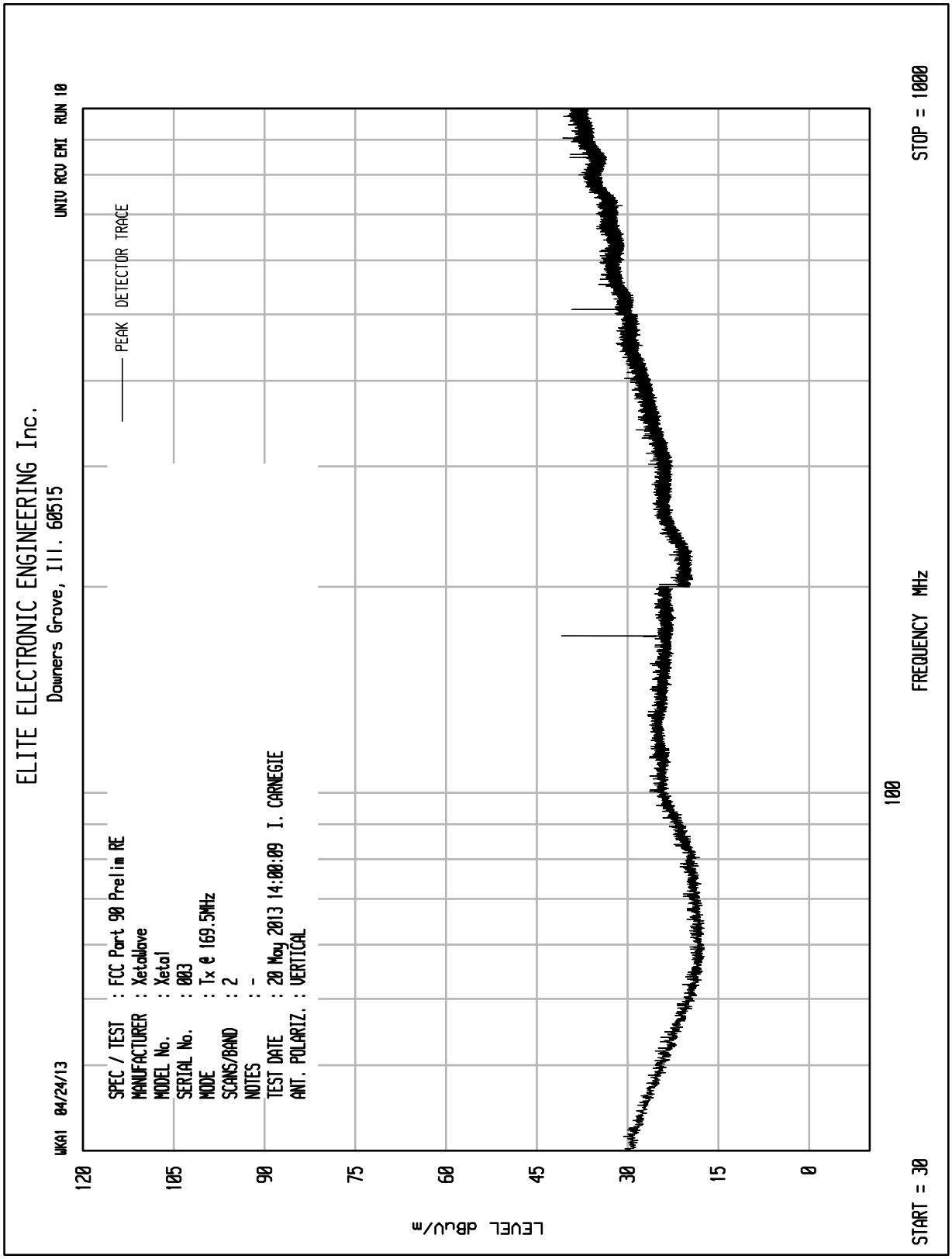

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 24
UKA1 04/26/11
SPEC / TEST : Antenna Port Cond Emiss
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz, 32QAM Mod
SCANS/BAND : 1
NOTES : -
TEST DATE : 22 May 2013 11:10:36 I. CARNEGIE
Limit
PEAK DETECTOR TRACE
LEVEL dBm
40
30
20
10
0
-10
-20
-30
-40
-50
-60
START = 30
100
1000
FREQUENCY MHz
STOP = 11000

