Measurement of RF Interference from an Orion SE Mobile Transceiver

For	Badger Meter, Inc. 4545 W. Brown Deer Road Milwaukee, WI 53224
P.O. Number	557427
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Test Personnel	Mark Longinotti
Specification	FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Frequency Hopping Spread Spectrum Intentional Radiators within the band 902-928MHz FCC “Code of Federal Regulations” Title 47, Part15, Subpart 15B, Section 15.107 and 15.109 for Receivers Industry Canada RSS-210 Industry Canada RSS-GEN

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REVISION HISTORY

Revision	Date	Description
—	September 16, 2011	Initial release

Measurement of RF Emissions from an Orion SE Mobile Transceiver

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Badger Meter, Inc. Orion SE Mobile, Serial No. None Assigned, transceiver (hereinafter referred to as the EUT). The EUT is a frequency hopping spread spectrum transceiver. The transceiver was designed to transmit and receive in the 902-928 MHz band using a removable magnetic mount monopole antenna. The EUT contained a super-heterodyne type receiver. The EUT was manufactured and submitted for testing by Badger Meter, Inc. located in Milwaukee, WI.

1.2 Purpose

The test series was performed to determine if the EUT meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109, for receivers and Subpart C, Sections 15.207 and 15.249 for Intentional Radiators Operating within the 902-928 MHz band.

The test series was also performed to determine if the EUT meets the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 7.2.4 and Section 6.1 for receivers and the Industry Canada Radio Standards Specification RSS-Gen Section 7.2.4 and RSS-210 Annex 8, for Transmitters.

Testing was performed in accordance with ANSI C63.4-2003.

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 National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.5 Laboratory Conditions

The temperature at the time of the test was 23C 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 15, Subparts B and C, dated 1 October 2010

- ANSI C63.4-2003, "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"

- FCC Public Notice, DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems", Released March 30, 2000

- Industry Canada RSS-210, Issue 8,December 2010, “Spectrum Management and Telecommunications Radio Standards Specification, Low-power License-exempt radio communication devices (All Frequency Bands): Category I Equipment”

- Industry Canada RSS-GEN, Issue 3, December 2010, “Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment”

3. EUT SET-UP AND OPERATION

3.1 General Description

The EUT is an Orion SE Mobile Transceiver. A block diagram of the EUT setup is shown as Figure 1.

3.1.1 Power Input

The EUT was powdered by 5VDC over USB cable.

3.1.2 Peripheral Equipment

The following peripheral equipment was submitted with the EUT:

Item	Description
Laptop Computer	Sony Vaio M/N: PCG-GRT390ZP with Sony AC Adapter PCGA-AC19V7

3.1.3 Interconnect Cables

The following interconnect cables were submitted with the EUT:

Item	Description
USB Cable	36 feet of USB repeater cable used to connect the EUT to the laptop computer. The cable was used to provide 5VDC power to the EUT and to program the EUT via the laptop computer. The 36 feet of USB repeater cable was used for spurious radiated emissions tests and for peak output power tests (EIRP). The laptop computer was external to the test chamber.
USB Cable	6 feet of standard USB cable was used to connect the EUT to the laptop computer. The cable was used to provide 5VDC power to the EUT and to program the EUT via the laptop computer. The 5 feet of standard USB cable was used for all tests except spurious radiated emissions tests and for peak output power tests (EIRP).
Antenna	Antenex Laird model B8965C antenna was connected to the antenna port of the EUT

3.1.4 Grounding

The EUT was not grounded during the tests.

3.2 Operational Mode

For all tests, the EUT was placed on an 80cm high non-conductive stand. The EUT was energized. The unit was programmed to operate in one of the following modes:

- Transmit at 904.9MHz (Channel 1)
- Transmit at 913.9MHz (Channel 24)
- Transmit at 923.7MHz (Channel 48)
- Receive at 904.9MHz (Channel 1)
- Receive at 913.9MHz (Channel 24)
- Receive at 923.7MHz (Channel 48)
- Frequency Hopping Enabled

3.3 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 C63.4-2003 for site attenuation.

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9 1. The receiver allows measurements with the bandwidths and detectors specified by the FCC.

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:

Conducted Emission Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

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

5. TEST PROCEDURES

5.1 Receiver

5.1.1 Powerline Conducted Emissions

5.1.1.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, 15.107(a) and Industry Canada RSS-Gen section 7.2.4, all radio frequency voltages on the power lines of a receiver shall be below the values shown below when using a quasi-peak or average detector:

CONDUCTED LIMITS FOR A RECEIVER

Frequency MHz	RFI Voltage dBuV(QP)	RFI Voltage dBuV(Average)
0.15-0.5	66 decreasing with logarithm of frequency to 56	56 decreasing with logarithm of frequency to 46
0.5-5	56	46
5-30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the EUT is considered to have met both requirements and measurements do not need to be performed using the Average detector.

5.1.1.2 Procedures

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

a) The laptop computer used to power the EUT via power over USB was operated in the Running Windows mode.

b) Measurements were first made on the 115V, 60Hz high line of the Sony AC Adapter PCGA-AC19V7 used to provide 19.5VDC to the Sony Vaio M/N: PCG-GRT390ZP laptop computer.

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

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

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

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

g) Steps (c) through (f) were repeated on the 115V, 60Hz return line of the Sony AC Adapter PCGA-AC19V7 used to provide 19.5VDC to the Sony Vaio M/N: PCG-GRT390ZP laptop computer.

h) Steps (b) through (g) were repeated with the EUT (powered via power over USB from the Sony Vaio M/N: PCG-GRT390ZP laptop computer) operated in the Receive at 913.9MHz (Channel 24) mode.

5.1.1.3 Results

The plots of the peak, quasi-peak, and average conducted voltage levels acquired from each input power line of the Sony AC Adapter used to power the Sony Vaio laptop computer running Windows are shown on pages 25 and 27. The tabular quasi-peak and average results from each input power line of the Sony AC Adapter used to power the Sony Vaio laptop computer running Windows are shown on pages 24 and 26. All power line conducted emissions measured were within the specification limits.

The plots of the peak, quasi-peak, and average conducted voltage levels acquired from each input power line of the Sony AC Adapter used to power the Sony Vaio laptop computer which was used to provide USB power to the EUT which was running the Receive at 914.09MHz mode are shown on pages 29 and 31. The tabular quasi-peak and average results from each input power line of the Sony AC Adapter used to power the Sony Vaio laptop computer which was used to provide USB power to the EUT which was running the Receive at 914.09MHz mode are shown on pages 28 and 30. All power line conducted emissions measured from the EUT were within the specification limits. The emissions level closest to the limit (worst case) occurred at 21.295MHz. The emissions level at this frequency was 8.1dB within the limit. Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown on Figure 2.

5.1.2 FCC Antenna Power Conducted Emissions

5.1.2.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Section 15.111, receivers that provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the radiated emissions limits with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements shall not exceed 2.0 nanowatts.

5.1.2.2 Procedures

The output of the EUT was connected to the spectrum analyzer. The EUT was set to receive continuously. Testing was performed separately on a low, middle, and high channel. The emissions in the frequency range of 30MHz to 5GHz were measured and plotted using a 'screen-dump' utility.

5.1.2.3 Results

The results of the antenna conducted measurements are presented on pages 32 through 34. The antenna power conducted limits are shown on the plots. As can be seen from the data, all emissions from the EUT were below the 2 nanowatt requirements. Since the emissions were below the 2 nanowatt limit, the antenna port can be terminated with a shielded load for the radiated emissions measurements. However, all radiated emissions tests were performed with the antenna connected to the antenna port of the EUT.

5.1.3 Industry Canada Antenna Power Conducted Emissions

5.1.3.1 Requirements

Per the Industry Canada, RSS-GEN section 6.2, if a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

5.1.3.2 Procedures

The output of the EUT was connected to the spectrum analyzer. The EUT was set to receive continuously. Testing was performed on a middle channel. The emissions in the frequency range of 30MHz to 3 times the highest tunable or local oscillator frequency, whichever is the higher, were measured and plotted.

5.1.3.3 Results

The results of the antenna conducted measurements are presented on page 35. The antenna power conducted limits are shown on the plots. As can be seen from the data, all emissions from the EUT were below the specification requirements.

5.1.4 Radiated Measurements

5.1.4.1 Requirements

Per the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Section 15.109(a) and Industry Canada RSS-Gen, Section 6.1, all radio frequency emissions from a receiver shall be below the limits shown on the following table:

RADIATION LIMITS FOR A 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.

5.1.4.2 Procedures

For FCC, testing was performed separately on a low, middle, and high channel. The emissions in the frequency range of 30MHz to 5GHz were measured and plotted using a 'screen-dump' utility. Testing was performed with the antenna of the EUT in place.

For Industry Canada, testing was performed on a middle channel. The emissions in the frequency range of 30MHz to 3 times the highest tuneable or local oscillator frequency, whichever is the higher, were measured and plotted. Testing was performed with the antenna of the EUT in place.

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 C63.4-2003 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 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.

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.

5.1.4.3 Results

The preliminary plots are presented on pages 36 through 47. The plots are presented for a reference only, and are not used to determine compliance. The final radiated levels are presented on pages 48 through 50. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closet to the limit (worst case) occurred at 40.88MHz. The emissions level at this frequency was 1.2dB within the limit. Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figure 3.

5.2 Transmitter

5.2.1 Powerline Conducted Emissions

5.2.1.1 Requirements

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

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

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the EUT is considered to have met both requirements and measurements do not need to be performed using the Average detector.

5.2.1.2 Procedures

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

a) The laptop computer used to power the EUT via power over USB was operated in the Running Windows mode.

b) Measurements were first made on the 115V, 60Hz high line of the Sony AC Adapter PCGA-AC19V7 used to provide 19.5VDC to the Sony Vaio M/N: PCG-GRT390ZP laptop computer.

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

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

e) The data thus obtained was then searched by the computer for the highest levels. Any emissions levels that were within 10dB of the average limit were then measured again using both a quasi-

peak detector and an average detector. (If no peak readings were within 10dB of the average limit, quasi-peak and average readings were taken on the highest emissions levels measured during the peak detector scan.)

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

g) Steps (c) through (f) were repeated on the 115V, 60Hz return line of the Sony AC Adapter PCGA-AC19V7 used to provide 19.5VDC to the Sony Vaio M/N: PCG-GRT390ZP laptop computer.

h) Steps (b) through (g) were repeated with the EUT (powered via power over USB from the Sony Vaio M/N: PCG-GRT390ZP laptop computer) operated in the Receive at 913.9MHz (Channel 24) mode.

5.2.1.3 Results

The plots of the peak, quasi-peak, and average conducted voltage levels acquired from each input power line of the Sony AC Adapter used to power the Sony Vaio laptop computer running Windows are shown on pages 52 through 54. The tabular quasi-peak and average results from each input power line of the Sony AC Adapter used to power the Sony Vaio laptop computer running Windows are shown on pages 51 through 53. All power line conducted emissions measured were within the specification limits.

The plots of the peak, quasi-peak, and average conducted voltage levels acquired from each input power line of the Sony AC Adapter used to power the Sony Vaio laptop computer which was used to provide USB power to the EUT which was running the Transmit at 914.09MHz mode are shown on pages 56 and 58. The tabular quasi-peak and average results from each input power line of the Sony AC Adapter used to power the Sony Vaio laptop computer which was used to provide USB power to the EUT which was running the Transmit at 914.09MHz mode are shown on pages 55 and 57. All power line conducted emissions measured from the EUT were within the specification limits. The emissions level closest to the limit (worst case) occurred at 20.777MHz. The emissions level at this frequency was 8.8dB within the limit. Photographs of the test configuration which yielded the highest or worst case, conducted emission levels are shown on Figure 2.

5.2.2 20dB Bandwidth

5.2.2.1 Requirements

Per 15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Per section 15.247(a)(1)(i), for frequency hopping systems operating in the 902-928MHz band, the 20dB bandwidth shall be measured for determination of the carrier frequency separation limits and must not exceed 500 kHz. If the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping channels. If the 20dB bandwidth of the hopping channel is 250kHz or greater (but not greater than 500kHz), the system shall use at least 25 hopping channels.

5.2.2.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function disabled, the EUT was allowed to transmit continuously. The frequency hopping channel was set separately to low, middle, and high hopping channels. The resolution bandwidth (RBW) was set to ≥ 1% of the 20 dB BW. The span was set to approximately 2 to 3 times the 20 dB bandwidth.

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

5.2.2.3 Results

The plots on pages 59 through 61 show that the maximum 20 dB bandwidth was 296kHz. The 99% bandwidth was measured to be 282kHz.Therefore, since the 20dB bandwidth of the hopping channel is 250kHz or greater, but not greater than 500kHz, the system shall use at least 25 hopping channels.

5.2.3 Carrier Frequency Separation

5.2.3.1 Requirements

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

5.2.3.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

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

5.2.3.3 Results

Page 62 shows the carrier frequency separation. As can be seen from this plot, the carrier frequency separation is 399kHz, which is greater than the 20dB bandwidth (296kHz).

5.2.4 Number of Hopping Frequencies

5.2.4.1 Requirements

Per section 15.247(a)(1)(i), for frequency hopping systems operating in the 902-928MHz band, the 20dB bandwidth shall be measured for determination of the carrier frequency separation limits and must not exceed 500 kHz. If the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping channels. If the 20dB bandwidth of the hopping channel is 250kHz or greater (but not greater than 500kHz), the system shall use at least 25 hopping channels.

5.2.4.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

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

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

5.2.4.3 Results

Page 63 shows the number of hopping frequencies. As can be seen from this plot, the number of hopping frequencies is 48 which is greater than 25 which is the minimum number of required hopping frequencies for systems with a 20dB bandwidth greater than 250kHz.

5.2.5 Time of Occupancy

5.2.5.1 Requirements

Per section 15.247(a)(1)(i), for frequency hopping systems operating in the 902-928MHz band, if the 20dB bandwidth of the hopping channel is 250kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

5.2.5.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function enabled, the EUT was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to 100kHz. The peak detector and 'Max-Hold' function were engaged. With the span set to 0Hz, the sweep time was adjusted to capture a single event in order to measure the dwell time per hop. The analyzer's display was plotted using a 'screen dump' utility. Then, the sweep time was expanded to 10 seconds to capture the number of hops in the appropriate sweep time. A single sweep was made. The analyzer's display was plotted using a 'screen dump' utility. The dwell time in the specified time period was then calculated from dwell time per hop multiplied by the number of hops in the specified time period.

5.2.5.3 Results

Pages 64 and 65 show the plots for the time of occupancy. As can be seen from the plots, the time of occupancy can be determined by the dwell time/hop multiplied by the number of hops: 7.4msec/hop x 2 hops/10sec = 14.8msec = 0.0148sec. This calculated value is equal to 0.148 seconds which is less than the 0.4 seconds maximum allowed.

5.2.6 Antenna Conducted Peak Output Power

5.2.6.1 Requirements

Per section 15.247(b)(2), for frequency hopping systems operating in the 902-928MHz band and employing less than 50 hopping channels, but at least 25 hopping channels, the maximum peak output conducted power shall not be greater than 0.25W (24dBm).

5.2.6.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 40dB of attenuation. With the hopping function disabled, the EUT was allowed to transmit continuously. The frequency hopping channel was set separately to low, middle, and high hopping channels. The resolution bandwidth (RBW) was set to greater than the 20dB bandwidth. The span was set to approximately 5 times the 20 dB 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 hopping frequencies.

5.2.6.3 Results

The results are presented on pages 66 through 68. The maximum peak conducted output power from the transmitter was 0.027W (14.31dBm) which is below the 0.25 Watts limit.

5.2.7 Effective Isotropic Radiated Power (EIRP)

5.2.7.1 Requirements

Per section 15.247(b)(2), for frequency hopping systems operating in the 902-928MHz band and employing less than 50 hopping channels, but at least 25 hopping channels, the maximum peak output conducted power shall not be greater than 0.25W (24dBm). Per section 15.247(b)(4), this limit is based on the use of antennas with directional gains that do not exceed 6dBi. Since the limit allows for a 6dBi antenna gain, the maximum EIRP can be increased by 6dB to 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below 24dBm by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2.7.2 Procedures

The EUT was placed on the non-conductive stand and set to transmit. A dipole antenna was placed at a test distance of 3 meters from the EUT. The resolution bandwidth (RBW) of the spectrum analyzer was set to greater than the 20dB bandwidth. The span was set to approximately 5 times the 20 dB bandwidth. The EUT was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the low, middle and high hopping frequencies.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, a second 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 as required. The peak power output was calculated for low, middle, and high hopping frequencies.

5.2.7.3 Results

The results are presented on page 69. The maximum EIRP measured from the transmitter was 0.051W (17.1dBm) which is below the 1 Watt limit.

5.2.8 Antenna Conducted Spurious Emissions

5.2.8.1 Requirements

Per section 15.247(c), the spurious emissions in any 100 kHz BW outside the frequency band must be at least 20dB below the highest 100 kHz BW level measured within the band.

5.2.8.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 40dB of attenuation. The frequency hopping function was disabled. The resolution bandwidth (RBW) was set to 100kHz. The peak detector and 'Max-Hold' function were engaged. The emissions in the frequency range from 30MHz to 10GHz were observed and plotted separately with the EUT transmitting at low, middle and high hopping frequencies.

5.2.8.3 Results

The results of the antenna conducted emissions levels were plotted. These plots are presented on pages 70 through 72. These plots show that the spurious emissions were at least 20 dB below the level of the fundamental.

5.2.9 Duty Cycle Factor Measurements

5.2.9.1 Procedures

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

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

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

5.2.9.2 Results

The plots of the duty cycle are shown on data pages 73 through 74. The EUT transmits a 7.4msec pulse

approximately every 5 seconds. Since a word is greater than 100 msec long, the duty cycle factor was computed over a 100msec interval. The duty cycle correction factor was calculated to be -22.6dB (-22.6dB = 20*log(7.4msec/100msec).

5.2.10 Radiated Spurious Emissions Measurements

5.2.10.1 Requirements

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

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

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

5.2.10.2 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 10.0GHz was investigated using a peak detector function.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 10.0GHz

1) 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. 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. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.
   c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:
      i) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
      ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
      iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
      iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the EUT was rotated through all axis to ensure the maximum readings were recorded for the EUT.

d) For all radiated emissions measurements below 1 GHz, if the peak reading is below the limits listed in 15.209(a), no further measurements are required. If however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.

e) For all radiated emissions measurements above 1 GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).

f) Next, for all radiated emissions measurements above 1GHz, the resolution bandwidth was set to 1MHz. The analyzer was set to linear mode with a 10Hz video bandwidth in order to simulate an average detector. An average reading was taken. If the dwell time per channel of the hopping signal is less than 100msec, then the reading obtained with the 10 Hz video bandwidth may be further adjusted by a “duty cycle correction factor”, derived from 20*log(dwell time/100msec). These readings must be no greater than the limits specified in 15.209(a).

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

5.2.10.3 Results

Preliminary radiated emissions plots with the EUT transmitting at 904.9MHz, 913.9MHz, and 923.7MHz are shown on pages 75 through 86. Final radiated emissions data are presented on data pages 87 through 92. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closet to the limit (worst case) occurred at 9140.9MHz. The emissions level at this frequency was 13.7dB within the limit. Photographs of the test configuration which yielded the highest, or worst case, radiated emission levels are shown on Figure 3 and Figure 4.

5.2.11 Band Edge Compliance

5.2.11.1 Requirements

Per section 15.247(d), the emissions at the band-edges must be at least 20dB below the highest level measured within the band but attenuation below the general limits listed in 15.209(a) is not required.

5.2.11.2 Procedures

5.2.11.2.1 Low Band Edge

1) The output of the EUT was connected to the spectrum analyzer through 40dB of attenuation.
2) The EUT was set to transmit continuously at the channel closest to the low band-edge (hopping function disabled).
3) To determine the band edge compliance, the following spectrum analyzer settings were used:

   a. Center frequency = low band-edge frequency.
   b. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
   c. Resolution bandwidth (RBW) ≥ 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.

4) Step 3) was repeated with the frequency hopping function enabled.

5.2.11.2.2 High Band Edge

1) The output of the EUT was connected to the spectrum analyzer through 40dB of attenuation.
2) The EUT was set to transmit continuously at the channel closest to the high band-edge (hopping function disabled).
3) To determine the band edge compliance, the following spectrum analyzer settings were used:

   a. Center frequency = high 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) ≥ 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 right of the center frequency (band-edge) must be below the display line.)
   f. The analyzer's display was plotted using a 'screen dump' utility.

4) Step 3) was repeated with the frequency hopping function enabled.

5.2.11.3 Results

Pages 93 through 96 show the conducted band-edge compliance results. As can be seen from these plots, the emissions at the low end band edge and the high end band edge are within the 20 dB down limits.

6. CONCLUSIONS

It was determined that the Badger Meter, Inc. Orion SE Mobile, frequency hopping spread spectrum transceiver, Serial No. None Assigned, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart B, Sections 15.107 and 15.109 for receivers and Subpart C, Sections 15.207 and 15.247 for Intentional Radiators Operating within the 902-928 MHz, band, when tested per ANSI C63.4-2003.

It was also determined that the Badger Meter, Inc. Orion SE Mobile, frequency hopping spread spectrum transceiver, Serial No. None Assigned, did fully meet the conducted and radiated RF emission requirements of the Industry Canada Radio Standards Specification, RSS-Gen, Section 7.2.4 and Section 6.1 for receivers and the Industry Canada Radio Standards Specification RSS-Gen Section 7.2.4 and RSS-210 Annex 8 for transmitters, when tested per ANSI C63.4-2003.

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 endorsement by NVLAP or any agency of the US Government.

9. EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW3	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-35-120-5R0-10-12	PL2924	1GHZ-20GHZ	8/27/2010	9/27/2011
CDW3	COMPUTER			004		N/A	
CDW8	DESKTOP COMPUTER	ELITE ELECTRONIC ENG	PENTIUM 4	009	3.8GHZ	N/A	
CMA1	Controllers	EMCO	2090	9701-1213	---	N/A	
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	6/29/2011	6/29/2012
NWH0	RIDGED WAVE GUIDE	TENSOR	4105	2081	1-12.4GHZ	8/31/2010	9/30/2011
PLF5	CISPR16 50UH LISN	ELITE	CISPR16/15A	006	.15-30MHz	6/27/2011	6/27/2012
PLF7	CISPR16 50UH LISN	ELITE	CISPR16/15A	008	.15-30MHz	6/27/2011	6/27/2012
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	3/24/2011	3/24/2012
RBC1	ESCI EMI TEST RECEIVER	ROHDE & SCHWARZ	ESCI	100341	9KHZ-3GHZ	7/5/2011	9/5/2012
T1D2	10DB 20W ATTENUATOR	NARDA	768-10	6	DC-11GHZ	1/3/2011	1/3/2012
T2D1	20DB, 25W ATTENUATOR	WEINSCHEL	46-20-43	AV5814	DC-18GHZ	1/3/2011	1/3/2012
T2S3	20DB 25W ATTENUATOR	WEINSCHEL	46-20-34	BV3544	DC-18GHZ	1/3/2011	1/3/2012
XLJU	5W, 50 OHM TERMINATION	JFW INDUSTRIES	50T-052	29	DC-2GHZ	1/3/2011	1/3/2012
XPQ2	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-0	3	1.8-10GHZ	10/28/2010	10/28/2011

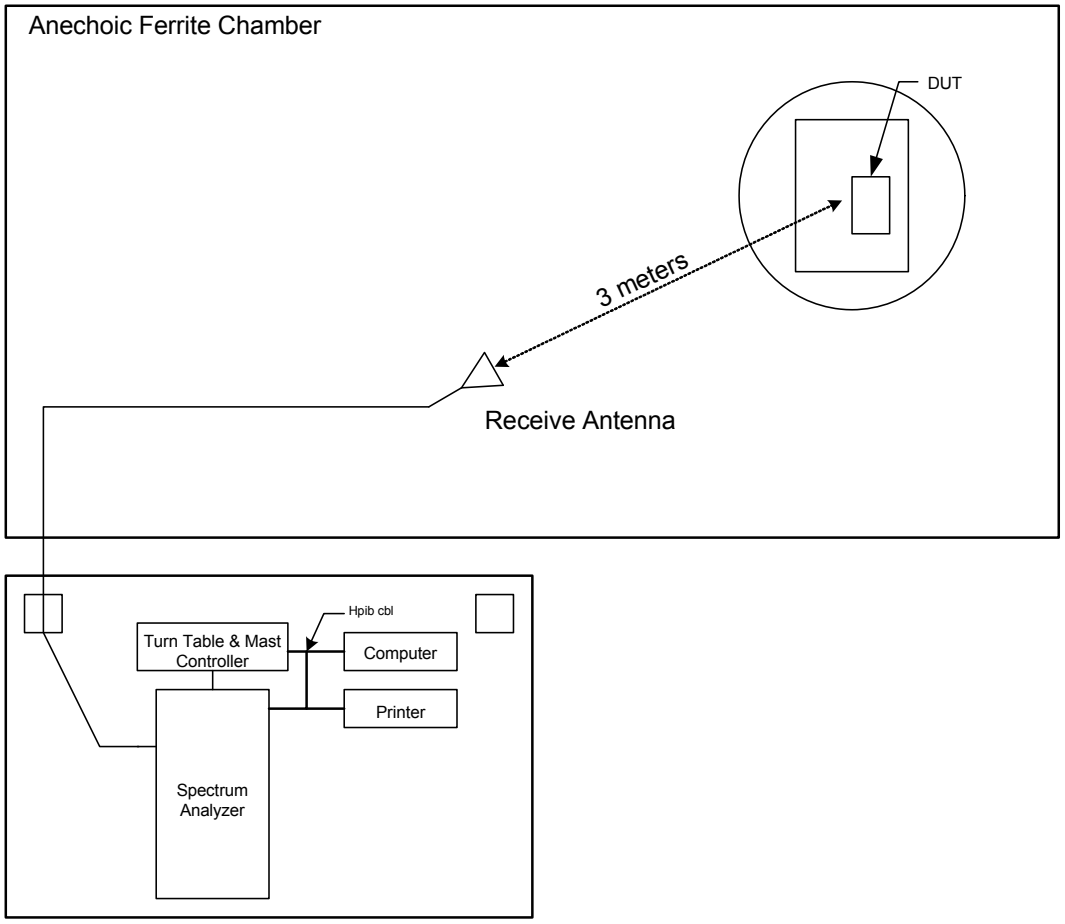
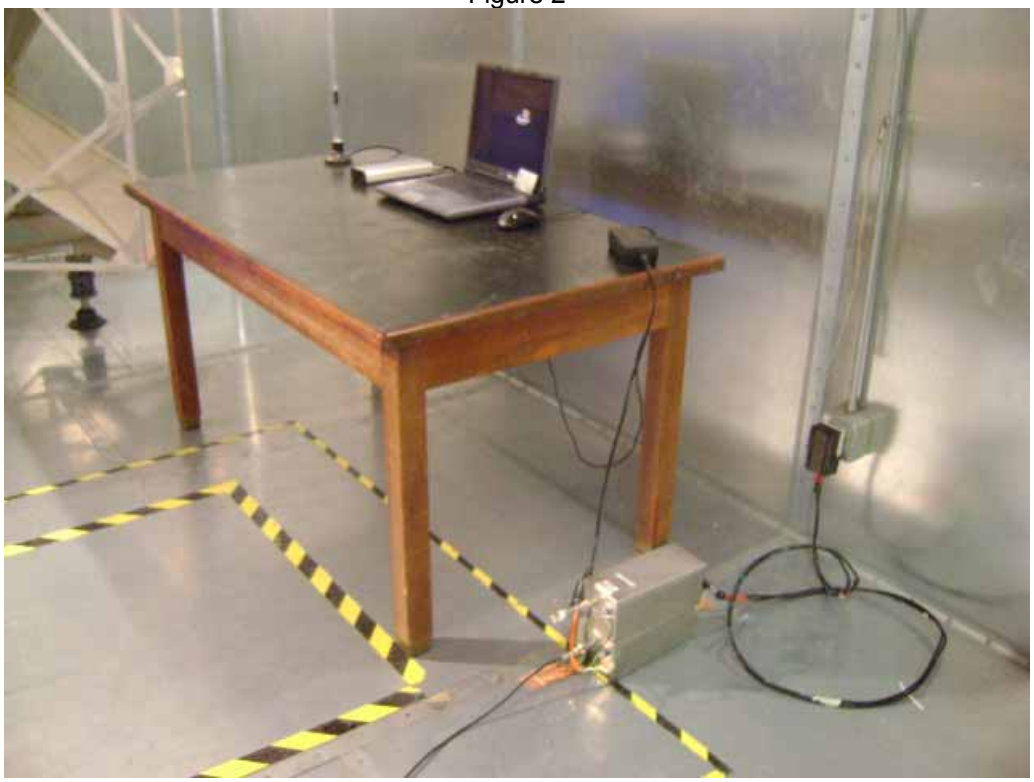


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 2



Test Setup for Conducted Emissions

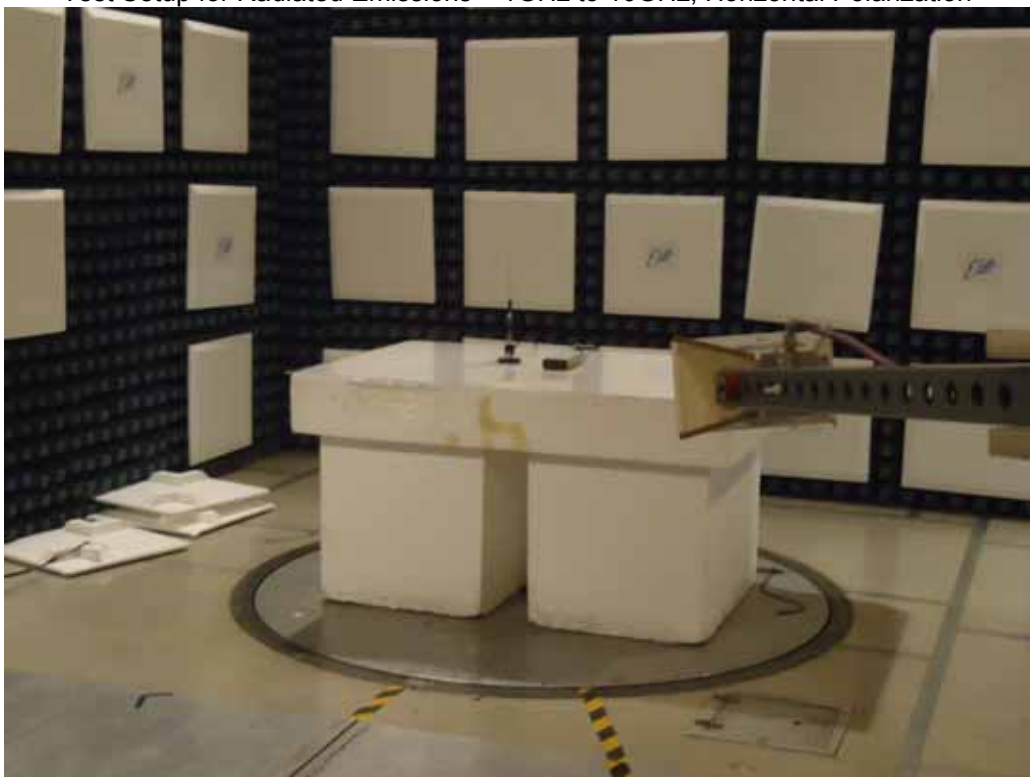
Figure 3

Test Setup for Radiated Emissions

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

Figure 4

Test Setup for Radiated Emissions – 1GHz to 10GHz, Horizontal Polarization



Test Setup for Radiated Emissions – 1GHz to 10GHz, Vertical Polarization

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	SONY VAIO PCG-390ZP
DUT Revision	:	PCG-GRT390ZP
Serial Number	:	
DUT Mode	:	RUNNING WINDOWS
Line Tested	:	115V, 60Hz HIGH OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 10:39:26 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

