Measurement of RF Interference from an Orion SE Water Meter with Metal Lid Frequency Hopping Spread Spectrum Transceiver

For	Badger Meter, Incorporated 4545 W. Brown Deer Road Milwaukee, WI 53223
P.O. Number	255148
Date Tested	Feburary 28 through April 3, 2013
Test Personnel	Richard E. King
Specification	FCC "Code of Federal Regulations" Title 47 Part 15, Subpart C, Section 15.247 for Frequency Hopping Intentional Radiators Operating within the 902-928MHz Industry Canada RSS-210, Annex 8, for Frequency Hopping Systems Operating in the Bands 902–928MHz Industry Canada RSS-GEN

Test Report By:

Richard E. King
EMC Engineer

Requested By:

Andy Davis
Badger Meter, Incorporated

Approved By:

Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894

Elite Electronic Engineering Inc.
1516 Centre Circle
Downers Grove, IL 60515
Tel : (630) 495-9770
Fax: (630) 495-9785
www.elitetest.com

TABLE OF CONTENTS

REVISION HISTORY

Revision	Date	Description
—	April 7, 2014	Initial release

Measurement of RF Emissions from a Frequency Hopping Spread Spectrum Transceiver, Part No. Orion SE Water Meter with Metal Lid

1. INTRODUCTION

1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Badger Meter, Incorporated Frequency Hopping Spread Spectrum Transceiver, Part No. Orion SE Water Meter with Metal Lid, No Serial No. was 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 0dBi USG-1430 antenna. The EUT was manufactured and submitted for testing by Badger Meter, Incorporated located in Milwaukee, WI.

The EUT has a fixed and a mobile power setting. The fixed power setting is a high power setting and utilizes 50 hopping channels. The mobile power setting is a low power setting and utilizes 48 hopping channels.

The receive portion of the EUT is a super-heterodyne type receiver designed to receive over the 902 to 928MHz band. The EUT contains a tuner which utilizes one local oscillator (LO) at the tuned frequency.

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 C63.4-2009.

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 22.9˚C and the relative humidity was humidity 23.3%.

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 2013
- ANSI C63.4-2009, "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 a Frequency Hopping Spread Spectrum Transceiver, Part No. Orion SE Water Meter with Metal Lid. A block diagram of the EUT setup is shown as Figure 1.

3.1.1 Power Input

The EUT typically obtains 3.6VDC from an internal battery. For testing purposes, the EUT obtained 3.6VDC from a DC power supply.

3.1.2 Peripheral Equipment

The EUT does not have connection to peripheral equipment.

3.1.3 Interconnect Cables

The EUT does not utilize any interconnect cables.

3.1.4 Grounding

The EUT was ungrounded during the tests.

3.2 Software

For all tests the EUT had Firmware Version 2.13MT:RTR loaded onto the device to provide correct load characteristics.

3.3 Operational Mode

For all tests, the EUT and peripheral equipment 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, Fixed Power Level
- Transmit at 914.5MHz, Fixed Power Level
- Transmit at 924.5MHz, Fixed Power Level
- Transmit at 904.9MHz, Mobile Power Level
- Transmit at 914.5MHz, Mobile Power Level
- Transmit at 923.7MHz, Mobile Power Level
- Receive at 904.9MHz
- Receive at 914.5MHz
- Receive at 924.5MHz
- Frequency Hopping Enabled

3.4 EUT Modifications

No modifications were required for compliance.

4. TEST FACILITY AND TEST INSTRUMENTATION

4.1 Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2009 for site attenuation.

4.2 Test Instrumentation

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

Conducted emission tests were performed with a spectrum analyzer in conjunction with a quasi-peak adapter. Radiated emissions were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths specified in the requirements and with the quasi-peak and average detector functions.

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 Emissions Measurements		
Combined Standard Uncertainty	1.06	-1.06
Expanded Uncertainty (95% confidence)	2.12	-2.12

Radiated Emissions Measurements		
Combined Standard Uncertainty	2.09	-2.09
Expanded Uncertainty (95% confidence)	4.19	-4.19

5. TEST PROCEDURES

5.1 Receiver

5.1.1 Powerline Conducted Emissions

5.1.1.1 Requirements

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

5.1.2 Radiated Measurements

5.1.2.1 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.

5.1.2.2 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 C63.4-2009 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

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.

   d) For hand-held or body-worn devices, the EUT was rotated through three orthogonal axes to determine which orientation produces the highest emission relative to the limit.

5.1.2.3 Results

The preliminary plots are presented on pages 20 through 31. The plots are presented for a reference only, and are not used to determine compliance. The final radiated levels are presented on pages 32 through 37. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figures 2 and 3.

5.2 Transmitter

5.2.1 20dB Bandwidth

5.2.1.1 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.

5.2.1.2 Procedures

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

5.2.1.3 Results

The plots are presented on pages 46 through 51.

For the mobile power setting the maximum 20 dB bandwidth was measured to be 282.6kHz. 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 when using the mobile power setting. The 99% bandwidth was measured to be 304.6kHz.

For the fixed power setting the maximum 20 dB bandwidth was measured to be 120.2kHz. Since the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping channels when using the fixed power setting. The 99% bandwidth was measured to be 120.2kHz.

5.2.2 Carrier Frequency Separation

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.

5.2.2.1 Procedures

The output of the EUT was connected to the spectrum analyzer through 40 dB 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.

5.2.2.2 Results

Pages 38 and 39 show the carrier frequency separation for both the fixed and mobile power levels, as can be seen from these plots, the frequency separation greater than the maximum 20dB bandwidth.

5.2.3 Number of Hopping Frequencies

5.2.3.1 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.

5.2.3.2 Procedures

The output of the EUT was connected to the spectrum analyzer through 40 dB 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.

5.2.3.3 Results

Pages 38 and 39 present the number of hopping frequencies for both the fixed and mobile power settings. As can be seen from these plots, the number of frequencies is 50 for the fixed power setting and 48 for the mobile power setting both of which is greater than the minimum required.

5.2.4 Time of Occupancy

5.2.4.1 Requirements

Per section 15.247(a)(1)(i), For frequency hopping systems operating in the 902-928MHz band. The average time of occupancy shall not be greater than 0.4 seconds within a 20 second period if the 20dB bandwidth is less than 250kHz. If the 20dB bandwidth is greater than 250kHz, the average time of occupancy shall not be greater than 0.4 seconds within a 10 second period.

5.2.4.2 Procedures

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

The resolution bandwidth (RBW) was set to 100 kHz. The peak detector and 'Max-Hold' function was 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. Then, the sweep time was expanded to capture the average time between hops. When the trace had stabilized after multiple scans, the time between hops was measured. 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.

5.2.4.3 Results

Pages 42 through 45 show the plots for the time of occupancy (dwell time). As can be seen from the plots, when set for the mobile power setting, the time of occupancy can be determined by dwell time/hop (10.42 mS) multiplied by number of hops (2). This calculated value is equal to 0.020 seconds, which is less than the 0.4 seconds maximum allowed. When the EUT is set for the fixed power setting, the time of occupancy can be determined by dwell time/hop (58.3 mS) multiplied by number of hops (6). This calculated value is equal to 0.3498 seconds, which is less than the 0.4 seconds maximum allowed.

5.2.5 Peak Output Power

5.2.5.1 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)(2), for frequency hopping systems operating in the 902-928MHz band and employing 50 hopping channels or more, the maximum peak output conducted power shall not be greater than 1W (30dBm).

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) for a transmitter with less than 50 hopping channels and 4 watts (36dBm) for a transmitter with at least 50 hopping channels.

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 for a transmitter employing less than 50 hopping channels and below 30dBm for a transmitter employing 50 hopping channels or more, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2.5.2 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.

The EUT was placed on the non-conductive stand and set to transmit. A bilog 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 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.

5.2.5.3 Results

The results of the output power measurement with the EUT set at the mobile power setting are presented on page 52. The maximum output power measured from the transceiver in the mobile power setting was 11.15 dBm which meets the 24 dBm limit.

The results of the output power measurement with the EUT set at the fixed power setting are presented on page 53. The maximum output power measured from the transceiver in the fixed power setting was 28.6 dBm which meets the 30 dBm limit.

The results are presented on pages 54 and 55. The maximum EIRP measured from the transceiver in the mobile power setting was 11.9 dBm which meets the De Facto 30 dBm limit. The maximum EIRP measured from the transceiver in the fixed power setting was 28.3 dBm which meets the De Facto 36 dBm limit.

5.2.6 Antenna Conducted Spurious Emissions

5.2.6.1 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.

5.2.6.2 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.

5.2.6.3 Results

The results of the antenna conducted emissions levels were plotted. These plots are presented on pages 28 through 36. These plots show that the spurious emissions were at least 20 dB below the level of the fundamental.

5.2.7 Radiated Spurious Emissions Measurements

5.2.7.1 Requirements

Per section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

5.2.7.2 Procedures

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

Preliminary radiated emissions tests were performed to determine the emission characteristics of the EUT. For the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 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 were 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).

5.2.7.3 Results

Preliminary radiated emissions plots with the EUT transmitting at Low Frequency, Middle Frequency, and High Frequency are shown on pages 62 through 85. Final radiated emissions data are presented on data pages 86 through 97. As can be seen from the data, all emissions measured from the EUT were within the specification limits.

Photographs of the test configuration which yielded the highest or worst case, radiated emission levels are shown on Figures 2 and 3.

5.2.8 Band Edge Compliance

5.2.8.1 Requirements

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

5.2.8.2 Procedures

5.2.8.2.1 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.

5.2.8.2.2 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.

5.2.8.3 Results

Pages 98 through 105 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, Incorporated Frequency Hopping Spread Spectrum Transceiver, Part No. Orion SE Water Meter with Metal Lid frequency hopping spread spectrum transceiver, No Serial No.assigned, did fully meet the technical 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 C63.4-2009.

It was also determined that the Badger Meter, Incorporated Frequency Hopping Spread Spectrum Transceiver, Part No. Orion SE Water Meter with Metal Lid frequency hopping spread spectrum transceiver, Serial No. S/N 1, did fully meet the technical 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 C63.4-2009.

7. CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUT at the test date. Any electrical or mechanical modification made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

8. ENDORSEMENT DISCLAIMER

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the Federal Government.

9. EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW3	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-35-120-5R0-10-12	PL2924	1GHZ-20GHZ	10/8/2013	10/8/2014
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
NTA3	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	2/19/2014	2/19/2015
NWQ0	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS LINDGREN	3117	66657	1GHZ-18GHZ	3/11/2014	3/11/2015
RAKI	RF SECTION	HEWLETT PACKARD	85462A	3411A00181	0.009-6500MHZ	3/19/2014	3/19/2015
RAKJ	RF FILTER SECTION	HEWLETT PACKARD	85460A	3330A00154	---	3/19/2014	3/19/2015
RBA1	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100146	20HZ-26.5GHZ	3/5/2014	3/5/2015
T2SB	20DB 25W ATTENUATOR	WEINSCHEL	46-20-34	DC5014	DC-18GHZ	11/7/2013	11/7/2014
T2SE	20DB 25W ATTENUATOR	WEINSCHEL	46-20-34	CD5019	DC-18GHZ	11/7/2013	11/7/2014
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	
WQB0	RE_8546A						
WQC0	HF_8546A						
XPQ2	HIGH PASS FILTER	K&L MICROWAVE	4IH30-1804/T10000-0	3	1.8-10GHZ	10/25/2013	10/25/2014
NDQ1	TUNED DIPOLE ANTENNA	EMCO	3121C-DB4	313	400-1000MHZ	4/18/2013	4/18/2014
GSD3	SIGNAL GENERATOR	ROHDE & SCHWARZ	SMB100A	104454	9KHZ-6GHZ	8/28/2013	8/28/2014

I/O: Initial Only N/A: Not Applicable

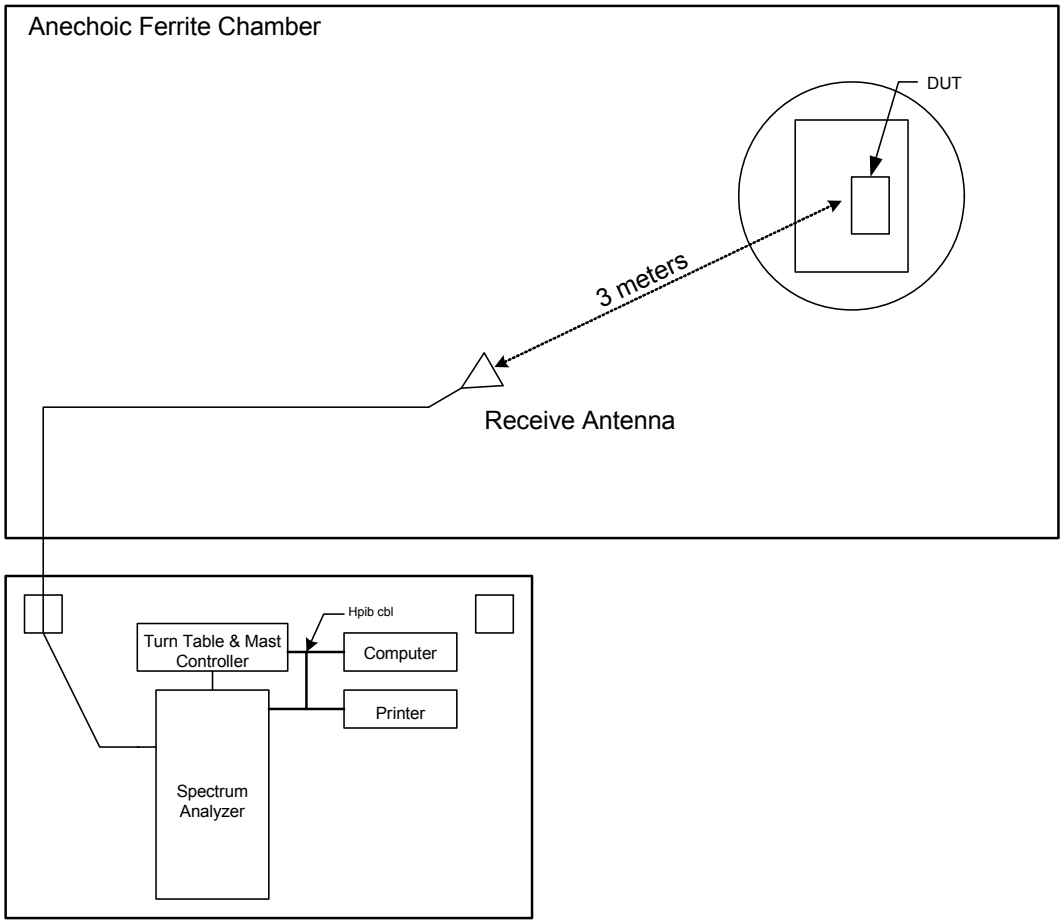


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

Figure 3

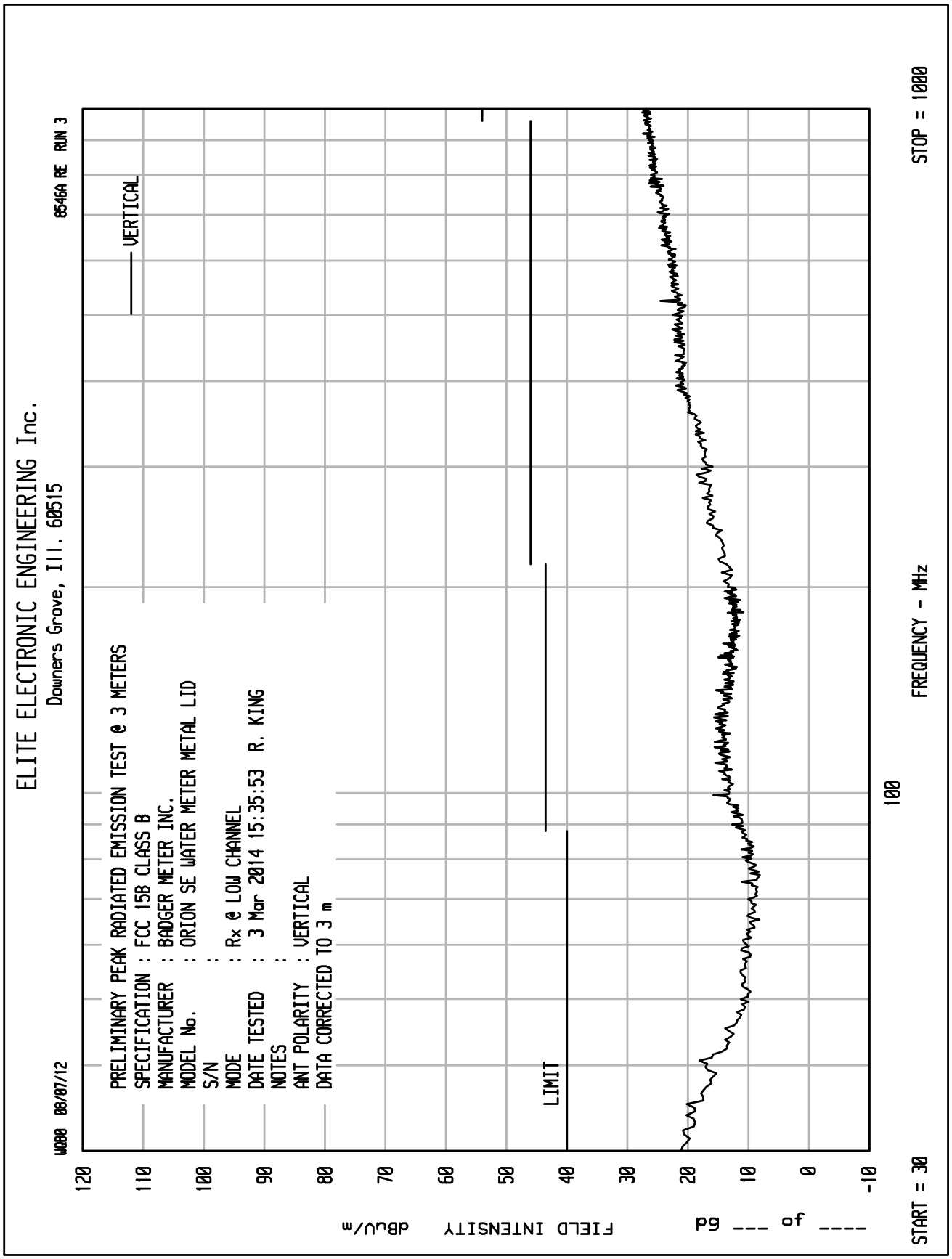
Test Setup for Radiated Emissions – Vertical Polarity