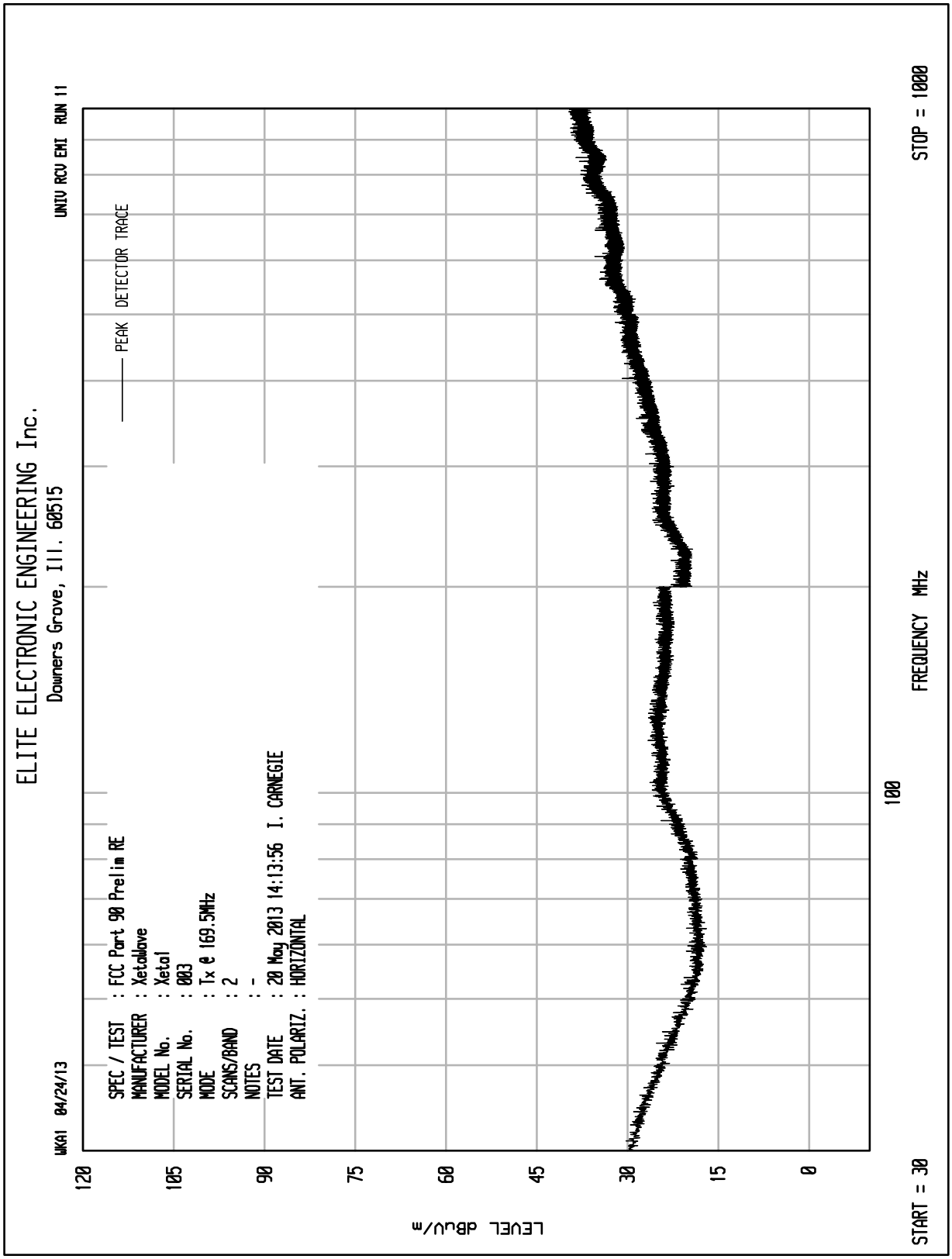

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 18
UKA1 04/24/13
SPEC / TEST : Prelim RE
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz
SCANS/BAND : 2
NOTES : -
TEST DATE : 21 May 2013 11:25:29 I. CARNEGIE
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