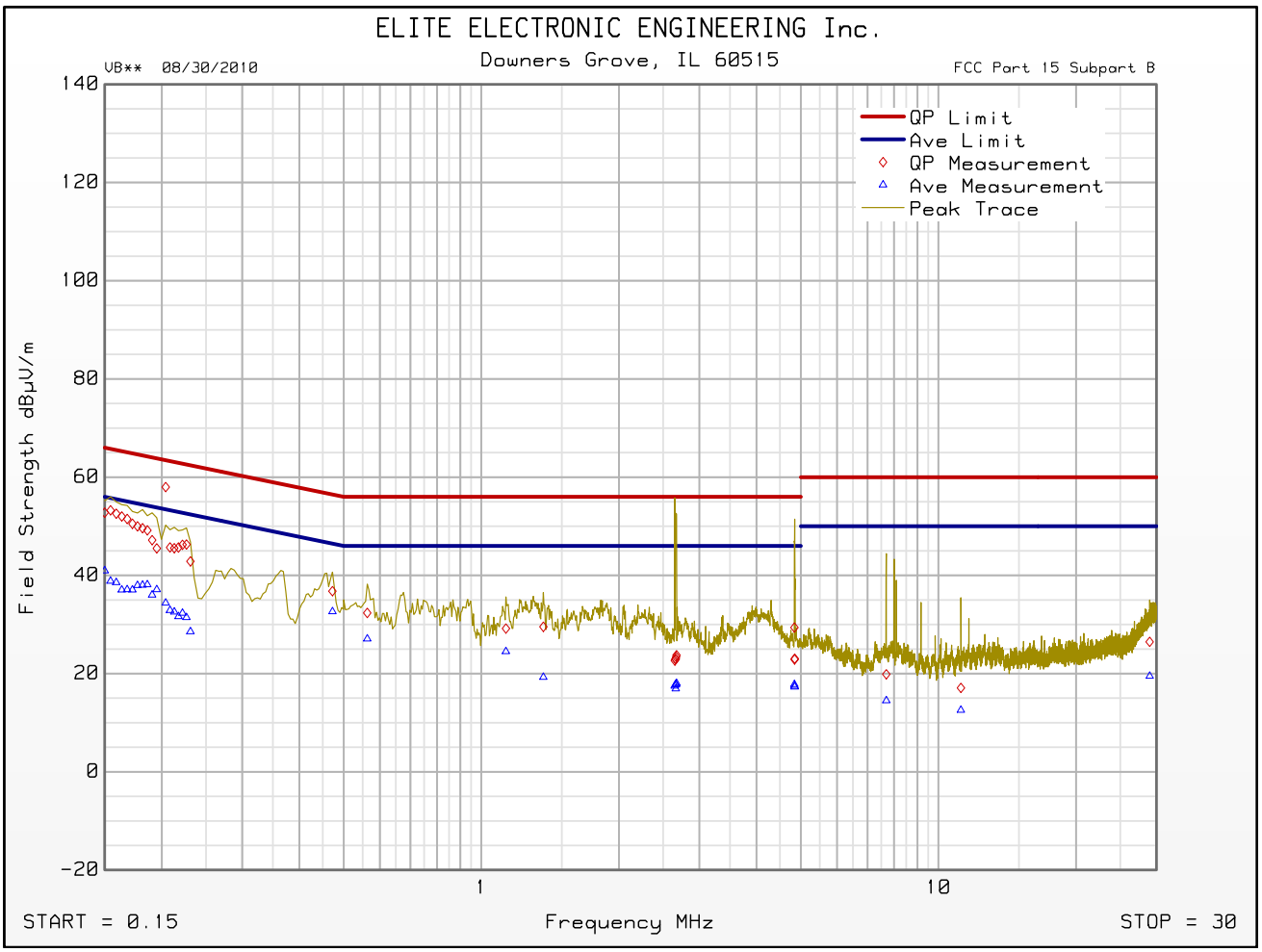
Freq MHz	Quasi-peak Level dBµV/m	Quasi-peak Limit dBµV/m	Excessive Quasi-peak Emissions	Average Level dBµV/m	Average Limit dBµV/m	Excessive Average Emissions
0.204	58.0	63.4		34.4	53.4	
0.473	36.8	56.5		32.6	46.5	
0.563	32.4	56.0		27.1	46.0	
1.132	29.2	56.0		24.5	46.0	
1.367	29.5	56.0		19.3	46.0	
2.673	23.8	56.0		18.0	46.0	
4.841	29.4	56.0		17.8	46.0	
7.691	19.9	60.0		14.5	50.0	
11.201	17.1	60.0		12.6	50.0	
28.985	26.5	60.0		19.5	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	SONY VAIO PCG-390ZP
DUT Revision	:	PCG-GRT390ZP
Serial Number	:	
DUT Mode	:	RUNNING WINDOWS
Line Tested	:	115V, 60Hz HIGH OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 10:39:26 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	SONY VAIO PCG-390ZP
DUT Revision	:	PCG-GRT390ZP
Serial Number	:	
DUT Mode	:	RUNNING WINDOWS
Line Tested	:	115V, 60Hz RETURN OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 10:46:08 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

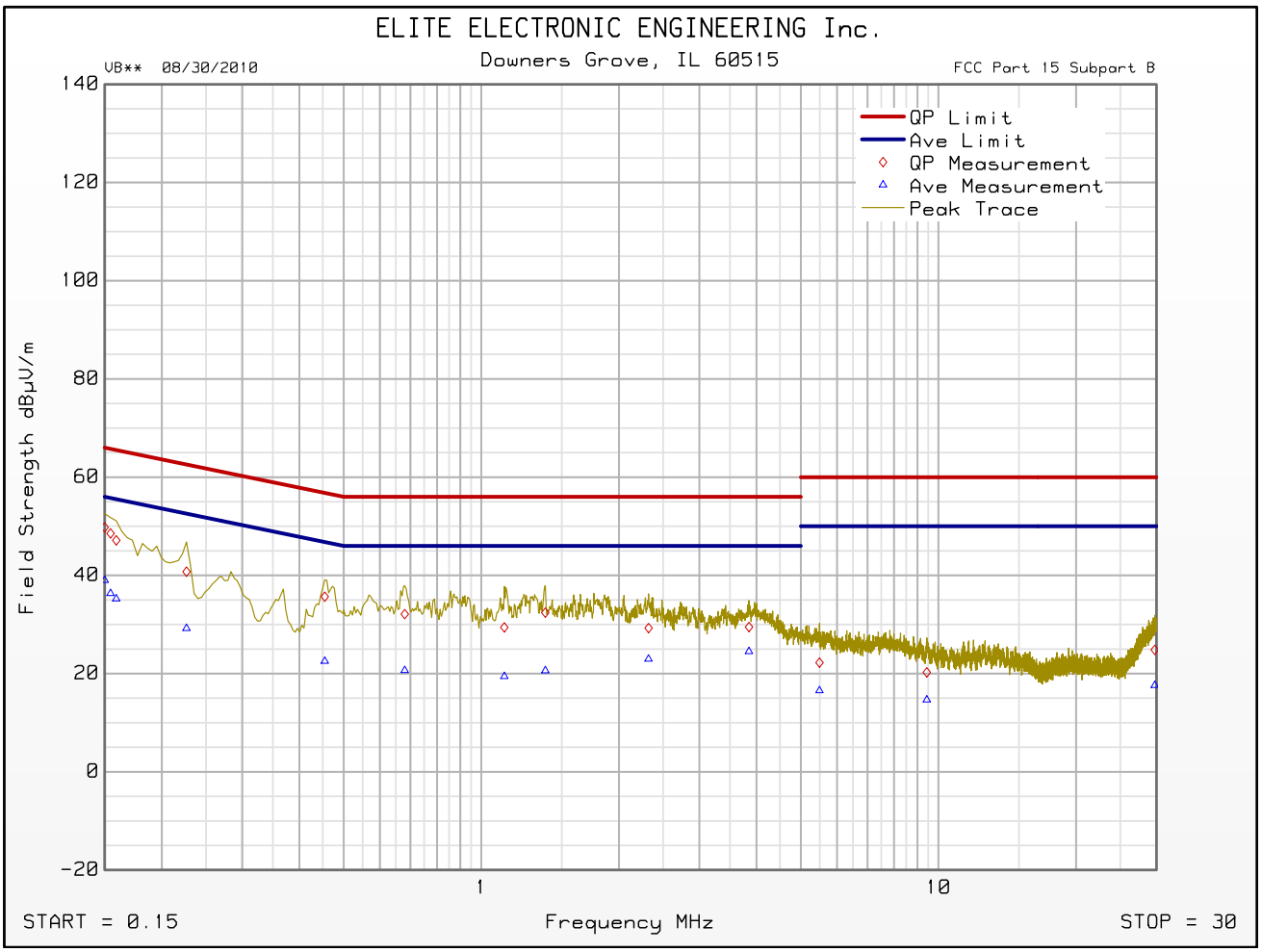
Freq MHz	Quasi-peak Level dBµV/m	Quasi-peak Limit dBµV/m	Excessive Quasi-peak Emissions	Average Level dBµV/m	Average Limit dBµV/m	Excessive Average Emissions
0.150	49.8	66.0		39.0	56.0	
0.455	35.7	56.8		22.5	46.8	
0.680	32.1	56.0		20.6	46.0	
1.123	29.4	56.0		19.4	46.0	
1.381	32.4	56.0		20.6	46.0	
2.322	29.3	56.0		23.0	46.0	
3.851	29.5	56.0		24.5	46.0	
5.495	22.2	60.0		16.5	50.0	
9.432	20.3	60.0		14.7	50.0	
29.737	24.8	60.0		17.6	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	SONY VAIO PCG-390ZP
DUT Revision	:	PCG-GRT390ZP
Serial Number	:	
DUT Mode	:	RUNNING WINDOWS
Line Tested	:	115V, 60Hz RETURN OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 10:46:08 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	ORION SE MOBILE TRANSCEIVER
DUT Revision	:	TESTED WITH SONY VAIO PCG-390Z
Serial Number	:	
DUT Mode	:	Rx @ 914.09MHz (Ch. 24)
Line Tested	:	115V, 60Hz RETURN OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	USB POWERED
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 11:48:43 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

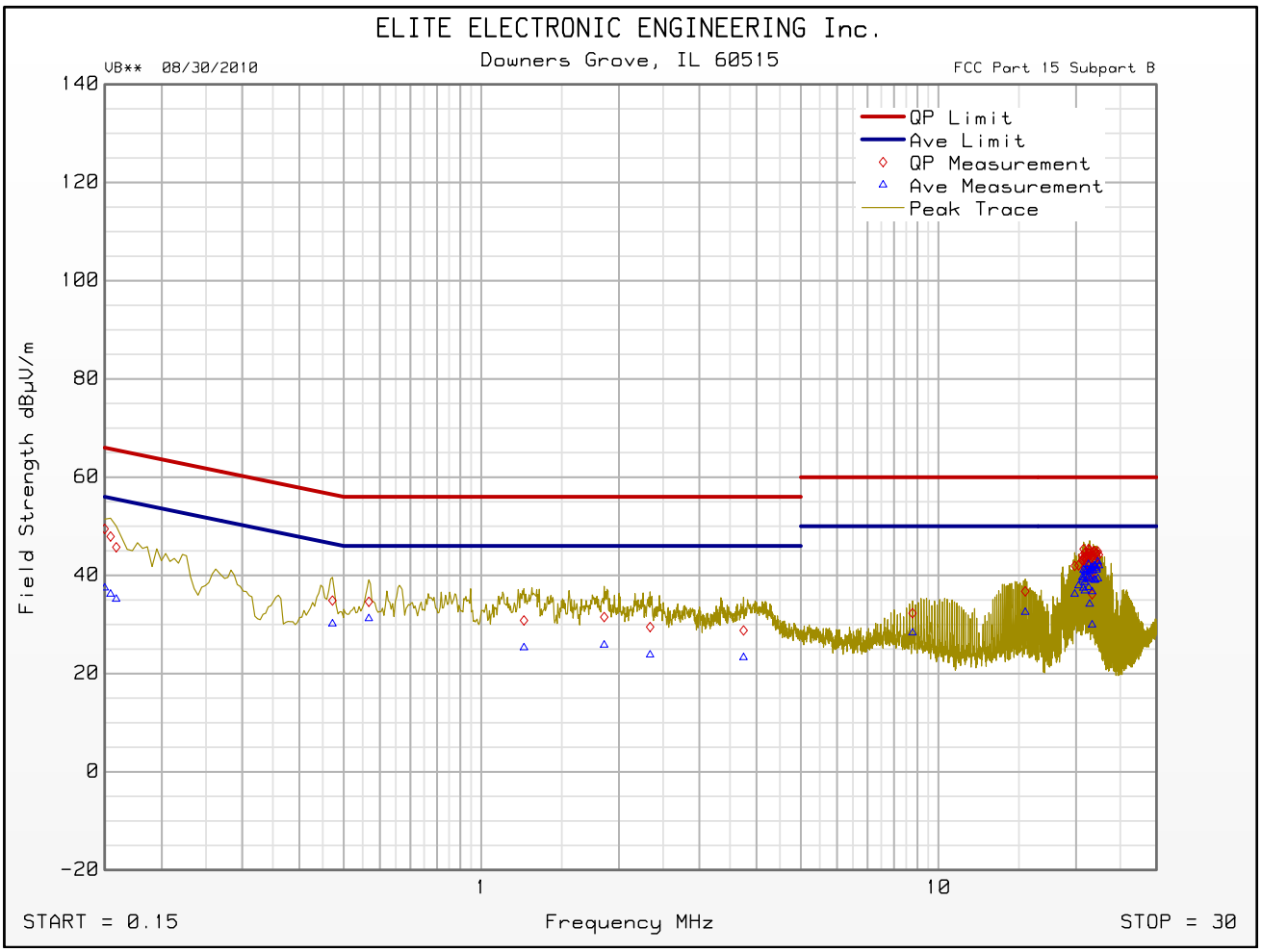
Freq MHz	Quasi-peak Level dBµV/m	Quasi-peak Limit dBµV/m	Excessive Quasi-peak Emissions	Average Level dBµV/m	Average Limit dBµV/m	Excessive Average Emissions
0.150	49.5	66.0		37.5	56.0	
0.473	34.9	56.5		30.1	46.5	
0.568	34.6	56.0		31.2	46.0	
1.240	30.8	56.0		25.3	46.0	
1.858	31.5	56.0		25.8	46.0	
2.340	29.5	56.0		23.8	46.0	
3.748	28.8	56.0		23.3	46.0	
8.776	32.3	60.0		28.3	50.0	
15.485	36.8	60.0		32.5	50.0	
20.777	45.4	60.0		41.1	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	ORION SE MOBILE TRANSCEIVER
DUT Revision	:	TESTED WITH SONY VAIO PCG-390Z
Serial Number	:	
DUT Mode	:	Rx @ 914.09MHz (Ch. 24)
Line Tested	:	115V, 60Hz RETURN OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	USB POWERED
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 11:48:43 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	ORION SE MOBILE TRANSCEIVER
DUT Revision	:	TESTED WITH SONY VAIO PCG-390Z
Serial Number	:	
DUT Mode	:	Rx @ 914.09MHz (Ch. 24)
Line Tested	:	115V, 60Hz HIGH OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	USB POWERED
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 11:42:07 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

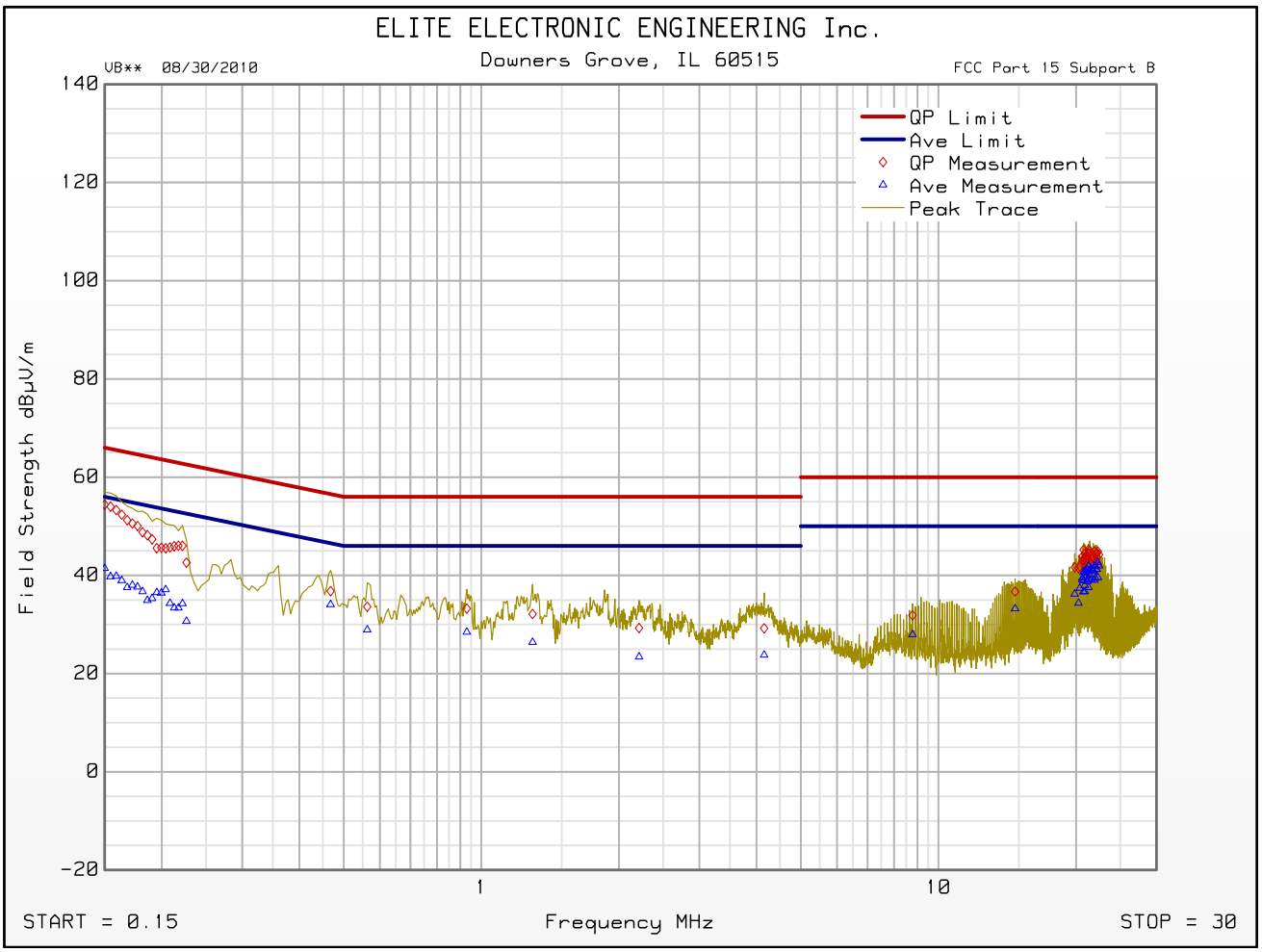
Freq MHz	Quasi-peak Level dBµV/m	Quasi-peak Limit dBµV/m	Excessive Quasi-peak Emissions	Average Level dBµV/m	Average Limit dBµV/m	Excessive Average Emissions
0.150	54.4	66.0		41.4	56.0	
0.468	36.8	56.5		34.1	46.5	
0.563	33.6	56.0		28.9	46.0	
0.930	33.2	56.0		28.5	46.0	
1.295	32.1	56.0		26.4	46.0	
2.214	29.3	56.0		23.4	46.0	
4.157	29.2	56.0		23.8	46.0	
8.776	31.9	60.0		28.0	50.0	
14.711	36.7	60.0		33.2	50.0	
21.295	45.2	60.0		41.9	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

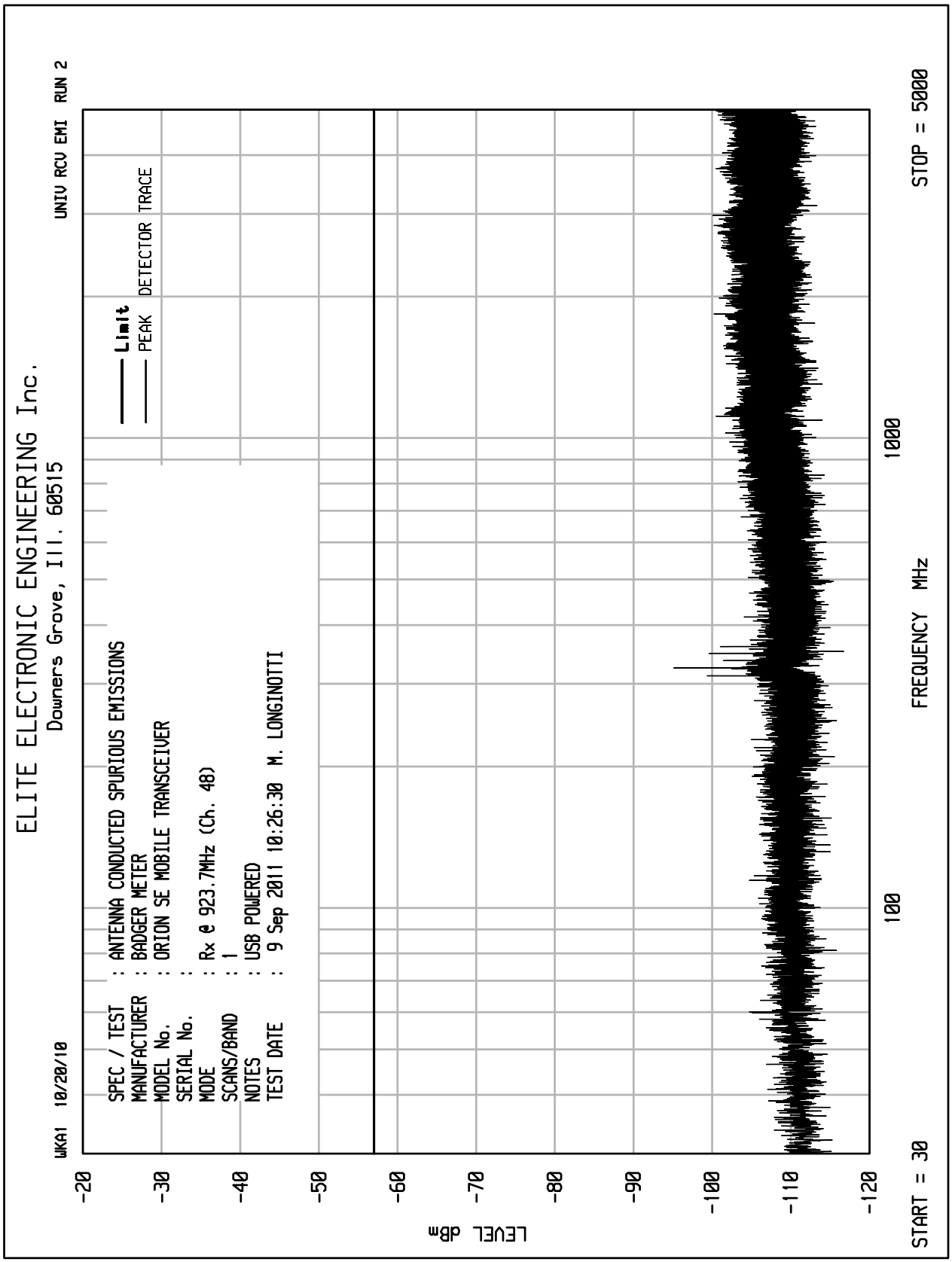
Cumulative Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	ORION SE MOBILE TRANSCEIVER
DUT Revision	:	TESTED WITH SONY VAIO PCG-390Z
Serial Number	:	
DUT Mode	:	Rx @ 914.09MHz (Ch. 24)
Line Tested	:	115V, 60Hz HIGH OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	USB POWERED
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 11:42:07 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit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Downers Grove, Ill. 60515
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WKA1 10/20/10
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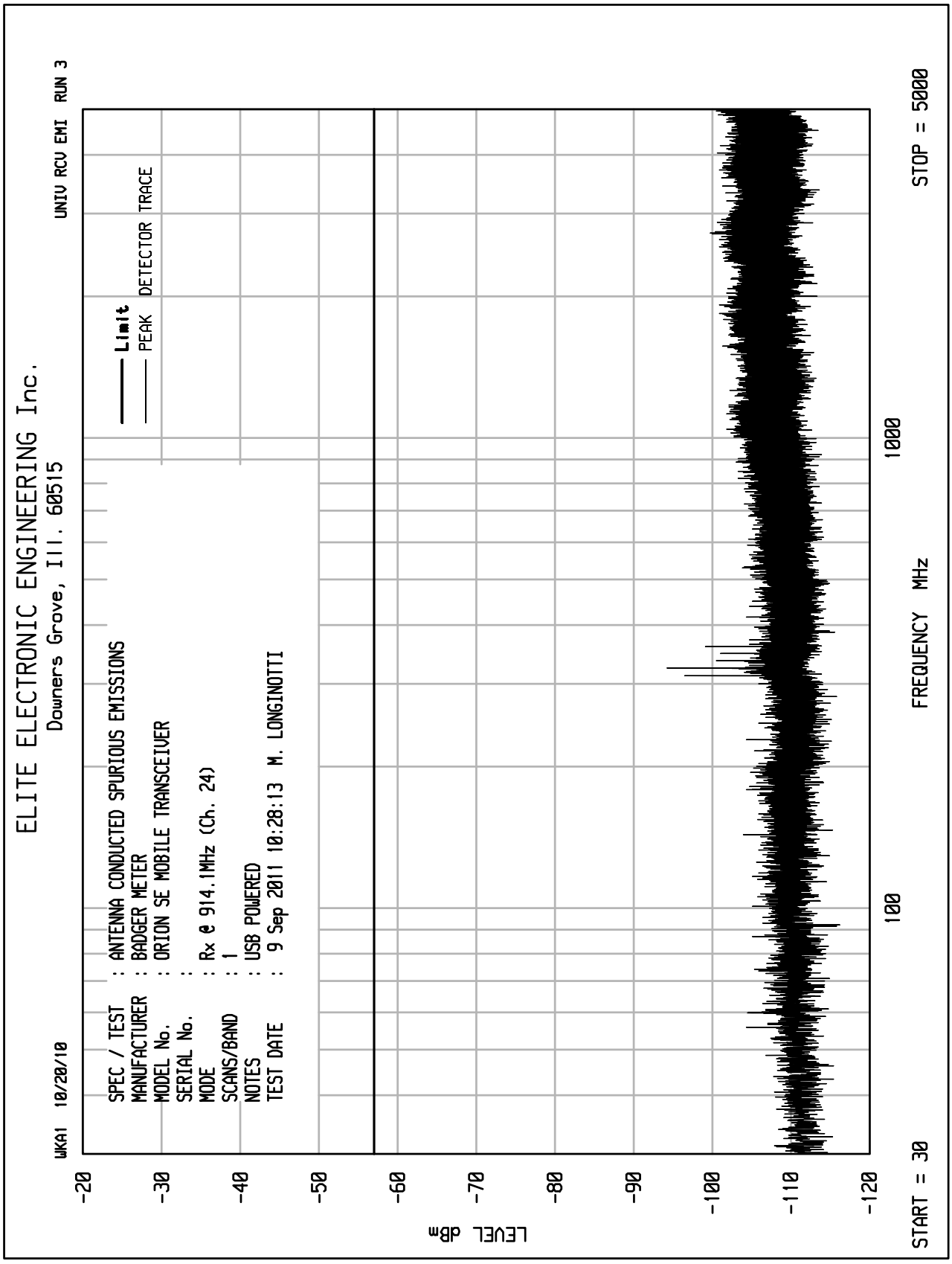
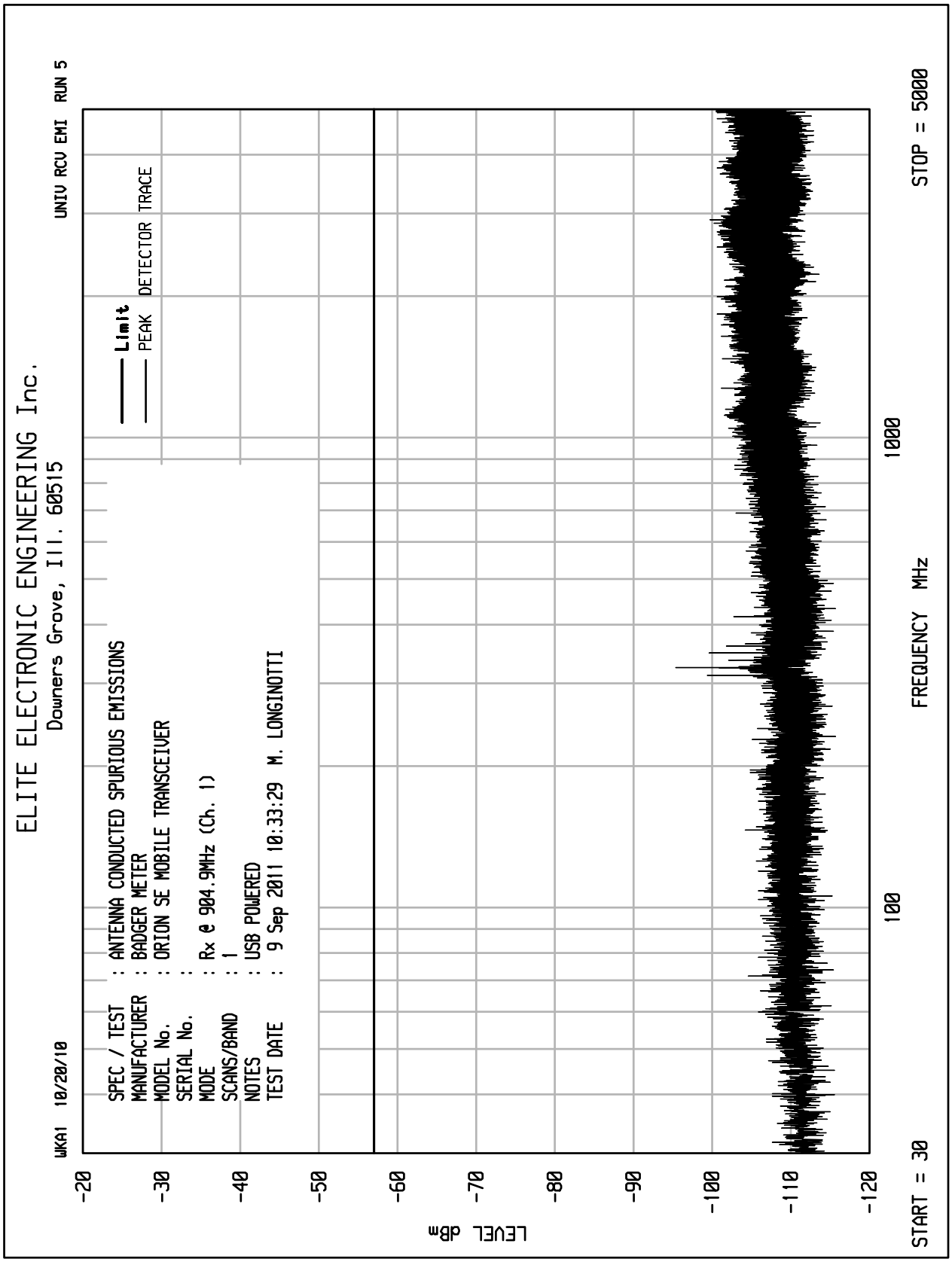
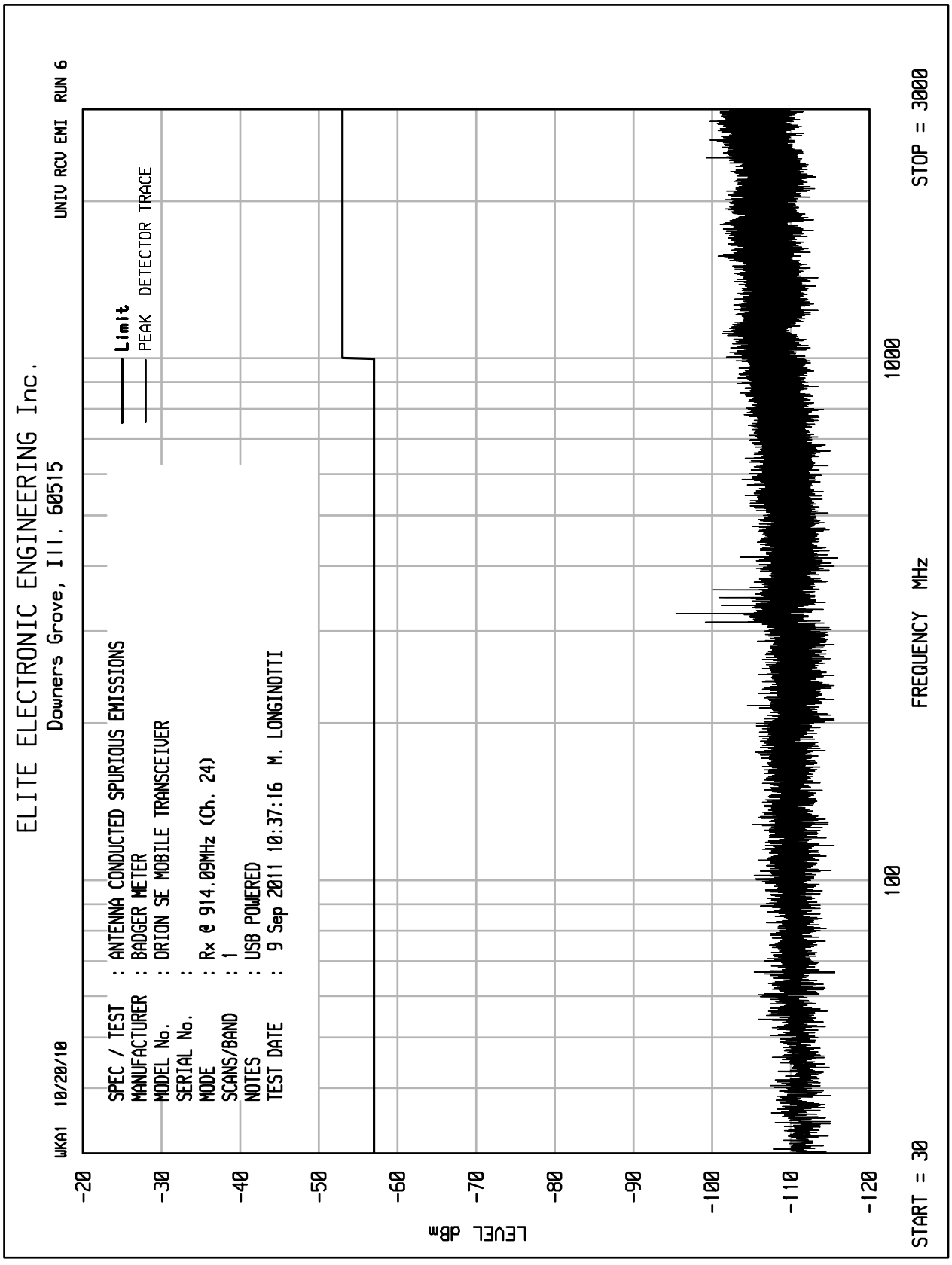
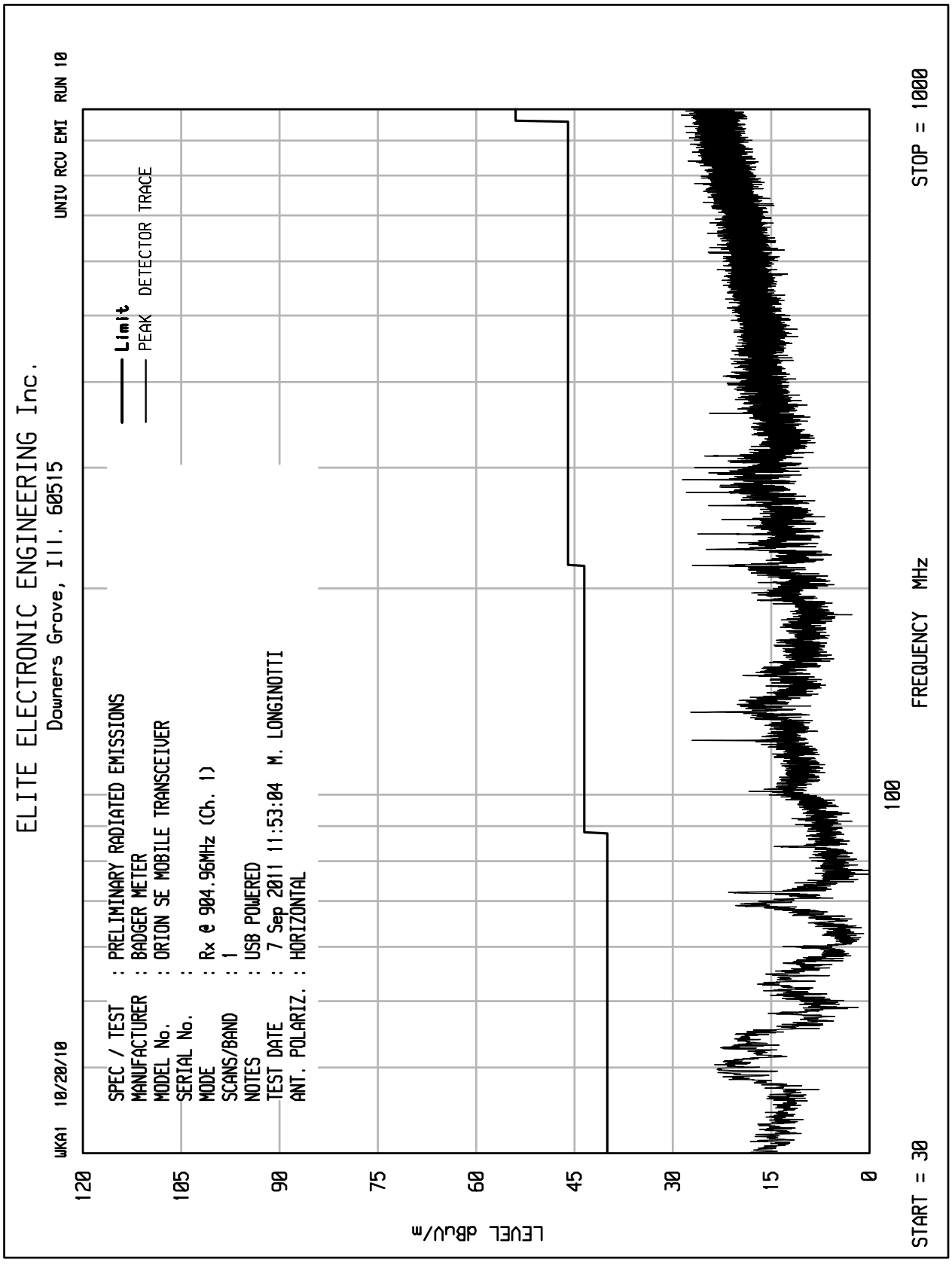
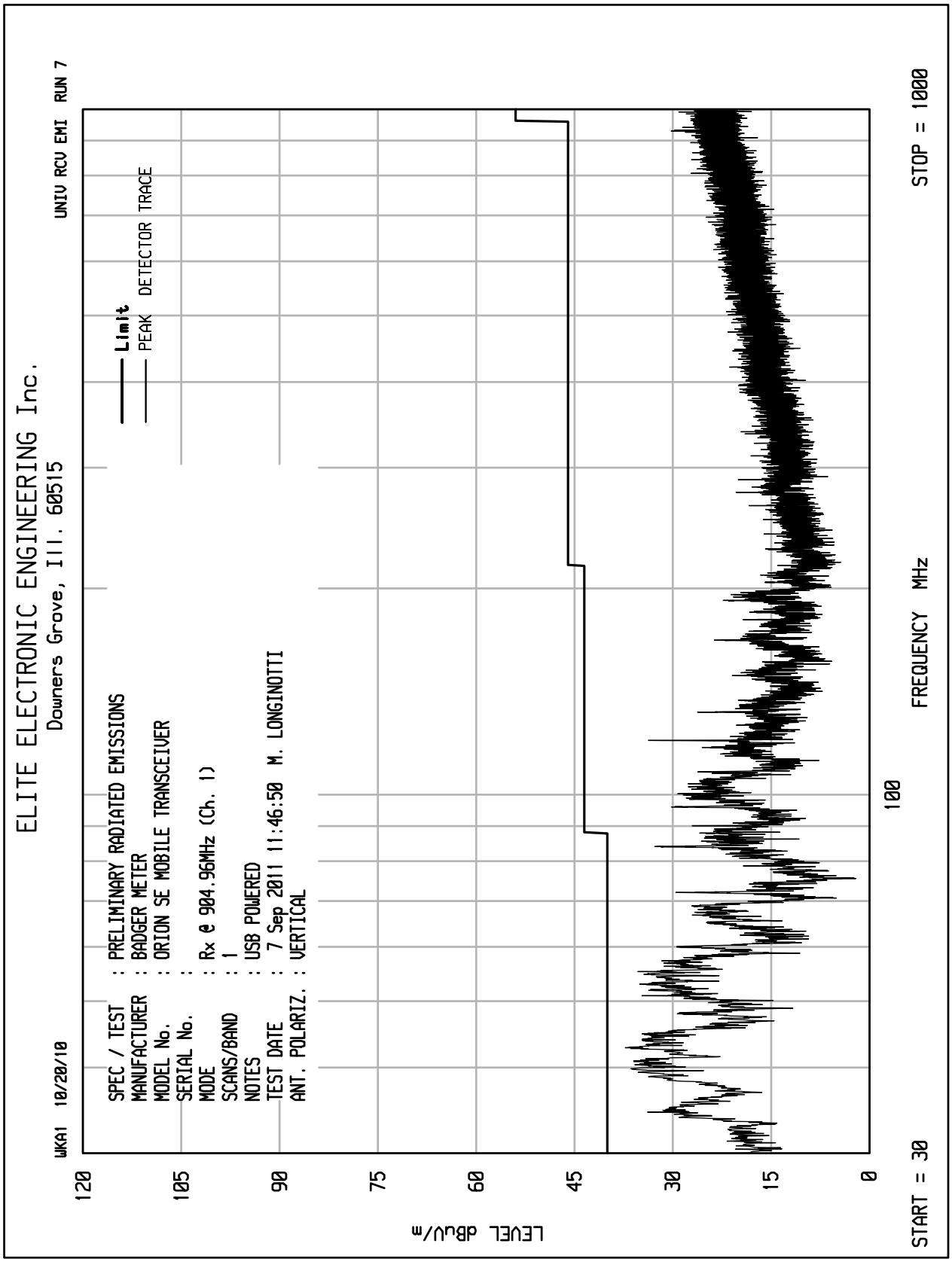
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 923.7MHz (Ch. 40)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 9 Sep 2011 10:26:30 M. LONGINOTTI
Limit
PEAK DETECTOR TRACE
LEVEL dBm
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
START = 30
100
1000
STOP = 5000
FREQUENCY MHz