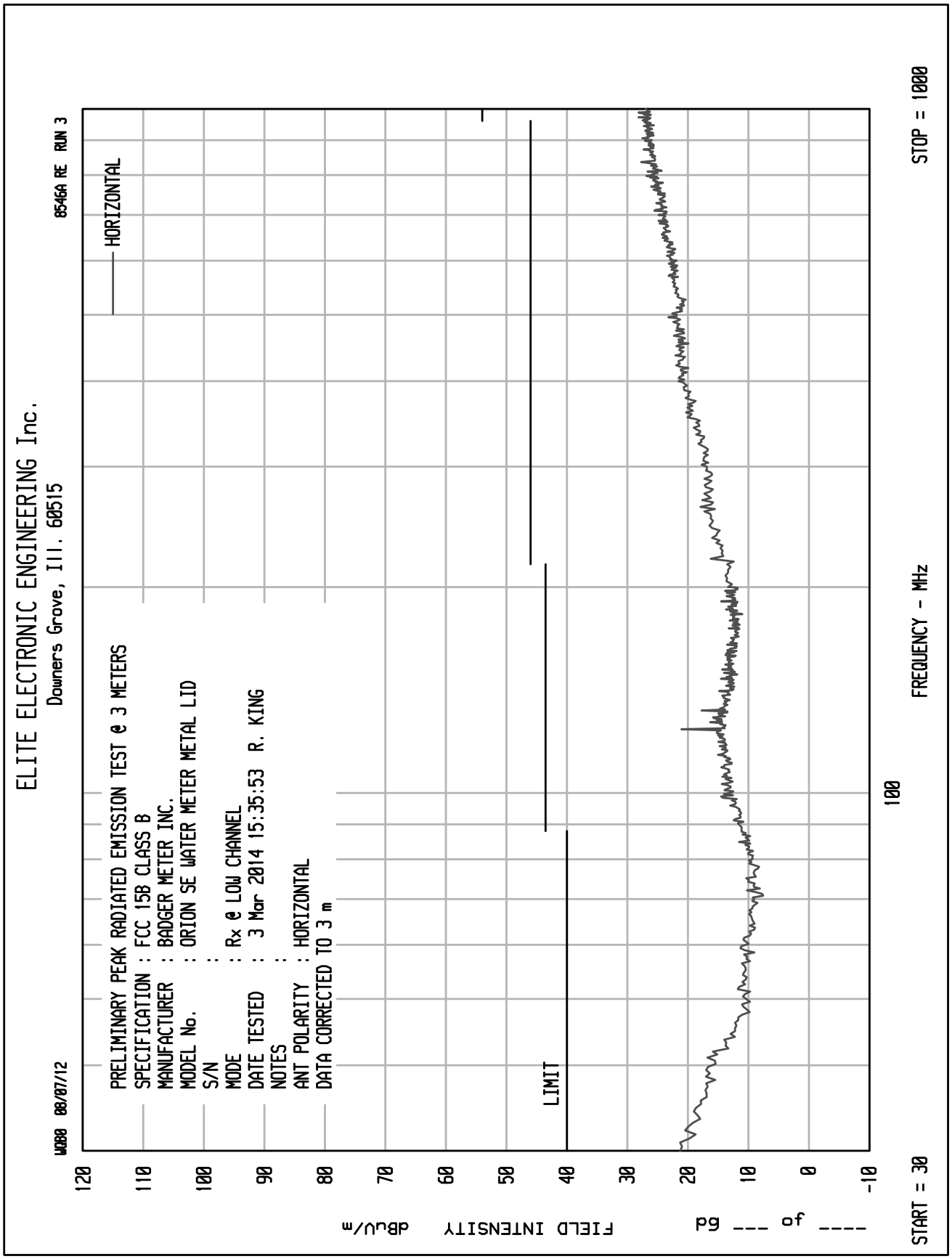
Test Setup for Radiated Emissions – EUT

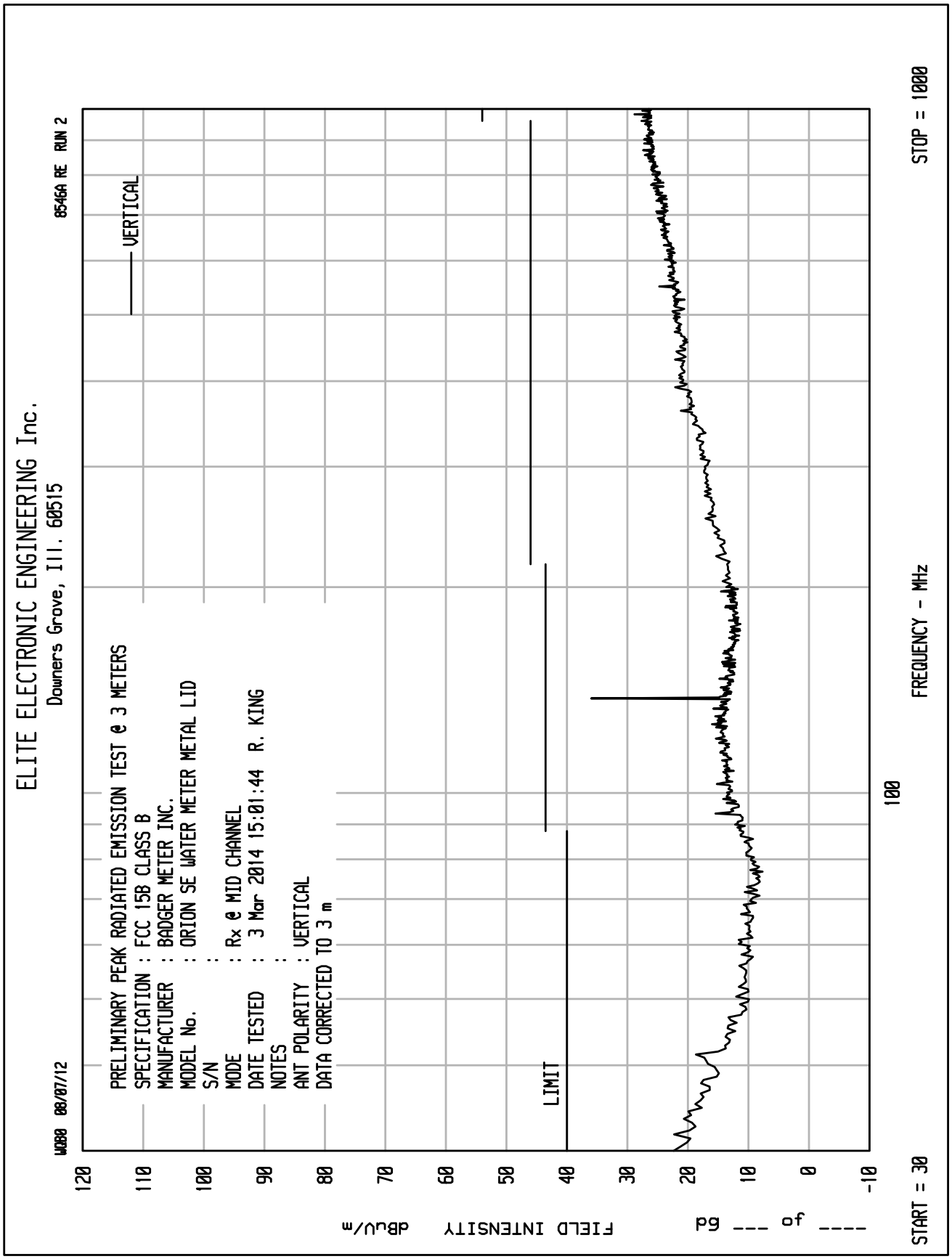
Figure 3

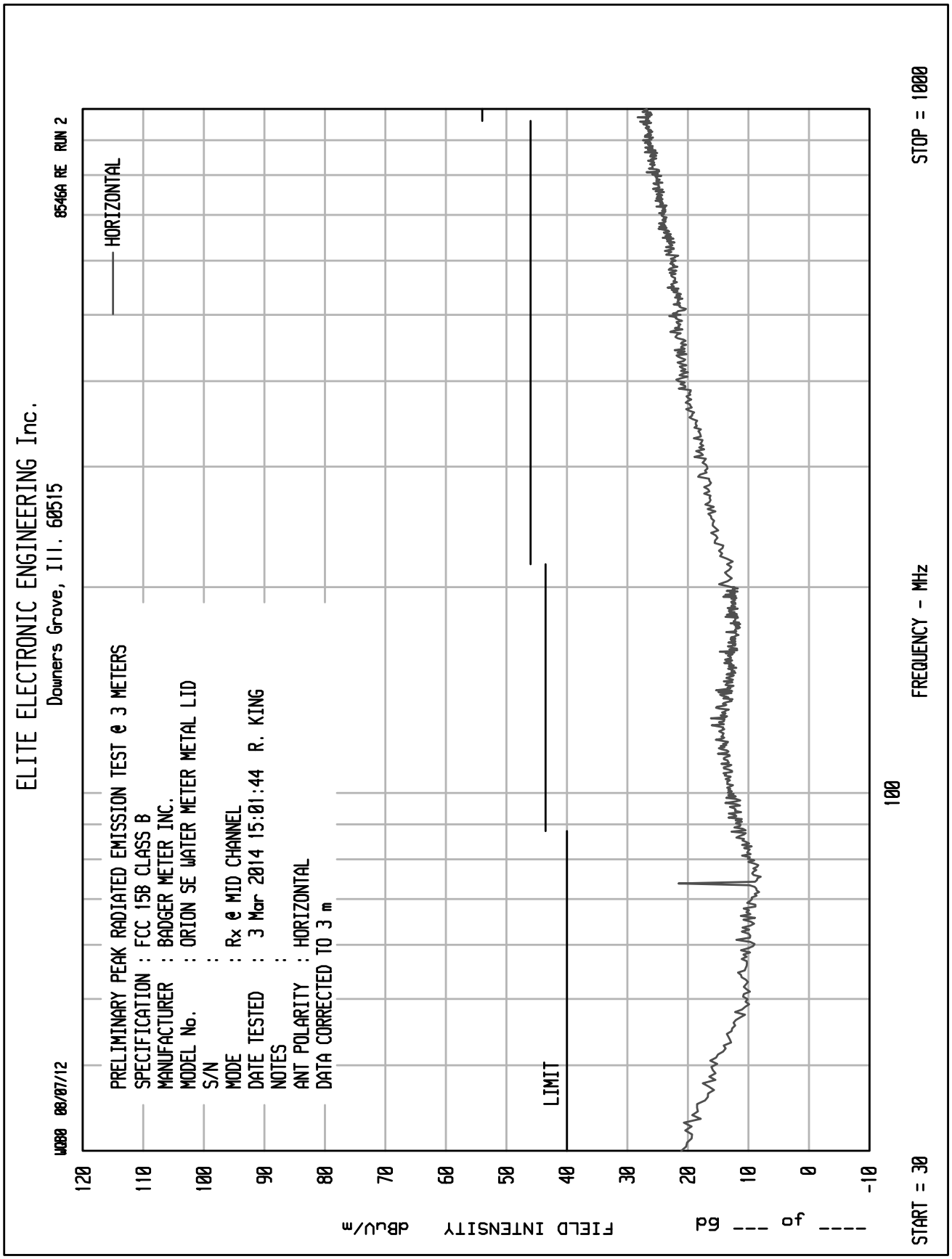
Test Setup for Radiated Emissions – 2GHz to 10GHz, Horizontal Polarization

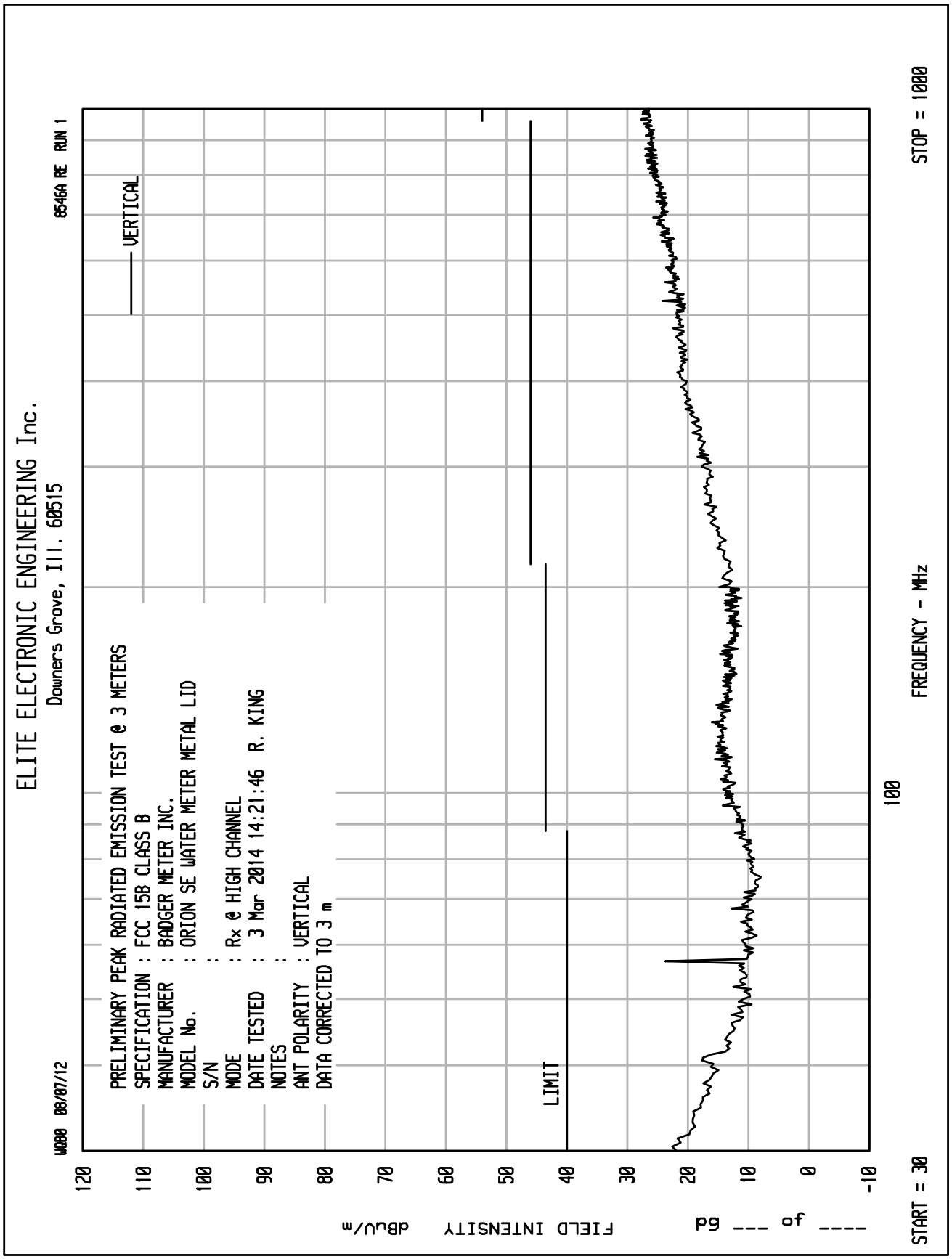
Test Setup for Radiated Emissions – 2GHz to 10GHz, Vertical Polarization

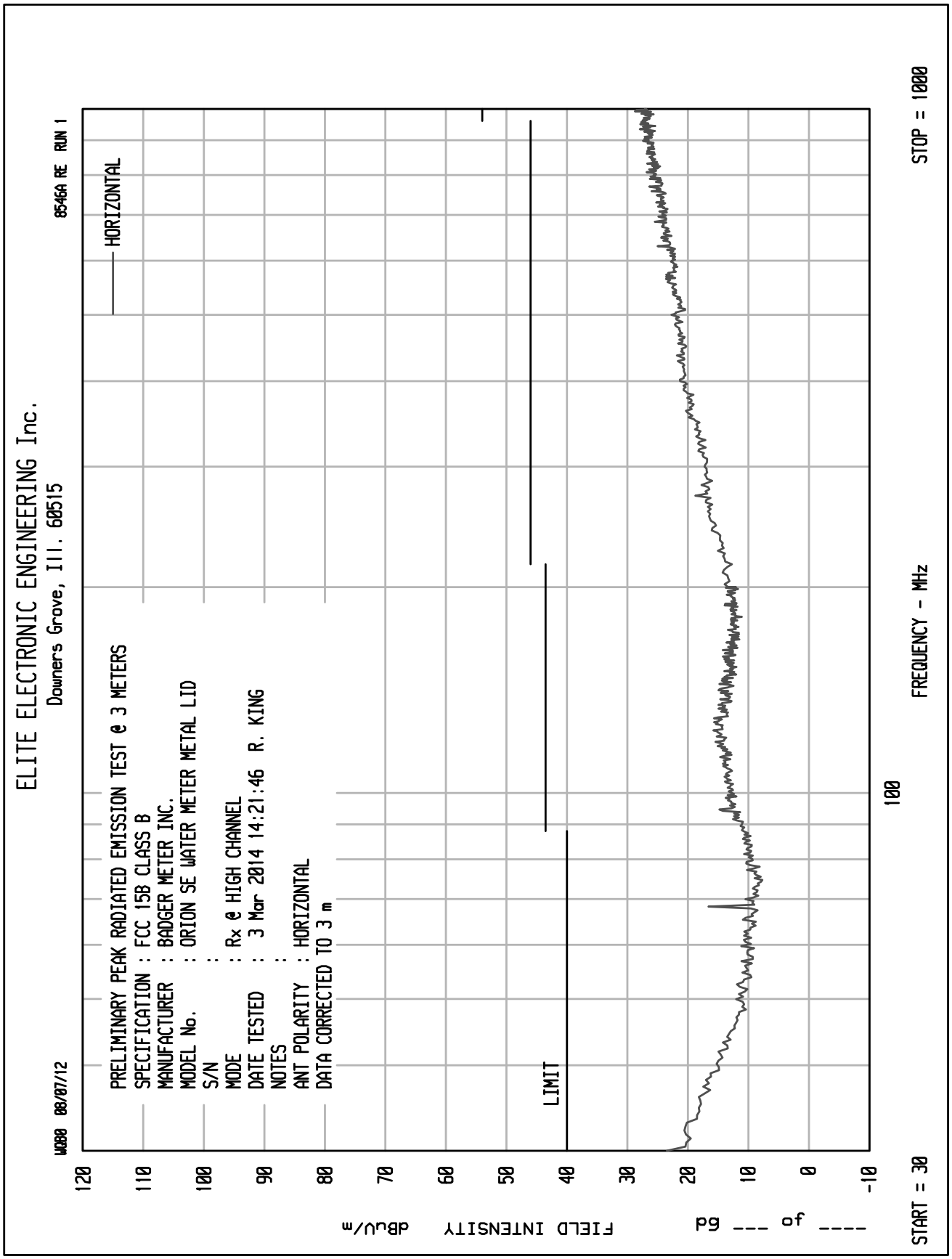

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A RE RUN 3
VERTICAL
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N :
MODE : Rx @ LOW CHANNEL
DATE TESTED : 3 Mar 2014 15:35:53 R. KING
NOTES :
ANT POLARITY : VERTICAL
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
FREQUENCY - MHz
START = 30
100
STOP = 1000
120
110
100
90
80
70
60
50
40
30
20
10
0
-10

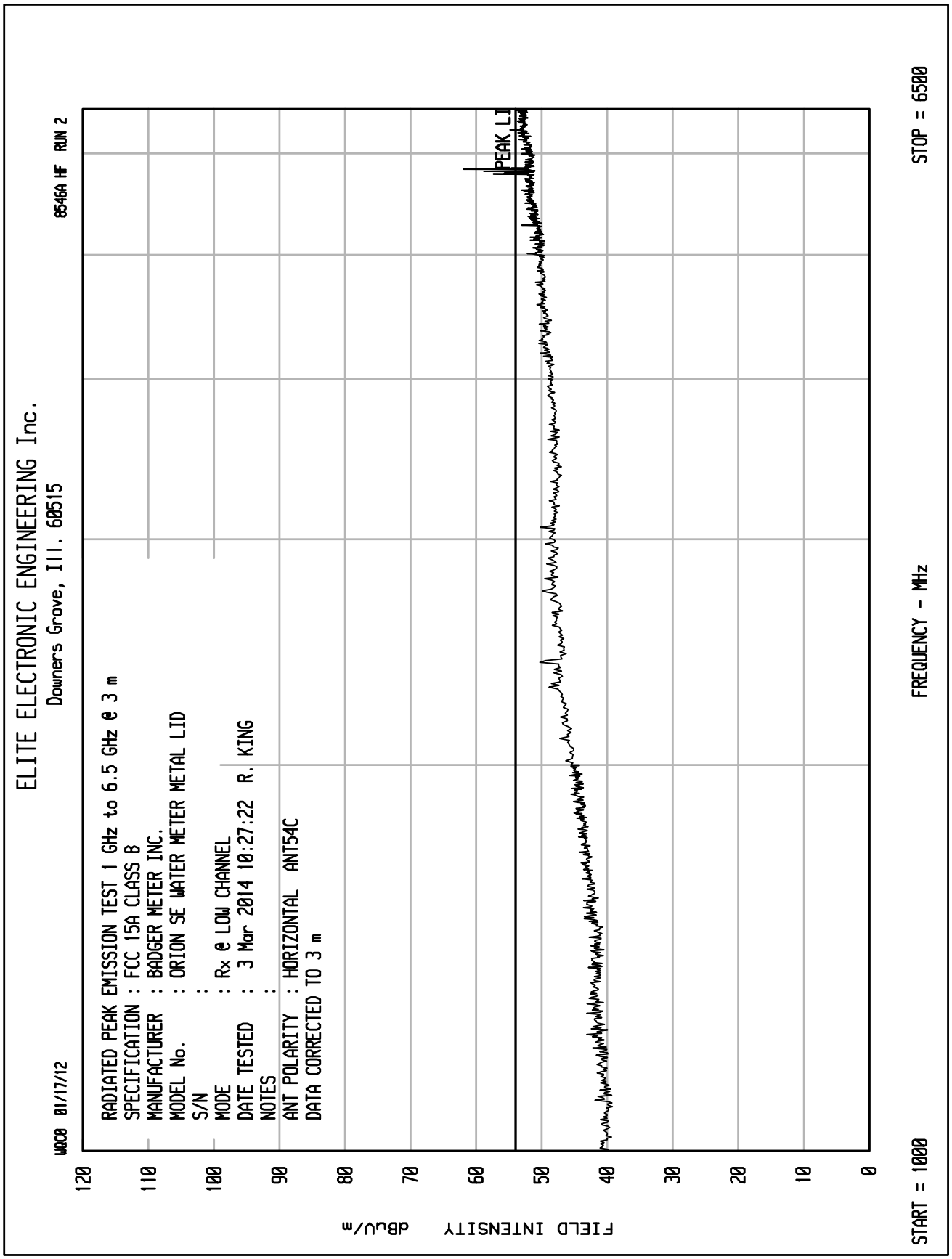

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A RE RUN 3
HORIZONTAL
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N :
MODE : Rx @ LOW CHANNEL
DATE TESTED : 3 Mar 2014 15:35:53 R. KING
NOTES :
ANT POLARITY : HORIZONTAL
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
FREQUENCY - MHz
START = 30
100
STOP = 1000
120
110
100
90
80
70
60
50
40
30
20
10
0
-10