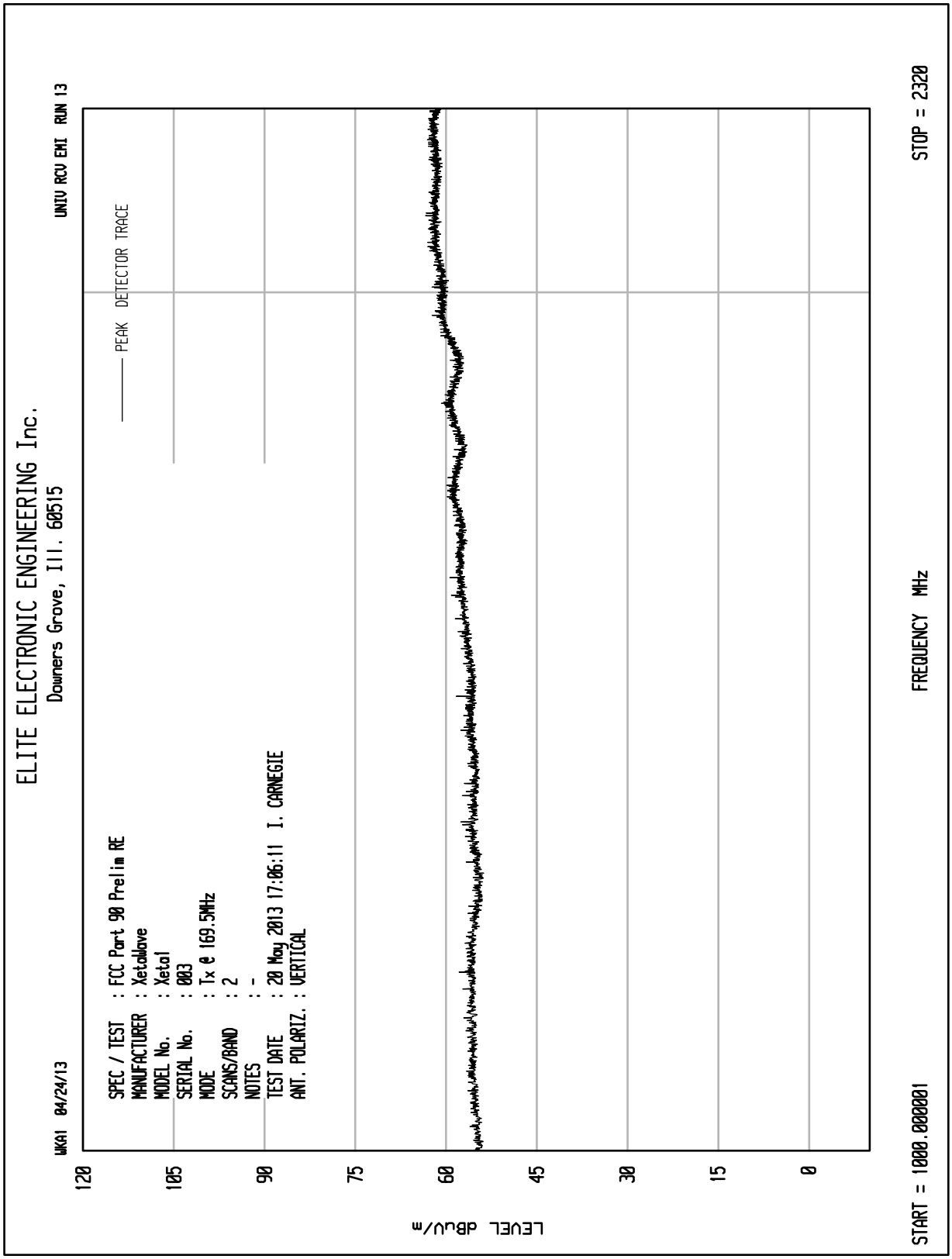

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 17
UKA1 04/24/13
SPEC / TEST : Prelim RE
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz
SCANS/BAND : 2
NOTES : -
TEST DATE : 21 May 2013 11:14:48 I. CARNEGIE
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