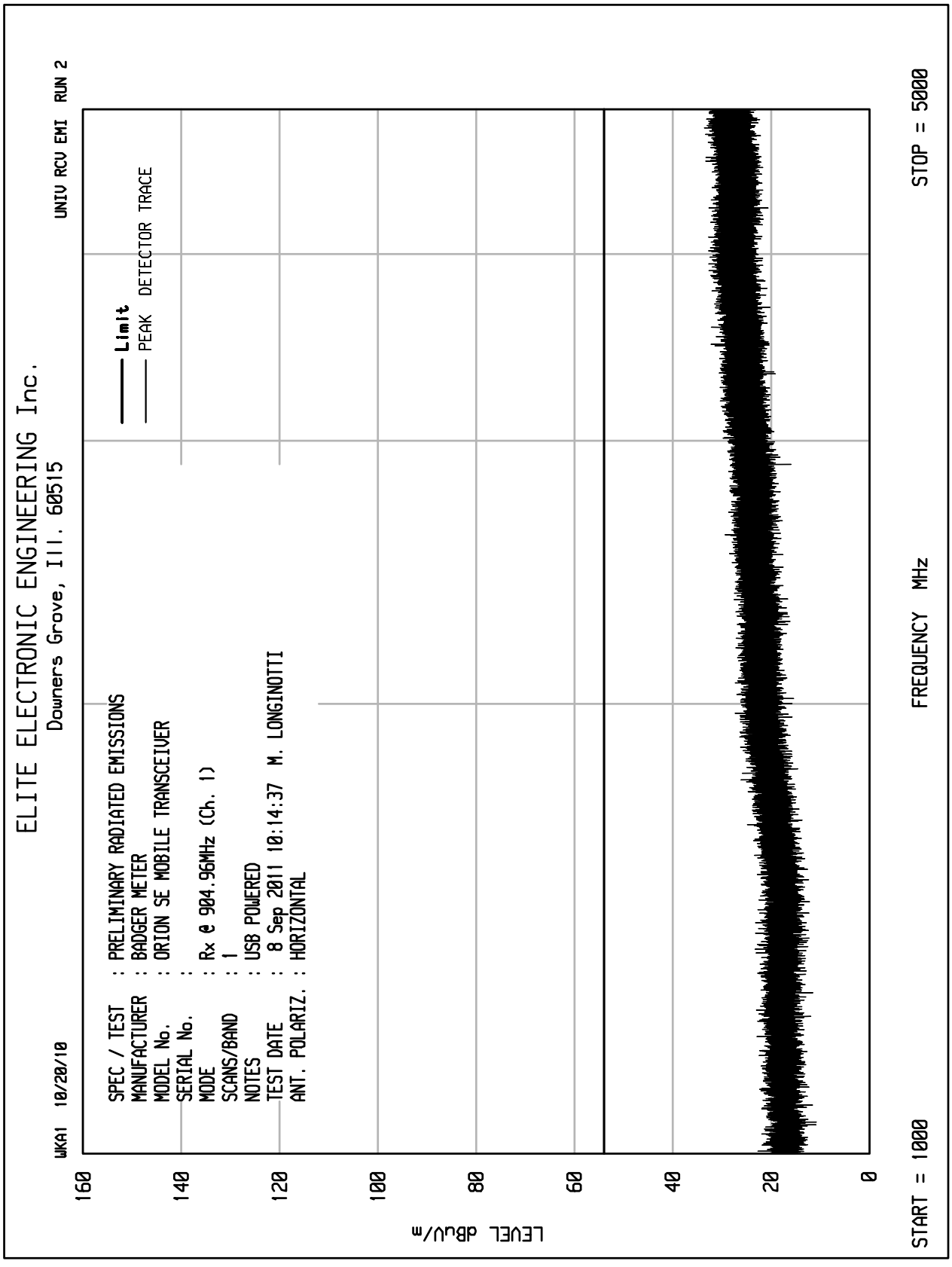

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKA1 10/20/10
SPEC / TEST : ANTENNA CONDUCTED SPURIOUS EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 914.1MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 9 Sep 2011 10:28:13 M. LONGINOTTI
Limit
PEAK DETECTOR TRACE
LEVEL dBm
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
START = 30
100
1000
FREQUENCY MHz
STOP = 5000

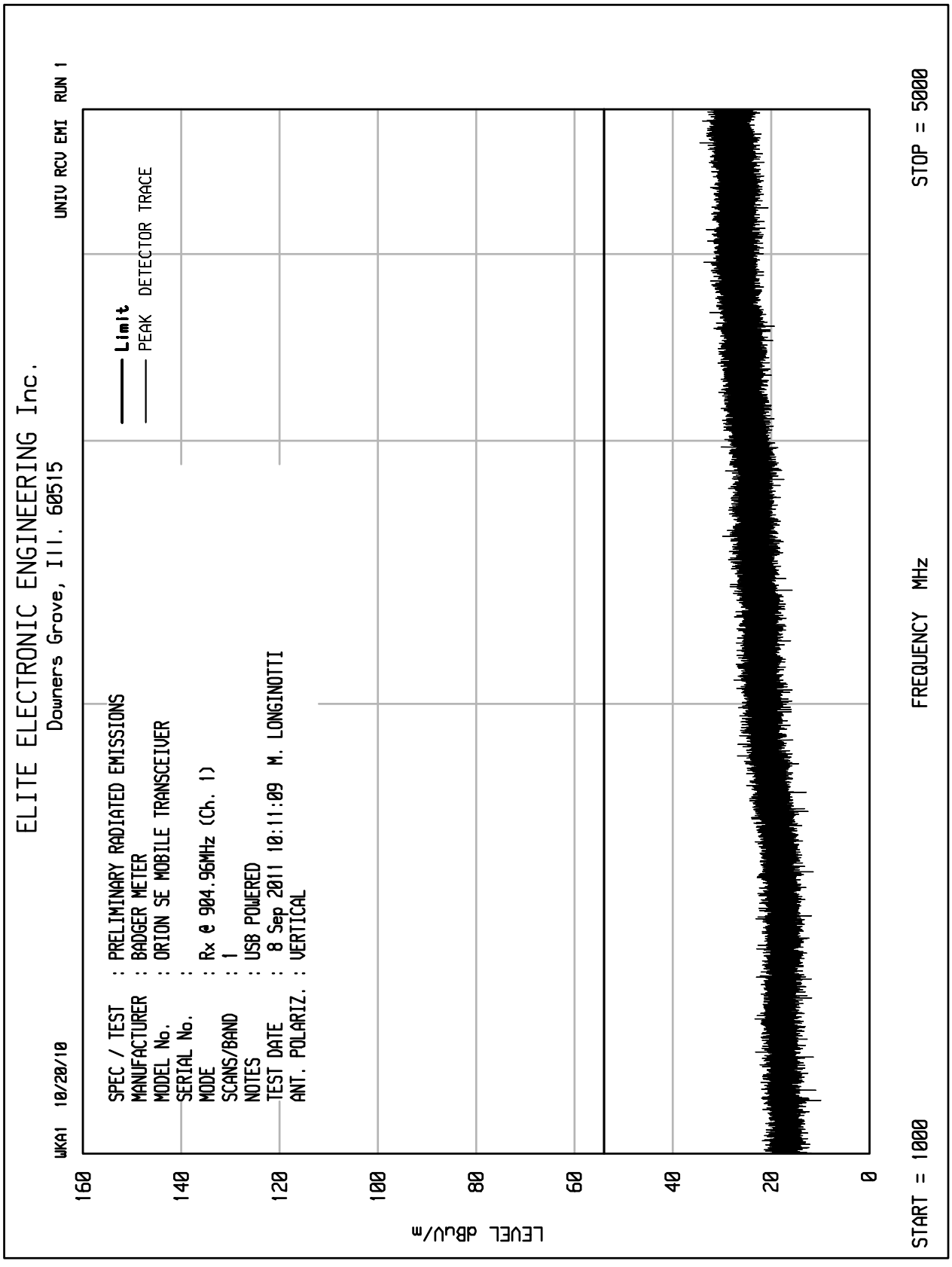

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKA1 10/20/10
SPEC / TEST : ANTENNA CONDUCTED SPURIOUS EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 904.9MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 9 Sep 2011 10:33:29 M. LONGINOTTI
Limit
PEAK DETECTOR TRACE
LEVEL dBm
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
START = 30
100
1000
STOP = 5000
FREQUENCY MHz

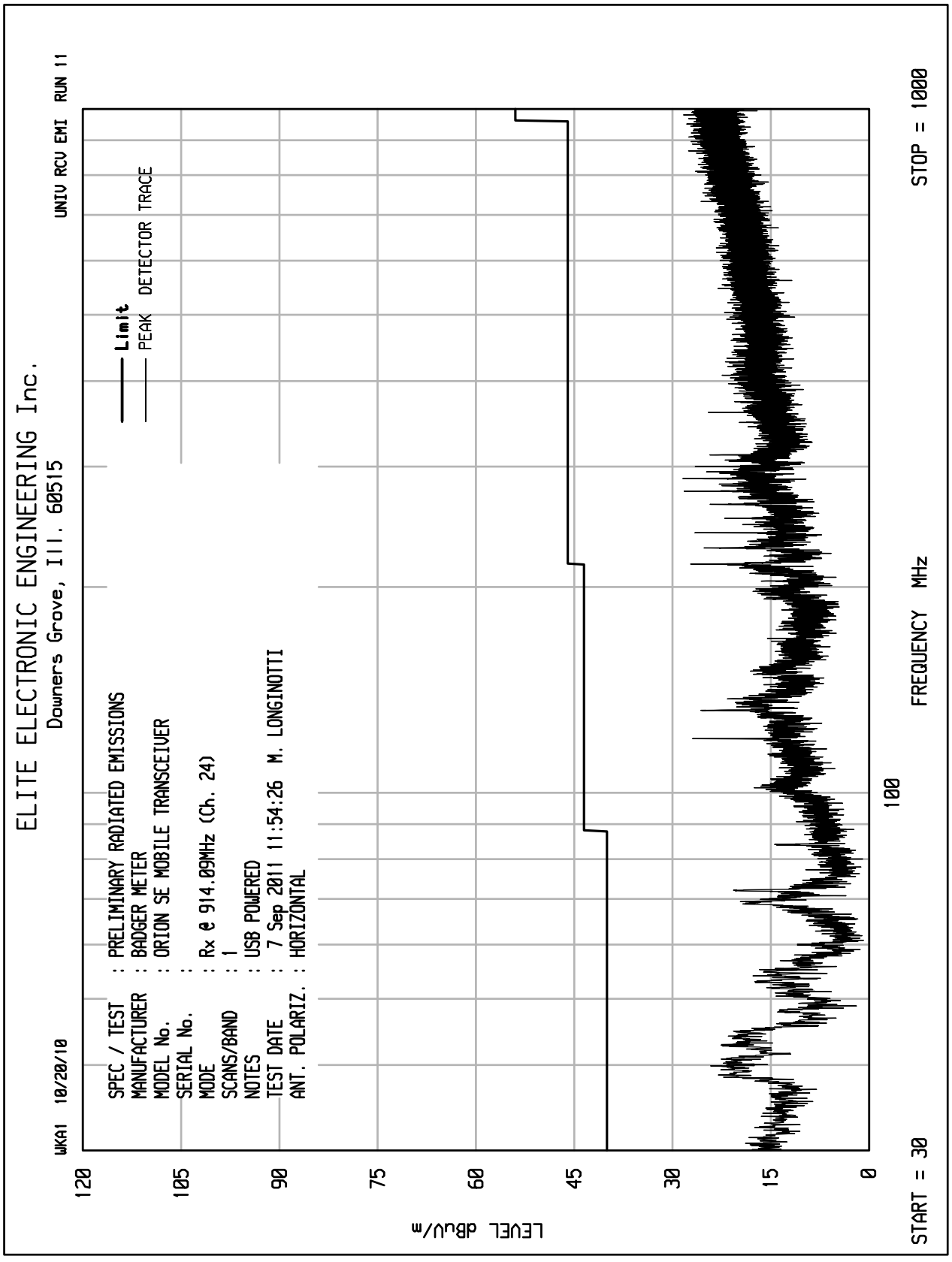

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 6
WKAI 10/20/10
SPEC / TEST : ANTENNA CONDUCTED SPURIOUS EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 9 Sep 2011 10:37:16 M. LONGINOTTI
Limit
PEAK DETECTOR TRACE
LEVEL dBm
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
START = 30
100
1000
STOP = 3000
FREQUENCY MHz

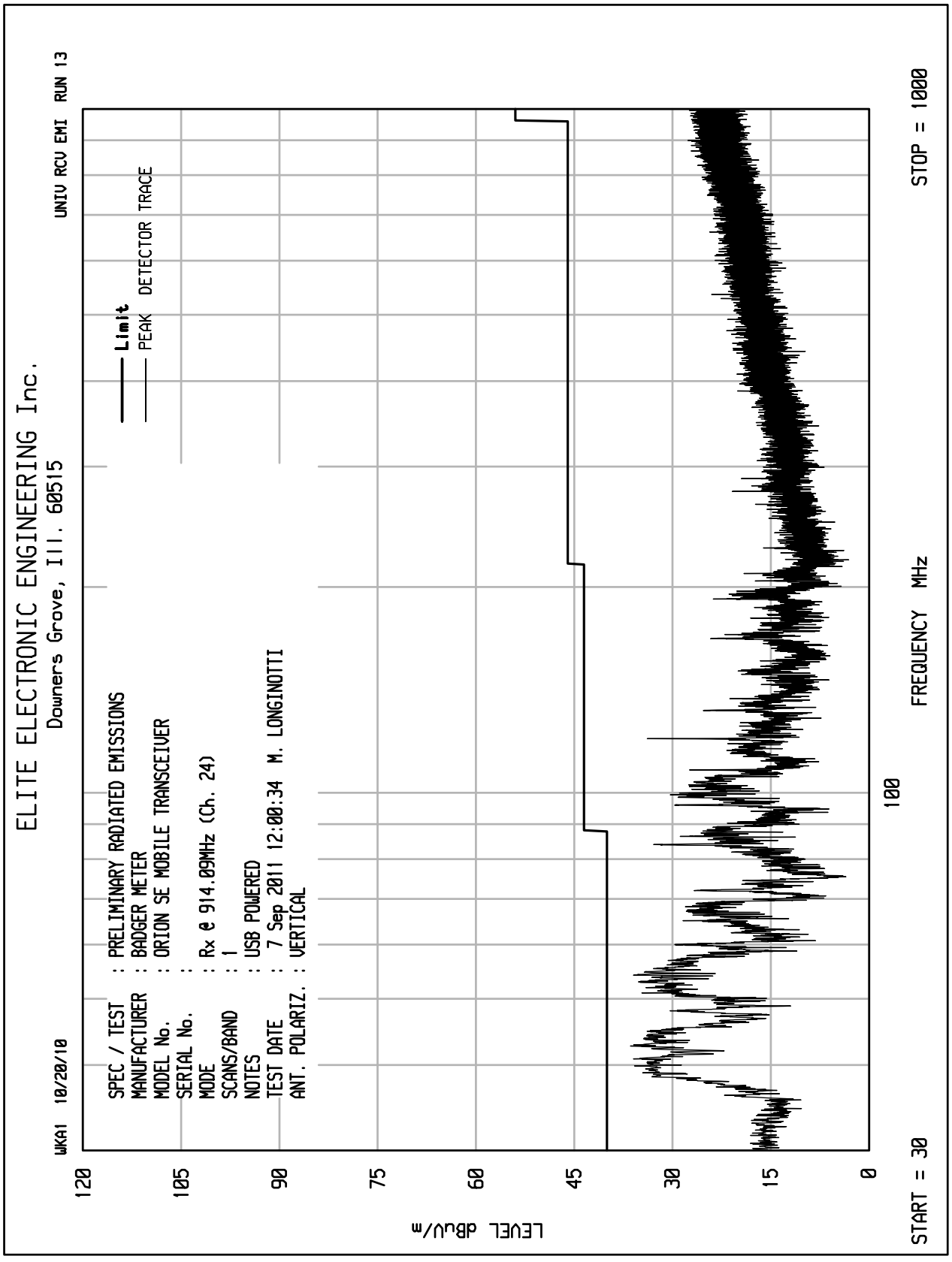

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 10
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 904.96MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 11:53:04 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

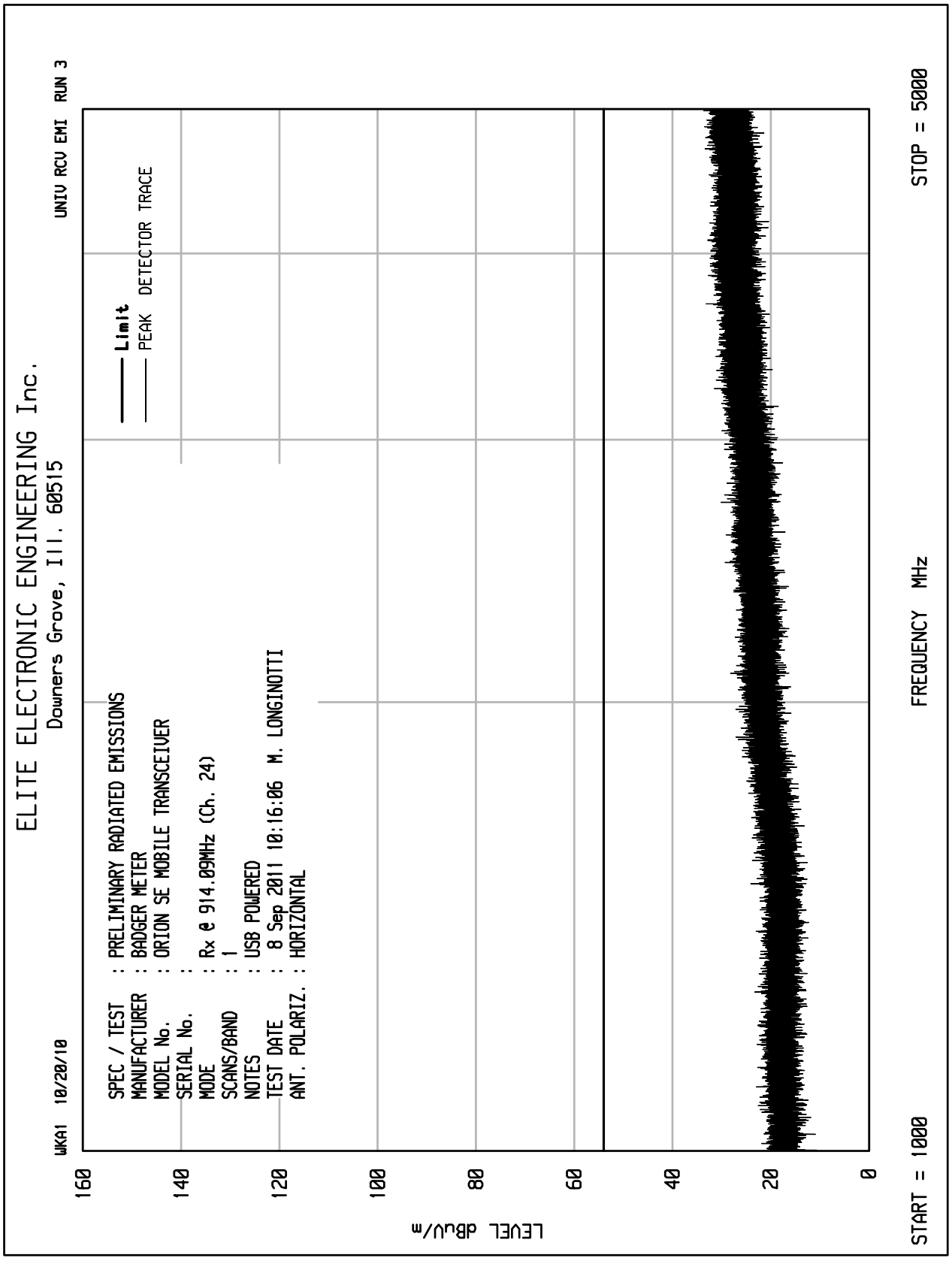

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 7
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 904.96MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 11:46:50 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

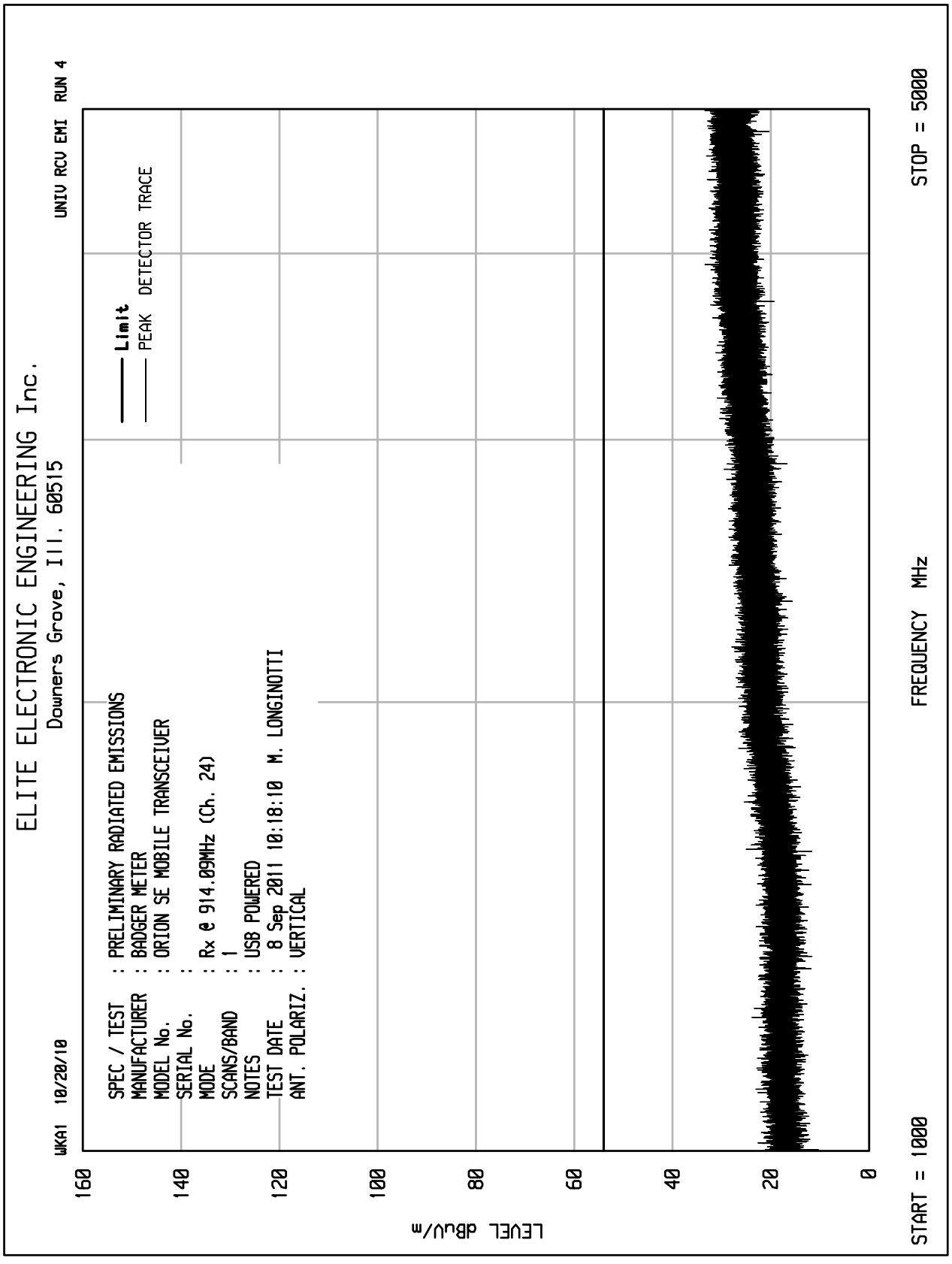

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 904.96MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 8 Sep 2011 10:14:37 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
160
140
120
100
80
60
40
20
0
START = 1000
FREQUENCY MHz
STOP = 5000