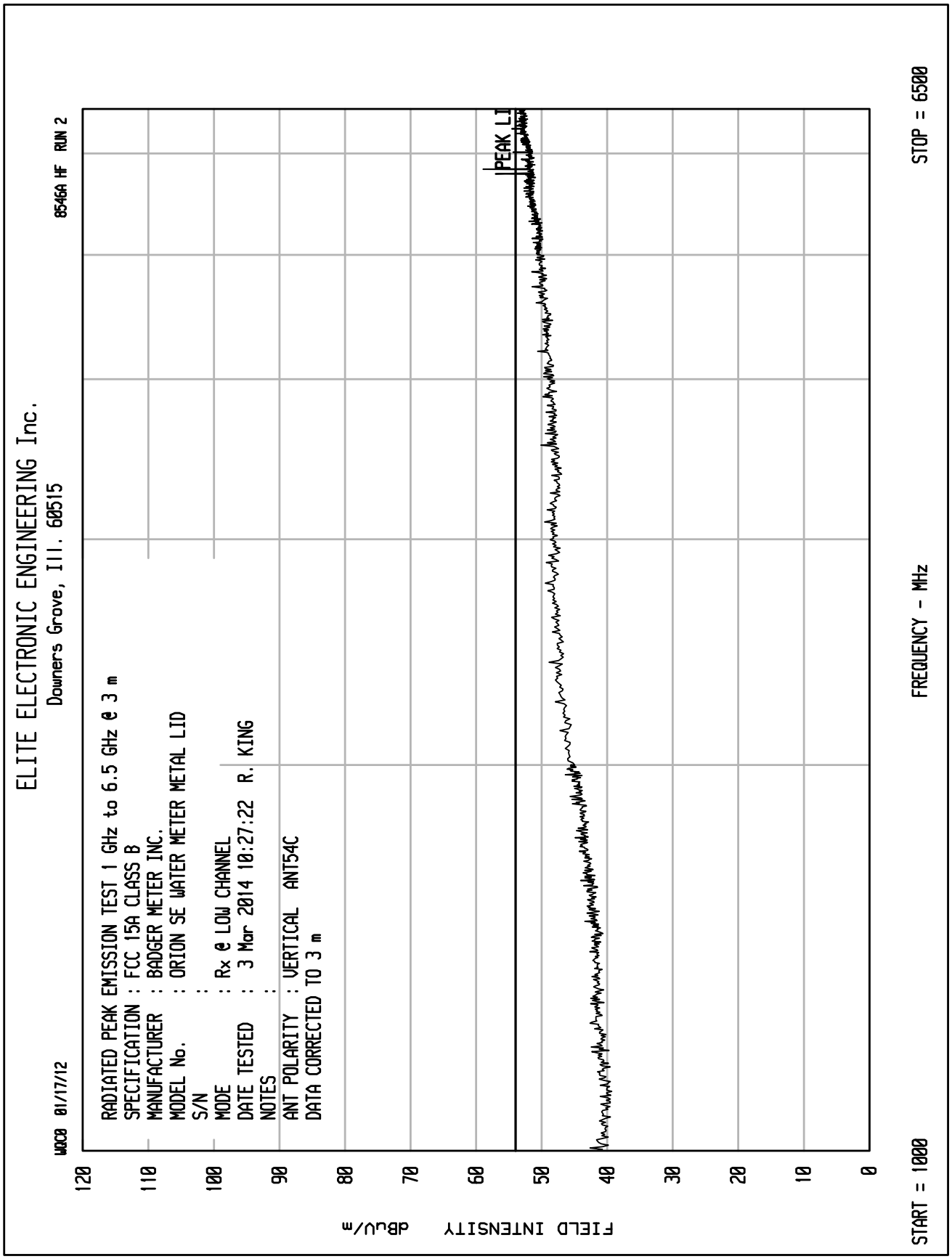

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A RE RUN 2
VERTICAL
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N :
MODE : Rx @ MID CHANNEL
DATE TESTED : 3 Mar 2014 15:01:44 R. KING
NOTES :
ANT POLARITY : VERTICAL
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
START = 30
100
STOP = 1000
FREQUENCY - MHz
---- of ---- pg

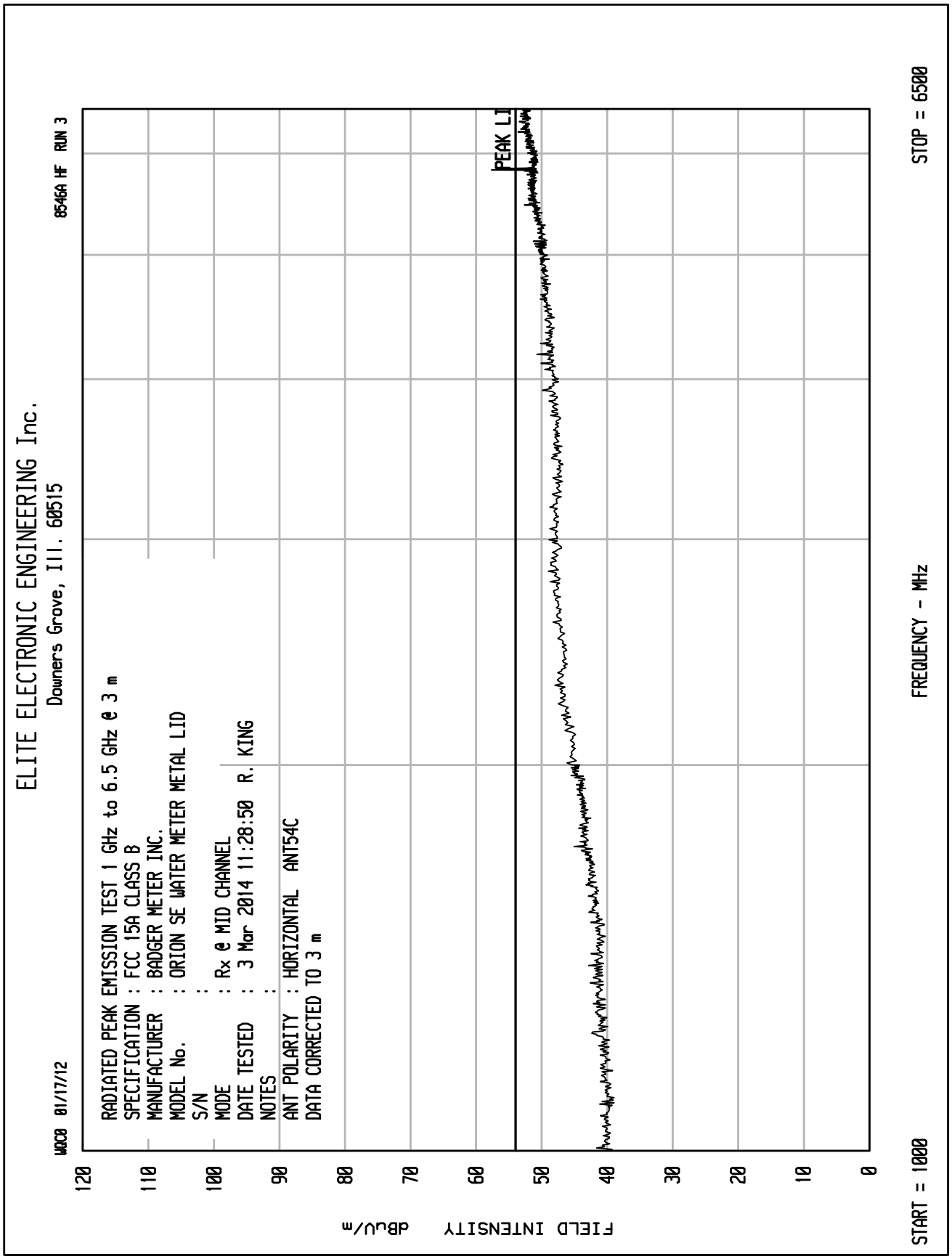

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A RE RUN 2
HORIZONTAL
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N :
MODE : Rx @ MID CHANNEL
DATE TESTED : 3 Mar 2014 15:01:44 R. KING
NOTES :
ANT POLARITY : HORIZONTAL
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
FREQUENCY - MHz
START = 30
100
STOP = 1000
120
110
100
90
80
70
60
50
40
30
20
10
0
-10

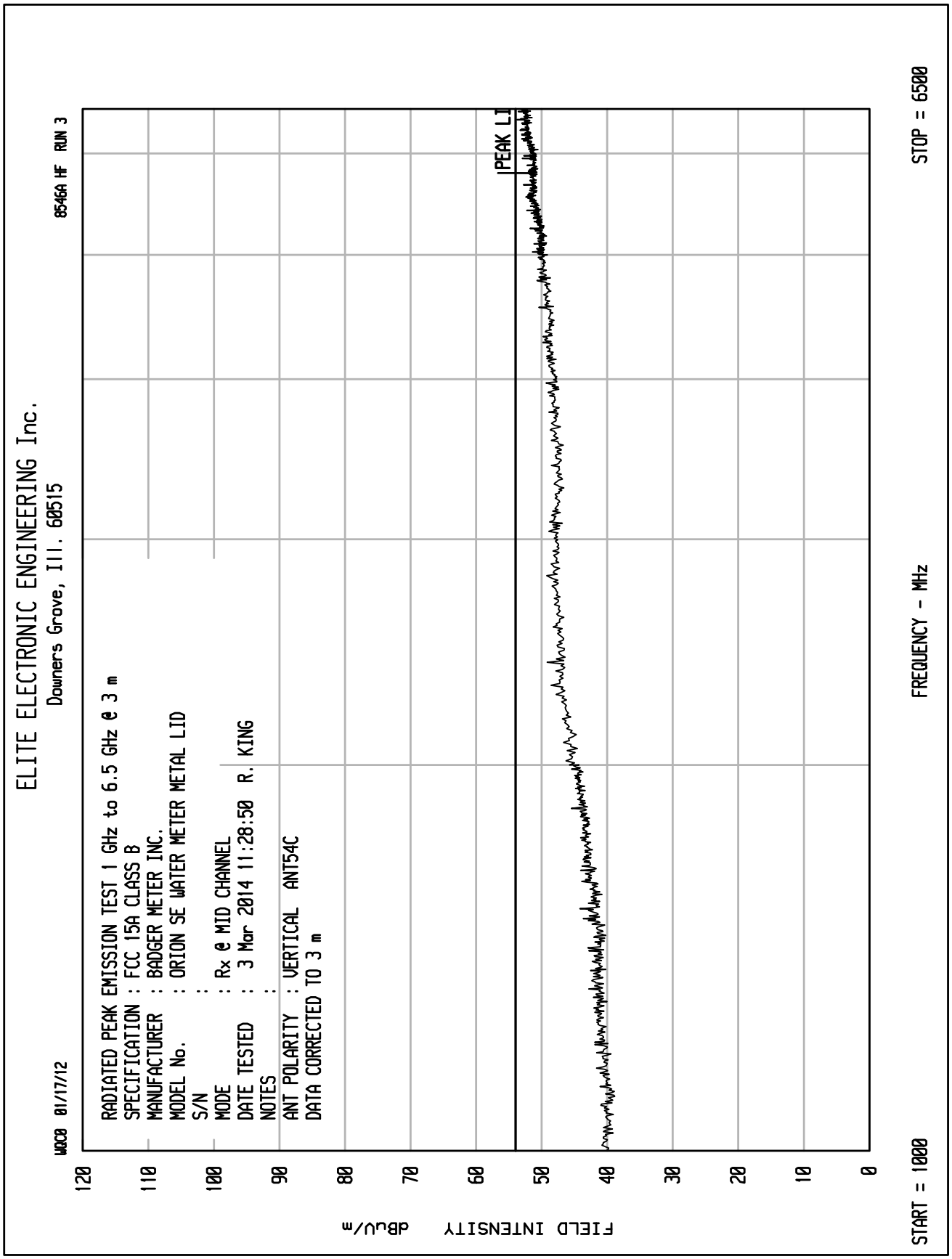

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A RE RUN 1
VERTICAL
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N :
MODE : Rx @ HIGH CHANNEL
DATE TESTED : 3 Mar 2014 14:21:46 R. KING
NOTES :
ANT POLARITY : VERTICAL
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
START = 30
100
STOP = 1000
FREQUENCY - MHz

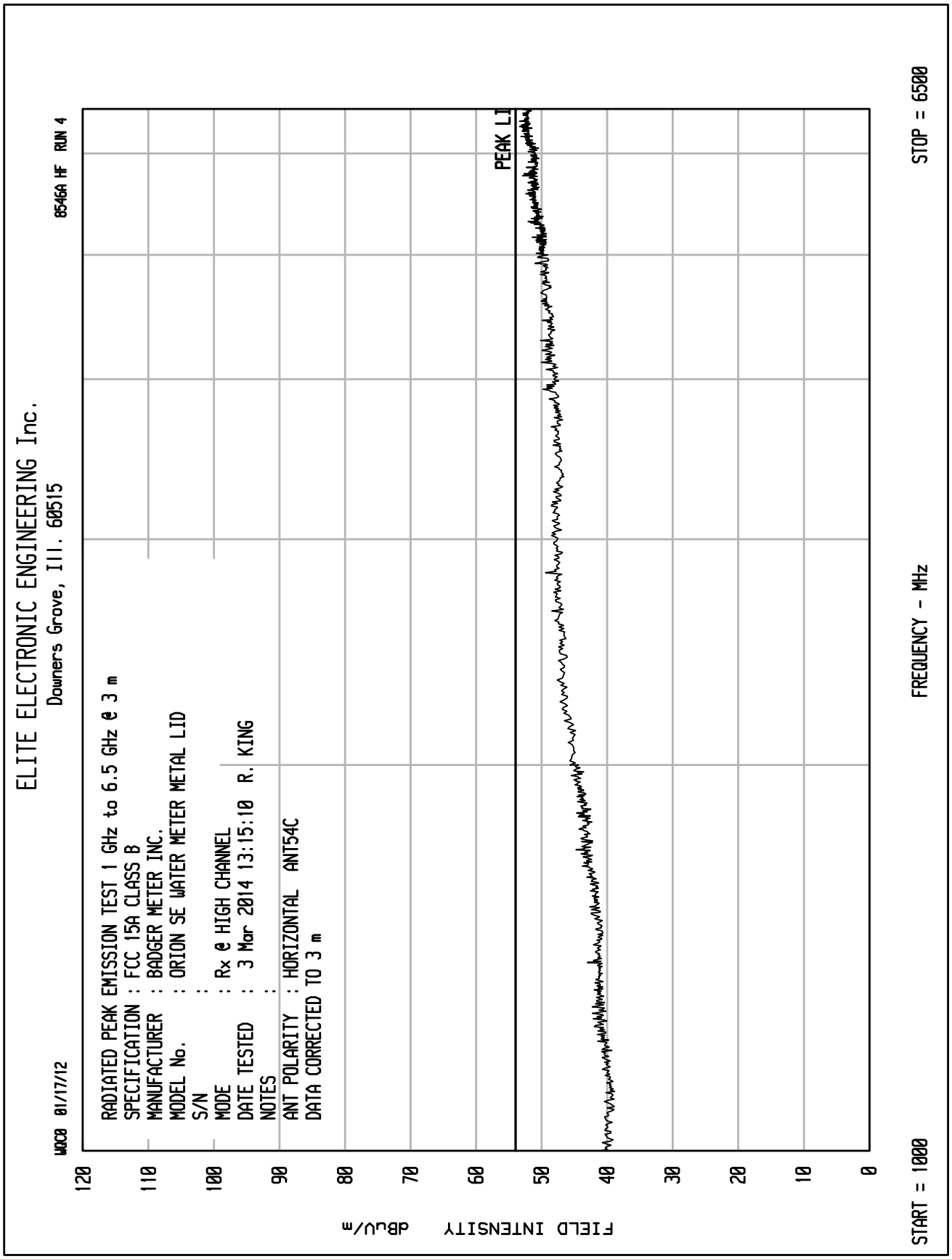

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A RE RUN 1
HORIZONTAL
PRELIMINARY PEAK RADIATED EMISSION TEST @ 3 METERS
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N :
MODE : Rx @ HIGH CHANNEL
DATE TESTED : 3 Mar 2014 14:21:46 R. KING
NOTES :
ANT POLARITY : HORIZONTAL
DATA CORRECTED TO 3 m
LIMIT
FIELD INTENSITY dBuV/m
FREQUENCY - MHz
START = 30
100
STOP = 1000
120
110
100
90
80
70
60
50
40
30
20
10
0
-10

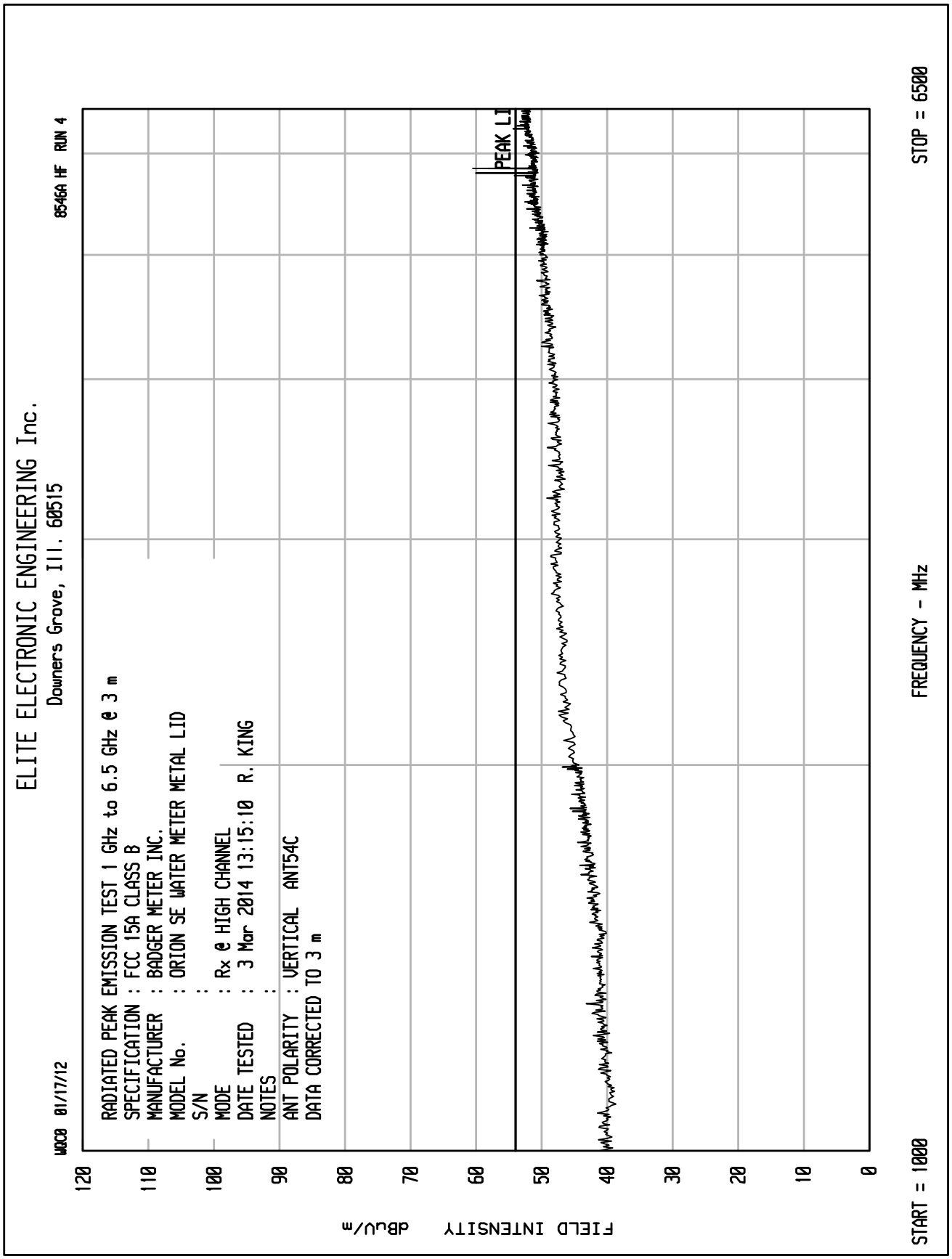

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC9 01/17/12
8546A HF RUN 2
RADIATED PEAK EMISSION TEST 1 GHz to 6.5 GHz @ 3 m
SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N : :
MODE : Rx @ LOW CHANNEL
DATE TESTED : 3 Mar 2014 10:27:22 R. KING
NOTES : :
ANT POLARITY : HORIZONTAL ANT54C
DATA CORRECTED TO 3 m
PEAK LI
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
8546A HF RUN 2
WQC9 01/17/12
RADIATED PEAK EMISSION TEST 1 GHz to 6.5 GHz @ 3 m
SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N : :
MODE : Rx @ LOW CHANNEL
DATE TESTED : 3 Mar 2014 10:27:22 R. KING
NOTES : :
ANT POLARITY : VERTICAL ANT54C
DATA CORRECTED TO 3 m
PEAK LI
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC9 01/17/12
8546A HF RUN 3
RADIATED PEAK EMISSION TEST 1 GHz to 6.5 GHz @ 3 m
SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N : :
MODE : Rx @ MID CHANNEL
DATE TESTED : 3 Mar 2014 11:28:50 R. KING
NOTES : :
ANT POLARITY : HORIZONTAL ANT54C
DATA CORRECTED TO 3 m
PEAK LI
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC9 01/17/12
8546A HF RUN 3
RADIATED PEAK EMISSION TEST 1 GHz to 6.5 GHz @ 3 m
SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N : :
MODE : Rx @ MID CHANNEL
DATE TESTED : 3 Mar 2014 11:28:50 R. KING
NOTES : :
ANT POLARITY : VERTICAL ANT54C
DATA CORRECTED TO 3 m
PEAK LI
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC9 01/17/12
8546A HF RUN 4
RADIATED PEAK EMISSION TEST 1 GHz to 6.5 GHz @ 3 m
SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N : :
MODE : Rx @ HIGH CHANNEL
DATE TESTED : 3 Mar 2014 13:15:10 R. KING
NOTES : :
ANT POLARITY : HORIZONTAL ANT54C
DATA CORRECTED TO 3 m
PEAK LI
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WQC9 01/17/12
8546A HF RUN 4
RADIATED PEAK EMISSION TEST 1 GHz to 6.5 GHz @ 3 m
SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
S/N : :
MODE : Rx @ HIGH CHANNEL
DATE TESTED : 3 Mar 2014 13:15:10 R. KING
NOTES : :
ANT POLARITY : VERTICAL ANT54C
DATA CORRECTED TO 3 m
PEAK LI
FIELD INTENSITY dBuV/m
120
110
100
90
80
70
60
50
40
30
20
10
0
START = 1000
FREQUENCY - MHz
STOP = 6500