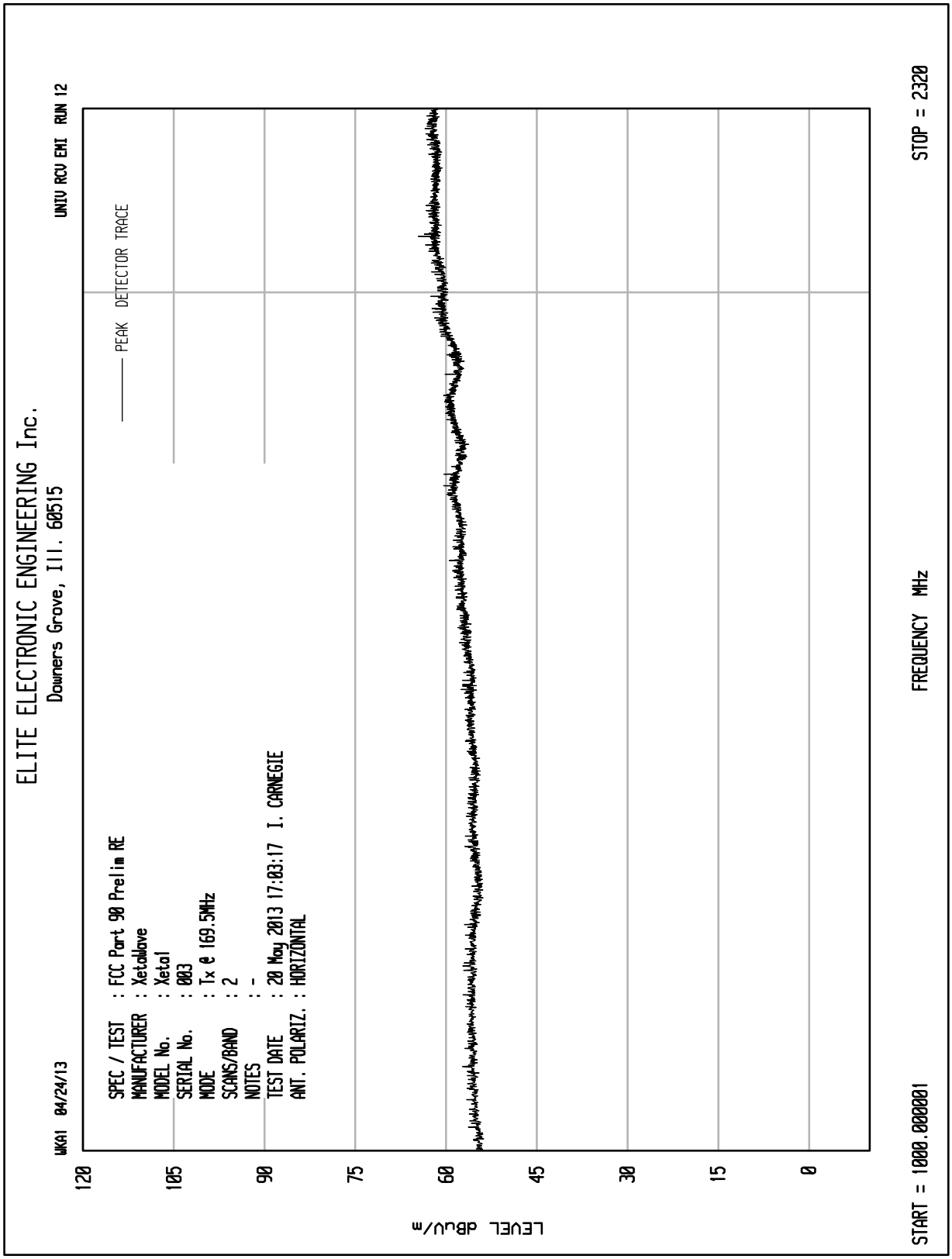

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 16
WKA1 04/24/13
SPEC / TEST : Prelim RE
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz
SCANS/BAND : 2
NOTES : -
TEST DATE : 21 May 2013 09:14:30 I. CARNEGIE
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000.000001
FREQUENCY MHz
STOP = 2320