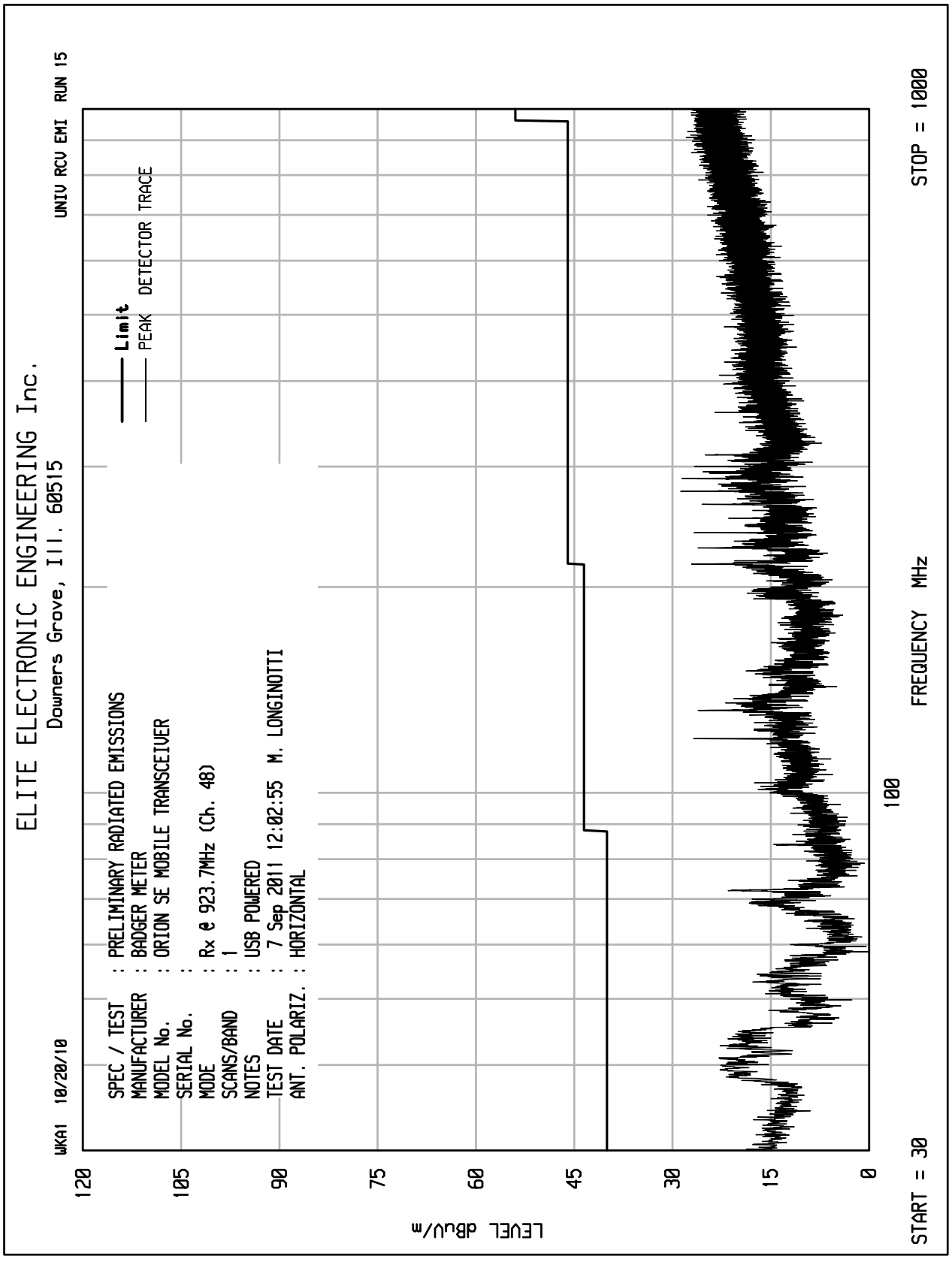

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 1
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 904.96MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 8 Sep 2011 10:11:09 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
160
140
120
100
80
60
40
20
0
START = 1000
FREQUENCY MHz
STOP = 5000

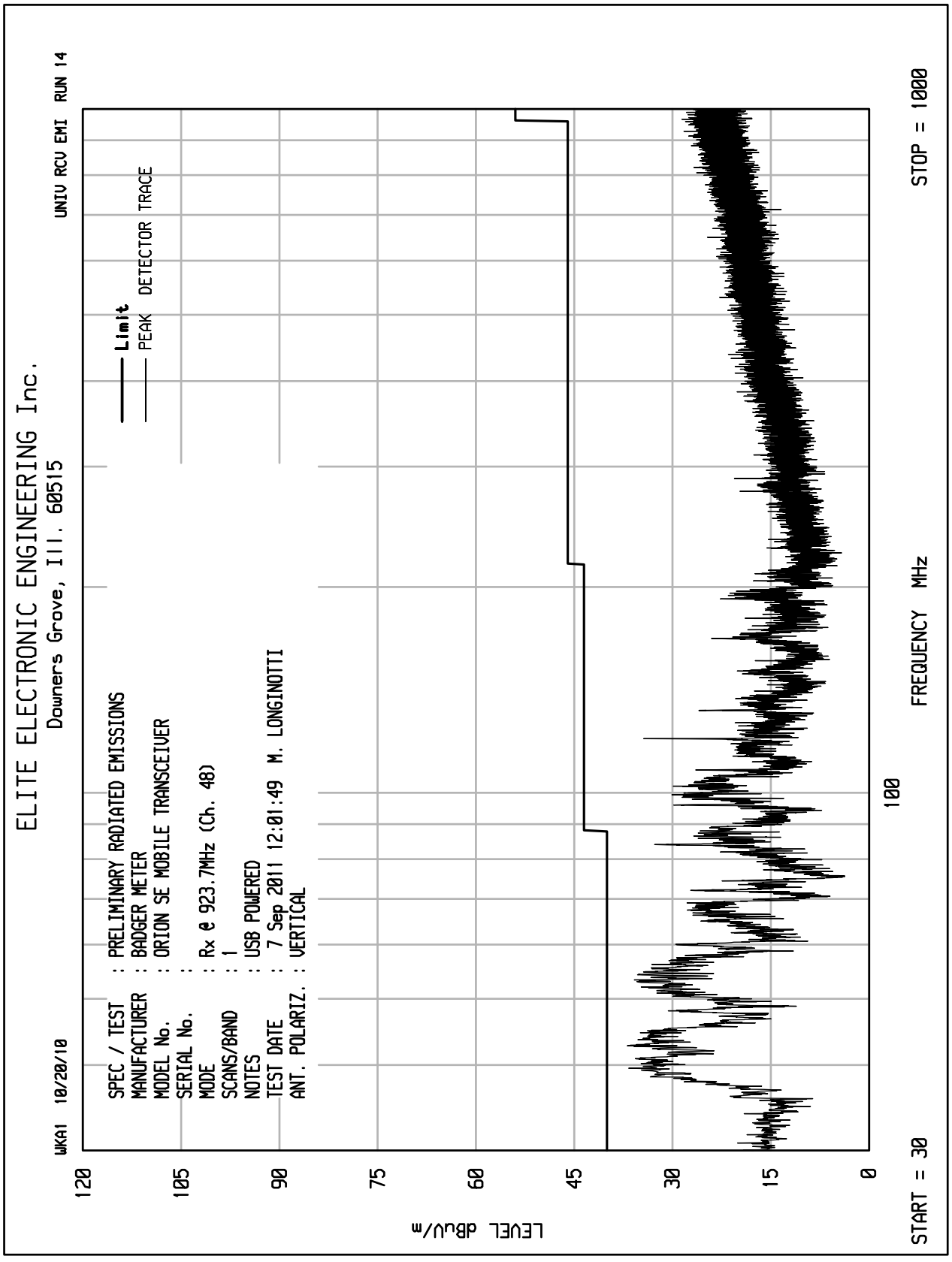

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 11
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 11:54:26 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

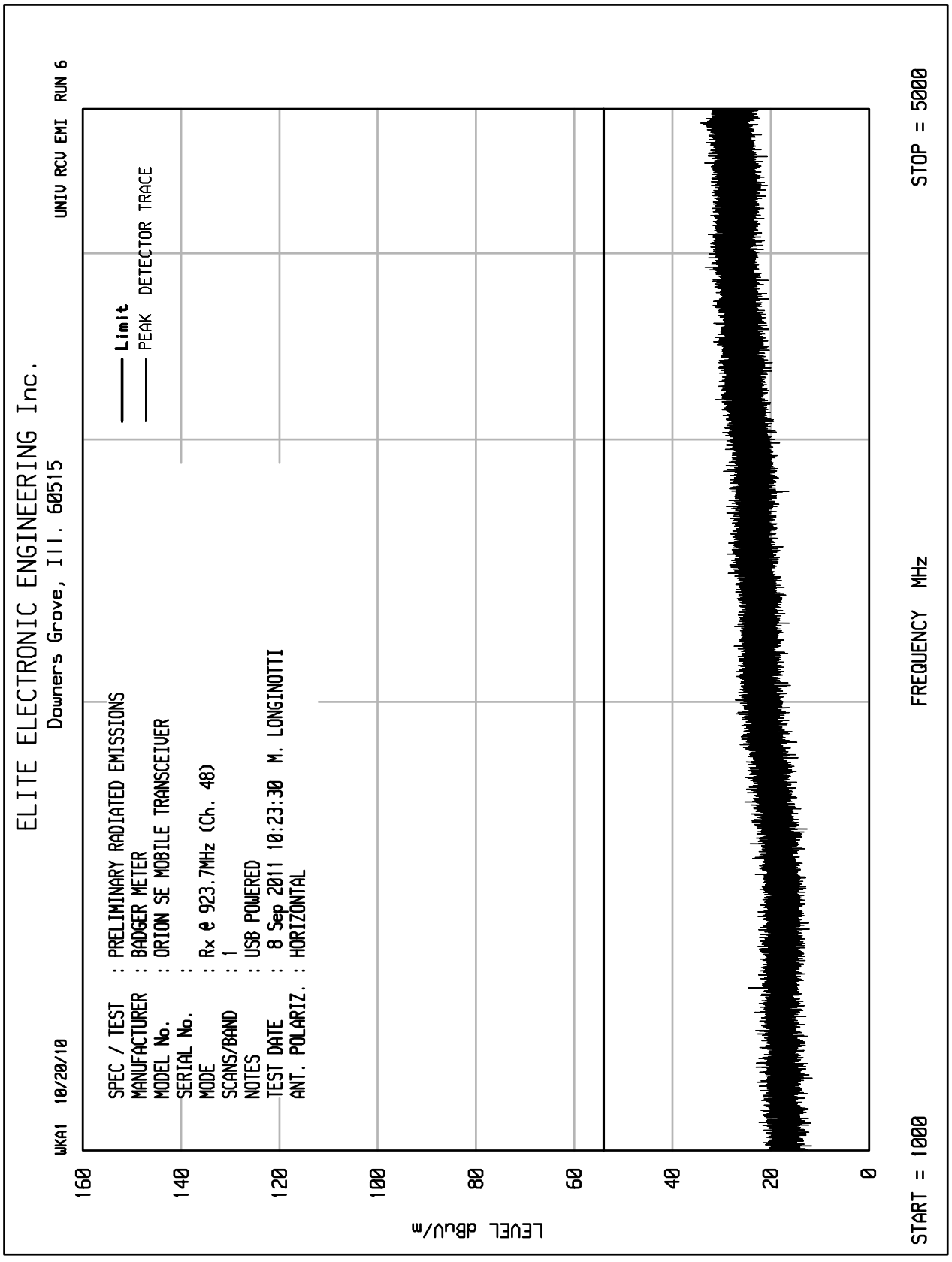

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 13
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:00:34 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

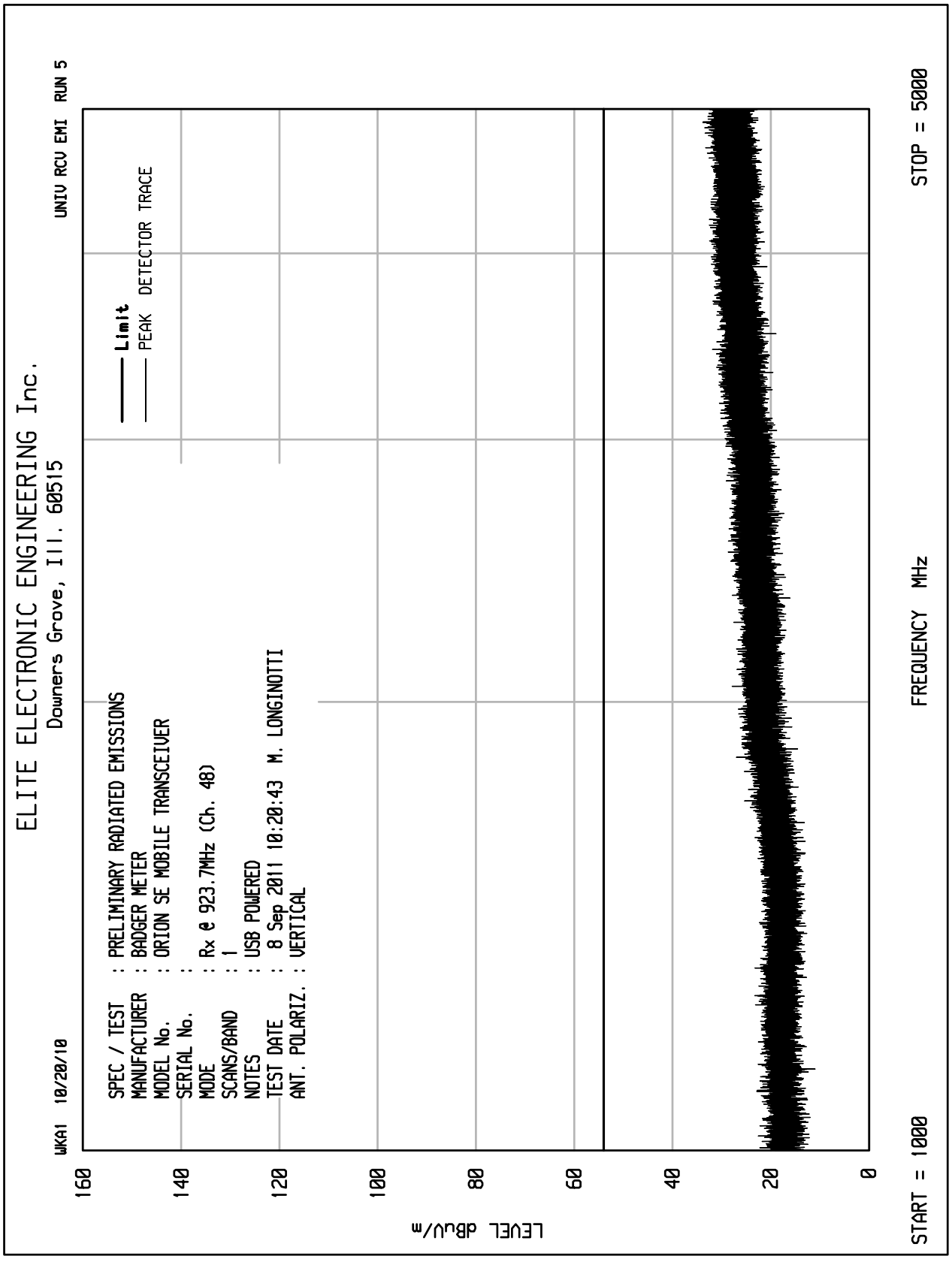

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 8 Sep 2011 10:16:06 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
160
140
120
100
80
60
40
20
0
START = 1000
FREQUENCY MHz
STOP = 5000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 8 Sep 2011 10:18:10 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
160
140
120
100
80
60
40
20
0
START = 1000
FREQUENCY MHz
STOP = 5000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 15
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:02:55 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
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 14
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:01:49 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
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 6
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 8 Sep 2011 10:23:30 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
160
140
120
100
80
60
40
20
0
START = 1000
FREQUENCY MHz
STOP = 5000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Rx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 8 Sep 2011 10:20:43 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
160
140
120
100
80
60
40
20
0
START = 1000
FREQUENCY MHz
STOP = 5000

Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15B Spurious Radiated Emissions
Date : September 8, 2011
Mode : Rx @ 904.9MHz (Ch. 1)
Notes : Test Distance is 3 meters
Notes : USB Powered

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
904.960	H	5.3	Ambient	2.0	21.8	0.0	0.0	29.1	28.5	200.0
904.960	V	5.7	Ambient	2.0	21.8	0.0	0.0	29.5	29.9	200.0
1809.920	H	49.3	Ambient	2.9	26.6	-40.6	0.0	38.1	80.2	500.0
1809.920	V	49.6	Ambient	2.9	26.6	-40.6	0.0	38.4	83.0	500.0
2714.880	H	48.1	Ambient	3.7	29.6	-40.3	0.0	41.0	112.3	500.0
2714.880	V	48.5	Ambient	3.7	29.6	-40.3	0.0	41.4	117.5	500.0
3619.840	H	47.4	Ambient	4.3	32.1	-39.9	0.0	43.9	156.6	500.0
3619.840	V	47.6	Ambient	4.3	32.1	-39.9	0.0	44.1	160.3	500.0
4524.800	H	47.1	Ambient	4.8	33.0	-40.0	0.0	44.9	175.2	500.0
4524.800	V	47.0	Ambient	4.8	33.0	-40.0	0.0	44.8	173.2	500.0

FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB))
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15B Spurious Radiated Emissions
Date : September 8, 2011
Mode : Rx @ 913.9MHz (Ch. 24)
Notes : Test Distance is 3 meters
Notes : USB Powered

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
914.090	H	5.3	Ambient	2.0	21.8	0.0	29.1	28.5	200.0	-16.9
914.090	V	6.5	Ambient	2.0	21.8	0.0	30.3	32.7	200.0	-15.7
1828.180	H	49.0	Ambient	2.9	26.8	-40.6	38.0	79.8	500.0	-15.9
1828.180	V	49.4	Ambient	2.9	26.8	-40.6	38.4	83.6	500.0	-15.5
2742.270	H	48.3	Ambient	3.7	29.6	-40.3	41.2	115.1	500.0	-12.8
2742.270	V	48.0	Ambient	3.7	29.6	-40.3	40.9	111.2	500.0	-13.1
3656.360	H	47.7	Ambient	4.3	32.2	-39.8	44.5	167.4	500.0	-9.5
3656.360	V	47.6	Ambient	4.3	32.2	-39.8	44.4	165.5	500.0	-9.6
4570.450	H	46.5	Ambient	4.8	33.1	-40.0	44.4	166.4	500.0	-9.6
4570.450	V	46.5	Ambient	4.8	33.1	-40.0	44.4	166.4	500.0	-9.6

FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB))
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15B Spurious Radiated Emissions
Date : September 8, 2011
Mode : Rx @ 923.9MHz (Ch. 48)
Notes : Test Distance is 3 meters
Notes : USB Powered

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
40.880	V	25.3		0.5	13.0	0.0	38.8	87.5	100.0	-1.2
42.810	V	24.6		0.5	12.1	0.0	37.2	72.1	100.0	-2.8
52.900	V	25.8		0.5	8.0	0.0	34.3	51.7	100.0	-5.7
54.600	V	24.4		0.5	7.5	0.0	32.4	41.7	100.0	-7.6
923.700	H	5.3	Ambient	2.0	21.8	0.0	29.1	28.6	200.0	-16.9
923.700	V	5.7	Ambient	2.0	21.8	0.0	29.5	30.0	200.0	-16.5
1847.400	H	48.7	Ambient	2.9	27.0	-40.5	38.0	79.5	500.0	-16.0
1847.400	V	49.4	Ambient	2.9	27.0	-40.5	38.7	86.2	500.0	-15.3
2771.100	H	48.6	Ambient	3.7	29.6	-40.3	41.5	119.3	500.0	-12.4
2771.100	V	48.1	Ambient	3.7	29.6	-40.3	41.0	112.7	500.0	-12.9
3694.800	H	48.2	Ambient	4.3	32.4	-39.7	45.3	183.3	500.0	-8.7
3694.800	V	47.5	Ambient	4.3	32.4	-39.7	44.6	169.1	500.0	-9.4
4618.500	H	46.9	Ambient	4.8	33.3	-40.0	45.0	177.4	500.0	-9.0
4618.500	V	46.4	Ambient	4.8	33.3	-40.0	44.5	167.4	500.0	-9.5

FS (dBuV/m) = MTR (dBuV) + AF (dB/m) + CF (dB) + (- PA (dB))
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	SONY VAIO PCG-390ZP
DUT Revision	:	PCG-GRT390ZP
Serial Number	:	
DUT Mode	:	RUNNING WINDOWS
Line Tested	:	115V, 60Hz HIGH OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 10:39:26 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

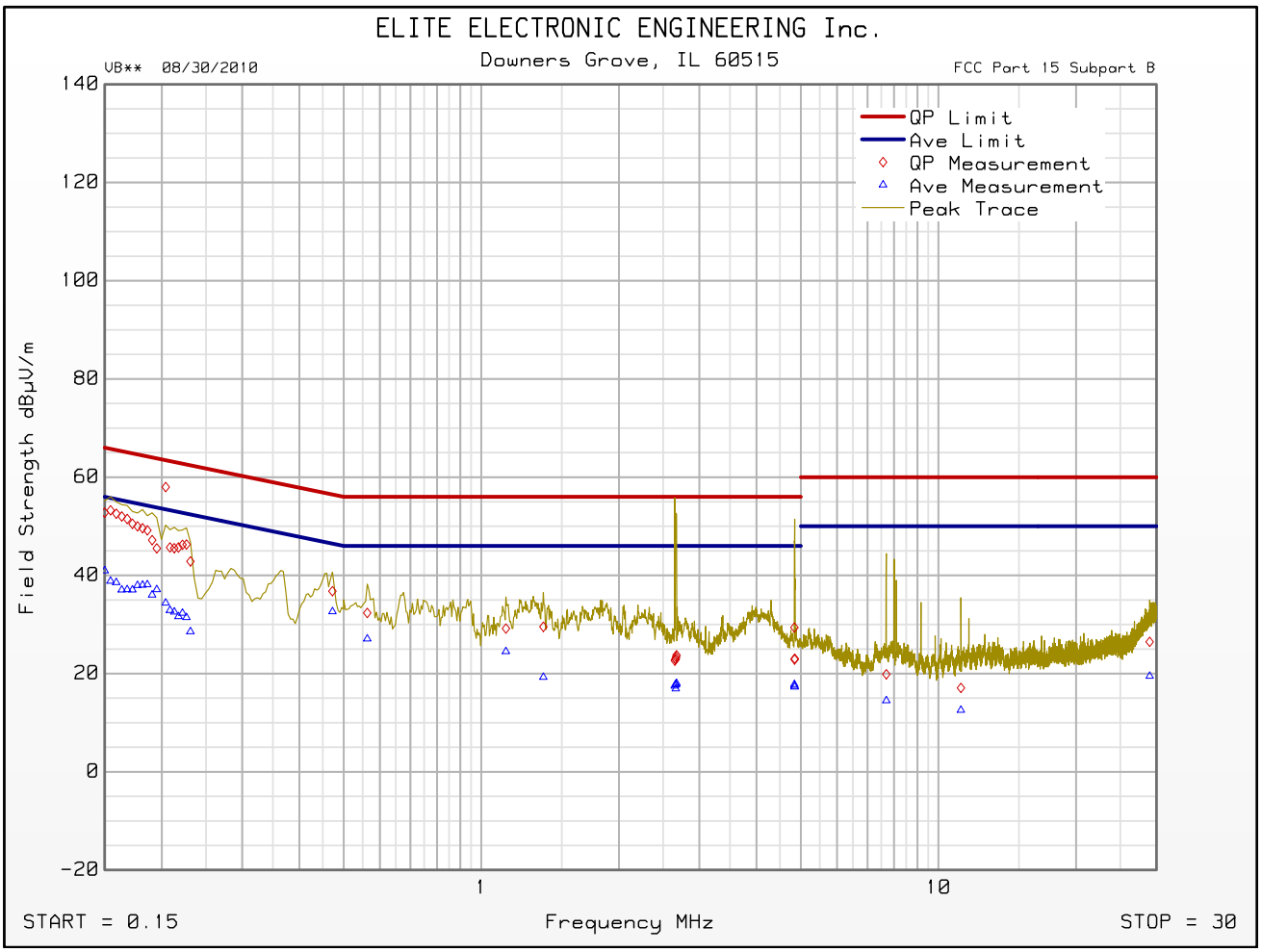
Freq MHz	Quasi-peak Level dBµV/m	Quasi-peak Limit dBµV/m	Excessive Quasi-peak Emissions	Average Level dBµV/m	Average Limit dBµV/m	Excessive Average Emissions
0.204	58.0	63.4		34.4	53.4	
0.473	36.8	56.5		32.6	46.5	
0.563	32.4	56.0		27.1	46.0	
1.132	29.2	56.0		24.5	46.0	
1.367	29.5	56.0		19.3	46.0	
2.673	23.8	56.0		18.0	46.0	
4.841	29.4	56.0		17.8	46.0	
7.691	19.9	60.0		14.5	50.0	
11.201	17.1	60.0		12.6	50.0	
28.985	26.5	60.0		19.5	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	SONY VAIO PCG-390ZP
DUT Revision	:	PCG-GRT390ZP
Serial Number	:	
DUT Mode	:	RUNNING WINDOWS
Line Tested	:	115V, 60Hz HIGH OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 10:39:26 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	SONY VAIO PCG-390ZP
DUT Revision	:	PCG-GRT390ZP
Serial Number	:	
DUT Mode	:	RUNNING WINDOWS
Line Tested	:	115V, 60Hz RETURN OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 10:46:08 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

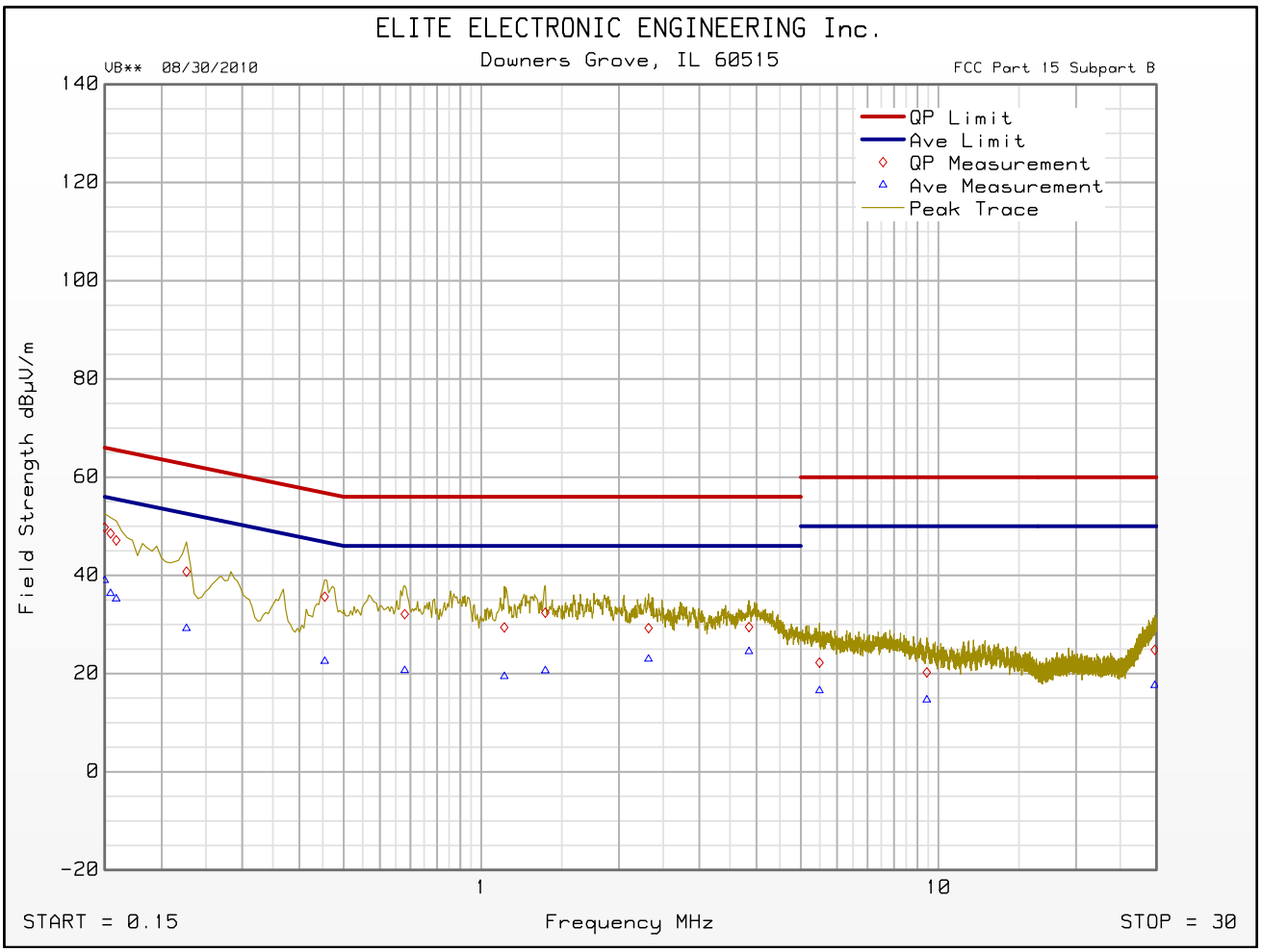
Freq MHz	Quasi-peak Level dBµV/m	Quasi-peak Limit dBµV/m	Excessive Quasi-peak Emissions	Average Level dBµV/m	Average Limit dBµV/m	Excessive Average Emissions
0.150	49.8	66.0		39.0	56.0	
0.455	35.7	56.8		22.5	46.8	
0.680	32.1	56.0		20.6	46.0	
1.123	29.4	56.0		19.4	46.0	
1.381	32.4	56.0		20.6	46.0	
2.322	29.3	56.0		23.0	46.0	
3.851	29.5	56.0		24.5	46.0	
5.495	22.2	60.0		16.5	50.0	
9.432	20.3	60.0		14.7	50.0	
29.737	24.8	60.0		17.6	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	SONY VAIO PCG-390ZP
DUT Revision	:	PCG-GRT390ZP
Serial Number	:	
DUT Mode	:	RUNNING WINDOWS
Line Tested	:	115V, 60Hz RETURN OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 10:46:08 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	ORION SE MOBILE TRANSCEIVER
DUT Revision	:	TESTED WITH SONY VAIO PCG-390Z
Serial Number	:	
DUT Mode	:	Tx @ 914.09MHz (Ch. 24)
Line Tested	:	115V, 60Hz HIGH OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	USB POWERED
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 11:31:48 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