ETR No. 8546A
DATA SHEET TEST NO. 3

RADIATED QP EMISSION MEASUREMENTS in a 3 m SEMI-ANECHOIC ROOM
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL NO. : ORION SE WATER METER METAL LID
SERIAL NO. :
TEST MODE : Rx @ LOW CHANNEL
NOTES :
TEST DATE : 3 Mar 2014 15:35:53
TEST DISTANCE : 3 m (DATA EXTRAPOLATED TO 3 m)

FREQUENCY	QP READING	ANT FAC	CBL FAC	EXT ATTN	DIST FAC	TOTAL	QP LIMIT	AZ	ANT HT	POLAR
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dBuV/m	deg	cm	
32.12	-6.6	18.2	.5	0.0	0.0	12.1	40.0	-0	200	H
59.94	-6.0	8.0	.5	0.0	0.0	2.5	40.0	315	340	H
84.25	-7.0	8.9	.5	0.0	0.0	2.3	40.0	135	200	H
98.84	-7.0	11.4	.5	0.0	0.0	4.9	43.5	0	340	V
124.54	-6.9	13.0	.7	0.0	0.0	6.7	43.5	135	120	H
159.02	-2.0	10.7	.8	0.0	0.0	9.6	43.5	0	120	V
184.28	-7.0	10.4	.9	0.0	0.0	4.3	43.5	180	200	H
261.08	-6.5	13.2	1.0	0.0	0.0	7.7	46.0	90	200	H
364.21	-5.2	15.6	1.3	0.0	0.0	11.7	46.0	314	340	H
471.93	-6.0	17.5	1.5	0.0	0.0	13.0	46.0	90	340	H
525.32	-6.6	18.0	1.5	0.0	0.0	13.0	46.0	225	120	V
689.89	-5.3	19.6	1.7	0.0	0.0	16.0	46.0	135	340	H
801.53	-5.5	20.7	2.0	0.0	0.0	17.3	46.0	45	200	H
842.86	-5.5	21.3	2.0	0.0	0.0	17.8	46.0	269	120	H
916.98	-5.6	21.7	2.0	0.0	0.0	18.1	46.0	225	200	V

Checked BY Richard E. King :

Richard E. King

ETR No. 8546A
DATA SHEET TEST NO. 2

RADIATED QP EMISSION MEASUREMENTS in a 3 m SEMI-ANECHOIC ROOM
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL NO. : ORION SE WATER METER METAL LID
SERIAL NO. :
TEST MODE : Rx @ MID CHANNEL
NOTES :
TEST DATE : 3 Mar 2014 15:01:44
TEST DISTANCE : 3 m (DATA EXTRAPOLATED TO 3 m)

FREQUENCY MHz	QP READING dBuV	ANT FAC dB	CBL FAC dB	EXT ATTN dB	DIST FAC dB	TOTAL dBuV/m	QP LIMIT dBuV/m	AZ deg	ANT HT cm	POLAR
74.85	-6.6	7.0	.5	0.0	0.0	.9	40.0	225	120	H
90.66	-7.0	10.1	.5	0.0	0.0	3.5	43.5	180	120	H
122.00	-5.5	12.9	.6	0.0	0.0	8.0	43.5	45	200	H
138.76	-6.8	11.9	.7	0.0	0.0	5.8	43.5	90	340	V
147.66	-7.2	11.3	.8	0.0	0.0	4.9	43.5	225	120	V
187.71	-7.1	10.5	1.0	0.0	0.0	4.4	43.5	45	120	V
197.78	-7.3	10.7	1.0	0.0	0.0	4.4	43.5	135	200	H
364.41	-5.2	15.6	1.3	0.0	0.0	11.7	46.0	90	200	V
475.89	-6.0	17.6	1.5	0.0	0.0	13.1	46.0	225	121	H
545.52	-6.6	18.8	1.5	0.0	0.0	13.7	46.0	180	121	V
676.12	-5.2	19.6	1.7	0.0	0.0	16.2	46.0	270	121	H
780.31	-5.6	20.5	2.0	0.0	0.0	16.8	46.0	46	200	V
902.96	-5.5	21.7	2.0	0.0	0.0	18.1	46.0	225	200	H
959.90	-5.9	22.1	2.0	0.0	0.0	18.3	46.0	270	120	H

Checked BY Richard E. King :

Richard E. King

.n

ETR No. 8546A
DATA SHEET TEST NO. 1

RADIATED QP EMISSION MEASUREMENTS in a 3 m SEMI-ANECHOIC ROOM
SPECIFICATION : FCC 15B CLASS B
MANUFACTURER : BADGER METER INC.
MODEL NO. : ORION SE WATER METER METAL LID
SERIAL NO. :
TEST MODE : Rx @ HIGH CHANNEL
NOTES :
TEST DATE : 3 Mar 2014 14:21:46
TEST DISTANCE : 3 m (DATA EXTRAPOLATED TO 3 m)

FREQUENCY	QP READING	ANT FAC	CBL FAC	EXT ATTN	DIST FAC	TOTAL	QP LIMIT	AZ	ANT HT	POLAR
MHz	dBuV	dB	dB	dB	dB	dBuV/m	dBuV/m	deg	cm	
32.01	-5.9	18.2	.5	0.0	0.0	12.8	40.0	270	200	H
57.88	-6.0	8.1	.5	0.0	0.0	2.7	40.0	225	200	V
87.19	-7.0	9.4	.5	0.0	0.0	2.9	40.0	315	200	V
111.85	-6.9	12.3	.6	0.0	0.0	6.0	43.5	-0	200	V
127.99	-4.4	12.7	.7	0.0	0.0	9.0	43.5	90	340	V
145.37	-6.9	11.4	.8	0.0	0.0	5.2	43.5	315	200	H
188.29	-7.0	10.5	1.0	0.0	0.0	4.5	43.5	0	120	V
196.54	-7.1	10.7	1.0	0.0	0.0	4.6	43.5	90	340	V
366.32	-5.3	15.6	1.4	0.0	0.0	11.7	46.0	90	340	V
465.10	-6.0	17.4	1.5	0.0	0.0	12.9	46.0	1	340	V
525.58	-6.7	18.0	1.5	0.0	0.0	12.9	46.0	225	120	V
681.67	-5.2	19.6	1.7	0.0	0.0	16.1	46.0	90	120	H
773.85	-5.7	20.4	1.9	0.0	0.0	16.6	46.0	270	340	H
899.38	-5.6	21.7	2.0	0.0	0.0	18.1	46.0	90	340	H
929.87	-5.7	21.8	2.0	0.0	0.0	18.1	46.0	270	200	H

Checked BY Richard E. King :

Richard E. King

DATA SHEET HF TEST NO. 2

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

SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL NO. : ORION SE WATER METER METAL LID
SERIAL NO. :
TEST MODE : Rx @ LOW CHANNEL
NOTES :
TEST DATE : 3 Mar 2014 10:27:22
TEST DISTANCE : 3 m
ANTENNA : ANT54C

FREQUENCY MHz	AVG READING dBuV	ANT FAC dB	CBL FAC dB	DIST FAC dB	TOTAL dBuV/m	AVG LIMIT dBuV/m	PASS/ FAIL	AZ deg	ANT HT cm	POLAR
1028.43	-2.0	27.7	2.0	0.0	27.7	54.0		135	121	V
1239.04	-2.3	28.4	2.3	0.0	28.5	54.0		135	340	H
1280.27	-3.2	28.7	2.4	0.0	27.9	54.0		90	340	H
1534.00	-2.3	28.7	2.6	0.0	29.1	54.0		45	340	H
1636.93	-2.7	29.4	2.7	0.0	29.4	54.0		45	200	V
1745.20	-2.1	30.1	2.8	0.0	30.8	54.0		45	200	V
1898.85	-2.8	30.9	2.9	0.0	31.0	54.0		0	340	V
2097.83	-2.4	31.4	3.1	0.0	32.2	54.0		0	340	H
2415.79	-2.3	32.3	3.4	0.0	33.5	54.0		315	340	H
2739.26	-2.0	32.6	3.7	0.0	34.3	54.0		225	340	H
3062.08	-2.9	32.9	3.9	0.0	33.9	54.0		315	120	H
3564.74	-3.4	33.1	4.3	0.0	33.9	54.0		135	340	V
4230.94	-2.6	33.6	4.6	0.0	35.6	54.0		45	340	V
4569.91	-2.5	33.7	4.8	0.0	36.0	54.0		90	340	V
4987.99	-3.0	34.5	5.0	0.0	36.5	54.0		45	340	H
5159.98	-3.1	34.5	5.0	0.0	36.4	54.0		90	200	H
5295.20	-3.0	34.5	5.0	0.0	36.5	54.0		135	200	H
5639.40	-2.6	34.5	5.0	0.0	36.9	54.0		90	120	H
5837.38	-2.8	34.5	5.0	0.0	36.7	54.0		270	200	H
5859.72	-2.9	34.5	5.0	0.0	36.6	54.0		315	340	H
6207.59	-2.6	34.5	5.0	0.0	36.9	54.0		315	340	V
6261.63	-2.5	34.5	5.0	0.0	37.0	54.0		-0	340	H
6459.02	-3.1	34.5	5.0	0.0	36.4	54.0		135	120	H

Checked BY Richard E. King :

Richard E. King

DATA SHEET HF TEST NO. 3

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

SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL NO. : ORION SE WATER METER METAL LID
SERIAL NO. :
TEST MODE : Rx @ MID CHANNEL
NOTES :
TEST DATE : 3 Mar 2014 11:28:50
TEST DISTANCE : 3 m
ANTENNA : ANT54C

FREQUENCY MHz	AVG READING dBuV	ANT FAC dB	CBL FAC dB	DIST FAC dB	TOTAL dBuV/m	AVG LIMIT dBuV/m	PASS/ FAIL	AZ deg	ANT HT cm	POLAR
1043.88	-2.3	27.7	2.1	0.0	27.5	54.0		225	120	H
1238.61	-2.7	28.4	2.3	0.0	28.0	54.0		0	120	H
1374.07	-2.3	28.7	2.5	0.0	28.8	54.0		135	120	H
1519.61	-2.9	28.6	2.6	0.0	28.3	54.0		180	200	V
1525.82	-2.5	28.7	2.6	0.0	28.8	54.0		0	200	V
1752.58	-2.5	30.2	2.8	0.0	30.5	54.0		270	340	H
1856.03	-3.0	30.7	2.9	0.0	30.6	54.0		45	340	V
2180.45	-2.5	32.0	3.2	0.0	32.7	54.0		225	120	H
2402.73	8.3	32.3	3.4	0.0	44.0	54.0		0	200	V
2801.32	-2.2	32.7	3.7	0.0	34.2	54.0		45	340	V
3019.18	-3.0	32.8	3.9	0.0	33.7	54.0		135	120	V
3791.66	-3.4	33.2	4.4	0.0	34.2	54.0		315	340	V
4185.77	-3.0	33.5	4.6	0.0	35.1	54.0		135	340	H
4540.48	-2.7	33.6	4.8	0.0	35.7	54.0		270	120	V
4784.35	-3.4	34.3	4.9	0.0	35.9	54.0		135	120	V
5026.32	-3.5	34.5	5.0	0.0	36.0	54.0		-0	340	V
5416.87	-2.7	34.5	5.0	0.0	36.8	54.0		315	120	V
5474.80	-2.7	34.5	5.0	0.0	36.8	54.0		180	340	H
5819.62	-3.0	34.5	5.0	0.0	36.5	54.0		90	340	H
5830.97	7.8	34.5	5.0	0.0	47.3	54.0		90	200	H
6210.22	-2.7	34.5	5.0	0.0	36.8	54.0		225	120	H
6381.51	-3.2	34.5	5.0	0.0	36.3	54.0		135	340	V
6436.01	-3.2	34.5	5.0	0.0	36.3	54.0		270	200	V

Checked BY Richard E. King :

Richard E. King

DATA SHEET HF TEST NO. 4

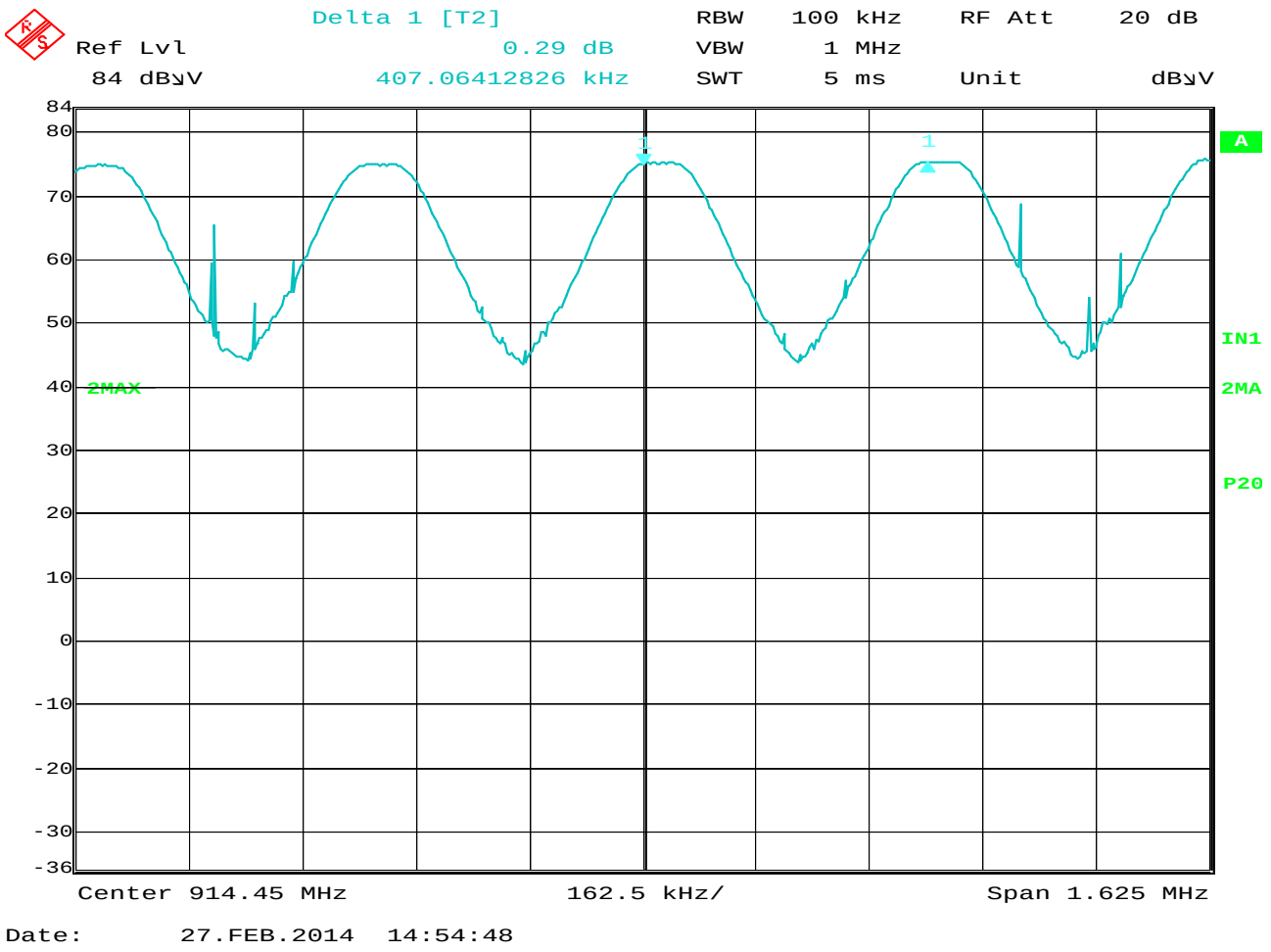
RADIATED AVG EMISSION MEASUREMENTS >=1000 MHz in a 3 m ANECHOIC ROOM

SPECIFICATION : FCC 15A CLASS B
MANUFACTURER : BADGER METER INC.
MODEL NO. : ORION SE WATER METER METAL LID
SERIAL NO. :
TEST MODE : Rx @ HIGH CHANNEL
NOTES :
TEST DATE : 3 Mar 2014 13:15:10
TEST DISTANCE : 3 m
ANTENNA : ANT54C

FREQUENCY MHz	AVG READING dBuV	ANT FAC dB	CBL FAC dB	DIST FAC dB	TOTAL dBuV/m	AVG LIMIT dBuV/m	PASS/ FAIL	AZ deg	ANT HT cm	POLAR
1067.96	-2.7	27.7	2.1	0.0	27.1	54.0		45	200	V
1231.46	-2.8	28.4	2.3	0.0	27.9	54.0		0	120	V
1328.14	-2.9	28.7	2.4	0.0	28.3	54.0		135	200	V
1396.21	-2.6	28.6	2.5	0.0	28.5	54.0		45	340	H
1687.08	-2.8	29.7	2.8	0.0	29.7	54.0		135	120	V
1709.97	-2.8	29.9	2.8	0.0	29.9	54.0		180	120	H
1871.14	-2.9	30.8	2.9	0.0	30.8	54.0		225	200	V
2196.17	-2.5	32.1	3.2	0.0	32.8	54.0		270	200	V
2605.14	-2.2	32.5	3.6	0.0	33.9	54.0		270	340	H
2819.03	-2.2	32.7	3.8	0.0	34.2	54.0		180	340	H
3210.71	-3.1	32.8	4.0	0.0	33.7	54.0		270	340	V
3546.17	-3.6	33.0	4.3	0.0	33.7	54.0		0	340	V
4126.67	-3.1	33.4	4.6	0.0	34.9	54.0		90	340	H
4680.27	-2.9	34.0	4.9	0.0	36.0	54.0		-0	340	V
4893.10	-3.2	34.4	5.0	0.0	36.1	54.0		180	120	H
5185.75	-3.4	34.5	5.0	0.0	36.2	54.0		225	120	H
5334.60	-3.1	34.5	5.0	0.0	36.4	54.0		180	120	H
5504.84	-2.7	34.5	5.0	0.0	36.8	54.0		225	200	V
5777.69	7.8	34.5	5.0	0.0	47.3	54.0		-0	340	V
5825.60	-3.1	34.5	5.0	0.0	36.4	54.0		225	340	V
6178.82	-2.9	34.5	5.0	0.0	36.6	54.0		-0	120	H
6282.17	-2.8	34.5	5.0	0.0	36.7	54.0		270	200	V
6473.19	-3.4	34.5	5.0	0.0	36.1	54.0		45	340	V

Checked BY Richard E. King :