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 14
UKA1 04/24/13
SPEC / TEST : Prelim RE
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 150.775MHz
SCANS/BAND : 2
NOTES : -
TEST DATE : 21 May 2013 09:11:22 I. CARNEGIE
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000.000001
FREQUENCY MHz
STOP = 2320


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 10
UKA1 04/24/13
SPEC / TEST : FCC Part 90 Prelim RE
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz
SCANS/BAND : 2
NOTES : -
TEST DATE : 20 May 2013 14:00:09 I. CARNEGIE
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 11
UKA1 04/24/13
SPEC / TEST : FCC Part 90 Prelim RE
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz
SCANS/BAND : 2
NOTES : -
TEST DATE : 20 May 2013 14:13:56 I. CARNEGIE
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 13
UKA1 04/24/13
SPEC / TEST : FCC Part 90 Prelim RE
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz
SCANS/BAND : 2
NOTES : -
TEST DATE : 20 May 2013 17:06:11 I. CARNEGIE
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000.000001
FREQUENCY MHz
STOP = 2320


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 12
WKA1 04/24/13
SPEC / TEST : FCC Part 90 Prelim RE
MANUFACTURER : Xetawave
MODEL No. : Xeta1
SERIAL No. : 003
MODE : Tx @ 169.5MHz
SCANS/BAND : 2
NOTES : -
TEST DATE : 20 May 2013 17:03:17 I. CARNEGIE
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000.000001
FREQUENCY MHz
STOP = 2320

MANUFACTURER : XetaWave
MODEL : Xeta1 12.5kHz Licensed Band Radio
SERIAL NO. : 003
SPECIFICATION : Spurious Radiated Emissions
TRANSMIT : Tx @ 150.775MHz
DATE : May 21st, 2013

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	Matched Sig. Gen. Reading (dBm)	Antenna Gain (dB)	Cable Loss (dB)	ERP (dBm)	Attenuation Below Output Power (dB)	Minimum Attenuation (dB)
301.55	H	24.3	Ambient	-56.0	0.0	1.2	-57.2	88.9	51.8
301.55	V	24.4	Ambient	-55.7	0.0	1.2	-56.9	88.6	51.8
452.33	H	47.0		-33.5	0.0	1.5	-35.0	66.7	51.8
452.33	V	46.82		-32.4	0.0	1.5	-33.9	65.6	51.8
603.10	H	26.6	Ambient	-51.9	0.0	1.7	-53.6	85.3	51.8
603.10	V	25.0	Ambient	-51.1	0.0	1.7	-52.8	84.5	51.8
753.88	H	24.2	Ambient	-52.2	0.0	1.9	-54.1	85.8	51.8
753.88	V	25.5	Ambient	-49.3	0.0	1.9	-51.2	82.9	51.8
904.65	H	26.5	Ambient	-47.5	0.0	2.0	-49.5	81.3	51.8
904.65	V	27.0	Ambient	-46.8	0.0	2.0	-48.8	80.6	51.8
1055.43	H	27.2	Ambient	-44.4	4.7	2.2	-41.9	73.7	51.8
1055.43	V	27.9	Ambient	-43.2	4.7	2.2	-40.7	72.5	51.8
1206.20	H	27.2	Ambient	-43.4	4.9	2.4	-40.9	72.6	51.8
1206.20	V	27.3	Ambient	-42.9	4.9	2.4	-40.4	72.1	51.8
1356.98	H	27.0	Ambient	-43.4	5.9	2.6	-40.0	71.7	51.8
1356.98	V	26.7	Ambient	-43.6	5.9	2.6	-40.2	72.0	51.8
1507.75	H	27.5	Ambient	-42.8	6.5	2.7	-39.0	70.7	51.8
1507.75	V	27.6	Ambient	-43.7	6.5	2.7	-39.9	71.6	51.8