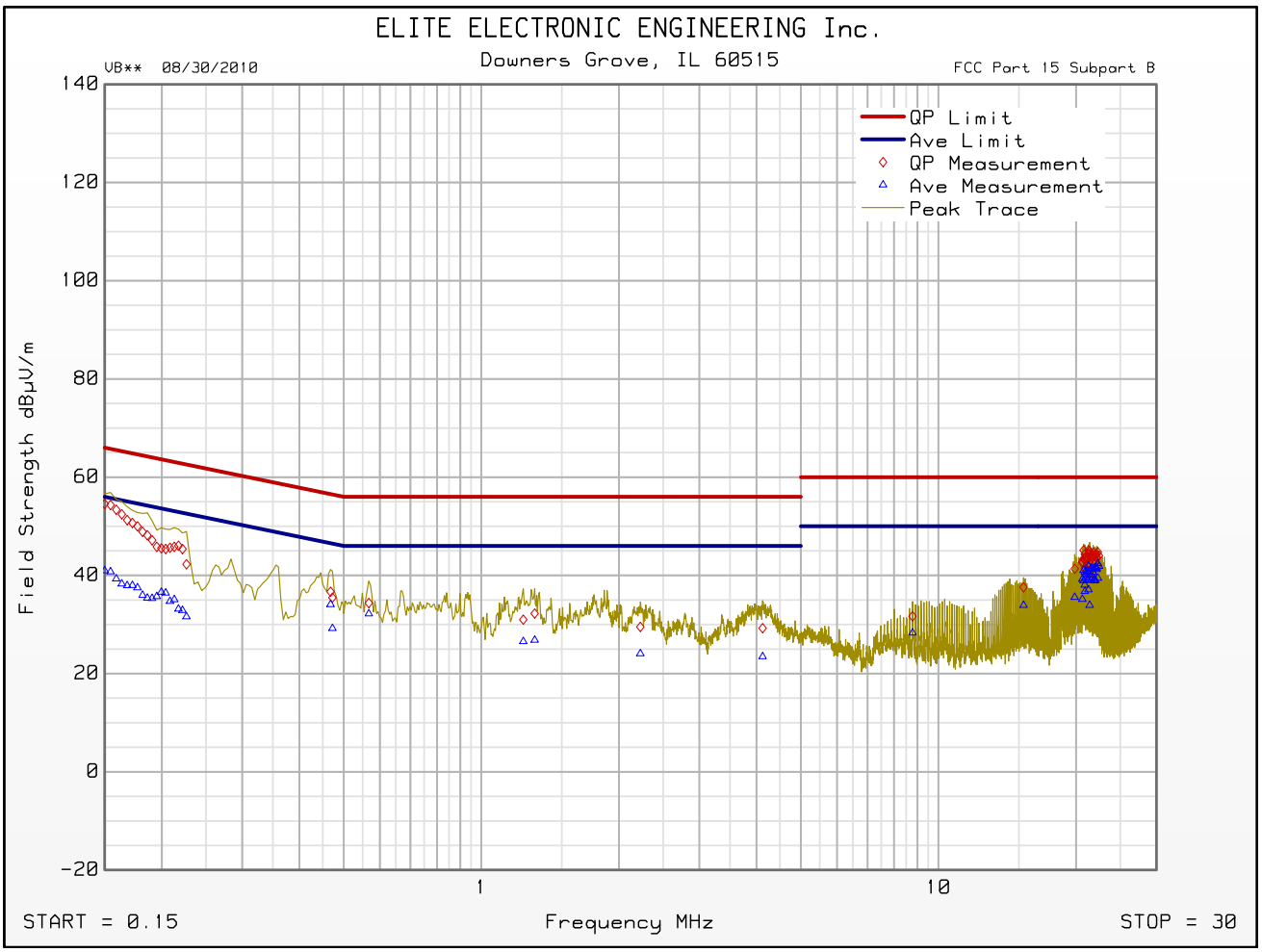
Freq MHz	Quasi-peak Level dBµV/m	Quasi-peak Limit dBµV/m	Excessive Quasi-peak Emissions	Average Level dBµV/m	Average Limit dBµV/m	Excessive Average Emissions
0.155	54.3	65.8		40.8	55.8	
0.468	36.7	56.5		34.1	46.5	
0.568	34.4	56.0		32.2	46.0	
1.236	31.0	56.0		26.6	46.0	
1.309	32.2	56.0		26.8	46.0	
2.228	29.5	56.0		24.1	46.0	
4.126	29.3	56.0		23.5	46.0	
8.776	31.7	60.0		28.3	50.0	
15.354	37.6	60.0		33.9	50.0	
20.777	45.1	60.0		41.0	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

Cumulative Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	ORION SE MOBILE TRANSCEIVER
DUT Revision	:	TESTED WITH SONY VAIO PCG-390Z
Serial Number	:	
DUT Mode	:	Tx @ 914.09MHz (Ch. 24)
Line Tested	:	115V, 60Hz HIGH OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	USB POWERED
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 11:31:48 AM



Emissions Meet QP Limit
Emissions Meet Ave Limit

FCC Part 15 Subpart B Conducted Emissions Test

Significant Emissions Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	ORION SE MOBILE TRANSCEIVER
DUT Revision	:	TESTED WITH SONY VAIO PCG-390Z
Serial Number	:	
DUT Mode	:	Tx @ 914.09MHz (Ch. 24)
Line Tested	:	115V, 60Hz RETURN OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	USB POWERED
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 11:25:10 AM
Data Filter	:	Up to 80 maximum levels detected with 6 dB level excursion threshold over 6 dB margin below limit

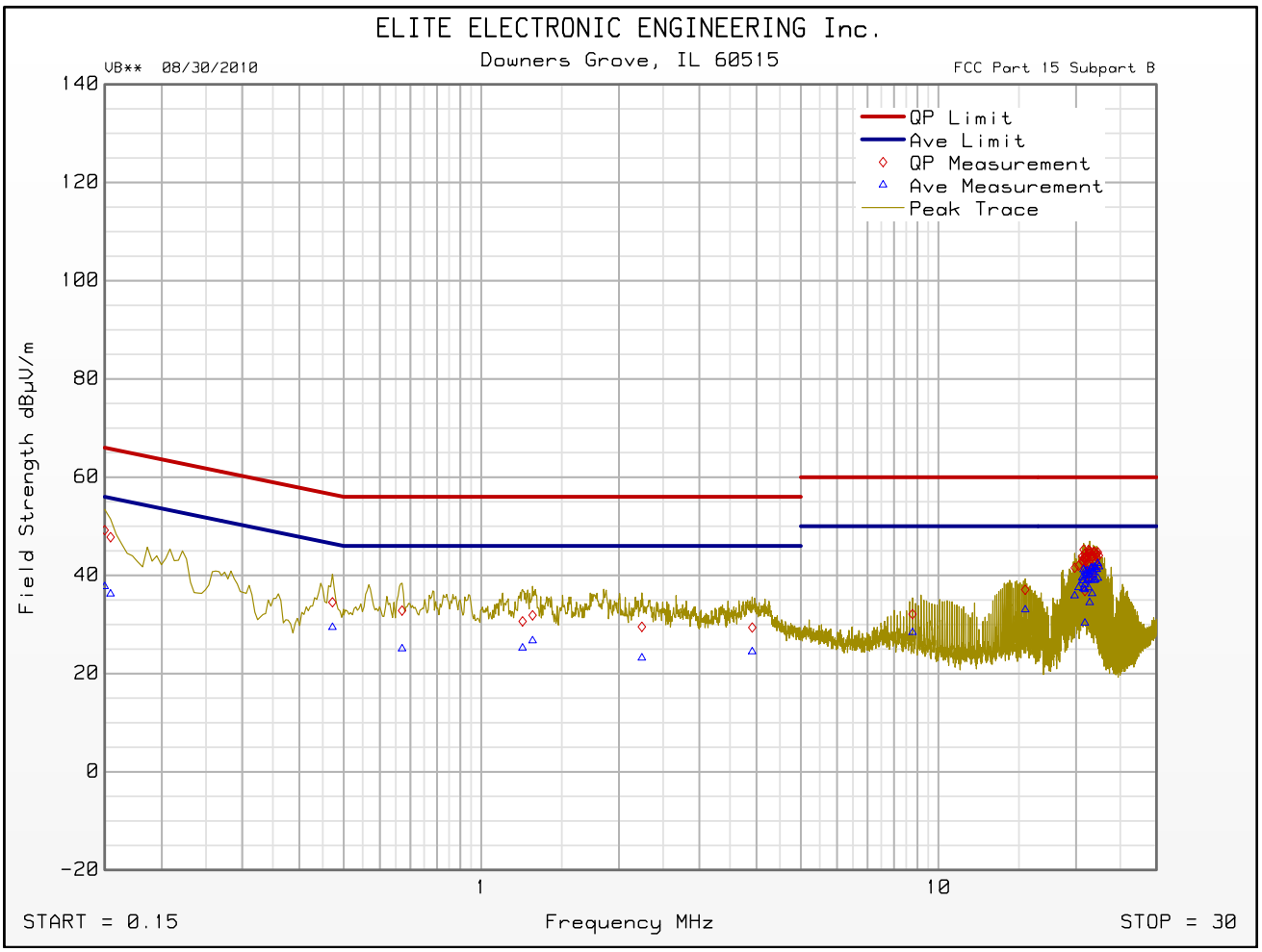
Freq MHz	Quasi-peak Level dBµV/m	Quasi-peak Limit dBµV/m	Excessive Quasi-peak Emissions	Average Level dBµV/m	Average Limit dBµV/m	Excessive Average Emissions
0.150	49.2	66.0		37.7	56.0	
0.473	34.5	56.5		29.4	46.5	
0.671	32.8	56.0		25.1	46.0	
1.231	30.6	56.0		25.2	46.0	
1.295	31.9	56.0		26.7	46.0	
2.246	29.5	56.0		23.2	46.0	
3.914	29.4	56.0		24.5	46.0	
8.776	32.1	60.0		28.4	50.0	
15.485	37.1	60.0		33.0	50.0	
20.777	45.2	60.0		41.2	50.0	

FCC Part 15 Subpart B Conducted Emissions Test

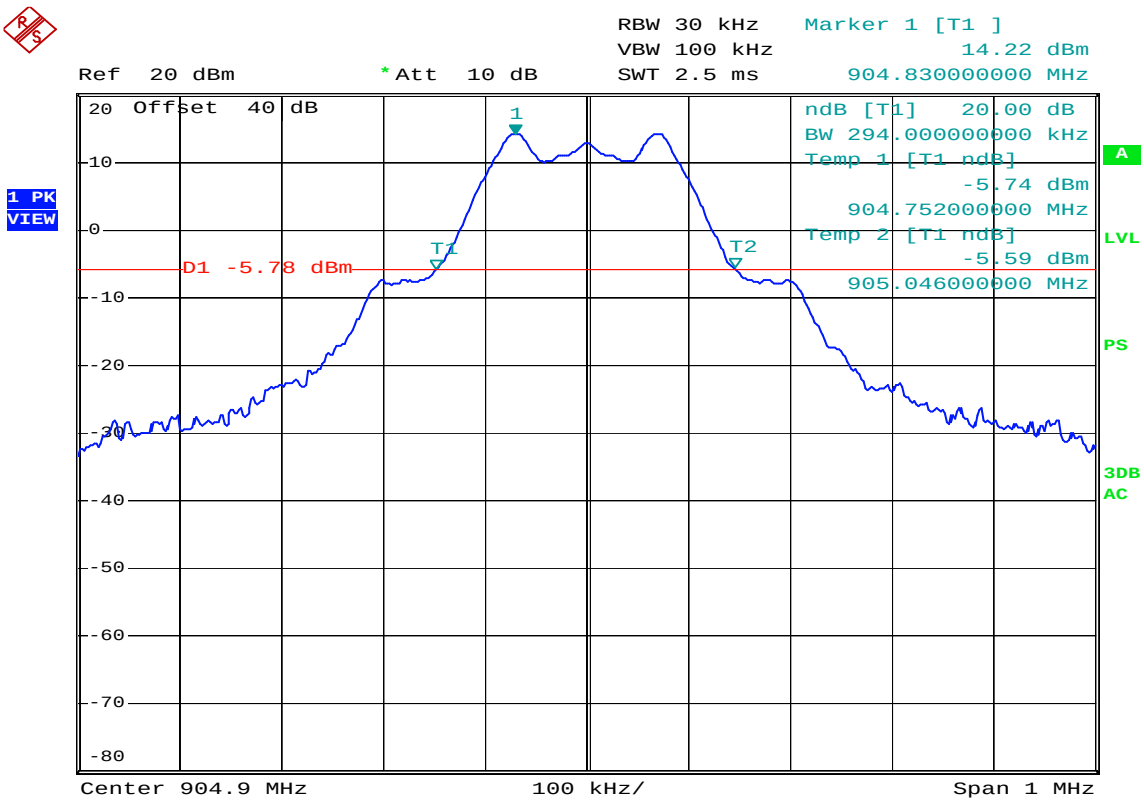
Cumulative Data

VB** 08/30/2010

Manufacturer	:	BADGER METER
Model	:	ORION SE MOBILE TRANSCEIVER
DUT Revision	:	TESTED WITH SONY VAIO PCG-390Z
Serial Number	:	
DUT Mode	:	Tx @ 914.09MHz (Ch. 24)
Line Tested	:	115V, 60Hz RETURN OF SONY AC ADAPTER PCGA-AC19V7
Scan Step Time [ms]	:	30
Meas. Threshold [dB]	:	-6
Notes	:	USB POWERED
Test Engineer	:	M. Longinotti
Limit	:	Class B
Test Date	:	Sep 08, 2011 11:25:10 AM



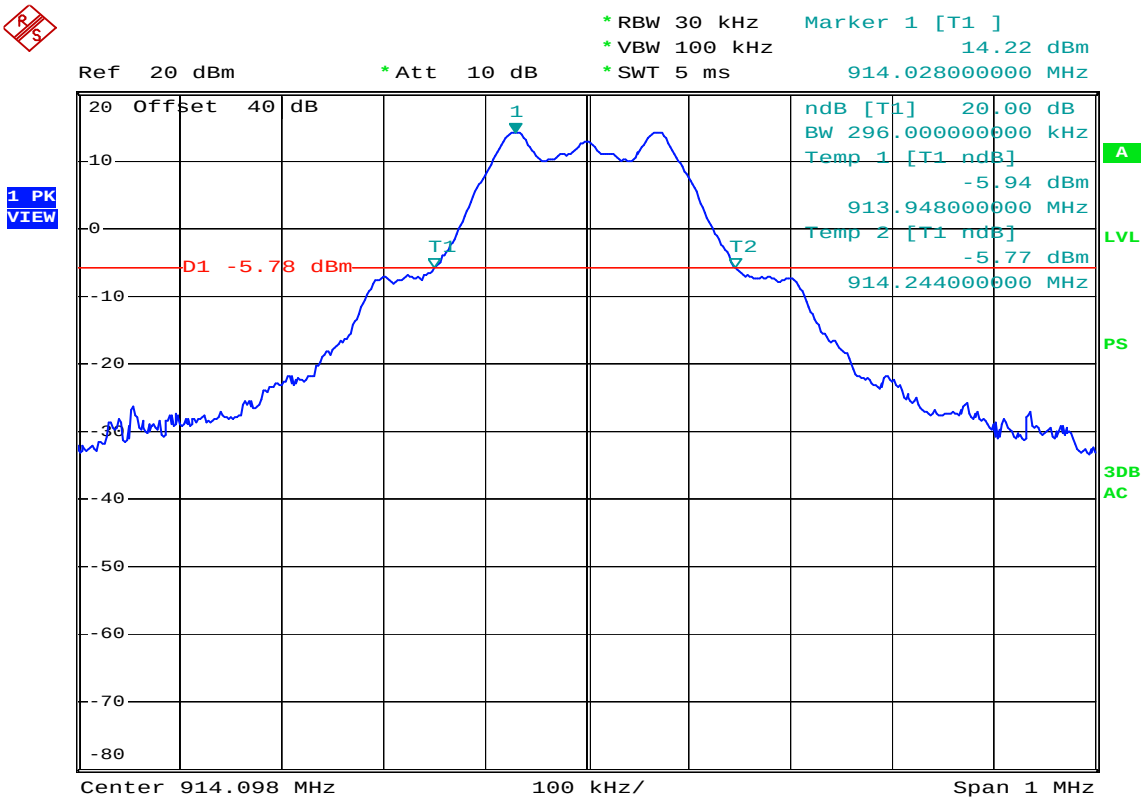
Emissions Meet QP Limit
Emissions Meet Ave Limit



Date: 8.SEP.2011 21:56:48

15.247(a) 20dB Bandwidth

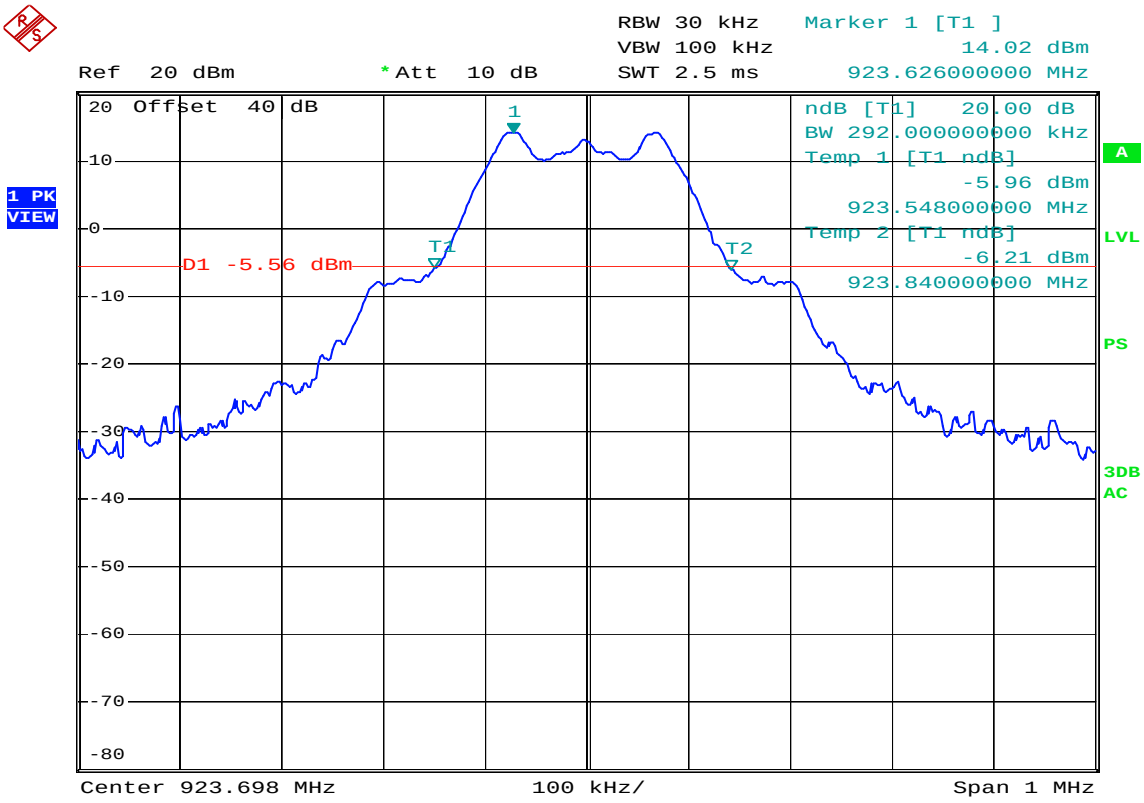
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 904.9MHz (Ch. 1)
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	20 dB Bandwidth
NOTES	:	20dB Bandwidth = 294kHz, 99% bandwidth = 278kHz
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 8.SEP.2011 22:15:22

15.247(a) 20dB Bandwidth

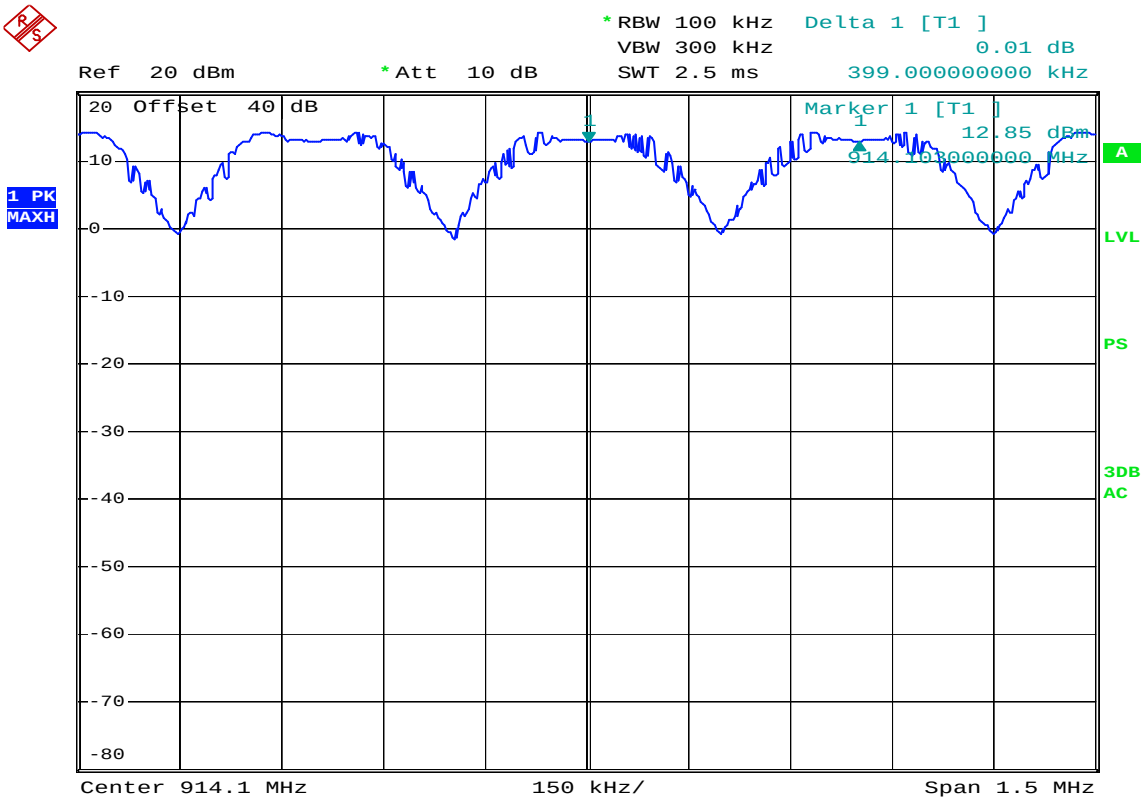
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 914.1MHz (Ch. 24)
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	20 dB Bandwidth
NOTES	:	20dB Bandwidth = 296kHz, 99% bandwidth = 282kHz
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 8.SEP.2011 22:22:26

15.247(a) 20dB Bandwidth

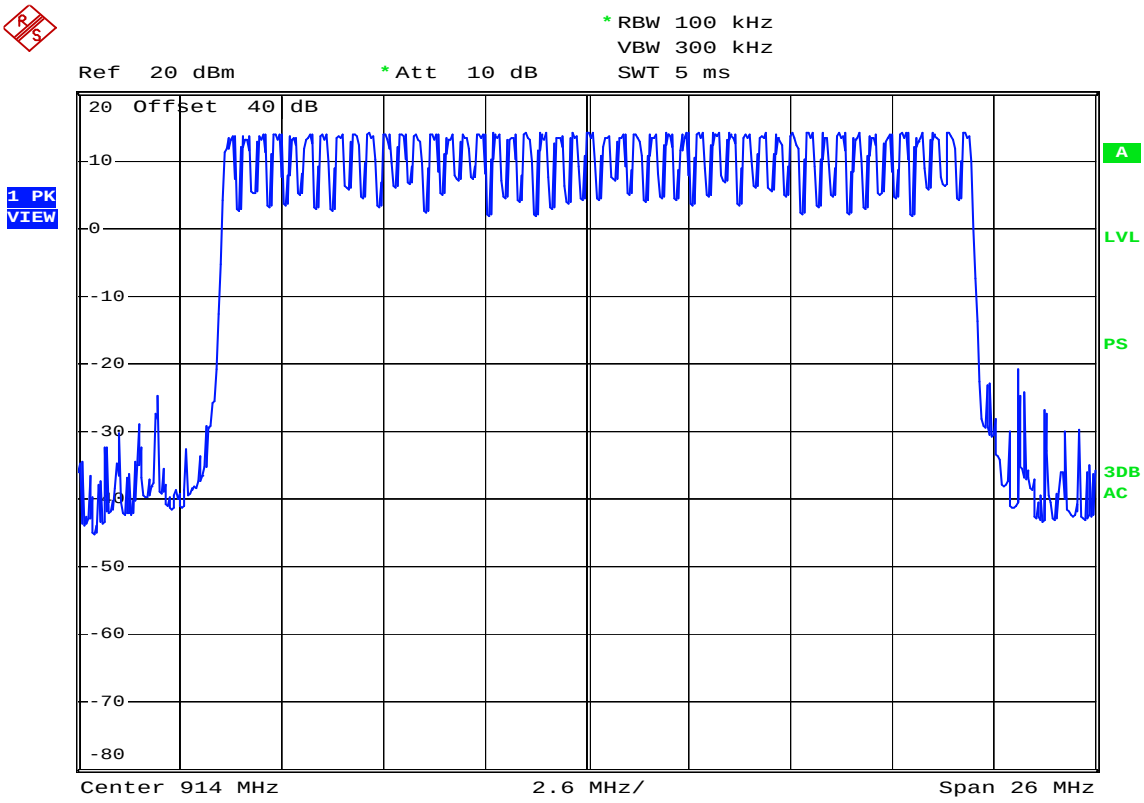
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 923.7MHz (Ch. 48)
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	20 dB Bandwidth
NOTES	:	20dB Bandwidth = 292kHz, 99% bandwidth = 272kHz
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 8.SEP.2011 23:22:24

15.247(a) Carrier Frequency Separation

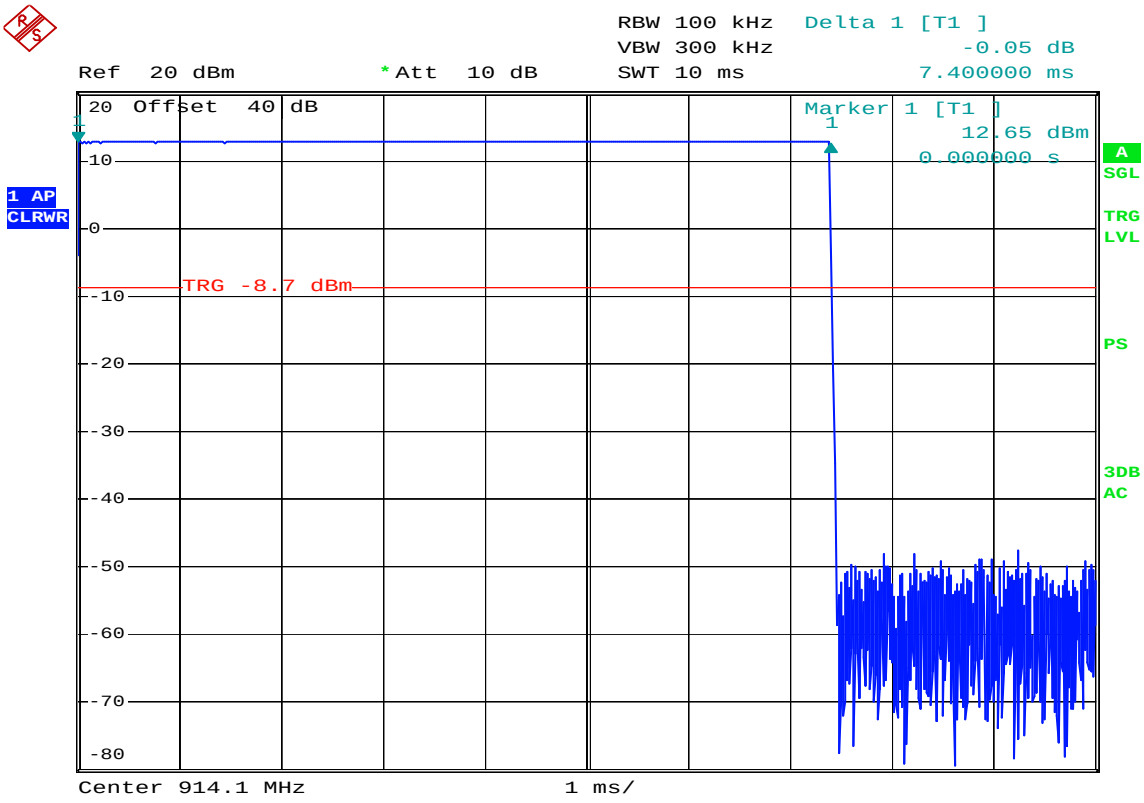
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Hoping Enabled
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Carrier Frequency Separation
NOTES	:	Carrier Frequency Separation = 399kHz
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 9.SEP.2011 17:15:36

15.247(a) Number of Hopping Frequencies

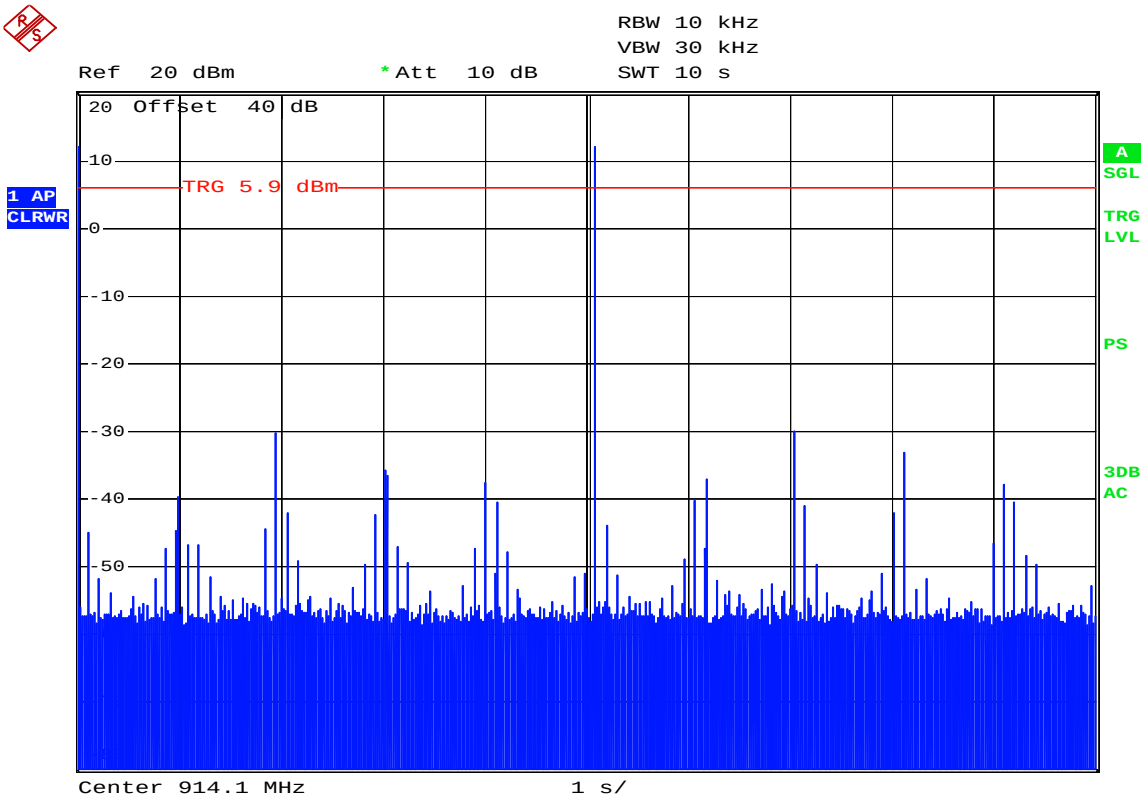
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Hopping Enabled
NOTES	:	USB Powered
TEST DATE	:	September 9, 2011
TEST PARAMETERS	:	Number of Hopping Channels
NOTES	:	Number of Hopping Channels = 48
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 9.SEP.2011 00:45:10

15.247(a) Time of Occupancy

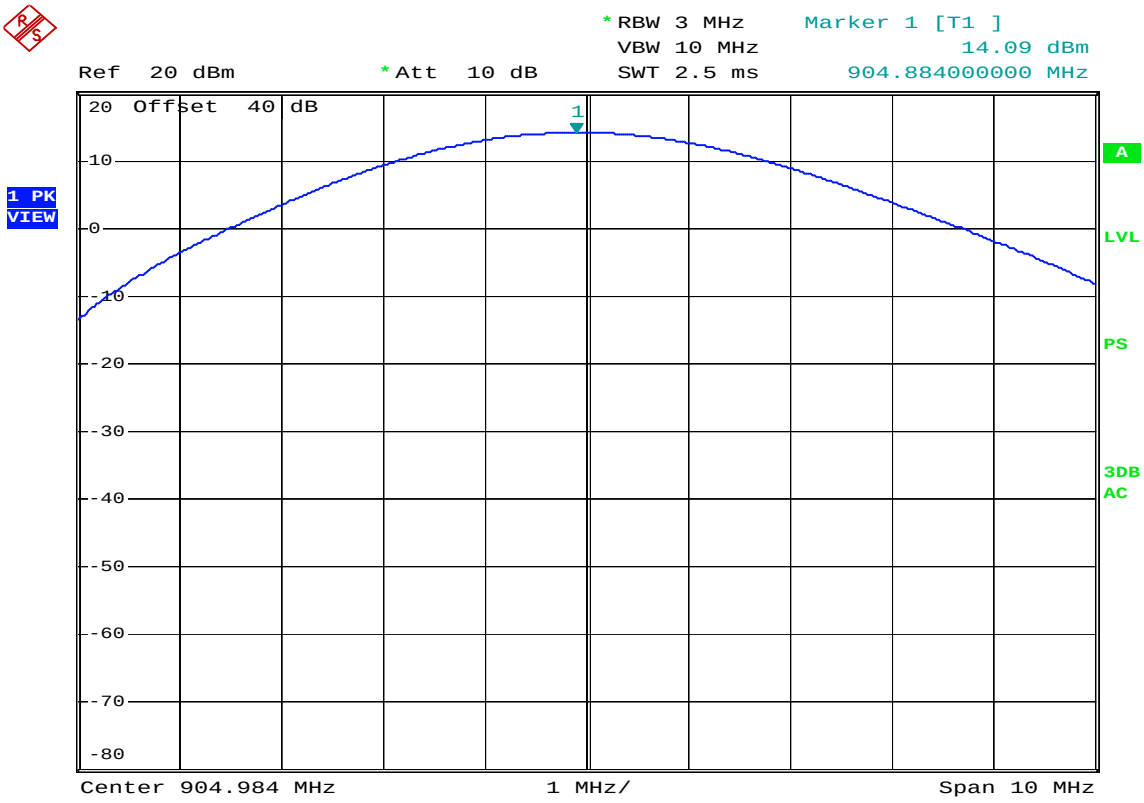
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Worst Case Data Rate
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Time of Occupancy
NOTES	:	Worst Case Pulse = 7.4 msec
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 9.SEP.2011 00:57:12