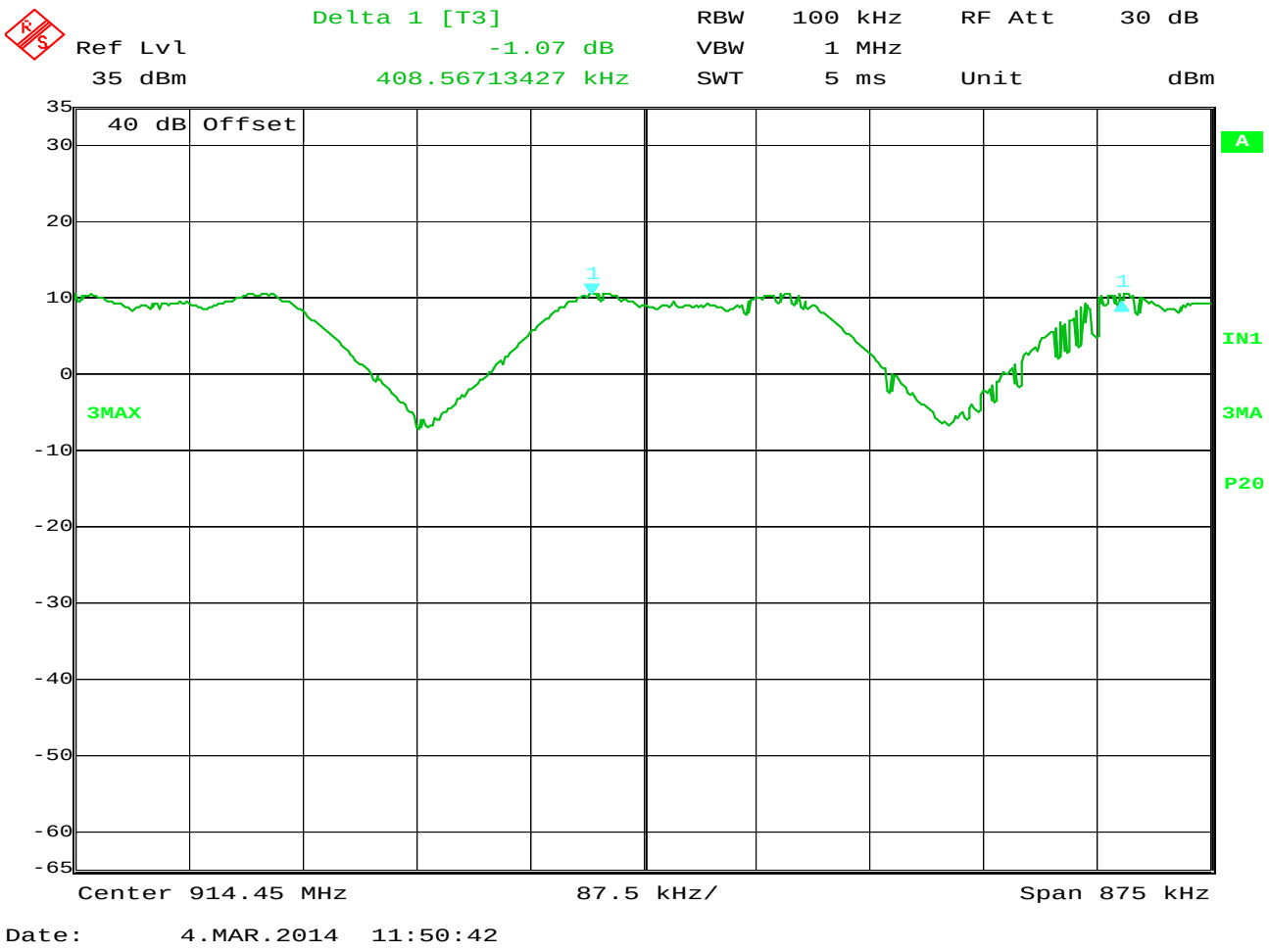
Richard E. King



FCC 15.247 Carrier Frequency Speration

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
TEST MODE	:	Hopping Enabled
NOTES	:	Carrier Frequency Seperation = 407.1kHz
POWER LEVEL	:	Fixed

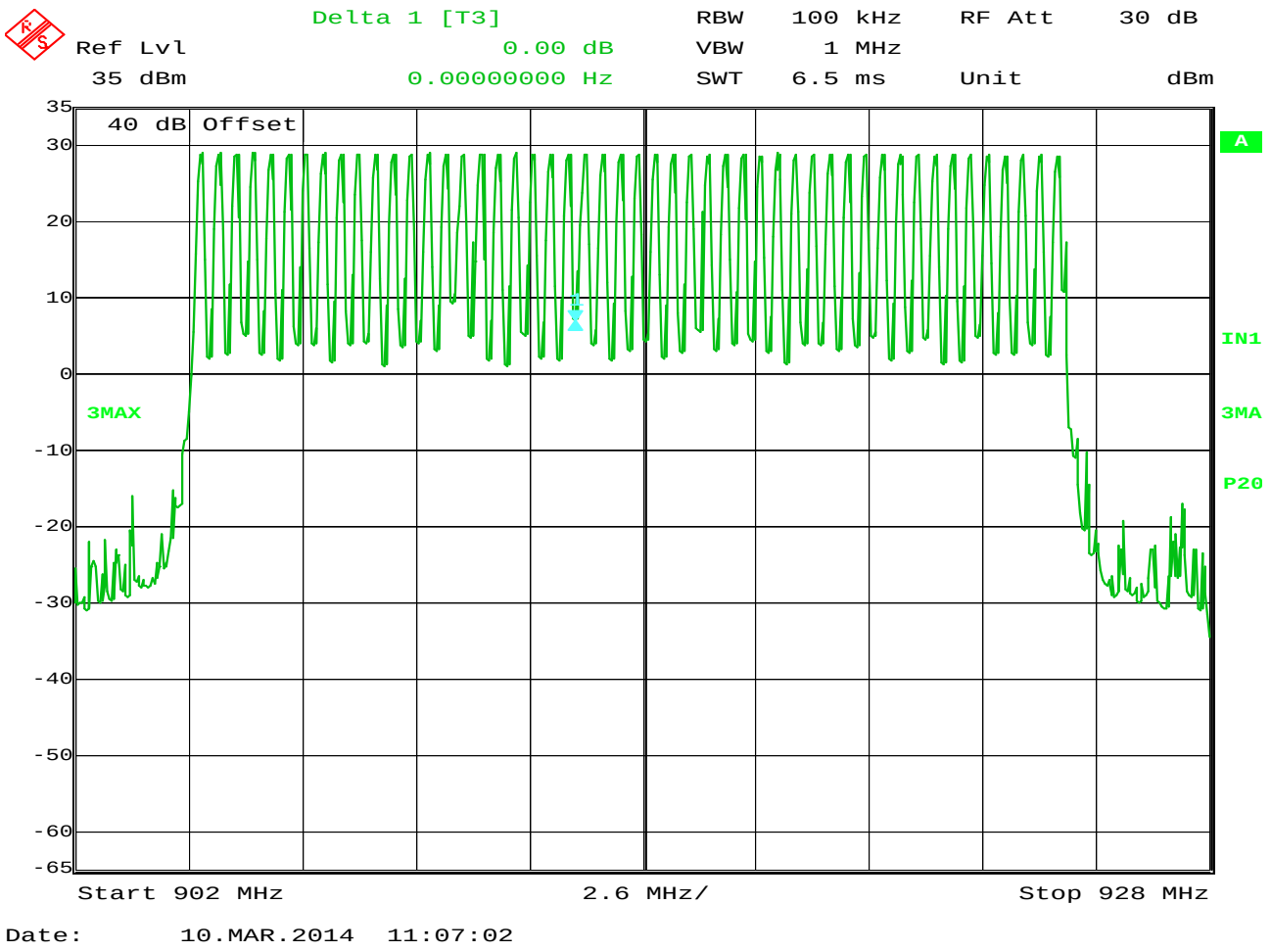
NOTES



FCC 15.247 Carrier Frequency Speration

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
TEST MODE	:	Hopping Enabled
NOTES	:	Carrier Frequency Seperation = 408.5kHz
POWER LEVEL	:	Mobile

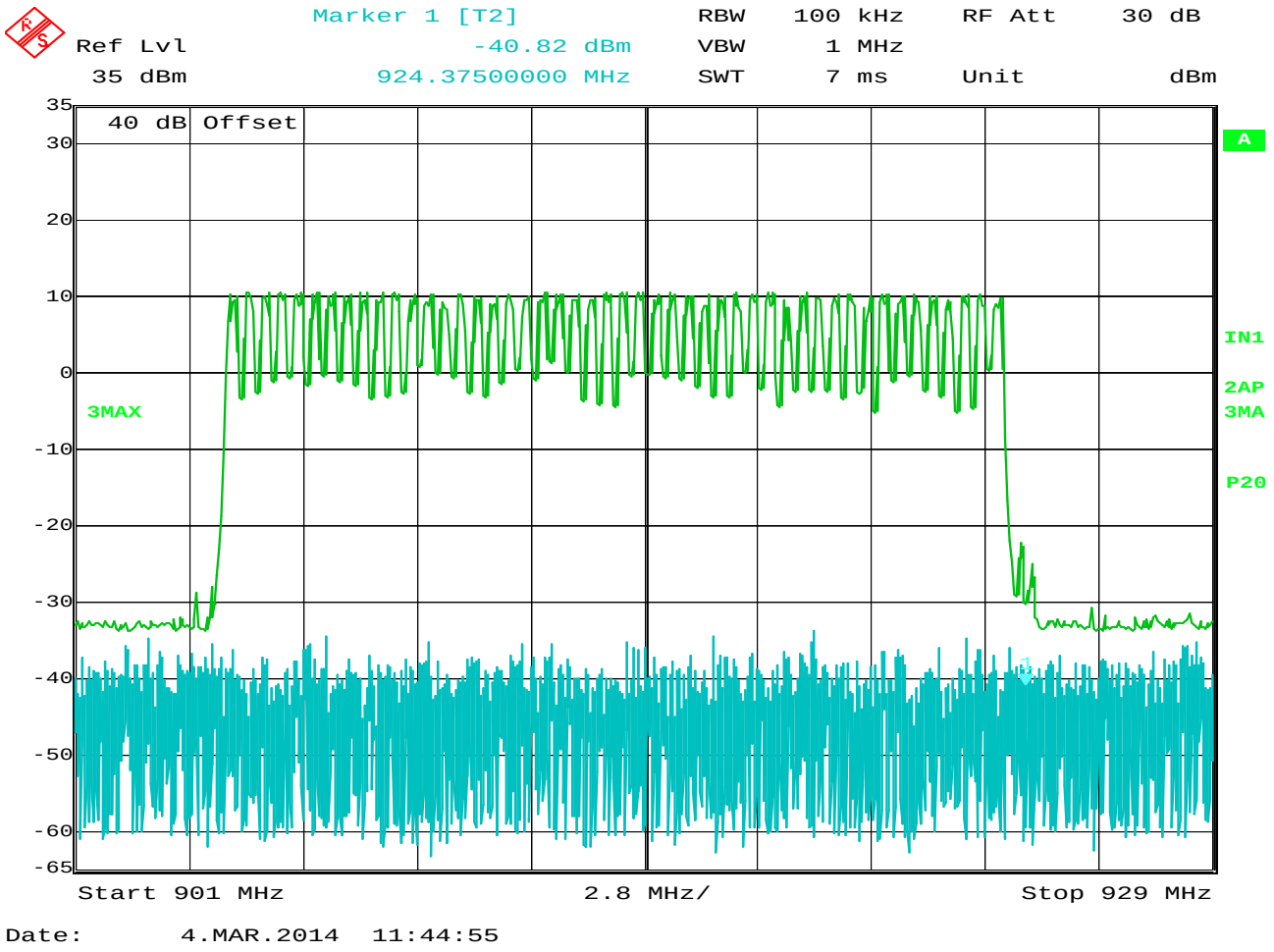
NOTES



FCC 15.247 Number of Hopping Channels

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
TEST MODE	:	Hopping Enabled
NOTES	:	Number of Hopping Channels = 50
POWER LEVEL	:	Fixed

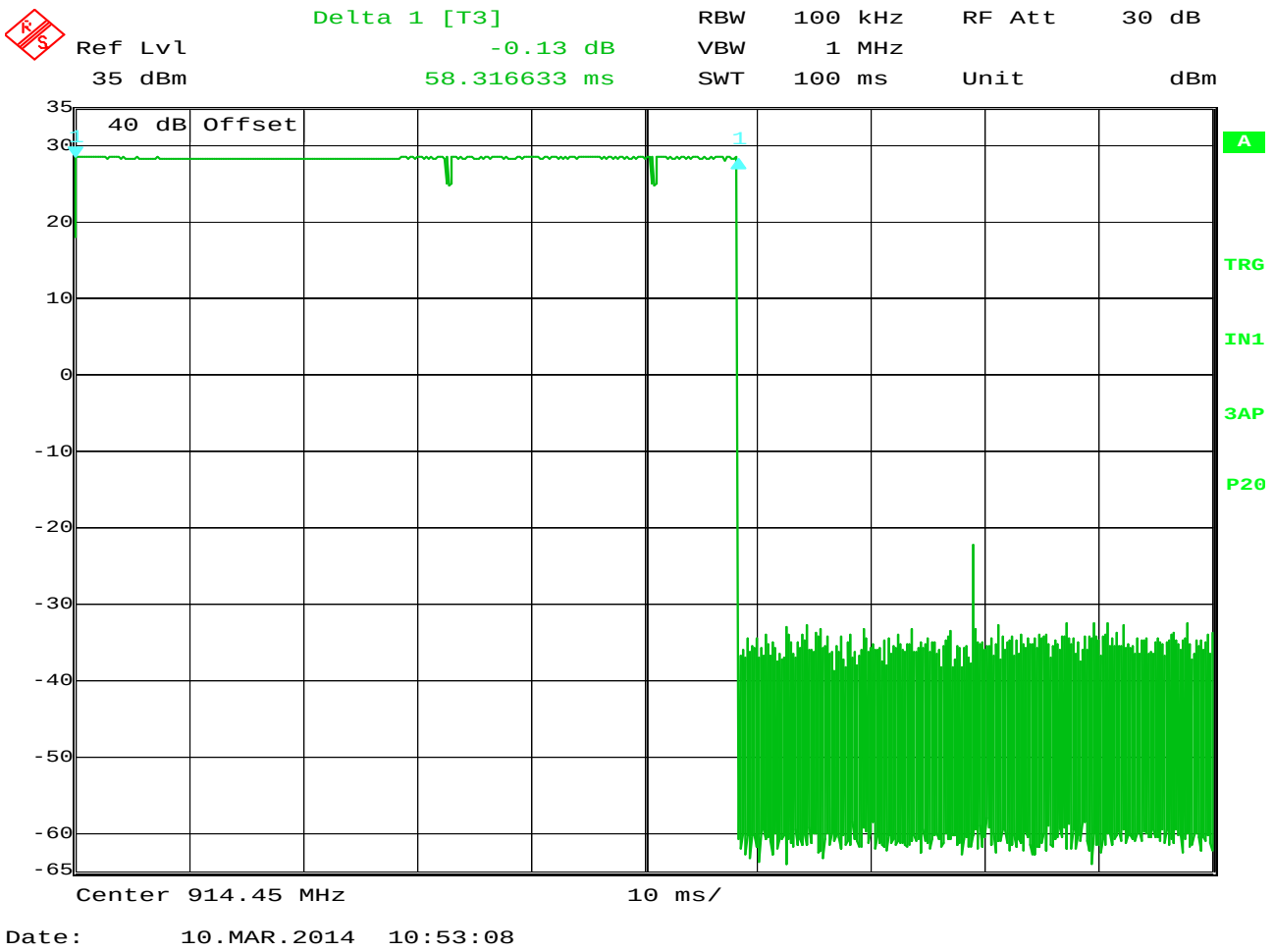
NOTES



FCC 15.247 Number of Hopping Channels

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
TEST MODE	:	Hopping Enabled
NOTES	:	Number of Hopping Channels = 48
POWER LEVEL	:	Mobile Setting

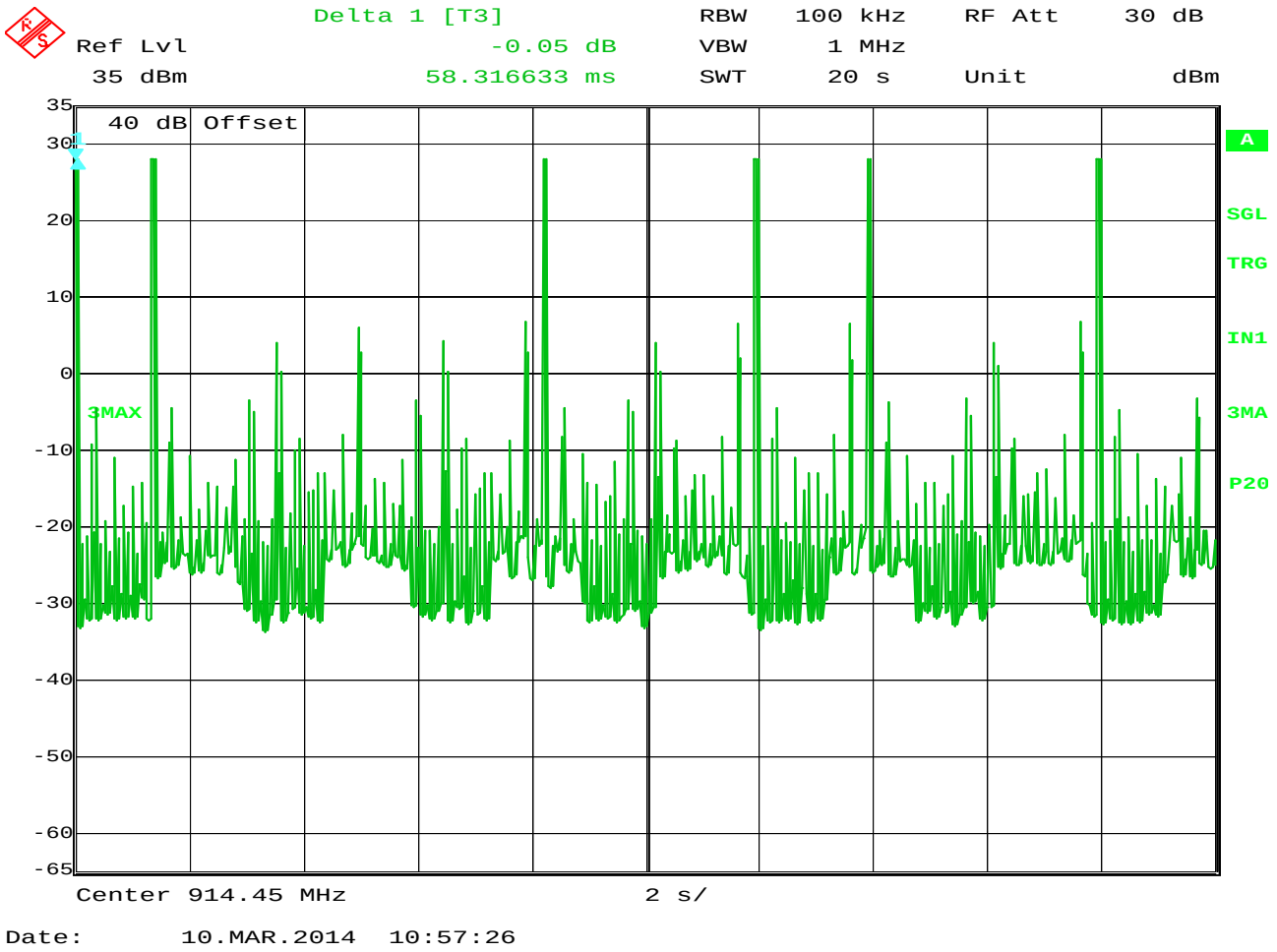
NOTES



FCC 15.247 Dwell Time

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER SETTING	:	Fixed
TEST MODE	:	Tx @ 914.45MHz
NOTES	:	Dwell Time Pulse Width = 58.3mS
	:	Duty Cycle = 20*LOG(pulse/100mS) = 20*LOG(58.3mS/100mS)=-4.69dB

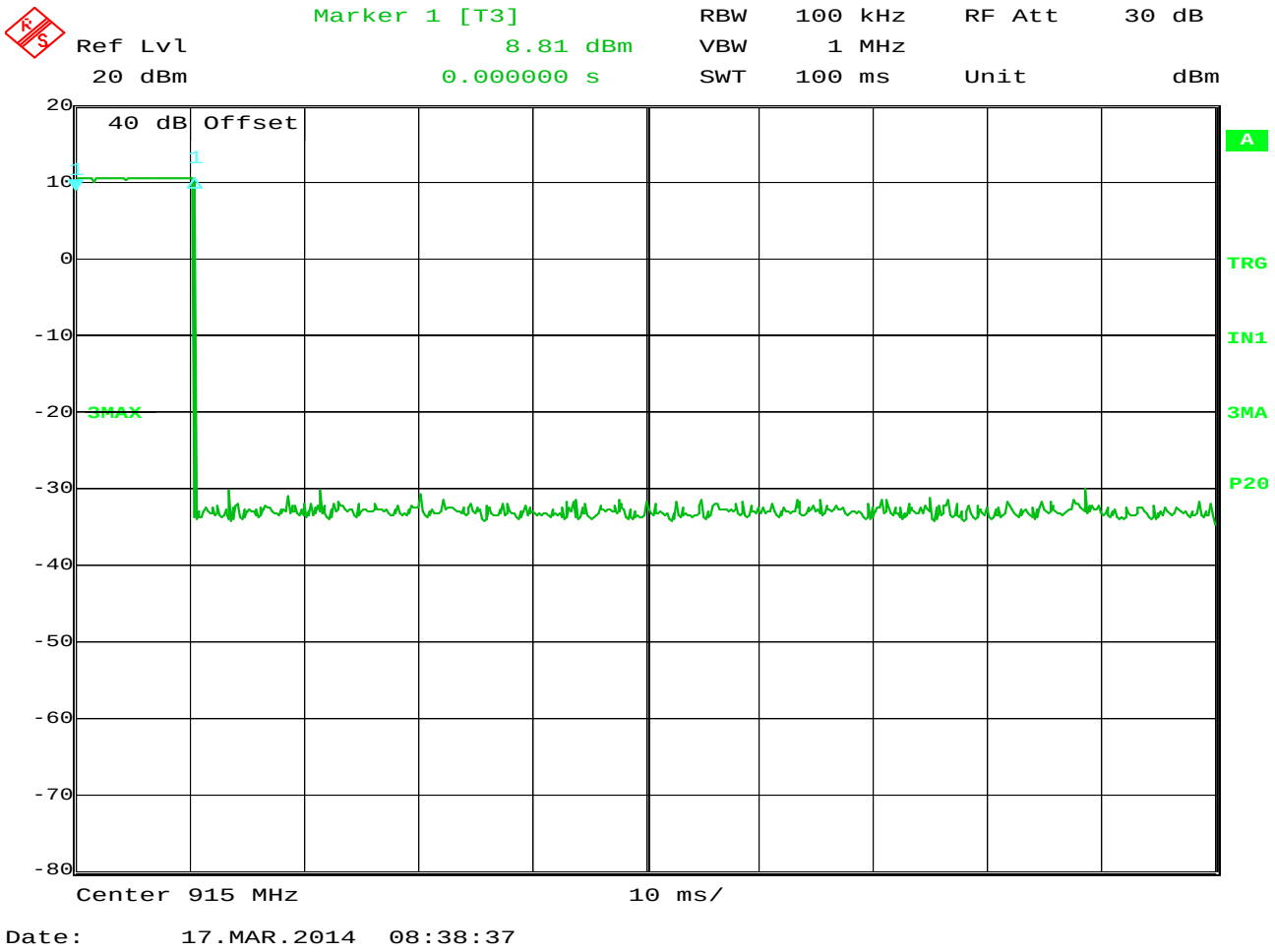
NOTES



FCC 15.247 Dwell Time

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Fixed
TEST MODE	:	Tx @ 914.45MHz
NOTES	:	Dwell Time Pulse Width = 58.3mS
	:	Dwell Time = Pulse Width (58.3mS) * 6 hops = (58.3mS*6) = .3498 Seconds