MIN ATTEN = (matched signal + antenna gain - cable loss) – power in dBm
Limit minimum attenuation = 50+ 10*log(Power in watts) = 50 + 10*log(1.5W) = 51.8

Checked By: _____
Ian Carnegie

MANUFACTURER : XetaWave
MODEL : Xeta1 12.5kHz Licensed Band Radio
SERIAL NO. : 003
SPECIFICATION : Spurious Radiated Emissions
TRANSMIT : Tx @ 169.5MHz
DATE : May 21st, 2013

Freq. MHz	Ant Pol	Meter Reading (dBuV)	Ambient	Matched Sig. Gen. Reading (dBm)	Antenna Gain (dB)	Cable Loss (dB)	ERP (dBm)	Attenuation Below Output Power (dB)	Minimum Attenuation (dB)
339.00	H	26.8		-54.3	0.0	1.3	-55.6	87.3	51.8
339.00	V	27.5		-53.0	0.0	1.3	-54.3	86.0	51.8
508.50	H	30.7		-49.1	0.0	1.5	-50.6	82.4	51.8
508.50	V	33.7		-45.0	0.0	1.5	-46.5	78.3	51.8
678.00	H	18.7	Ambient	-58.0	0.0	1.8	-59.8	91.5	51.8
678.00	V	18.4	Ambient	-57.8	0.0	1.8	-59.6	91.3	51.8
847.50	H	25.9		-50.2	0.0	2.0	-52.2	83.9	51.8
847.50	V	27.2		-48.3	0.0	2.0	-50.2	82.0	51.8
1017.00	H	26.6		-45.2	4.6	2.2	-42.7	74.5	51.8
1017.00	V	26.4		-45.6	4.6	2.2	-43.1	74.9	51.8
1186.50	H	27.0	Ambient	-42.6	4.9	2.4	-40.1	71.9	51.8
1186.50	V	27.0	Ambient	-45.6	4.9	2.4	-43.1	74.9	51.8
1356.00	H	26.8	Ambient	-42.6	5.9	2.5	-39.2	71.0	51.8
1356.00	V	27.2	Ambient	-45.1	5.9	2.5	-41.7	73.5	51.8
1525.50	H	27.5	Ambient	-42.6	6.6	2.7	-38.7	70.5	51.8
1525.50	V	27.2	Ambient	-45.4	6.6	2.7	-41.5	73.3	51.8
1695.00	H	26.7	Ambient	-42.3	6.2	2.8	-38.9	70.7	51.8
1695.00	V	26.8	Ambient	-44.2	6.2	2.8	-40.8	72.6	51.8

MIN ATTEN = (matched signal + antenna gain - cable loss) – power in dBm
Limit minimum attenuation = 50+ 10*log(Power in watts) = 50 + 10*log(1.5W) = 51.8

Checked By: Ian Carnegie

MANUFACTURER : XetaWave
MODEL : Xeta1
SPECIFICATION : Frequency Stability vs. Temperature
DATE : May 23rd, 2013
NOTES : Transmit