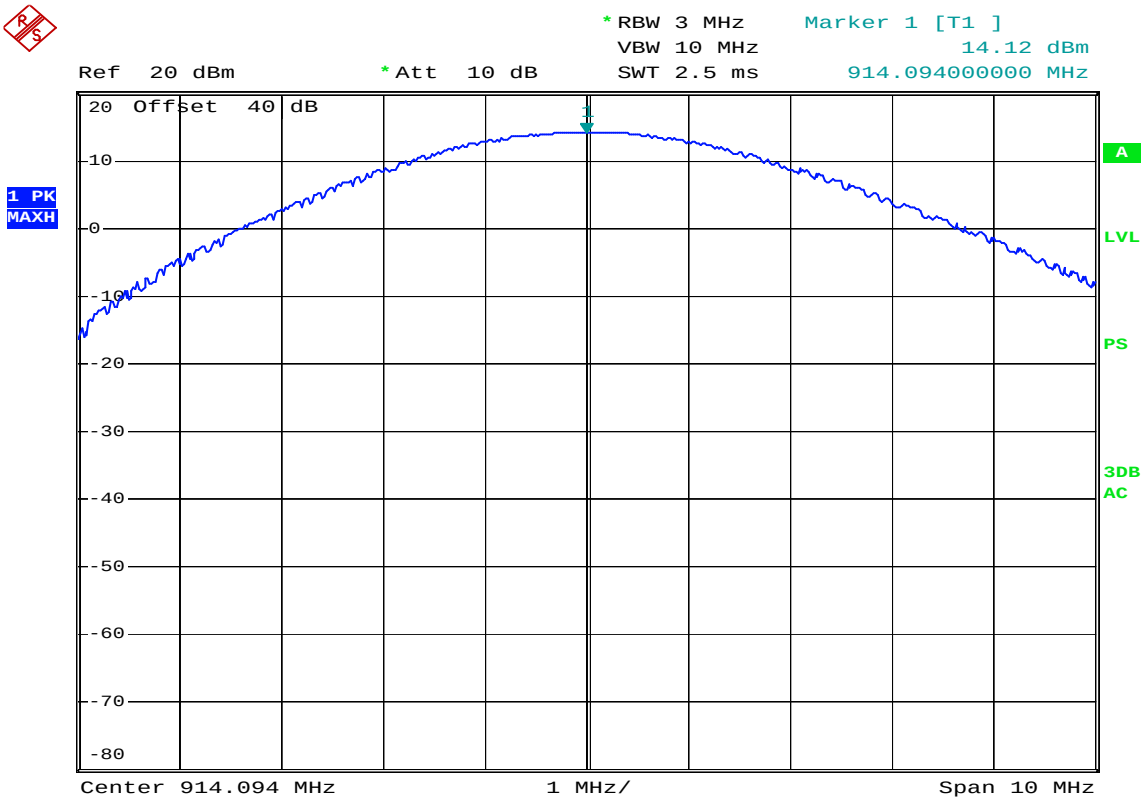
15.247(a) Time of Occupancy

MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Worst Case Data Rate
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Time of Occupancy
NOTES	:	Worst Case Pulse = 7.4msec. Number of times it hits a channel in a 10 second period is 2. Therefore the time of occupancy is 2 x 7.4msec = 14.8msec
EQUIPMENT USED	:	RBA0, T2D1, T2S3



15.247(b) Peak Output Power at Antenna Terminal

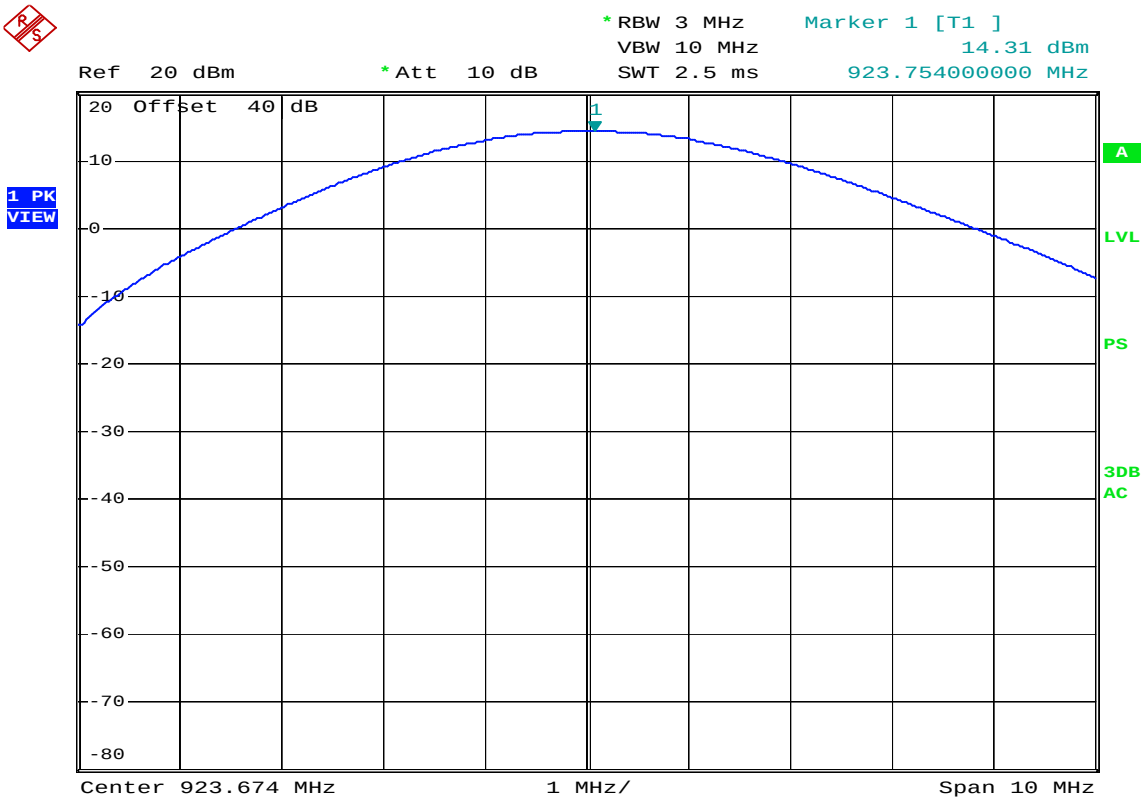
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 904.9MHz (Ch. 1)
NOTES	:	USB Powered
TEST DATE	:	September 9, 2011
TEST PARAMETERS	:	Peak Output Power
NOTES	:	Peak Output Power = 14.09dBm = 25.6mW
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 9.SEP.2011 17:34:31

15.247(b) Peak Output Power at Antenna Terminal

MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 914.1MHz (Ch. 24)
NOTES	:	USB Powered
TEST DATE	:	September 9, 2011
TEST PARAMETERS	:	Peak Output Power
NOTES	:	Peak Output Power = 14.12dBm = 25.8mW
EQUIPMENT USED	:	RBA0, T2D1, T2S3



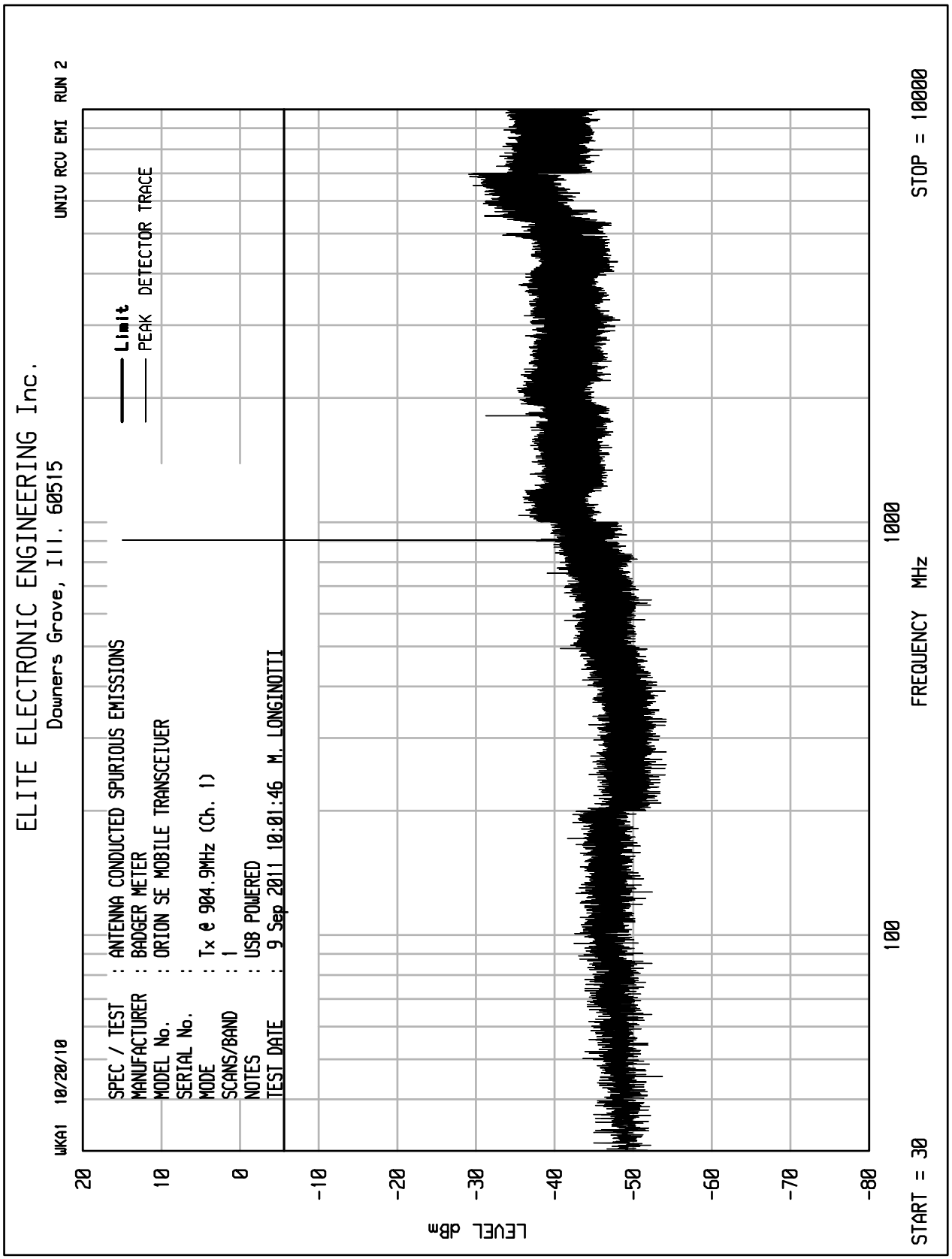
15.247(b) Peak Output Power at Antenna Terminal

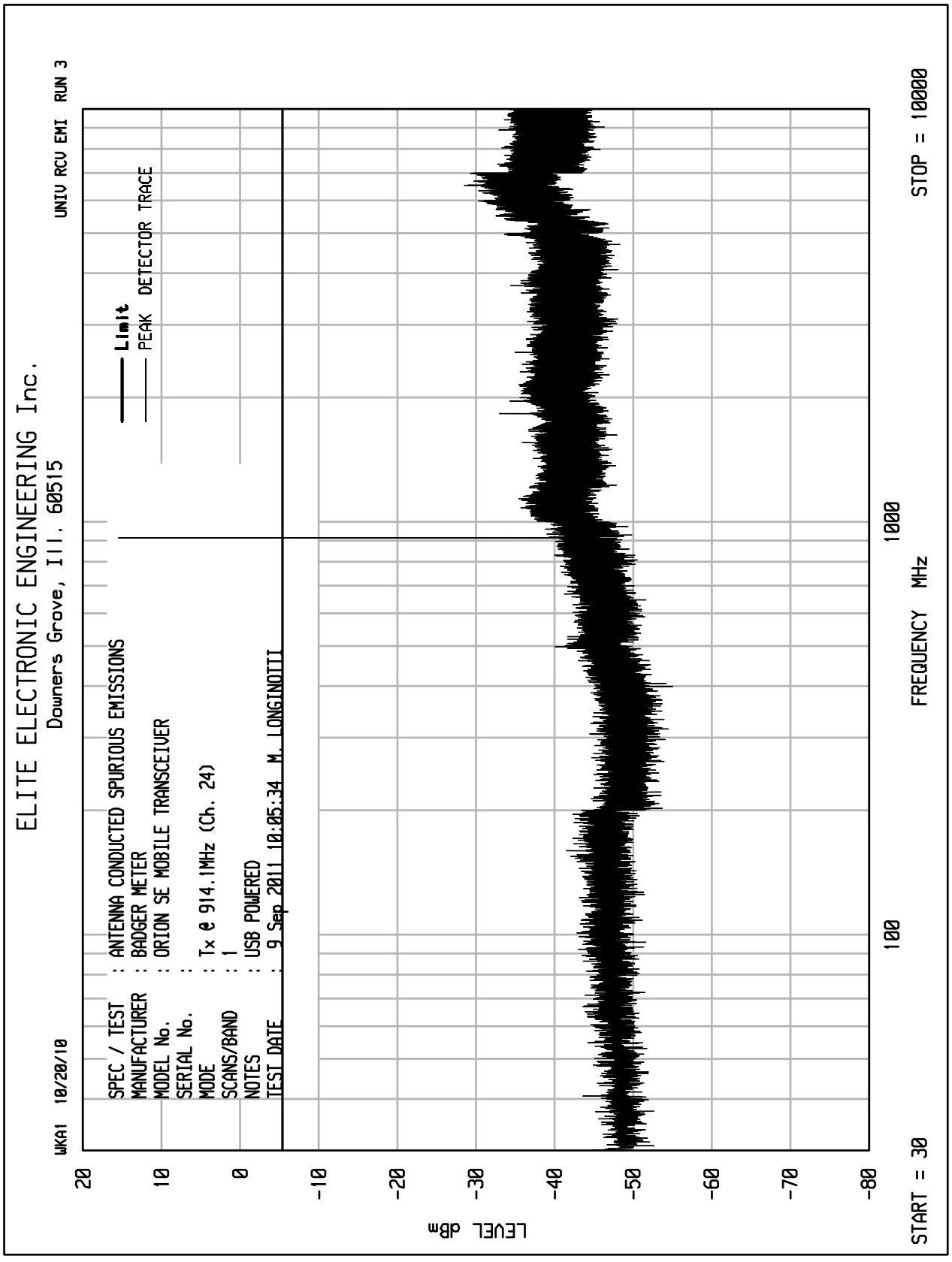
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 923.7MHz (Ch. 48)
NOTES	:	USB Powered
TEST DATE	:	September 9, 2011
TEST PARAMETERS	:	Peak Output Power
NOTES	:	Peak Output Power = 14.31dBm = 27.0mW
EQUIPMENT USED	:	RBA0, T2D1, T2S3

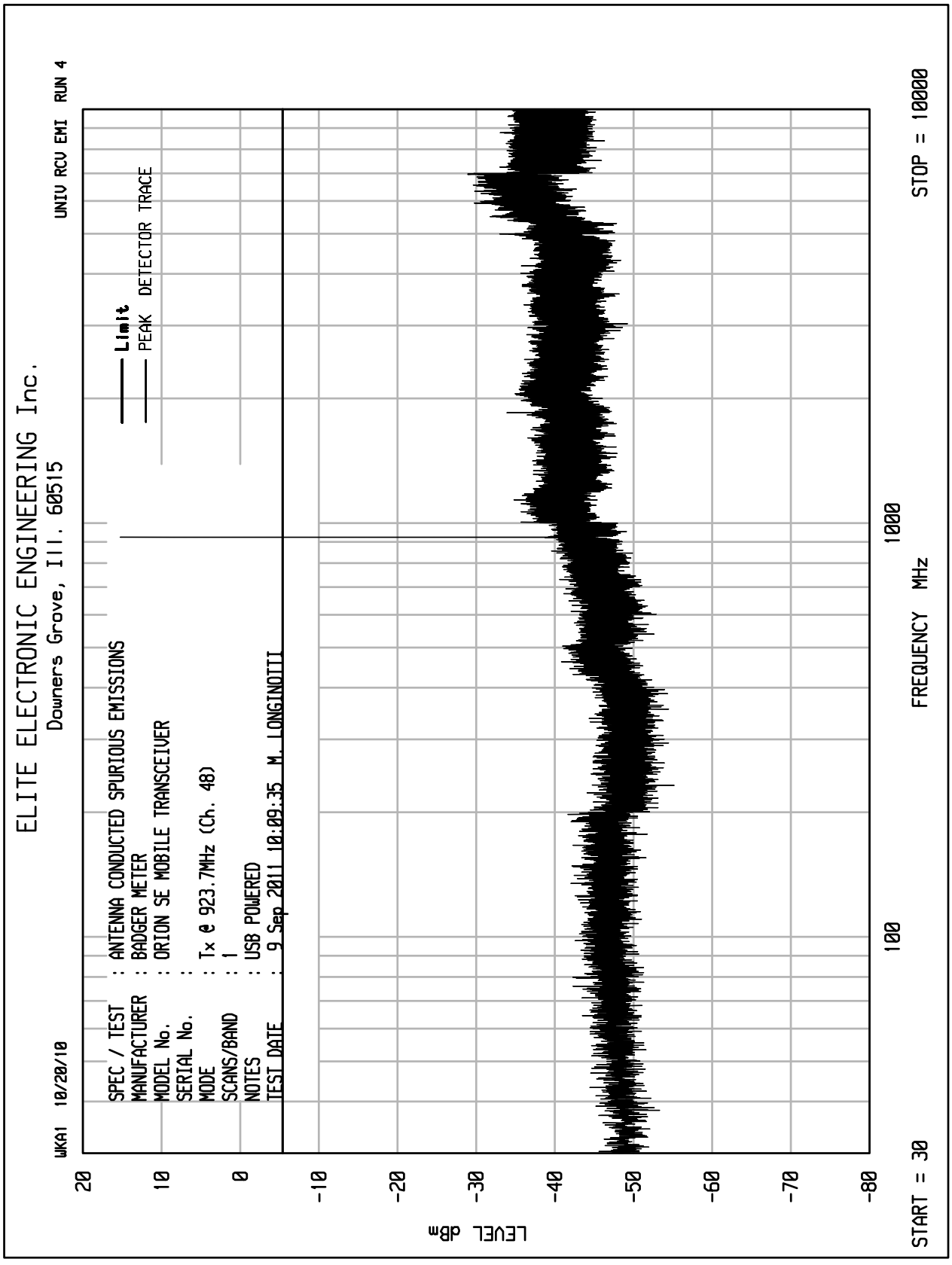
Manufacturer : Badger Meter, Inc.
Model Number : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15.247 Effective Isotropic Radiated Power (EIRP)
Date : September 7, 2011
Mode : USB Powered
Equipment Used : RBB0, NTA2, NDQ1, GBR5
Notes : Test Distance is 3 meters

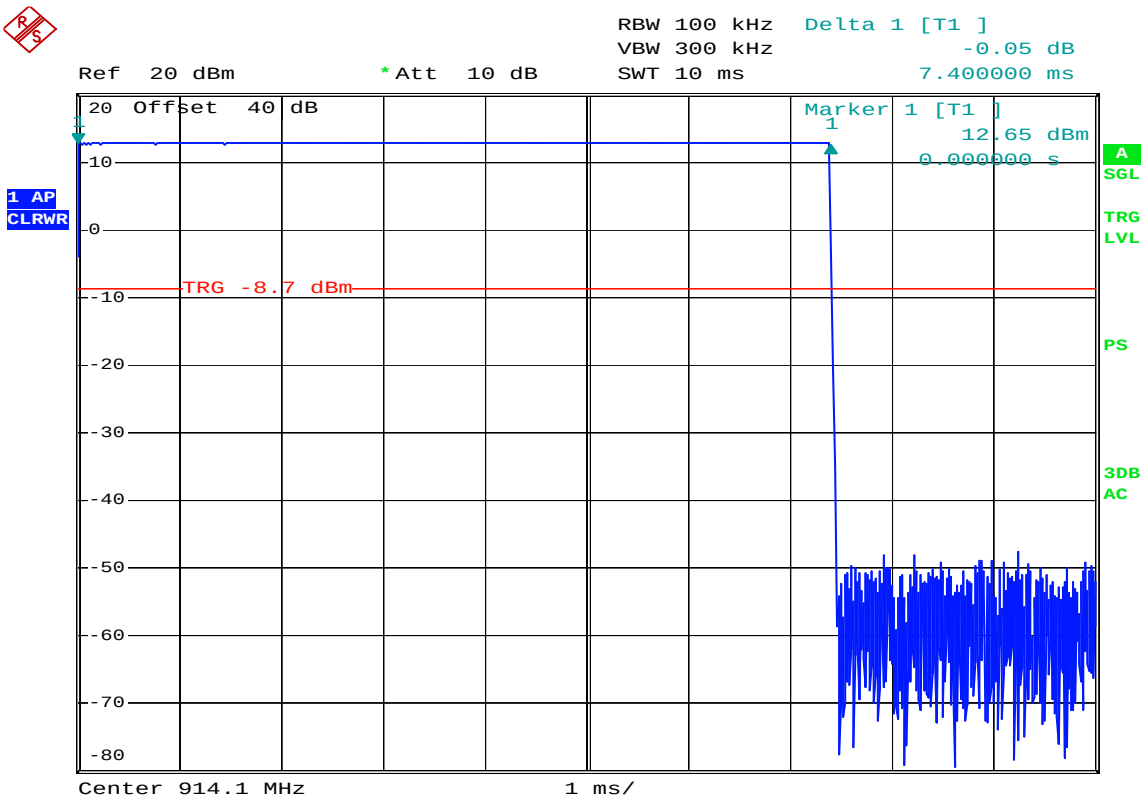
Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	Matched SIG. GEN. (dBm)	Ant Gain (dB)	CBL (dB)	EIRP Total (dBm)	Limit dBm
Transmit at 904.9MHz (Ch. 1)								
904.9	H	69.7		-5.4	2.2	2.0	-5.3	36.0
904.9	V	90.1		16.3	2.2	2.0	16.4	36.0
Transmit at 913.9 (Ch. 24)								
913.9	H	70.7		-4.1	2.2	2.0	-3.9	36.0
913.9	V	89.9		16.7	2.2	2.0	16.9	36.0
Transmit at 923.7MHz (Ch. 48)								
923.7	H	71.3		-3.1	2.2	2.0	-3.0	36.0
923.7	V	89.6		17.0	2.2	2.0	17.1	36.0

EIRP (dBm) = Matched Signal Generator (dBm) + Antenna Gain (dB) – Cable Loss (dB)


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKA1 10/20/10
SPEC / TEST : ANTENNA CONDUCTED SPURIOUS EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 904.9MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 9 Sep 2011 10:01:46 M. LONGINOTTI
Limit
PEAK DETECTOR TRACE
LEVEL dBm
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
START = 30
100
1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKA1 10/20/10
SPEC / TEST : ANTENNA CONDUCTED SPURIOUS EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 914.1MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 9 Sep 2011 10:05:34 M. LONGINOTTI
Limit
PEAK DETECTOR TRACE
LEVEL dBm
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
START = 30
100
1000
FREQUENCY MHz
STOP = 10000

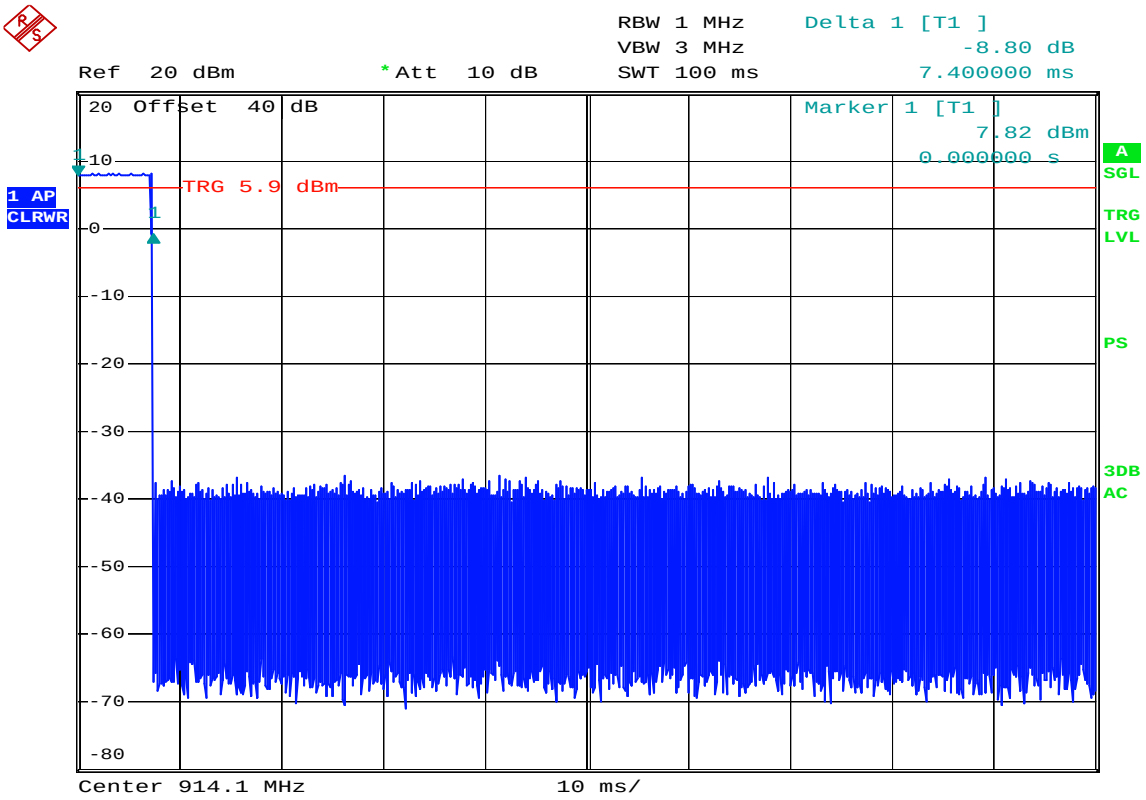

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKA1 10/20/10
SPEC / TEST : ANTENNA CONDUCTED SPURIOUS EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 9 Sep 2011 10:09:35 M. LONGINOTTI
Limit
PEAK DETECTOR TRACE
LEVEL dBm
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
START = 30
100
1000
FREQUENCY MHz
STOP = 10000



Date: 9.SEP.2011 00:45:10

15.247(a) Time of Occupancy

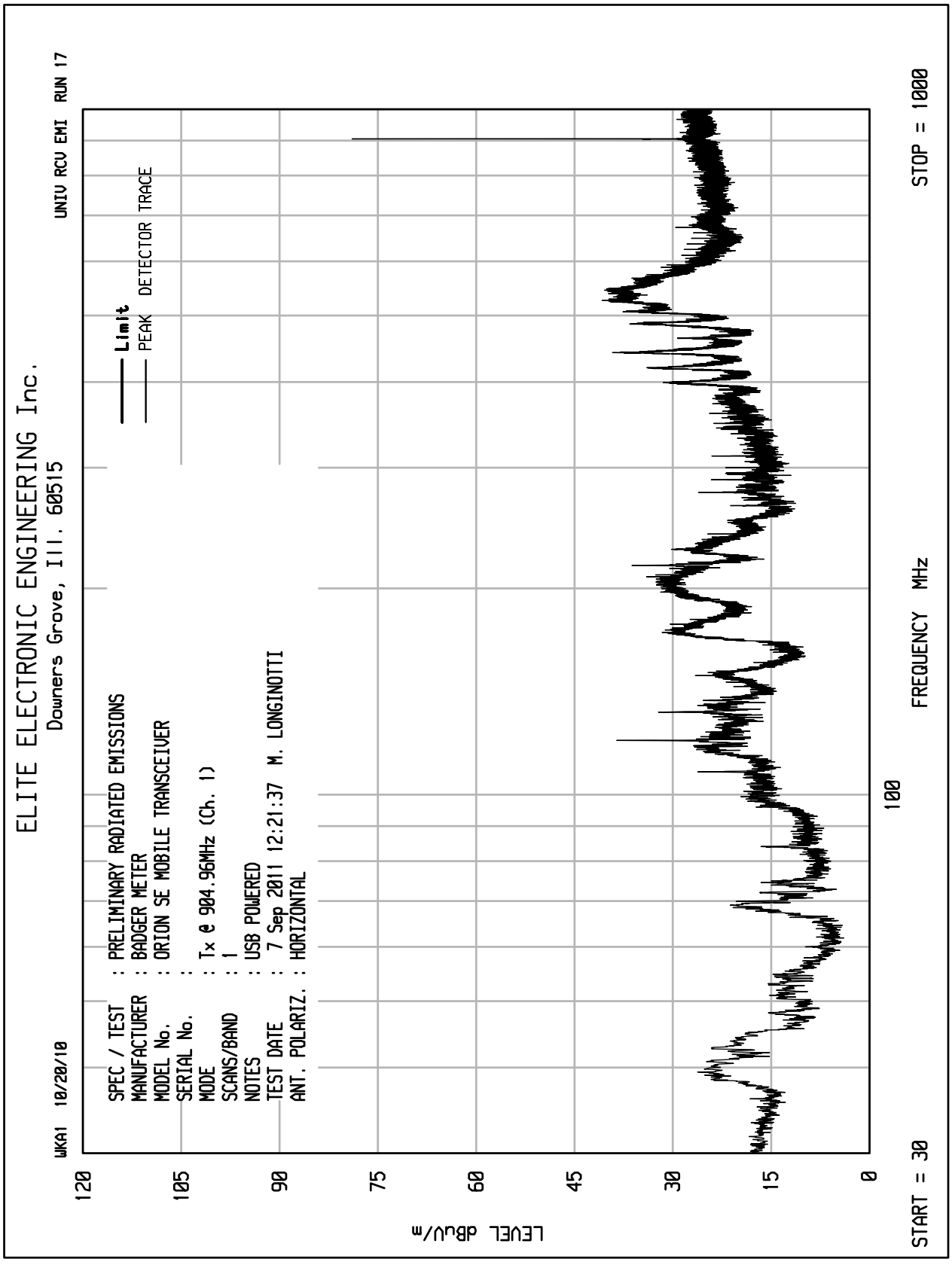
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Worst Case Data Rate
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Time of Occupancy
NOTES	:	Worst Case Pulse = 7.4 msec
EQUIPMENT USED	:	RBA0, T2D1, T2S3