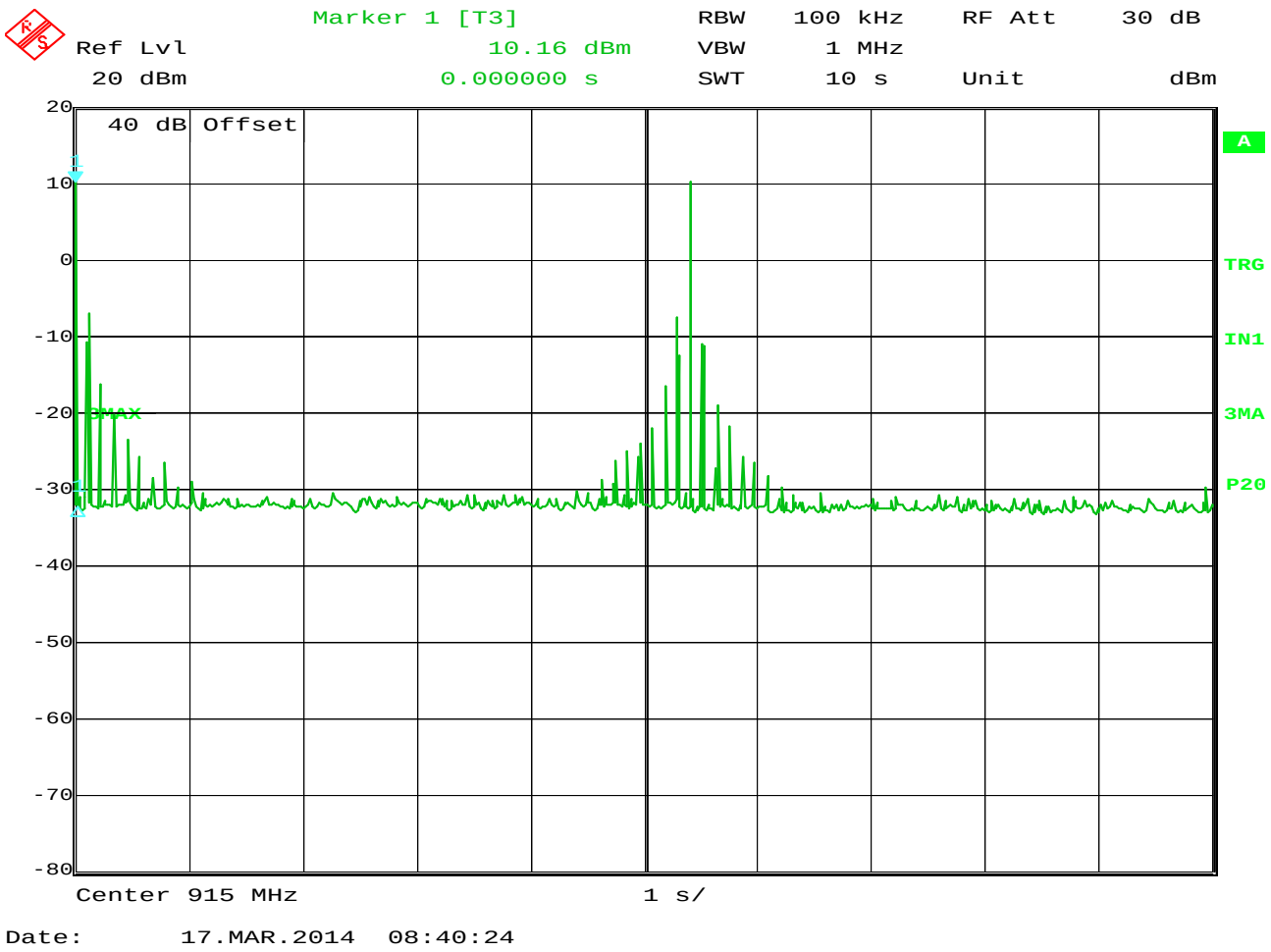
NOTES



FCC 15.247 Dwell Time

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Mobile
TEST MODE	:	Tx @ 914.45MHz
NOTES	:	Dwell Time Pulse Width = 10.42mS
	:	Duty Cycle = 20*LOG(pulse/100mS) = 20*LOG(10.4mS/100mS)=-19.65dB

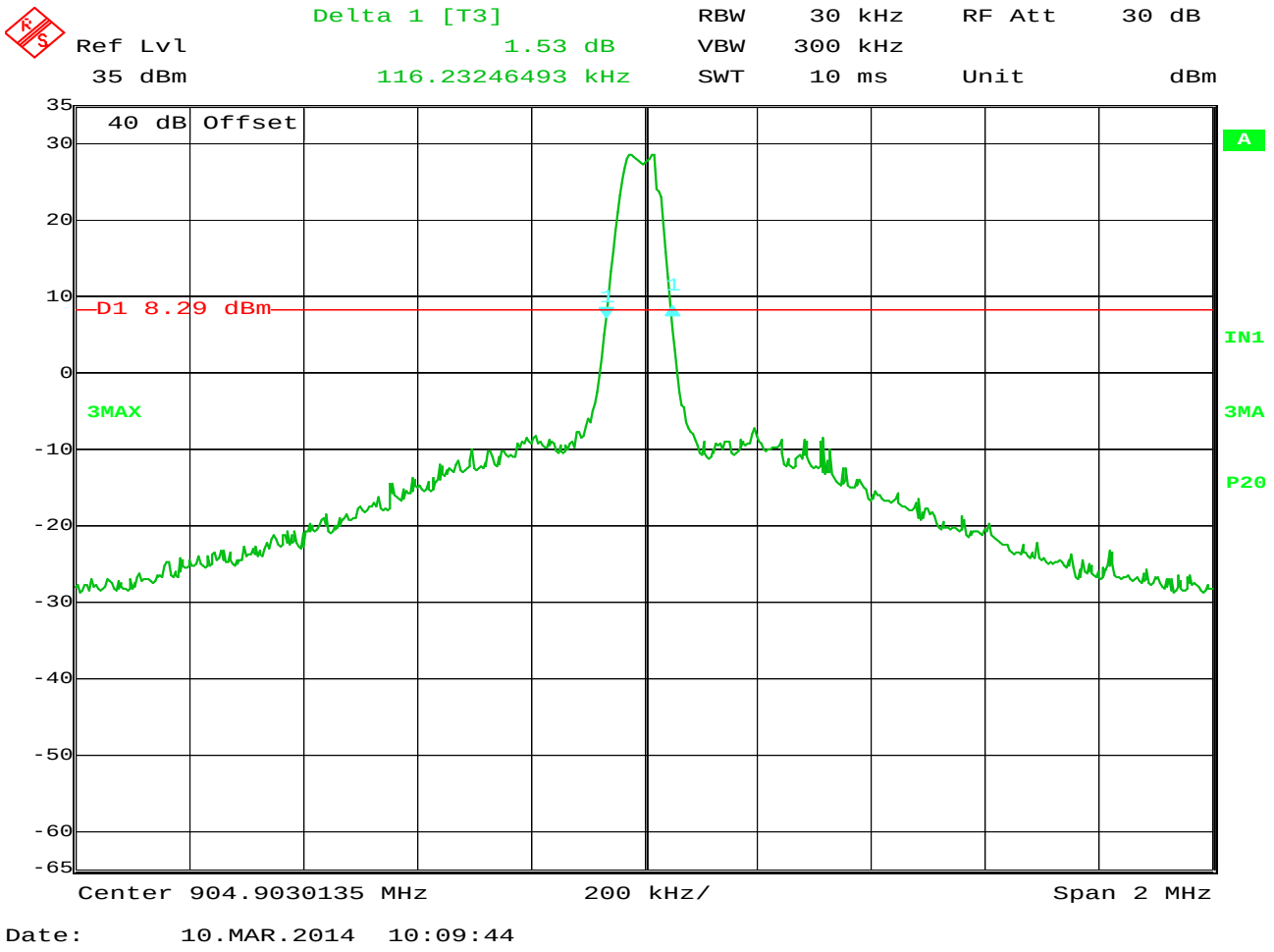
NOTES



FCC 15.247 Dwell Time

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Mobile
TEST MODE	:	Tx @ 914.45MHz
NOTES	:	Dwell Time = Pulse Width (10.4mS) * 2 hops = (10.4mS*2) = .0208 Seconds

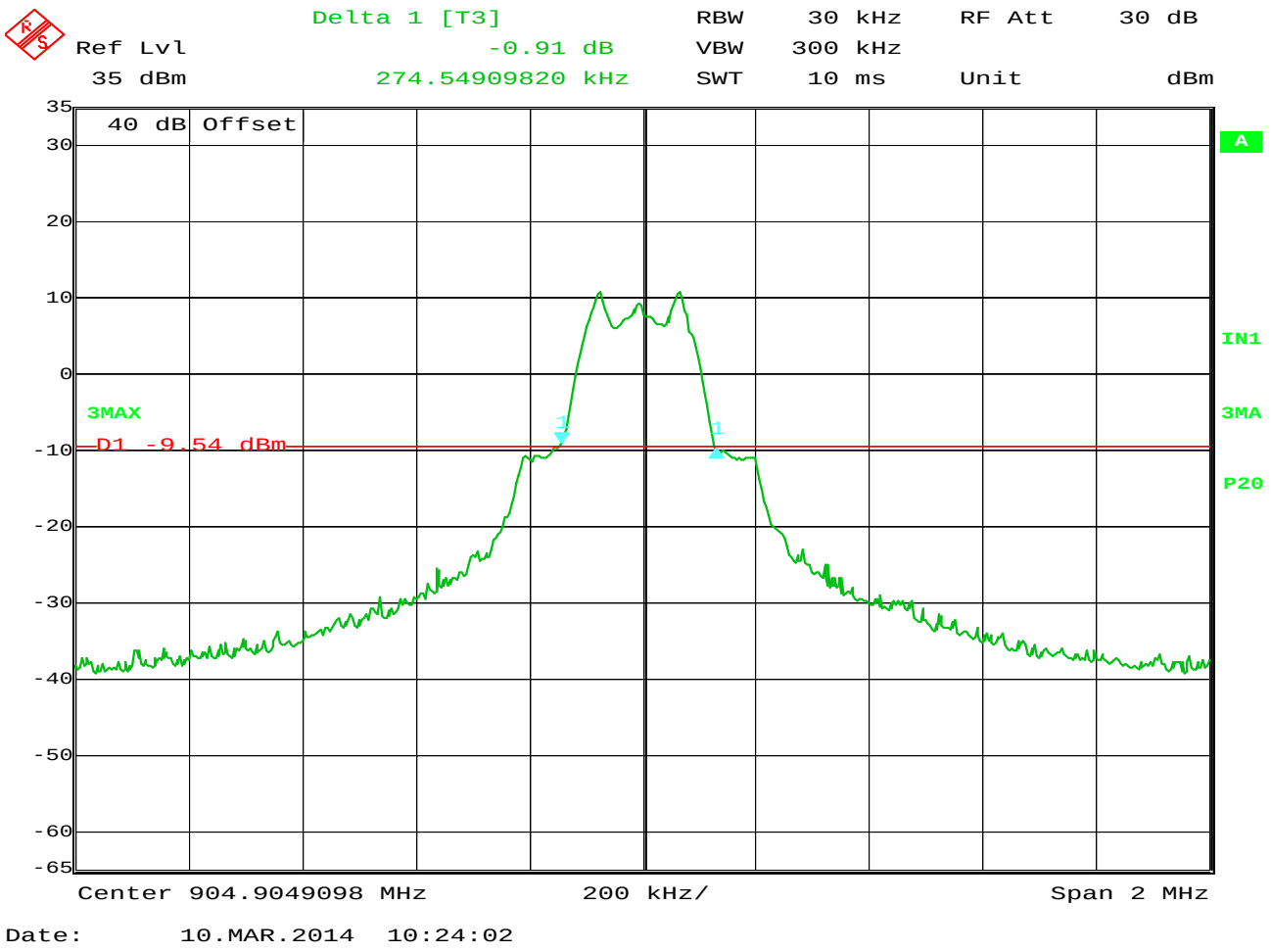
NOTES



FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER	: Badger Meter Inc.
MODEL NUMBER	: Orion SE Water Metal Lid Antenna
POWER LEVEL	: Fixed
TEST MODE	: Tx Low Channel
NOTES	: 20dB Bandwidth = 116.2 kHz

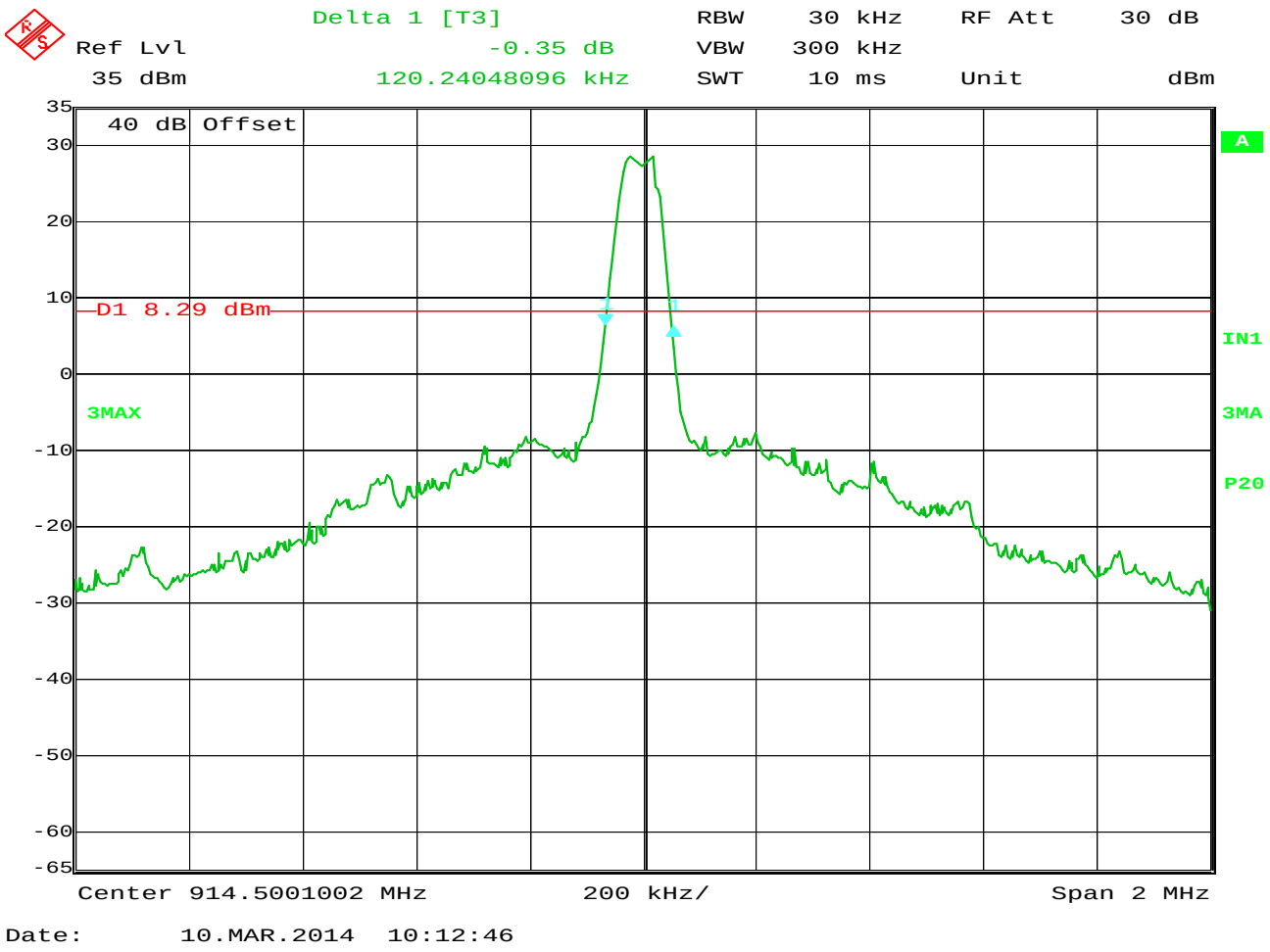
NOTES



FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER	: Badger Meter Inc.
MODEL NUMBER	: Orion SE Water Metal Lid Antenna
POWER LEVEL	: Mobile
TEST MODE	: Tx at Low Channel
NOTES	: 20 dB Bandwidth = 274.5 kHz

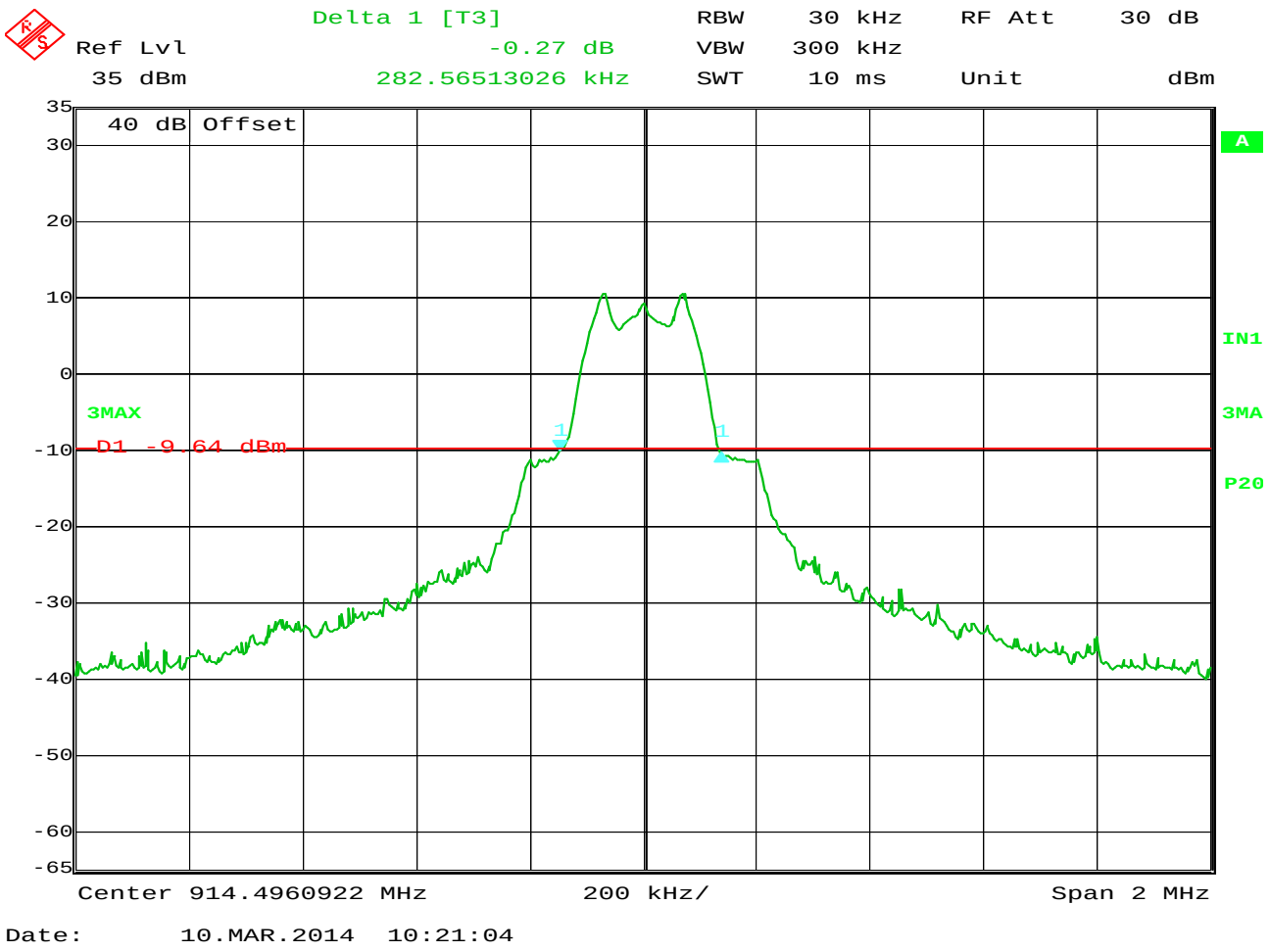
NOTES



FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Fixed
TEST MODE	:	Tx at Mid Channel
NOTES	:	20 dB Bandwidth = 120.24kHz