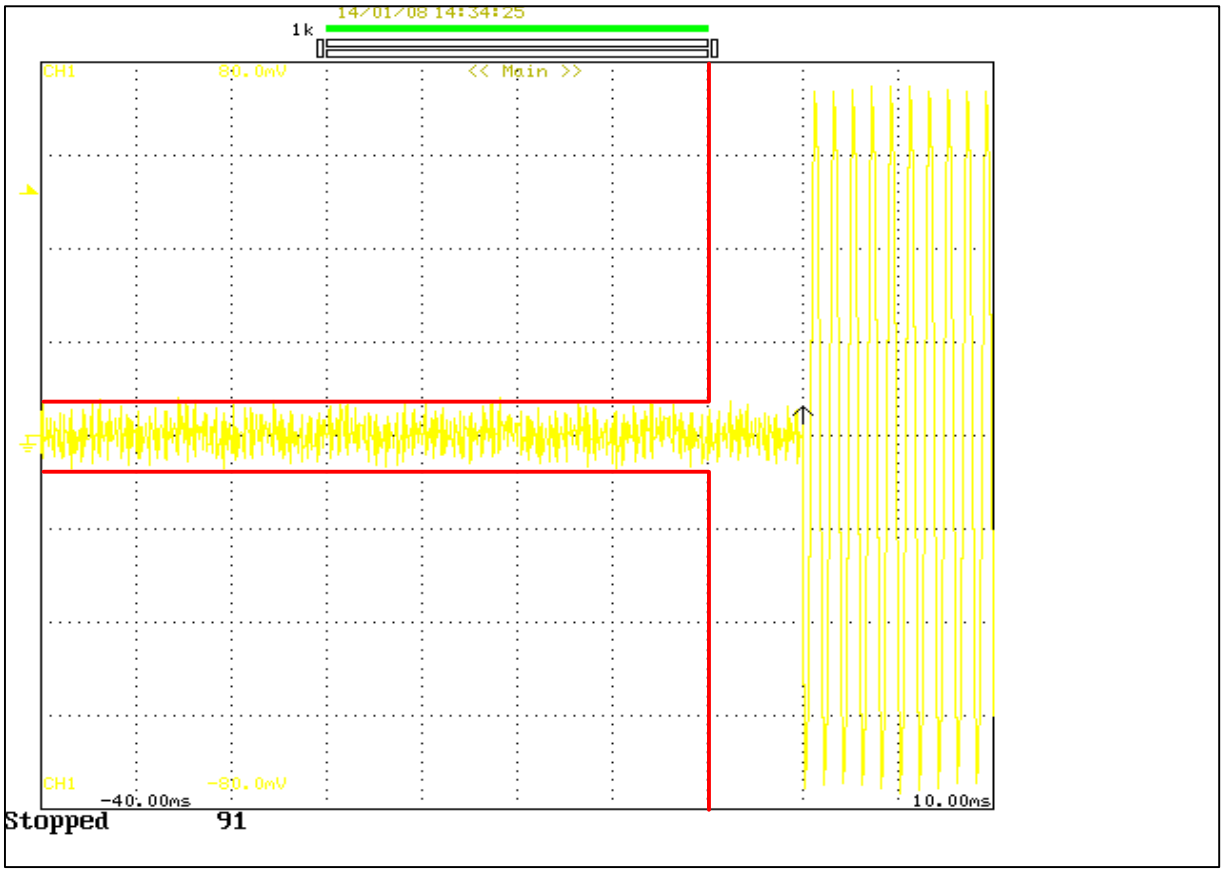
Temperature (°C)	Measured (Hz)	Frequency Error (Hz)	Error Limit (Hz)	IN BAND?
	Tx @ 150.775 MHz			
+23	150.774971	-29	±375	YES
-30	150.774975	-25	±375	YES
-20	150.775019	19	±375	YES
-10	150.775029	29	±375	YES
0	150.775018	18	±375	YES
+10	150.775028	28	±375	YES
+20	150.775008	8	±375	YES
+30	150.775010	10	±375	YES
+40	150.775005	5	±375	YES
+50	150.775030	30	±375	YES
	Tx @ 169.5 MHz			
+23	169.499970	-30	±375	YES
-30	169.499950	-50	±375	YES
-20	169.500020	20	±375	YES
-10	169.500020	20	±375	YES
0	169.500022	22	±375	YES
+10	169.500020	20	±375	YES
+20	169.500010	10	±375	YES
+30	169.499994	-6	±375	YES
+40	169.500010	10	±375	YES
+50	169.500017	17	±375	YES