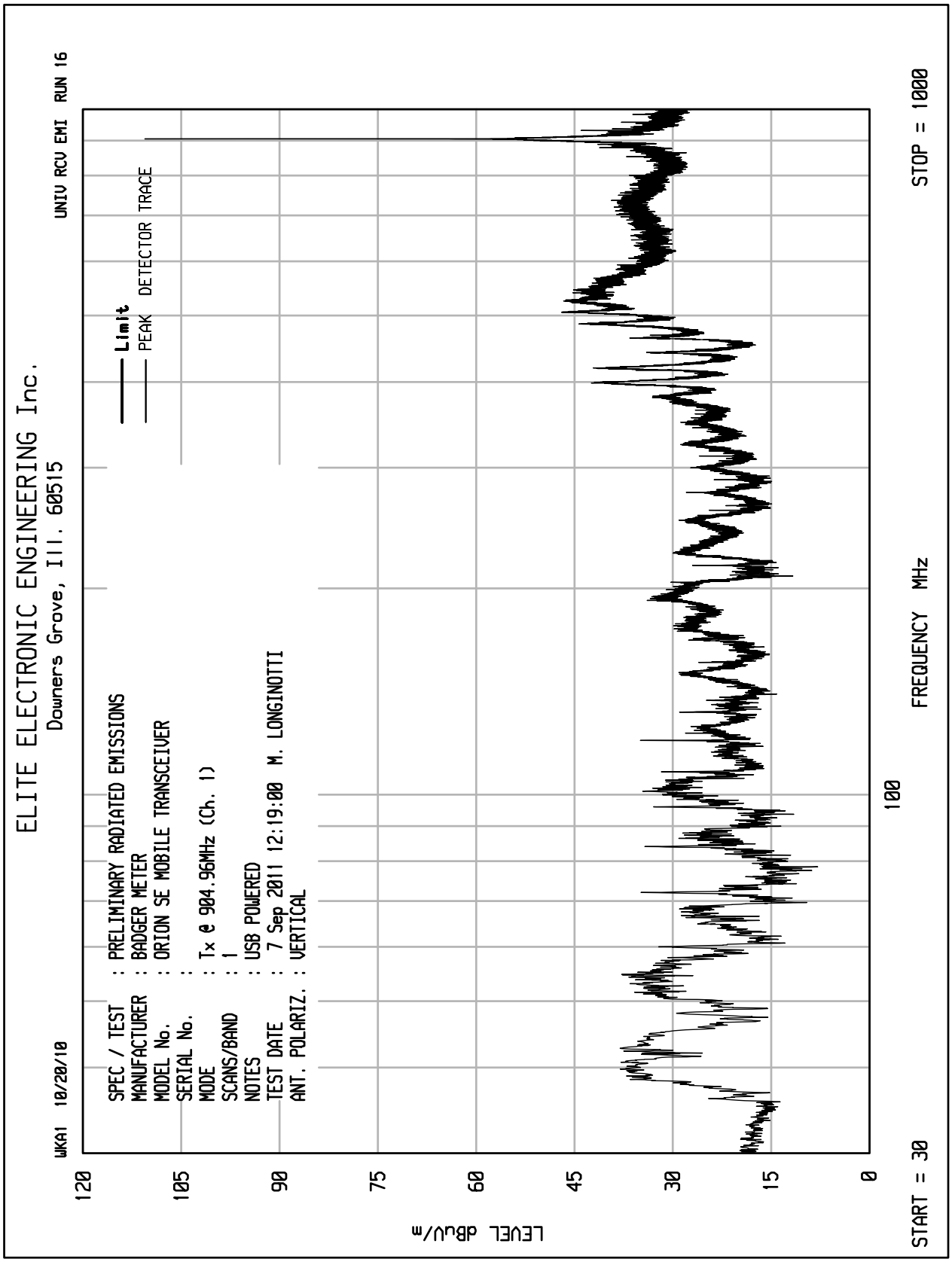


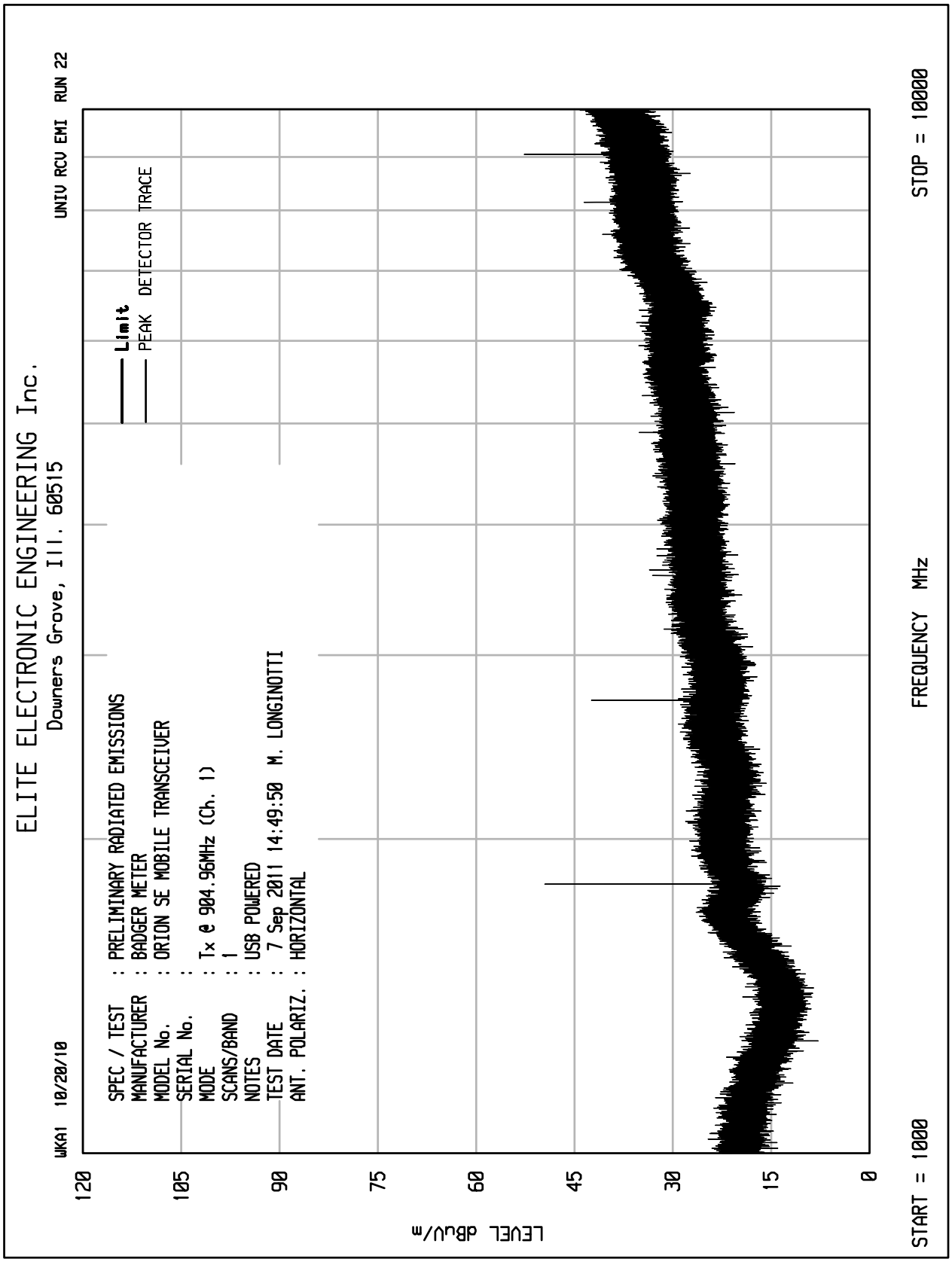
Date: 9.SEP.2011 00:51:30

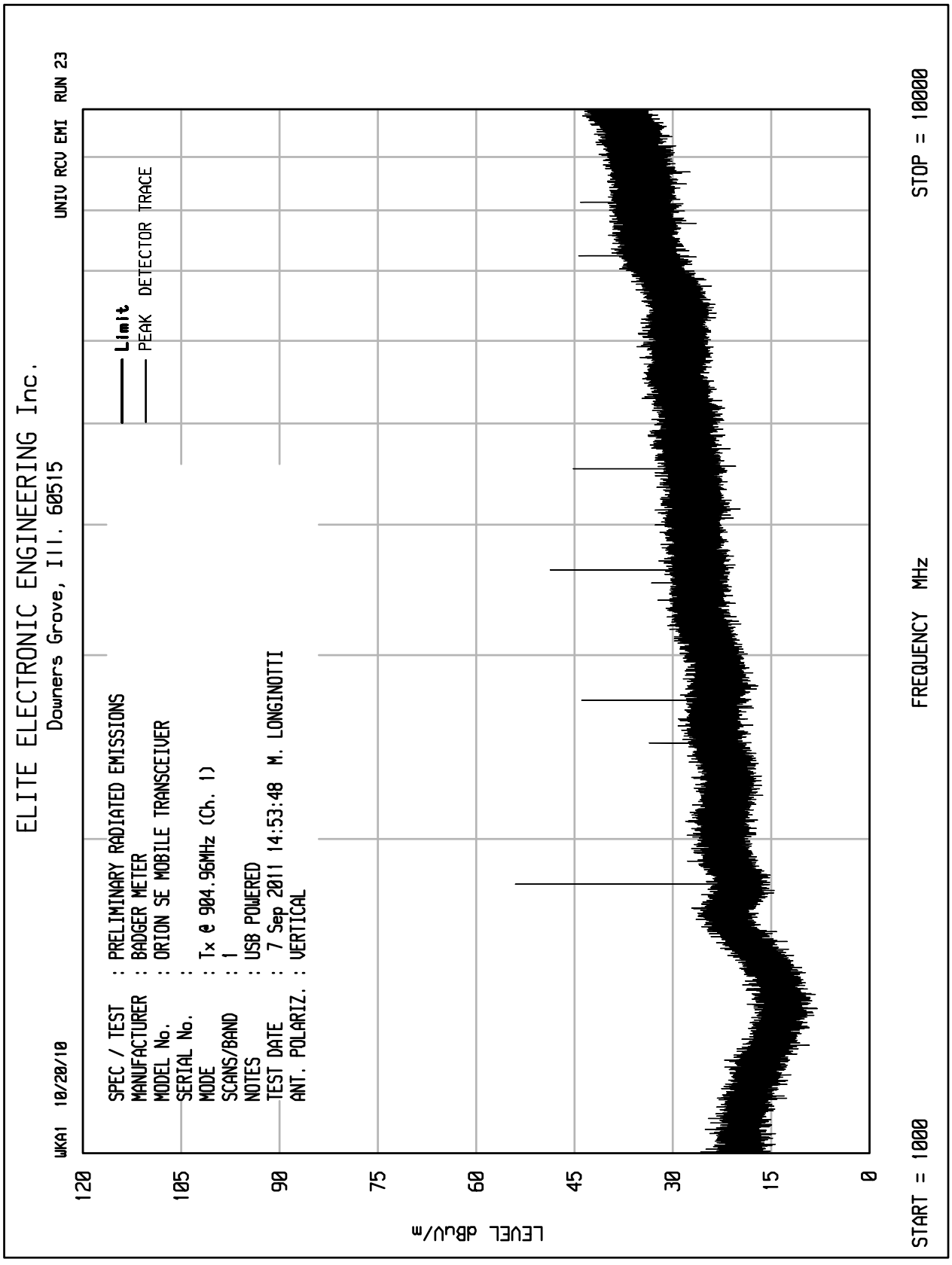
15.35(c) Duty Cycle Factor

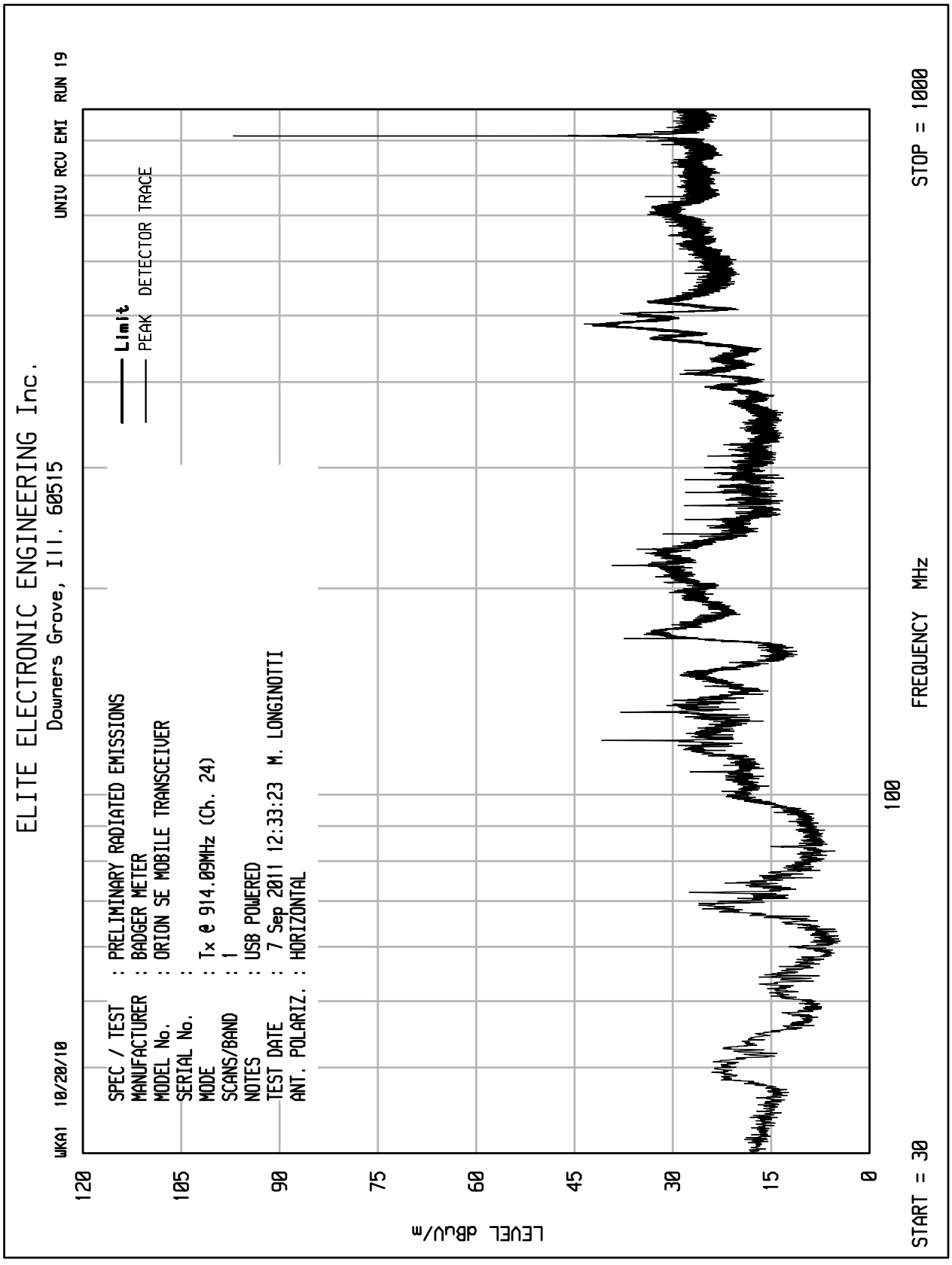
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Worst Case Data Rate
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Duty Cycle Correction Factor
NOTES	:	Duty Cycle Correction Factor = 20*log(7.4msec/100msec) = 20*log(.074) =
	:	-22.6dB
EQUIPMENT USED	:	RBA0, T2D1, T2S3

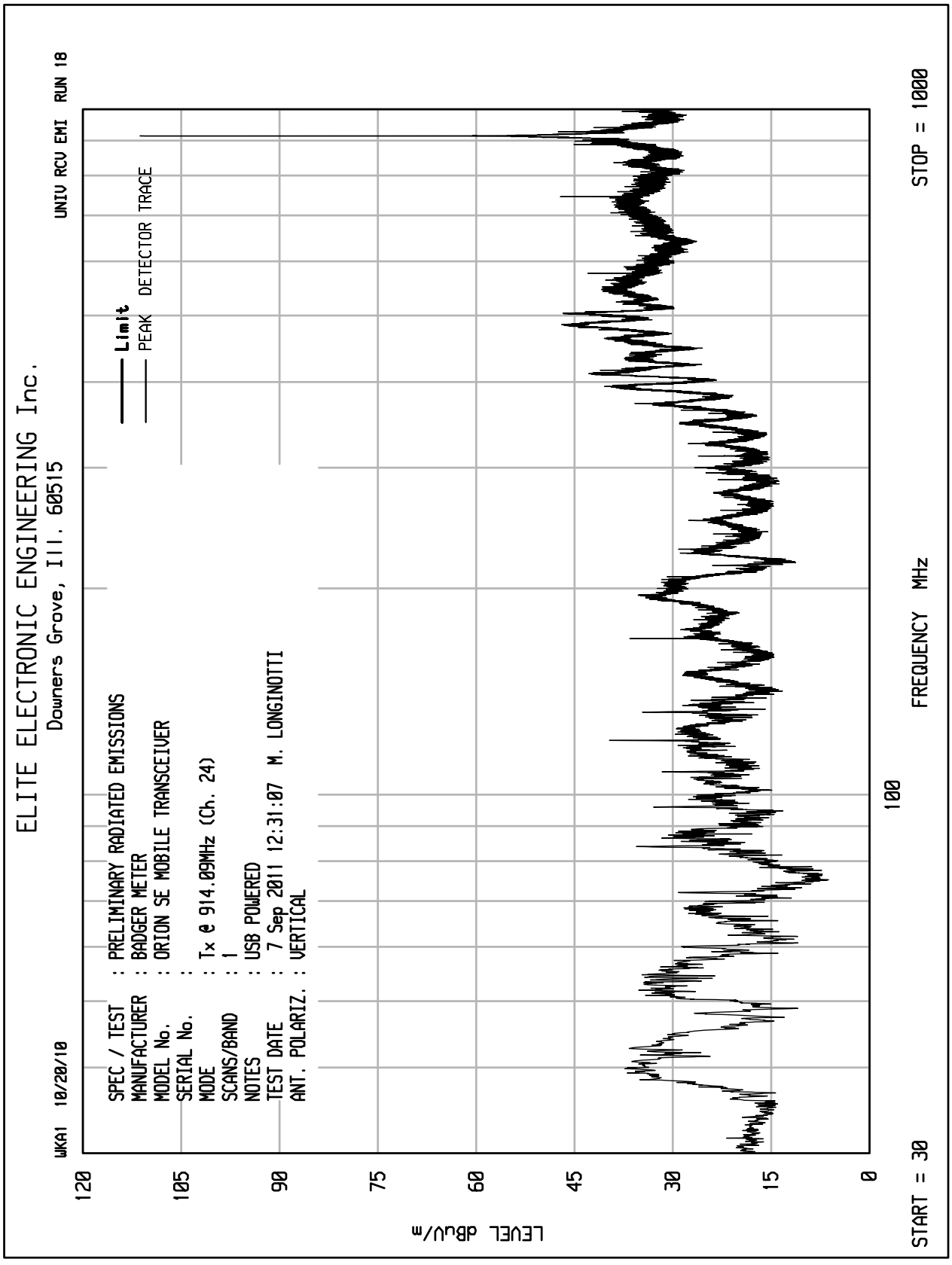

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 17
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 904.96MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:21:37 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

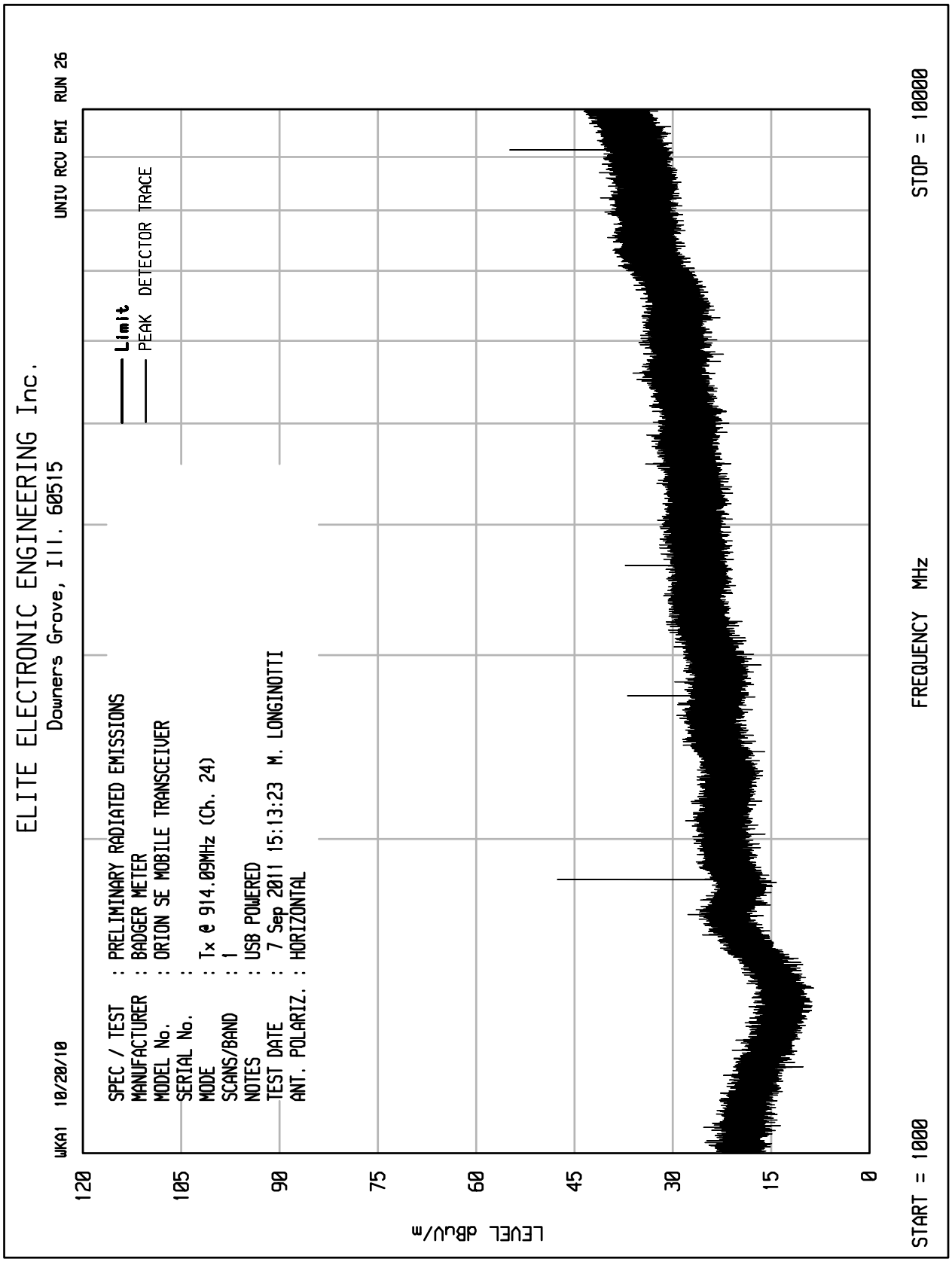

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 16
WKAI 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 904.96MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:19:00 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

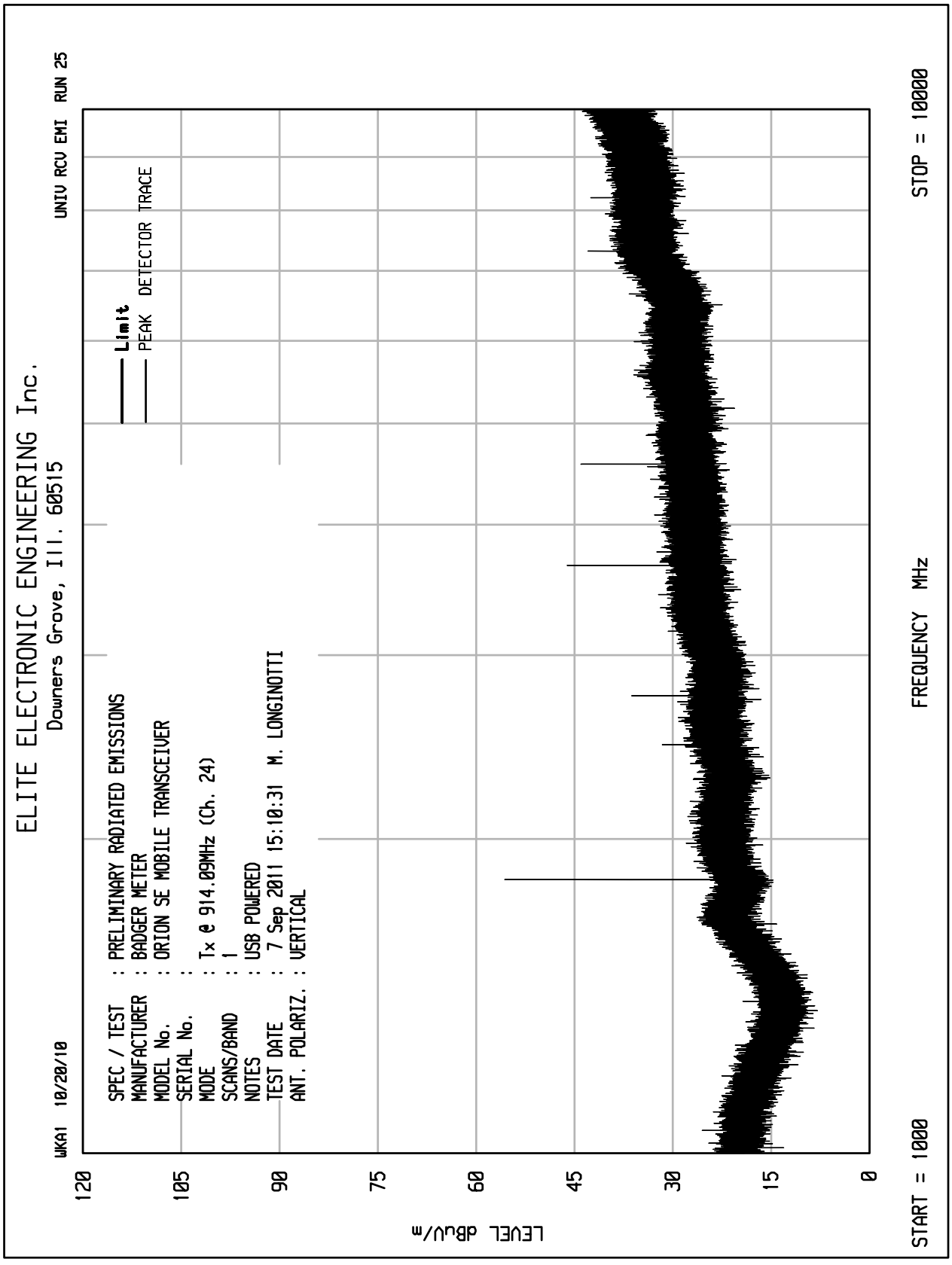

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 22
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 904.96MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 14:49:50 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

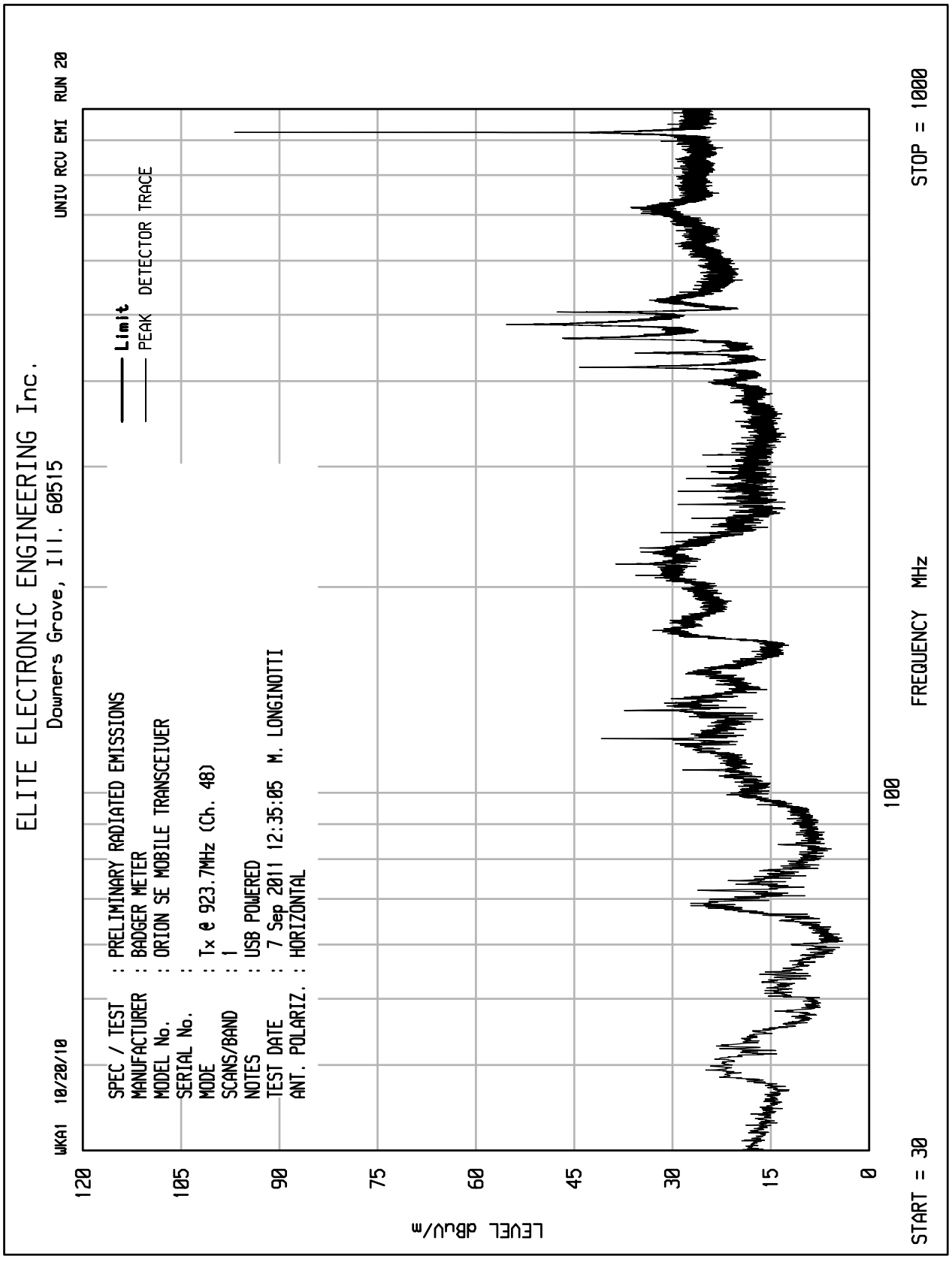

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 23
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 904.96MHz (Ch. 1)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 14:53:48 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

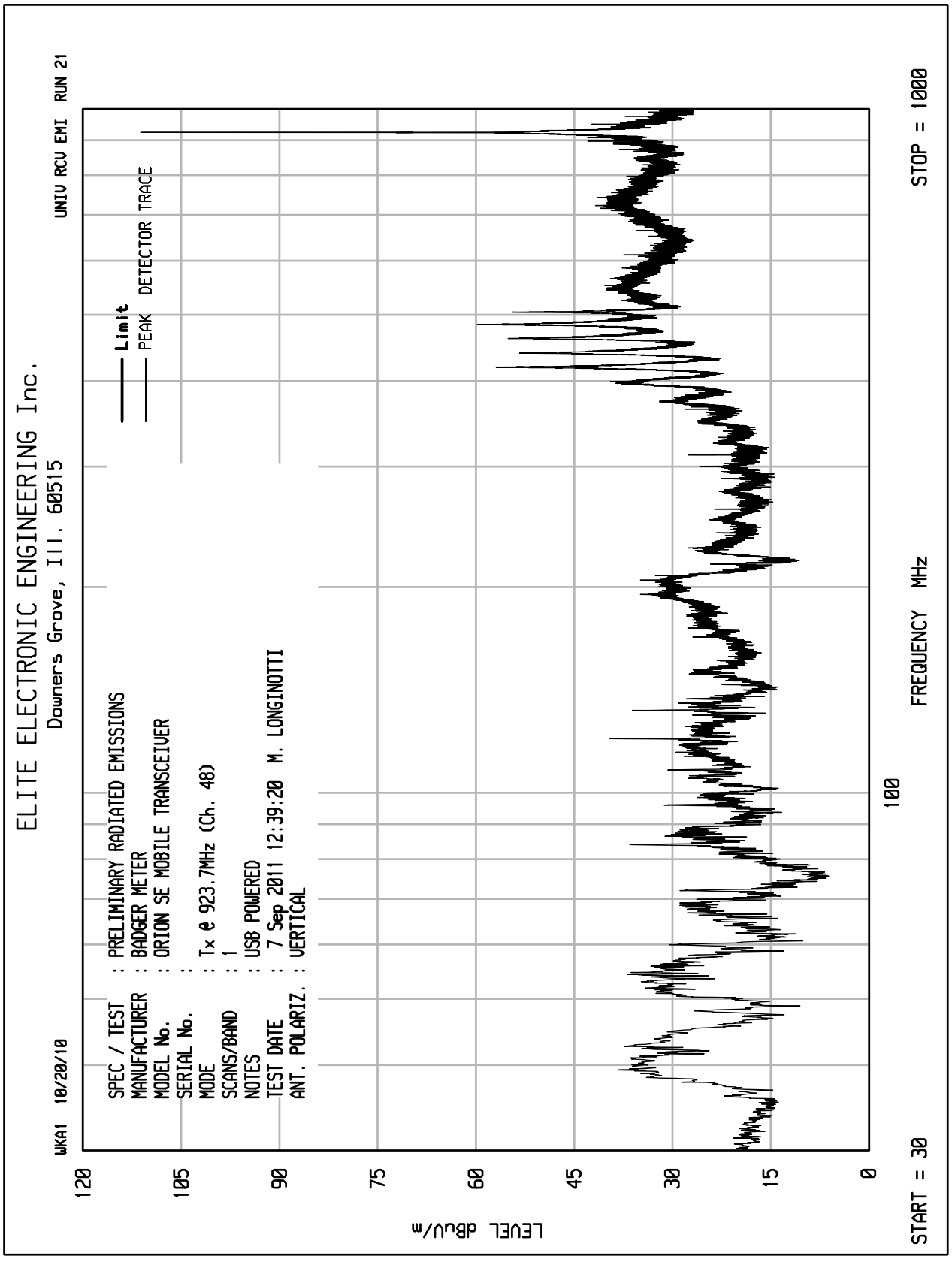

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 19
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:33:23 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