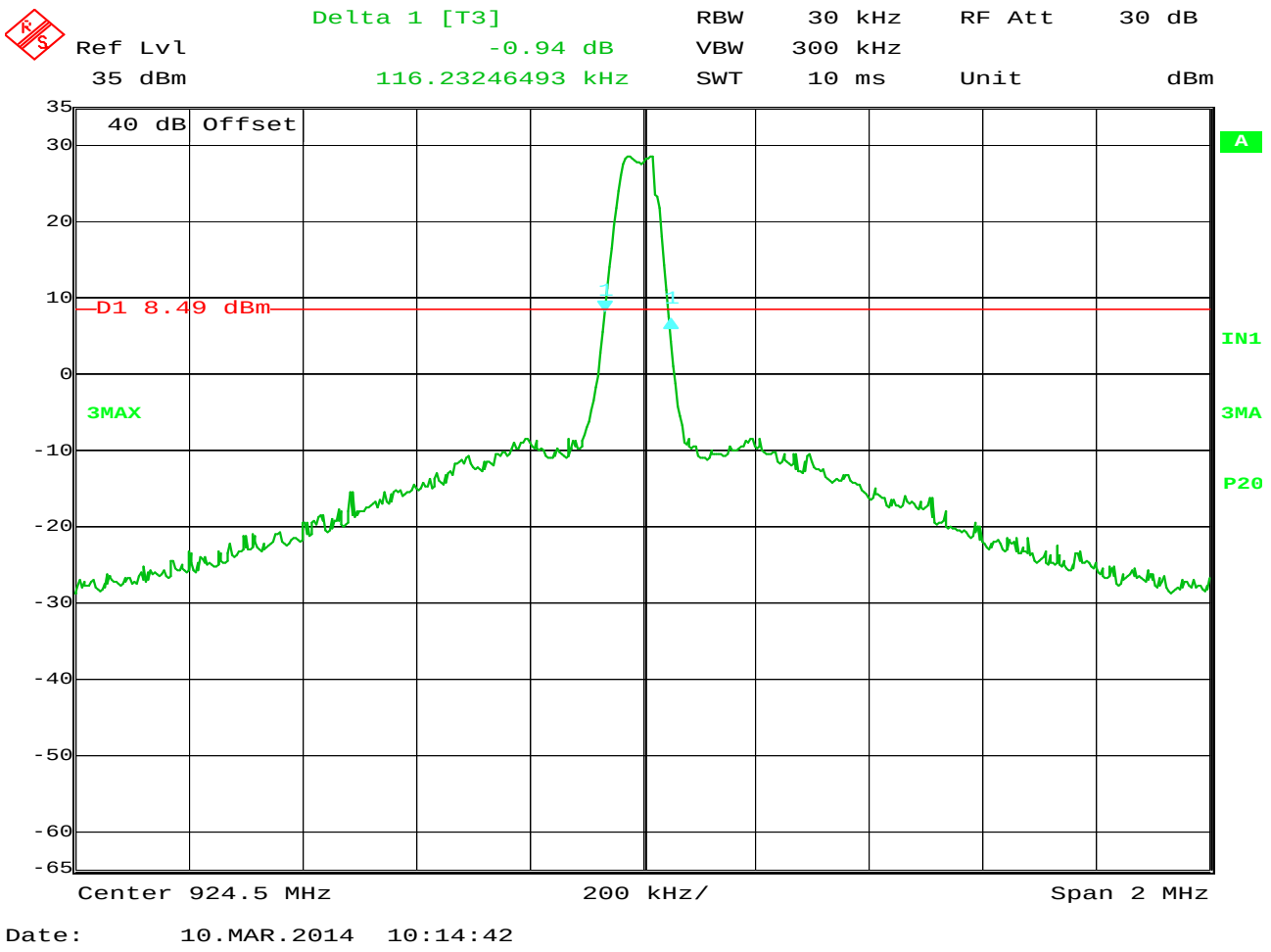
NOTES



FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Mobile
TEST MODE	:	Tx at Mid Channel
NOTES	:	20 dB Bandwidth = 282.6 kHz

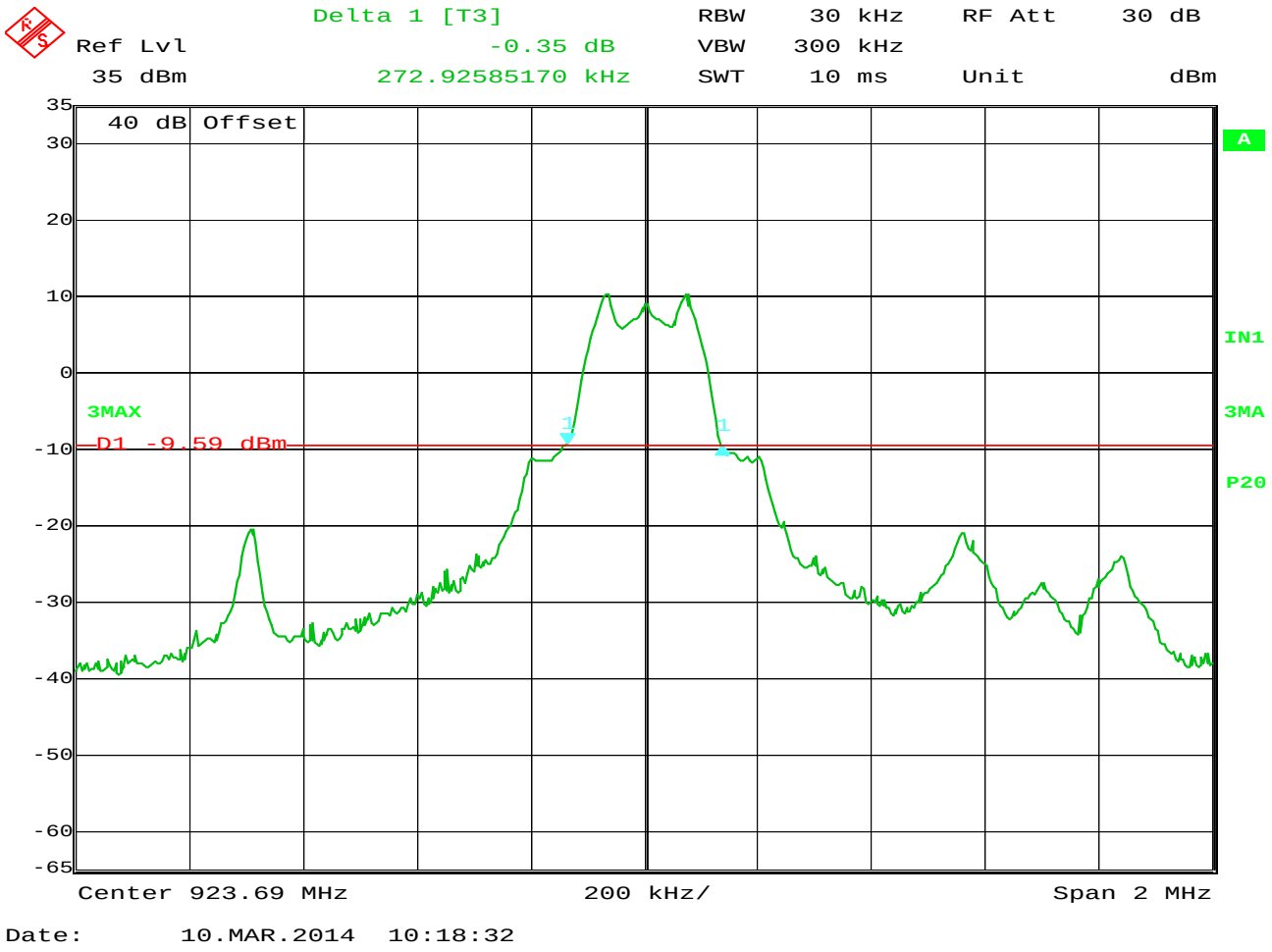
NOTES



FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER	: Badger Meter Inc.
MODEL NUMBER	: Orion SE Water Metal Lid Antenna
POWER LEVEL	: Fixed
TEST MODE	: Tx at High Channel
NOTES	: 20 dB Bandwidth = 116.23kHz

NOTES



FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Mobile
TEST MODE	:	Tx at High Channel
NOTES	:	20 dB Bandwidth = 272.92kHz

NOTES

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Peak Output Power
Date : Feburary 28, 2014
Notes : Mobile Power Setting

Frequency MHz	Meter Reading dBm	Meter Reading Watts	Limit dBm	Limit Watts
904.90	11.15	.013	24	.25
914.50	11.02	.012	24	.25
923.70	10.88	.012	24	.25

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Peak Output Power
Date : Feburary 28, 2014
Notes : Fixed Power Setting

Frequency MHz	Meter Reading dBm	Meter Reading Watts	Limit dBm	Limit Watts
904.90	28.6	0.731	30.0	1
914.50	28.4	0.690	30.0	1
924.48	28.3	0.670	30.0	1

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Peak Output Power
Date : Feburary 28, 2014
Notes : Mobile Power Setting

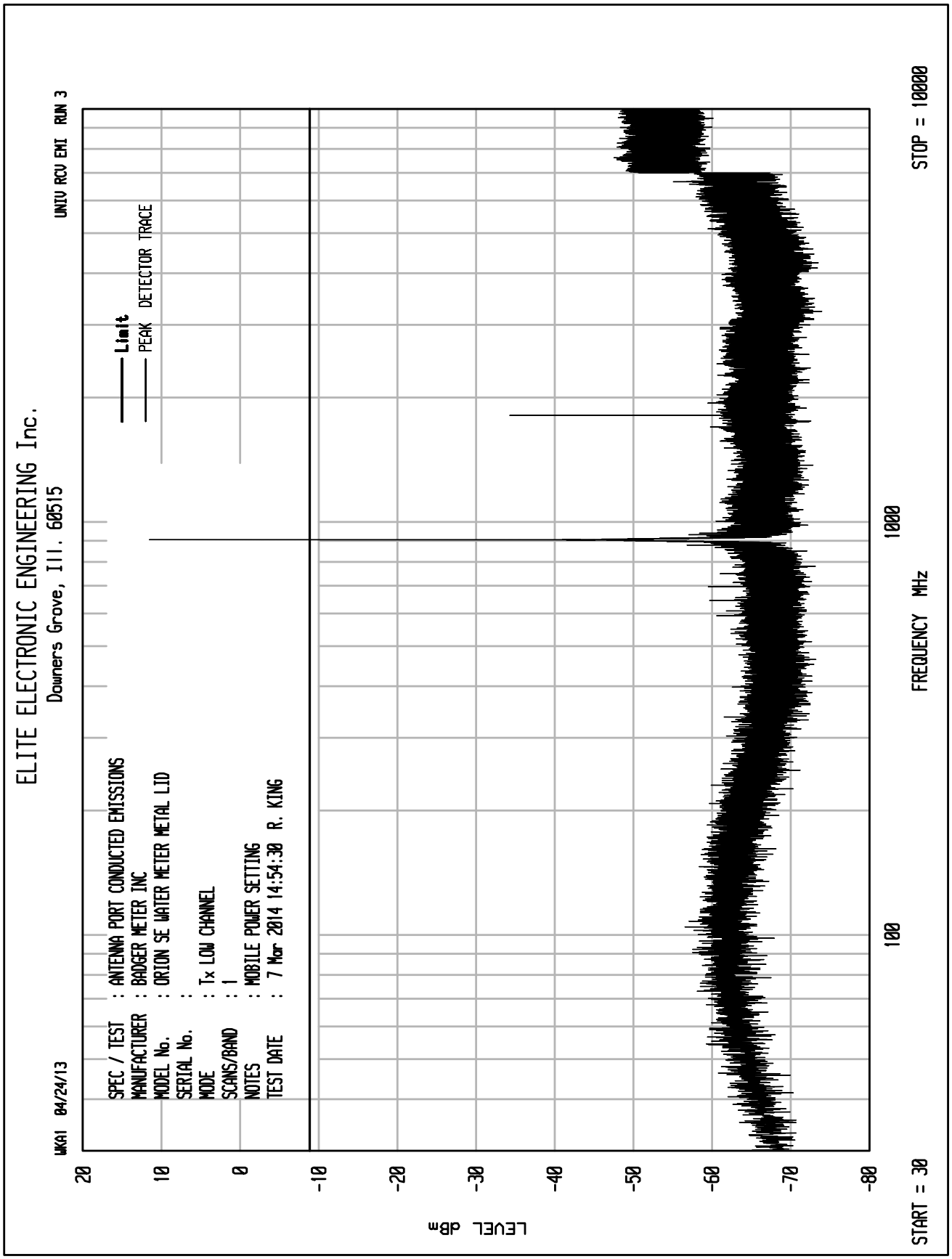
Frequency MHz	Antenna Polarity	Meter Reading dBuV	Matched Signal Generator Reading dBm	Antenna Gain dB	Cable Loss dB	EIRP dBm	Limit dBm
904.90	H	82.7	6.8	2.2	1.6	7.3	30.0
904.90	V	83.7	10.0	2.2	1.6	10.5	30.0
914.45	H	82.4	6.2	2.2	1.6	6.7	30.0
914.45	V	85.8	11.4	2.2	1.6	11.9	30.0
923.68	H	81.3	5.4	2.2	1.7	5.9	30.0
923.68	V	83.5	9.6	2.2	1.7	10.1	30.0

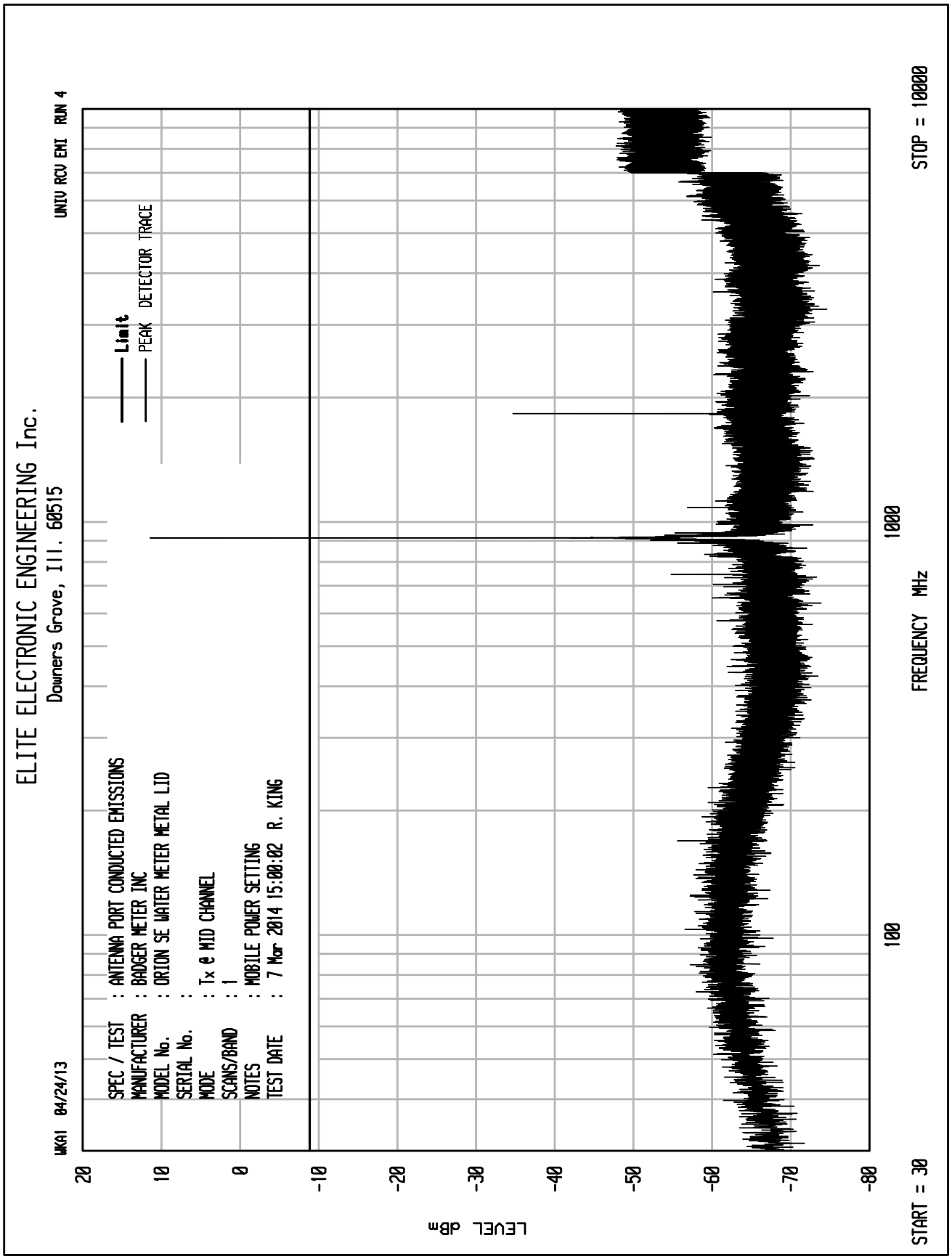
EIRP = Sig. Gen. Reading + Antenna Gain – Cable Loss

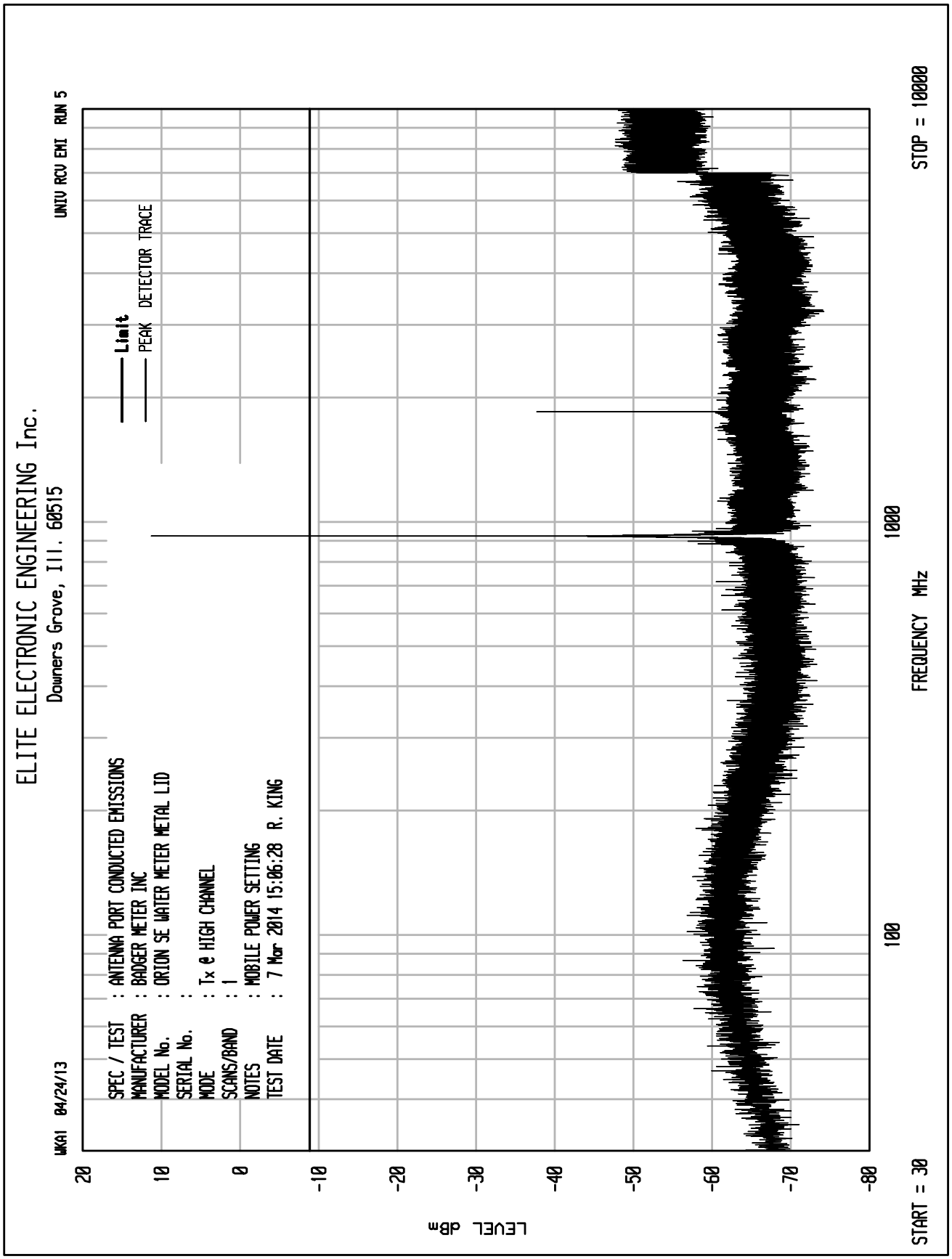
Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Peak Output Power
Date : Feburary 28, 2014
Notes : Fixed Power Setting