Checked By: Ian Carnegie

MANUFACTURER : XetaWave
MODEL : Xeta1
SPECIFICATION : Frequency Stability vs. Voltage
DATE : May 22nd, 2013
NOTES : Transmit at 150.775MHz

Voltage (DC)	Measured (kHz)	Frequency Error (Hz)	Error Limit (Hz)	IN BAND?
6.375	150,774.997	-3	±375	YES
7.5	150,775.002	+2	±375	YES
8.625	150,775.004	+4	±375	YES

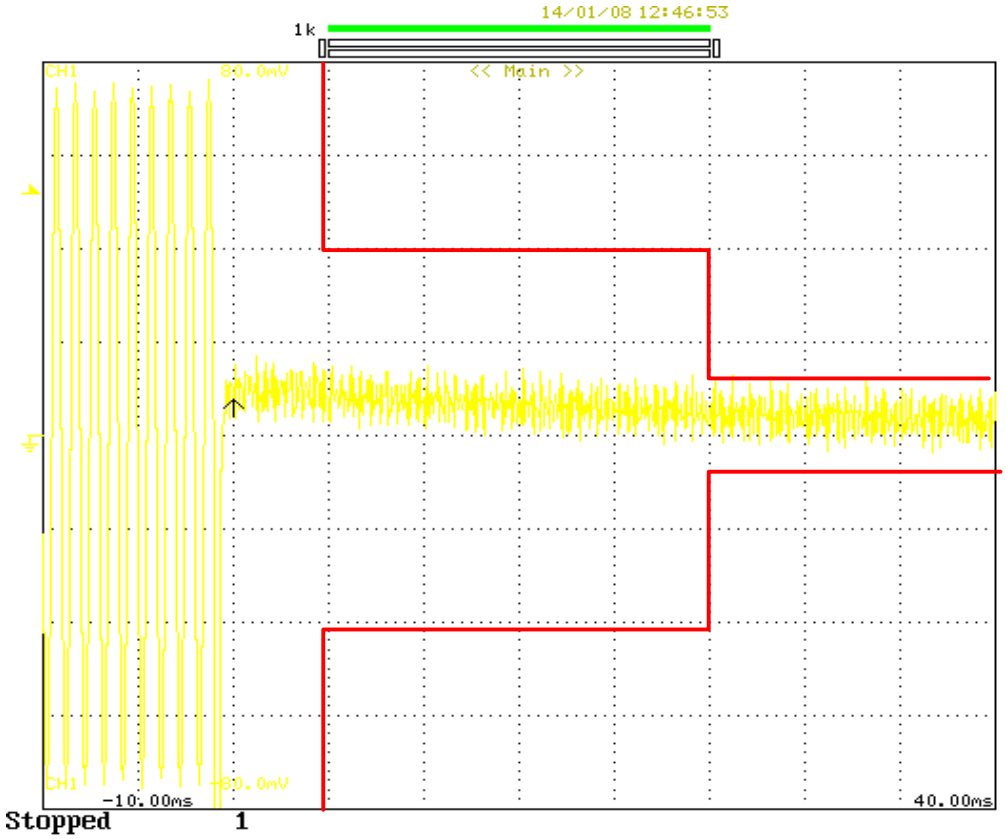
Checked By: Ian Carnegie



PART 90 - TRANSIENT FREQUENCY BEHAVIOR, ON TIME

MANUFACTURER	: XetaWave LLC.
MODEL NUMBER	: Xeta1
TEST MODE	: Tx @ 150.775MHz, 12.5kHz channel spacing
TEST	: Transmit off Time, t3=5msec
EQUIPMENT USED	: GRD6, RYE0, T1EK

Checked By: Dayne Putnam



PART 90 - TRANSIENT FREQUENCY BEHAVIOR, ON TIME

MANUFACTURER	: XetaWave LLC.
MODEL NUMBER	: Xeta1
TEST MODE	: Tx @ 150.775MHz, 12.5kHz channel spacing
TEST	: Transmit on Time, t2=5msec
EQUIPMENT USED	: GRD6, RYE0, T1EK

Checked By: Dayne Putnam