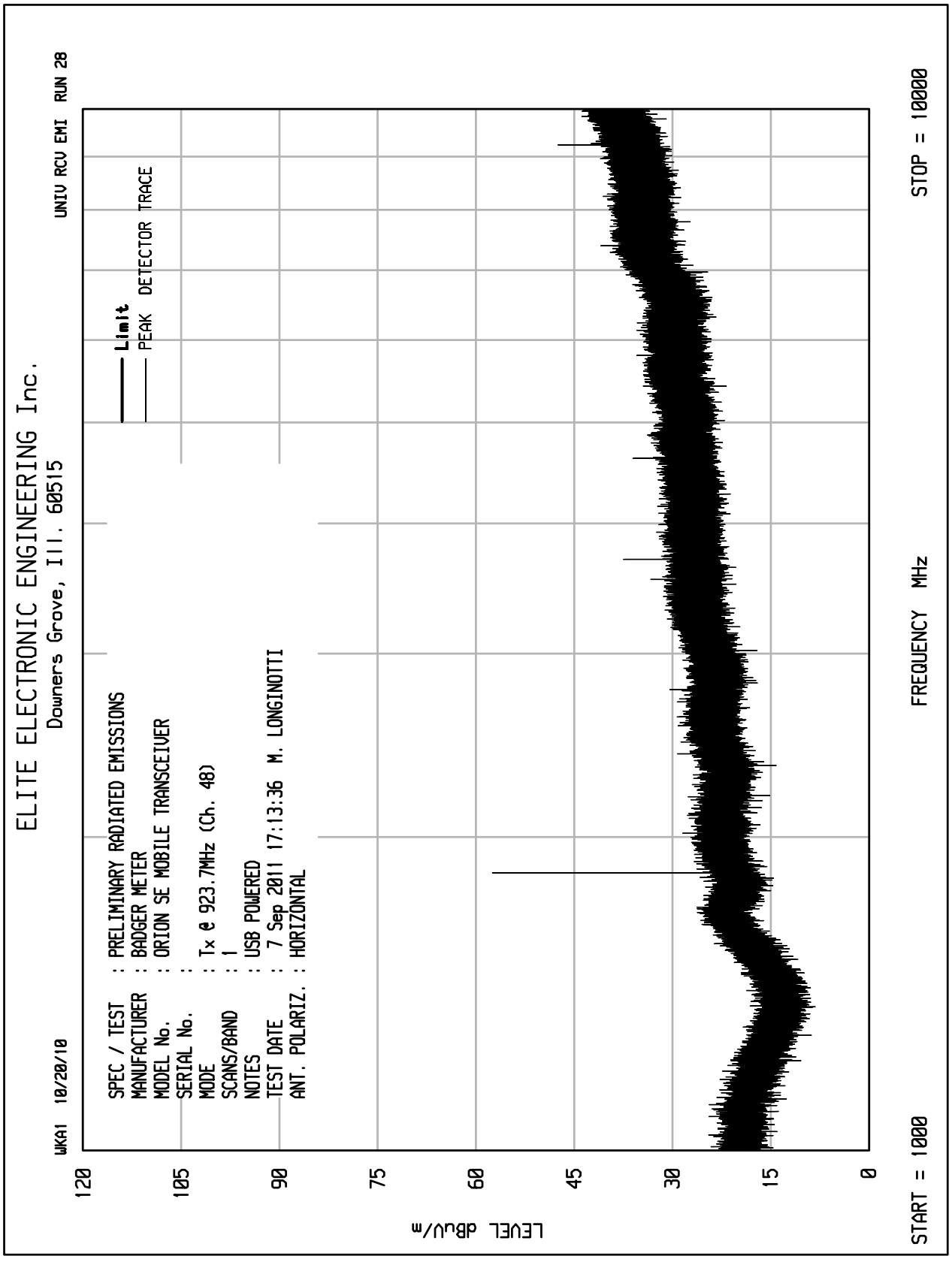

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 18
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:31:07 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

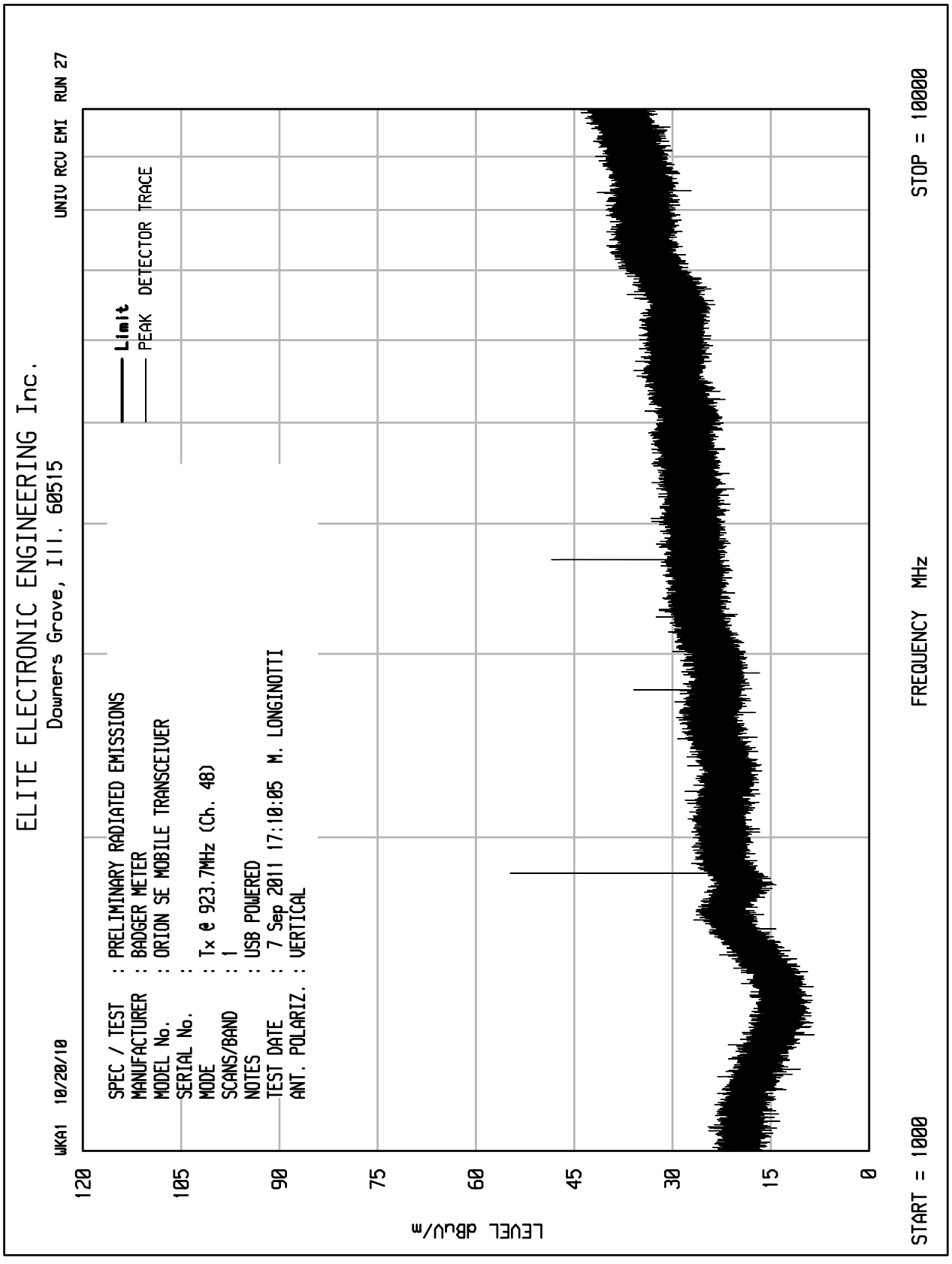

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 26
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 15:13:23 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 25
WKAI 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 914.09MHz (Ch. 24)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 15:10:31 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 20
WKAI 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:35:05 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
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 21
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 12:39:20 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
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 28
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 17:13:36 M. LONGINOTTI
ANT. POLARIZ. : HORIZONTAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 27
WKA1 10/20/10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER
MODEL No. : ORION SE MOBILE TRANSCEIVER
SERIAL No. :
MODE : Tx @ 923.7MHz (Ch. 48)
SCANS/BAND : 1
NOTES : USB POWERED
TEST DATE : 7 Sep 2011 17:10:05 M. LONGINOTTI
ANT. POLARIZ. : VERTICAL
Limit
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15.247 Spurious Radiated Emissions in Restricted Bands
Date : September, 7, 2011
Mode : Tx @ 904.9MHz (Ch. 1)
Equipment Used : RBB0, NTA2, NWH0, APW3, XPQ2, SES1
Notes : Test Distance is 3 meters
Notes : Peak Readings in Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
2714.880	H	58.4		3.7	29.6	-40.3	51.3	367.4	5000.0	-22.7
2714.850	V	57.0		3.7	29.6	-40.3	49.9	312.7	5000.0	-24.1
3619.840	H	55.1		4.3	32.1	-39.9	51.6	380.1	5000.0	-22.4
3619.800	V	57.0		4.3	32.1	-39.9	53.5	473.0	5000.0	-20.5
4524.800	H	54.7		4.8	33.0	-40.0	52.5	420.3	5000.0	-21.5
4524.750	V	54.0		4.8	33.0	-40.0	51.8	387.8	5000.0	-22.2
5429.760	H	47.4	Ambient	5.2	35.2	-40.1	47.7	243.3	5000.0	-26.3
5429.700	V	46.4	Ambient	5.2	35.2	-40.1	46.7	216.8	5000.0	-27.3
8144.640	H	51.3	Ambient	6.5	38.5	-39.6	56.7	684.7	5000.0	-17.3
8144.550	V	52.9	Ambient	6.5	38.5	-39.6	58.3	823.2	5000.0	-15.7
9049.600	H	51.9	Ambient	6.5	39.7	-39.1	59.0	894.1	5000.0	-15.0
9049.500	V	50.5	Ambient	6.5	39.7	-39.1	57.6	761.0	5000.0	-16.4

H – Horizontal V – Vertical

* - Ambient

Total (dBuV/m) = Meter Reading (dBuV) + Cable Factor (dB) + Antenna Factor (dB) + Pre Amp (dB)
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15.247 Spurious Radiated Emissions in Restricted Bands
Date : September 7, 2011
Mode : Tx @ 904.9MHz (Ch. 1)
Equipment Used : RBB0, NTA2, NWH0, APW3, XPQ2, SES1
Notes : Test Distance is 3 meters
Notes : Average Readings in Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
2714.9	H	55.5		3.7	29.6	-40.3	-22.6	25.8	19.5	500.0	-28.2
2714.9	V	53.4		3.7	29.6	-40.3	-22.6	23.7	15.3	500.0	-30.3
3619.8	H	51.8		4.3	32.1	-39.9	-22.6	25.7	19.3	500.0	-28.3
3619.8	V	54.3		4.3	32.1	-39.9	-22.6	28.2	25.7	500.0	-25.8
4524.8	H	50.0		4.8	33.0	-40.0	-22.6	25.2	18.1	500.0	-28.8
4524.8	V	49.4		4.8	33.0	-40.0	-22.6	24.6	16.9	500.0	-29.4
5429.8	H	34.3	Ambient	5.2	35.2	-40.1	-22.6	12.0	4.0	500.0	-42.0
5429.7	V	33.7	Ambient	5.2	35.2	-40.1	-22.6	11.4	3.7	500.0	-42.6
8144.6	H	42.4	Ambient	6.5	38.5	-39.6	-22.6	25.2	18.2	500.0	-28.8
8144.6	V	45.0	Ambient	6.5	38.5	-39.6	-22.6	27.8	24.6	500.0	-26.2
9049.6	H	43.9	Ambient	6.5	39.7	-39.1	-22.6	28.4	26.4	500.0	-25.6
9049.5	V	41.8	Ambient	6.5	39.7	-39.1	-22.6	26.3	20.7	500.0	-27.7

H – Horizontal V – Vertical

* - Ambient

Total (dBuV/m) = Meter Reading (dBuV) + Cable Factor (dB) + Antenna Factor (dB) + Pre Amp (dB) + Duty Cycle (dB)
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15.247 Spurious Radiated Emissions in Restricted Bands
Date : September, 7, 2011
Mode : Tx @ 913.9MHz (Ch. 24)
Equipment Used : RBB0, NTA2, NWH0, APW3, XPQ2, SES1
Notes : Test Distance is 3 meters
Notes : Peak Readings in Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
2742.270	H	55.3		3.7	29.6	-40.3	48.2	257.6	5000.0	-25.8
2742.270	V	55.1		3.7	29.6	-40.3	48.0	251.7	5000.0	-26.0
3656.360	H	60.0		4.3	32.2	-39.8	56.8	689.7	5000.0	-17.2
3656.360	V	57.6		4.3	32.2	-39.8	54.4	523.2	5000.0	-19.6
4570.450	H	52.4		4.8	33.1	-40.0	50.3	328.1	5000.0	-23.7
4570.450	V	53.5		4.8	33.1	-40.0	51.4	372.4	5000.0	-22.6
7312.720	H	52.1		6.2	37.3	-39.8	55.8	614.4	5000.0	-18.2
7312.720	V	51.6		6.2	37.3	-39.8	55.3	580.0	5000.0	-18.7
8226.810	H	53.5		6.5	38.6	-39.5	59.1	898.6	5000.0	-14.9
8226.810	V	51.1		6.5	38.6	-39.5	56.7	681.6	5000.0	-17.3
9140.900	H	52.9		6.6	39.8	-39.0	60.2	1027.6	5000.0	-13.7
9140.900	V	48.8	Ambient	6.6	39.8	-39.0	56.1	640.9	5000.0	-17.8

H – Horizontal V – Vertical

* - Ambient

Total (dBuV/m) = Meter Reading (dBuV) + Cable Factor (dB) + Antenna Factor (dB) + Pre Amp (dB)
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15.247 Spurious Radiated Emissions in Restricted Bands
Date : September 7, 2011
Mode : Tx @ 913.9MHz (Ch. 24)
Equipment Used : RBB0, NTA2, NWH0, APW3, XPQ2, SES1
Notes : Test Distance is 3 meters
Notes : Average Readings in Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
2742.3	H	50.6		3.7	29.6	-40.3	-22.6	20.9	11.1	500.0	-33.1
2742.3	V	52.2		3.7	29.6	-40.3	-22.6	22.5	13.4	500.0	-31.5
3656.4	H	57.2		4.3	32.2	-39.8	-22.6	31.4	37.0	500.0	-22.6
3656.4	V	54.7		4.3	32.2	-39.8	-22.6	28.9	27.8	500.0	-25.1
4570.5	H	47.0		4.8	33.1	-40.0	-22.6	22.3	13.1	500.0	-31.7
4570.5	V	47.6		4.8	33.1	-40.0	-22.6	22.9	14.0	500.0	-31.1
7312.7	H	44.4		6.2	37.3	-39.8	-22.6	25.5	18.8	500.0	-28.5
7312.7	V	42.7		6.2	37.3	-39.8	-22.6	23.8	15.4	500.0	-30.2
8226.8	H	44.2		6.5	38.6	-39.5	-22.6	27.2	22.8	500.0	-26.8
8226.8	V	42.7		6.5	38.6	-39.5	-22.6	25.7	19.2	500.0	-28.3
9140.9	H	45.0		6.6	39.8	-39.0	-22.6	29.7	30.7	500.0	-24.2
9140.9	V	36.7	Ambient	6.6	39.8	-39.0	-22.6	21.4	11.8	500.0	-32.5

H – Horizontal V – Vertical

* - Ambient

Total (dBuV/m) = Meter Reading (dBuV) + Cable Factor (dB) + Antenna Factor (dB) + Pre Amp (dB) + Duty Cycle (dB)
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15.247 Spurious Radiated Emissions in Restricted Bands
Date : September, 7, 2011
Mode : Tx @ 927.8MHz (Ch. 48)
Equipment Used : RBB0, NTA2, NWH0, APW3, XPQ2, SES1
Notes : Test Distance is 3 meters
Notes : Peak Readings in Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
2771.100	H	51.9		3.7	29.6	-40.3	44.8	174.5	5000.0	-29.1
2771.100	V	53.8		3.7	29.6	-40.3	46.7	217.1	5000.0	-27.2
3694.800	H	58.2		4.3	32.4	-39.7	55.3	579.5	5000.0	-18.7
3694.800	V	57.5		4.3	32.4	-39.7	54.6	534.7	5000.0	-19.4
4618.500	H	53.3		4.8	33.3	-40.0	51.4	370.5	5000.0	-22.6
4618.500	V	51.9		4.8	33.3	-40.0	50.0	315.4	5000.0	-24.0
7389.600	H	53.1		6.2	37.4	-39.7	56.9	702.9	5000.0	-17.0
7389.600	V	51.0		6.2	37.4	-39.7	54.8	552.0	5000.0	-19.1
8313.300	H	50.0		6.5	38.7	-39.5	55.7	612.3	5000.0	-18.2
8313.300	V	48.0		6.5	38.7	-39.5	53.7	486.3	5000.0	-20.2

H – Horizontal V – Vertical

* - Ambient

Total (dBuV/m) = Meter Reading (dBuV) + Cable Factor (dB) + Antenna Factor (dB) + Pre Amp (dB)
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]

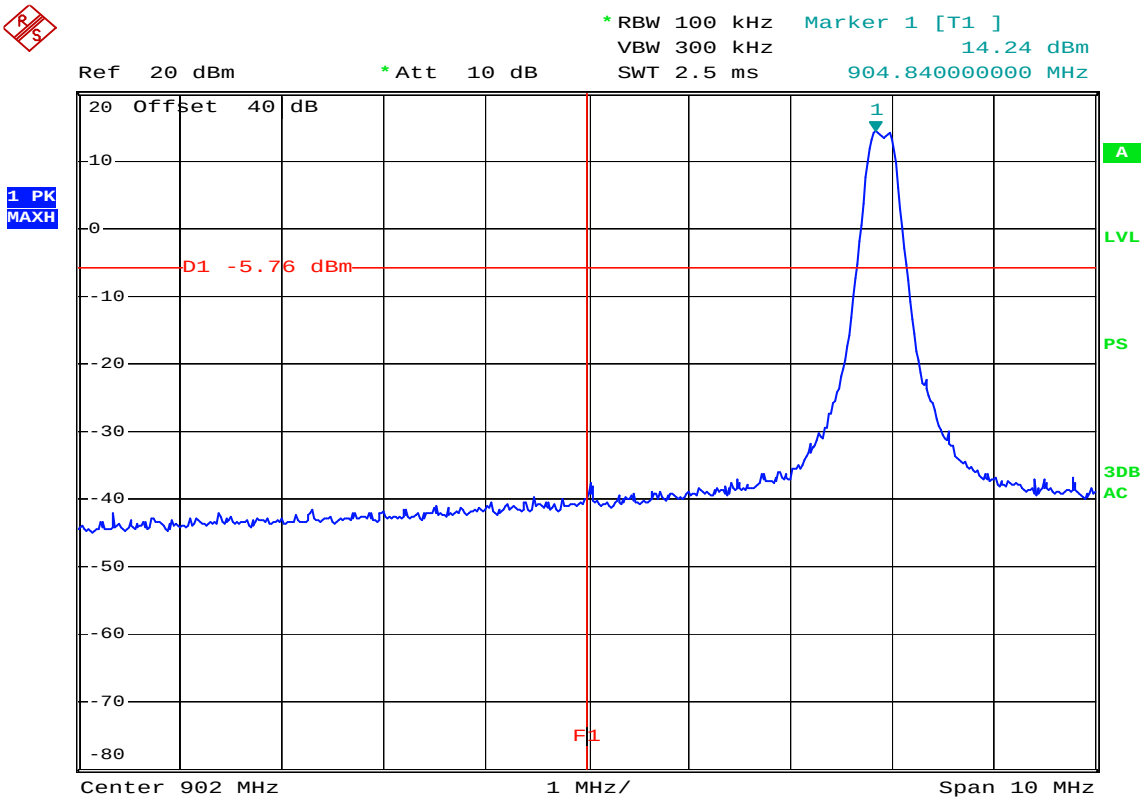
Manufacturer : Badger Meter, Inc.
Model No. : Orion SE Mobile
Serial No. : None Assigned
Specification : FCC-15.247 Spurious Radiated Emissions in Restricted Bands
Date : September 7, 2011
Mode : Tx @ 913.9MHz (Ch. 24)
Equipment Used : RBB0, NTA2, NWH0, APW3, XPQ2, SES1
Notes : Test Distance is 3 meters
Notes : Average Readings in Restricted Bands

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	Ambient	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total dBuV/m at 3 M	Total uV/m at 3M	Limit uV/m at 3M	Margin (dB)
2771.1	H	45.7		3.7	29.6	-40.3	-13.5	25.1	18.1	500.0	-28.8
2771.1	V	49.1		3.7	29.6	-40.3	-13.5	28.5	26.7	500.0	-25.4
3694.8	H	55.5		4.3	32.4	-39.7	-13.5	39.1	89.8	500.0	-14.9
3694.8	V	54.0		4.3	32.4	-39.7	-13.5	37.6	75.5	500.0	-16.4
4618.5	H	47.1		4.8	33.3	-40.0	-13.5	31.7	38.4	500.0	-22.3
4618.5	V	45.7		4.8	33.3	-40.0	-13.5	30.3	32.6	500.0	-23.7
7389.6	H	45.9		6.2	37.4	-39.7	-13.5	36.2	64.9	500.0	-17.7
7389.6	V	41.6		6.2	37.4	-39.7	-13.5	31.9	39.5	500.0	-22.0
8313.3	H	39.9		6.5	38.7	-39.5	-13.5	32.1	40.5	500.0	-21.8
8313.3	V	35.7		6.5	38.7	-39.5	-13.5	27.9	24.9	500.0	-26.0

H – Horizontal V – Vertical

* - Ambient

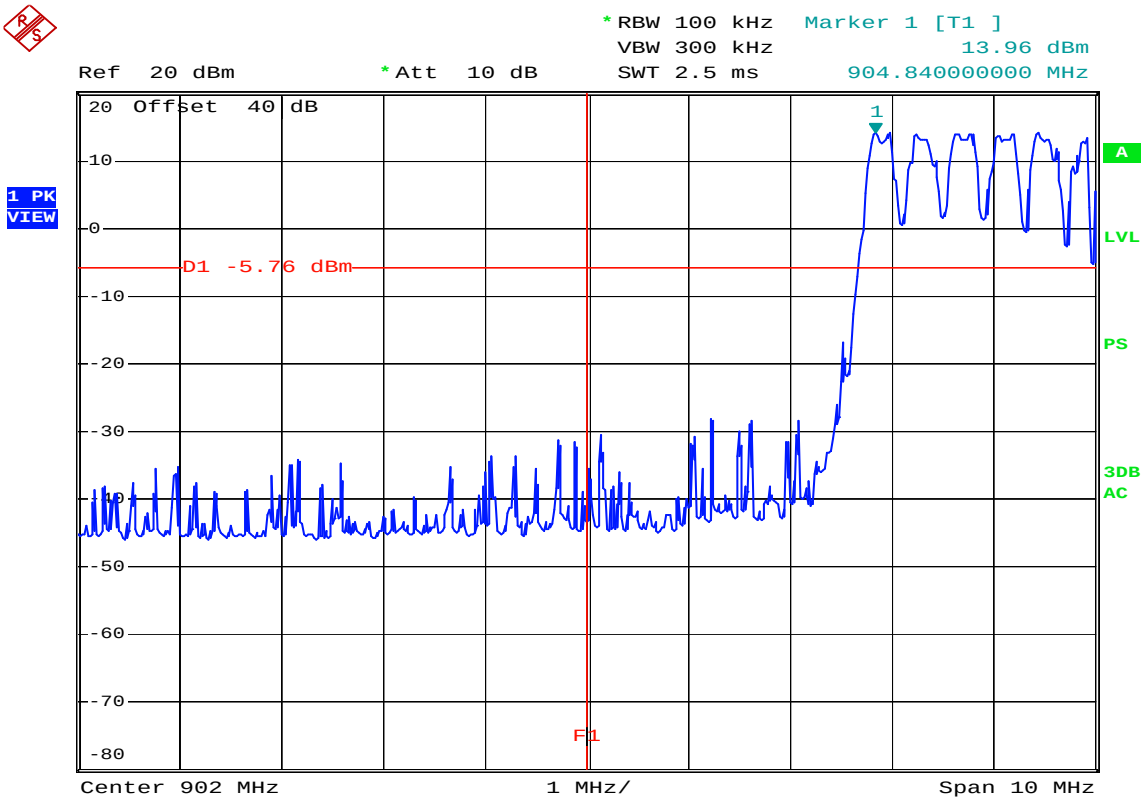
Total (dBuV/m) = Meter Reading (dBuV) + Cable Factor (dB) + Antenna Factor (dB) + Pre Amp (dB) + Duty Cycle (dB)
FS (uV/m) = AntiLog [(FS (dBuV/m))/20]



Date: 8.SEP.2011 23:00:25

15.247(d) Band Edge Compliance

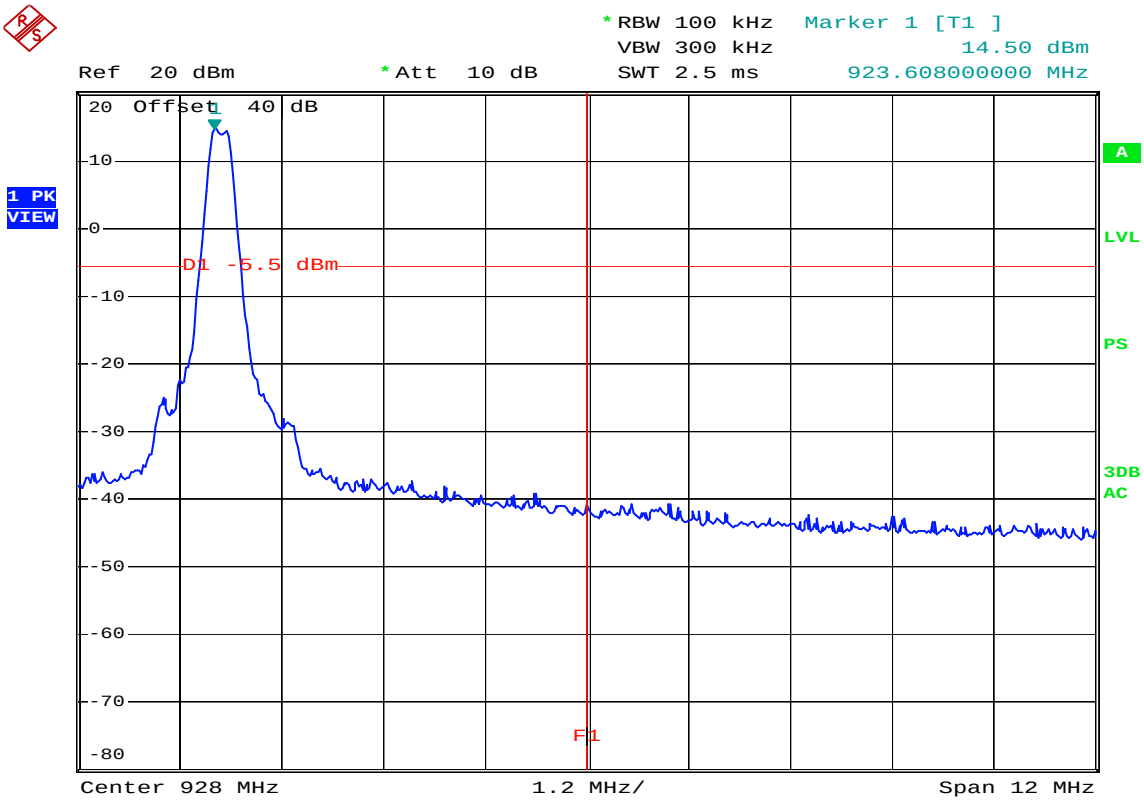
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 904.9MHz
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Band Edge Test
NOTES	:	Display Line D1 represents the 20dB down point from the peak emissions in a 100kHz bandwidth. Display Line F1 represents the band edge (928MHz).
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 8.SEP.2011 23:09:22

15.247(d) Band Edge Compliance

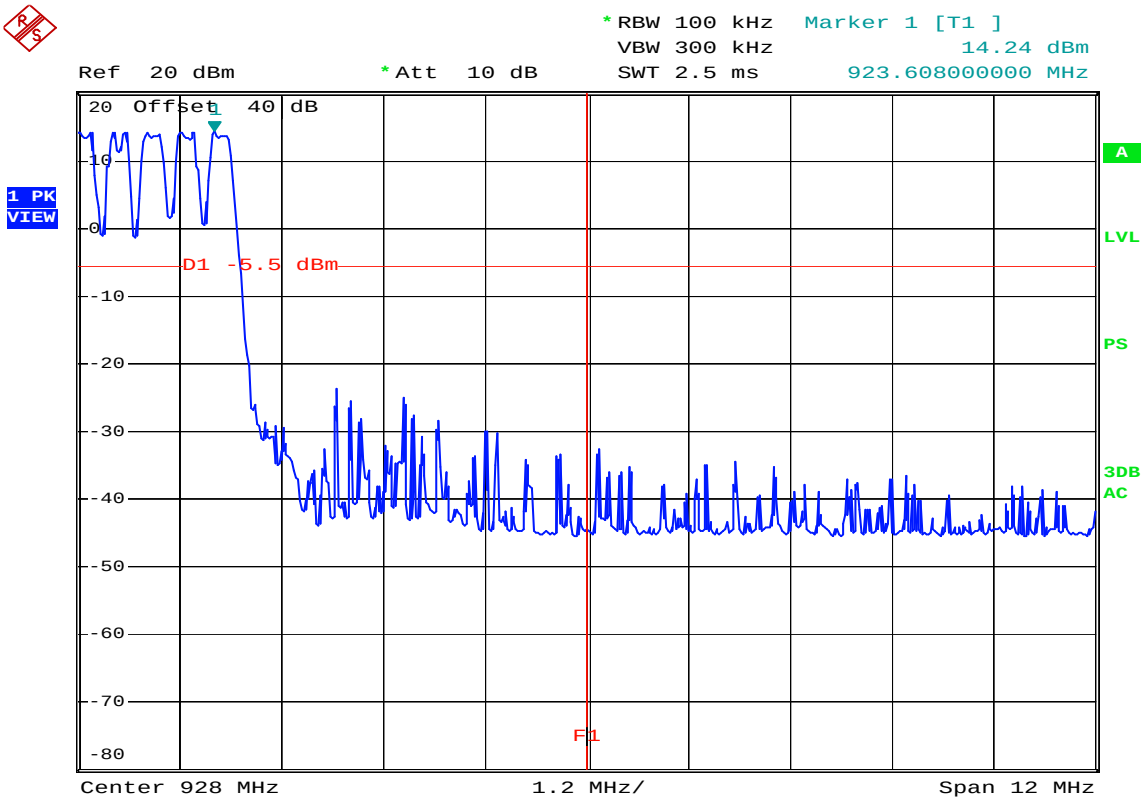
MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Hoping Enabled
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Band Edge Test
NOTES	:	Display Line D1 represents the 20dB down point from the peak emissions in a 100kHz bandwidth. Display Line F1 represents the band edge (928MHz).
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 8.SEP.2011 22:31:08

15.247(d) Band Edge Compliance

MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Tx @ 923.7MHz (Ch. 48)
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Band Edge Test
NOTES	:	Display Line D1 represents the 20dB down point from the peak emissions in a 100kHz bandwidth. Display Line F1 represents the band edge (928MHz).
EQUIPMENT USED	:	RBA0, T2D1, T2S3



Date: 8.SEP.2011 22:46:46

15.247(d) Band Edge Compliance

MANUFACTURER	:	Badger Meter
MODEL NUMBER	:	Orion SE Mobile Transceiver
SERIAL NUMBER	:	
TEST MODE	:	Hopping Enabled
NOTES	:	USB Powered
TEST DATE	:	September 8, 2011
TEST PARAMETERS	:	Band Edge Test
NOTES	:	Display Line D1 represents the 20dB down point from the peak emissions in a 100kHz bandwidth. Display Line F1 represents the band edge (928MHz).
EQUIPMENT USED	:	RBA0, T2D1, T2S3