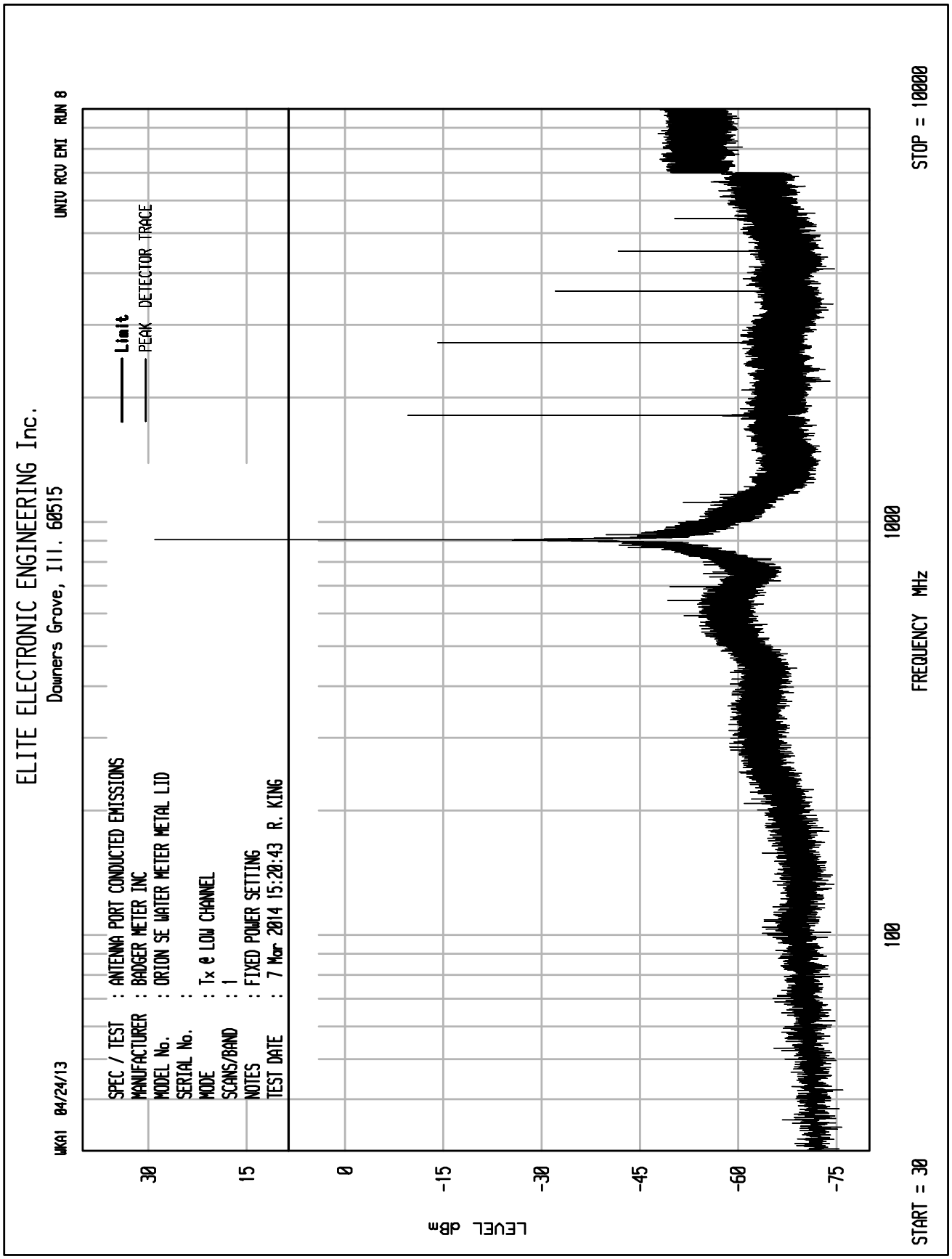
Frequency MHz	Antenna Polarity	Meter Reading dBuV	Matched Signal Generator Reading dBm	Antenna Gain dB	Cable Loss dB	EIRP dBm	Limit dBm
904.90	H	98.4	22.8	2.2	1.6	23.3	36.0
904.90	V	100.5	26.6	2.2	1.6	27.1	36.0
914.45	H	101.6	25.2	2.2	1.6	25.7	36.0
914.45	V	101.9	27.8	2.2	1.6	28.3	36.0
904.90	H	98.4	22.8	2.2	1.6	23.3	36.0
904.90	V	100.5	26.6	2.2	1.6	27.1	36.0

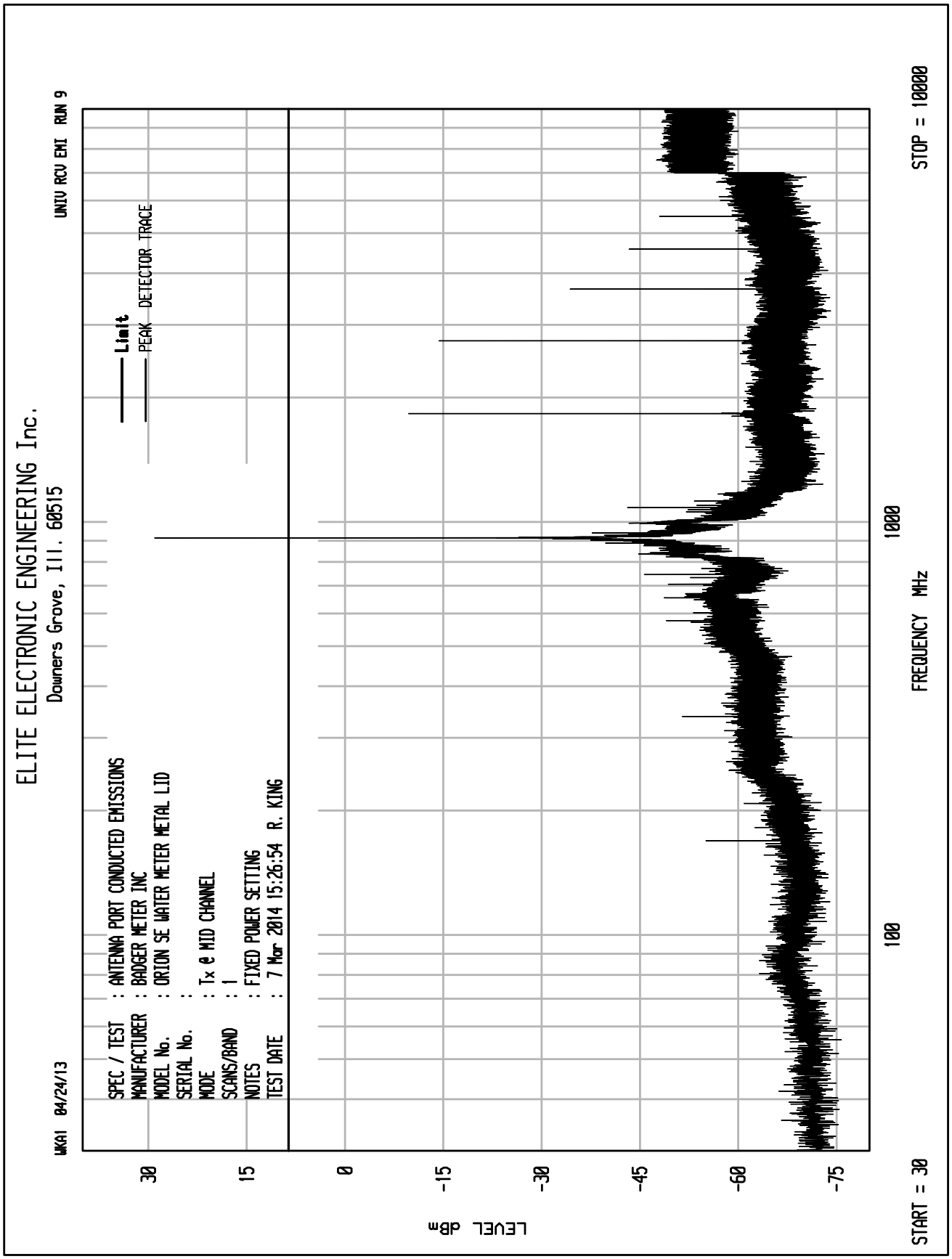
EIRP = Sig. Gen. Reading + Antenna Gain – Cable Loss

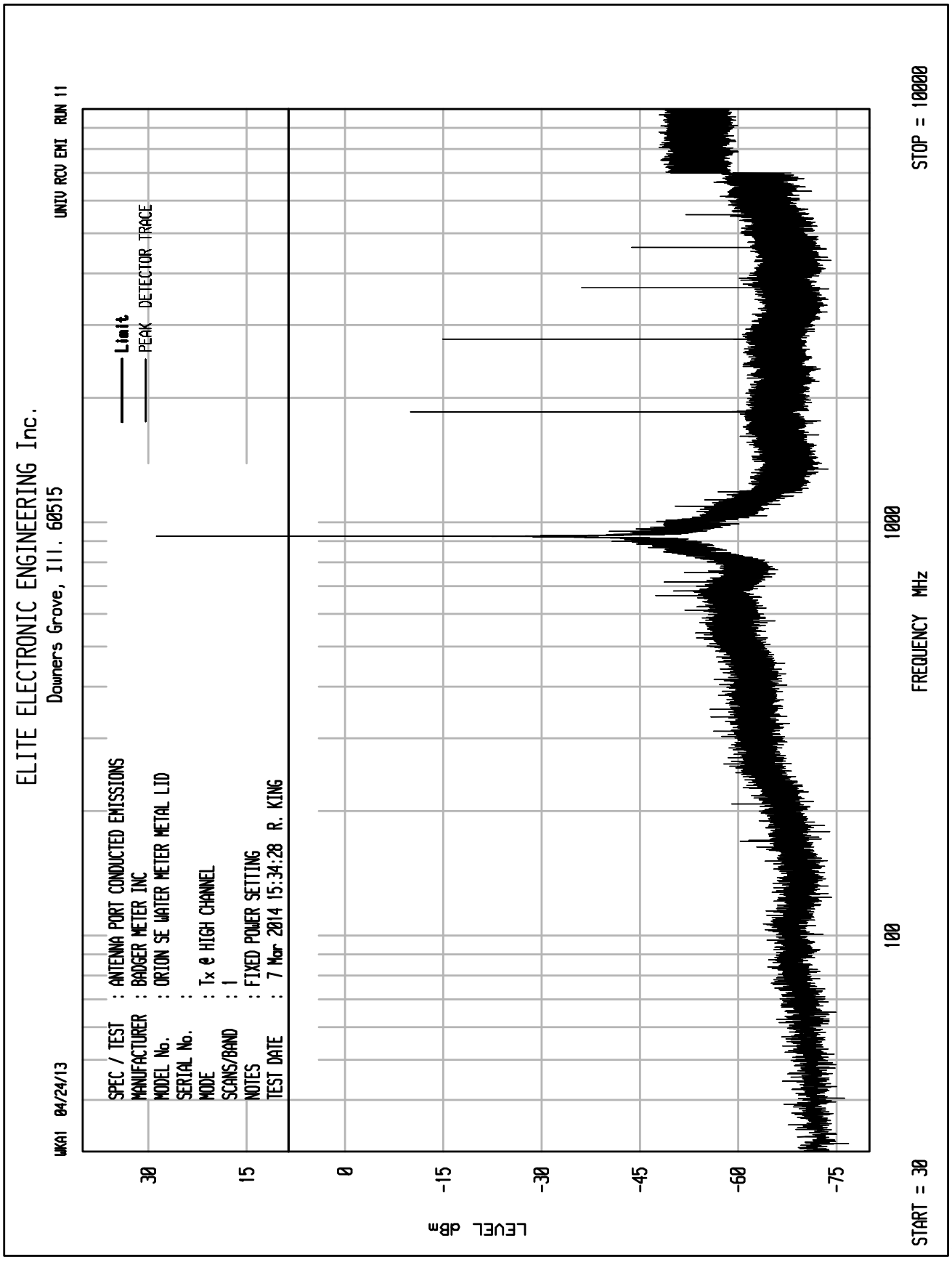

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKAI 04/24/13
SPEC / TEST : ANTENNA PORT CONDUCTED EMISSIONS
MANUFACTURER : BADGER METER INC
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx LOW CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER SETTING
TEST DATE : 7 Mar 2014 14:54:30 R. KING
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

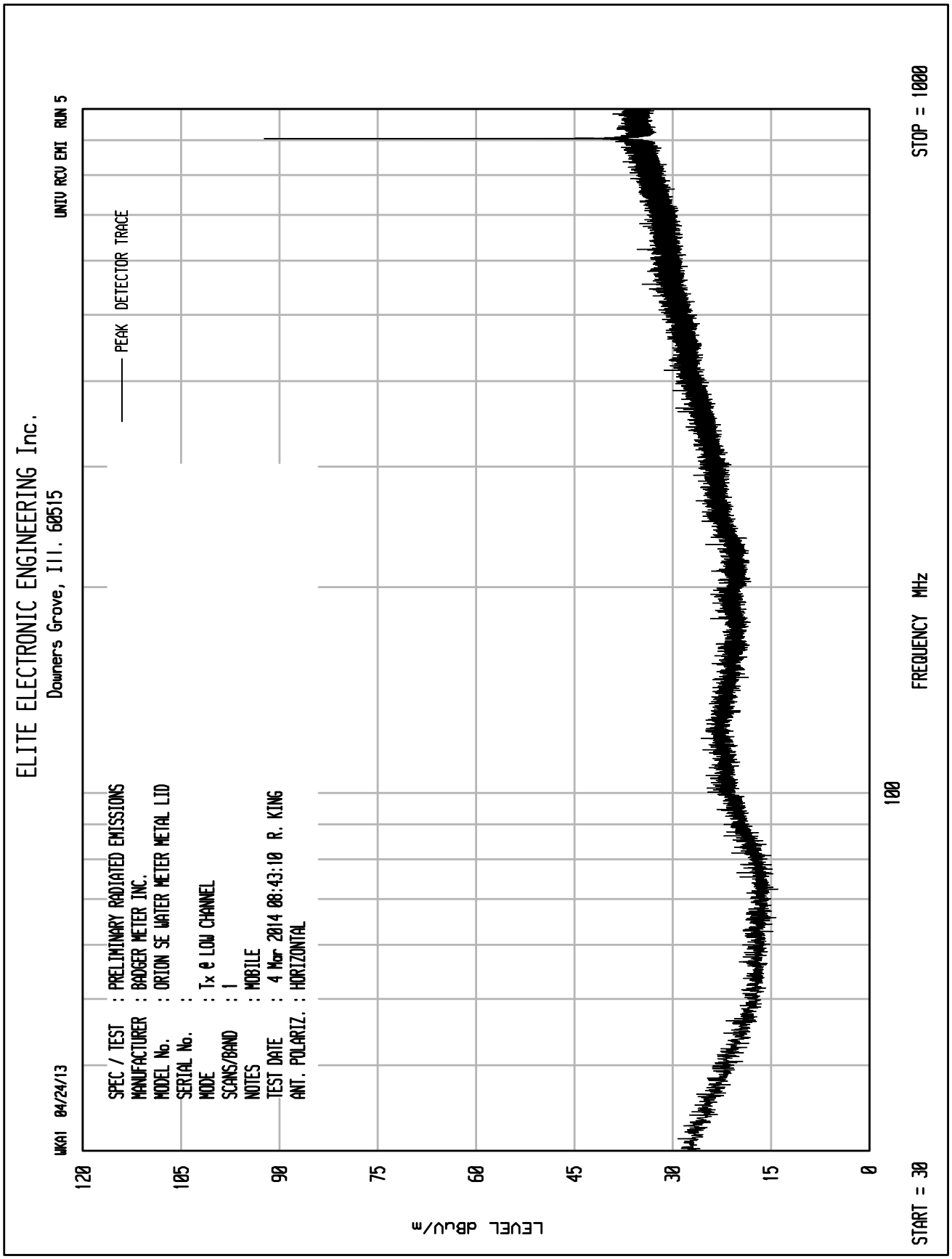

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKAI 04/24/13
SPEC / TEST : ANTENNA PORT CONDUCTED EMISSIONS
MANUFACTURER : BADGER METER INC
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER SETTING
TEST DATE : 7 Mar 2014 15:00:02 R. KING
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

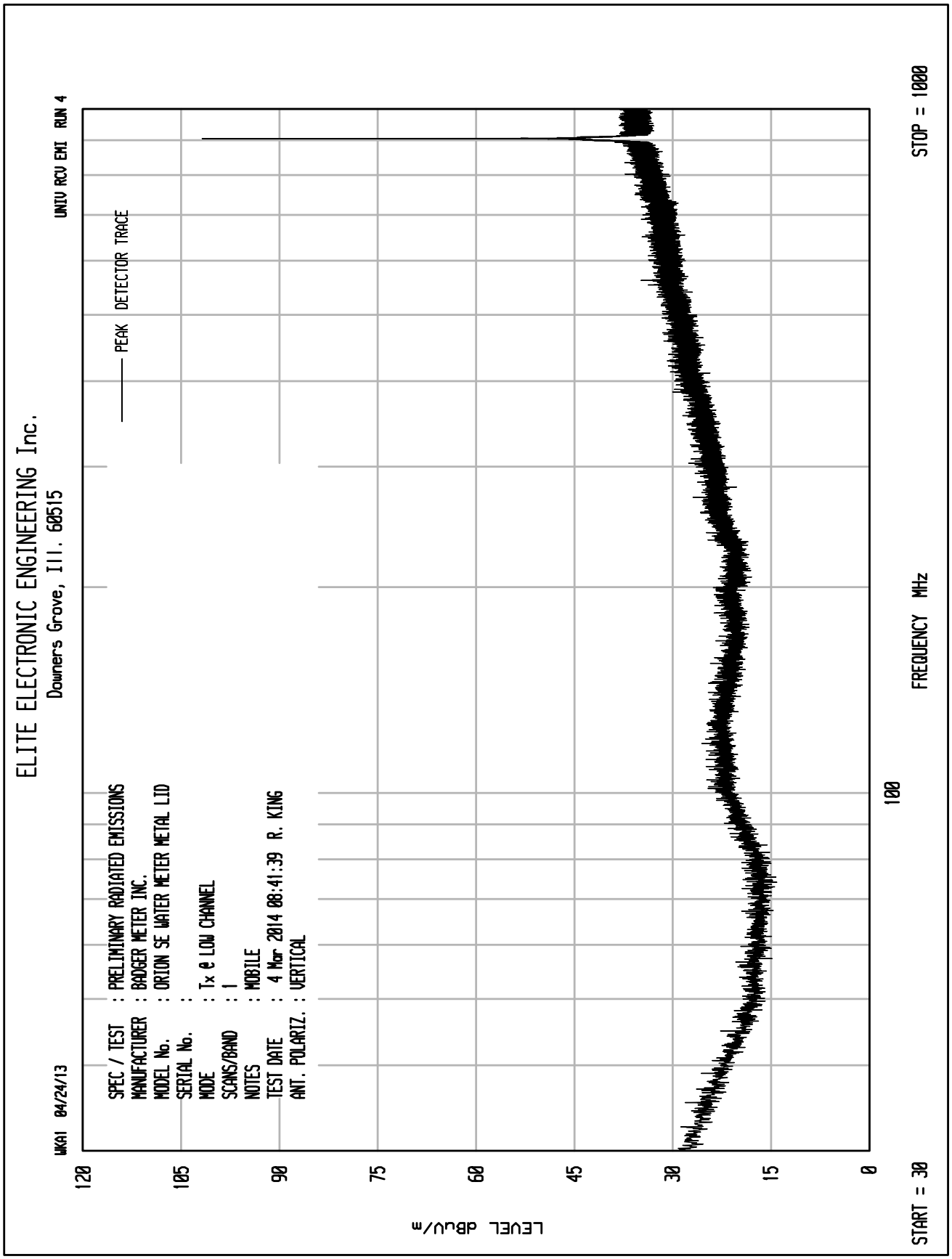

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKAI 04/24/13
SPEC / TEST : ANTENNA PORT CONDUCTED EMISSIONS
MANUFACTURER : BADGER METER INC
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER SETTING
TEST DATE : 7 Mar 2014 15:06:28 R. KING
Limit
PEAK DETECTOR TRACE
LEVEL dBm
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
START = 30
100
1000
STOP = 10000
FREQUENCY MHz

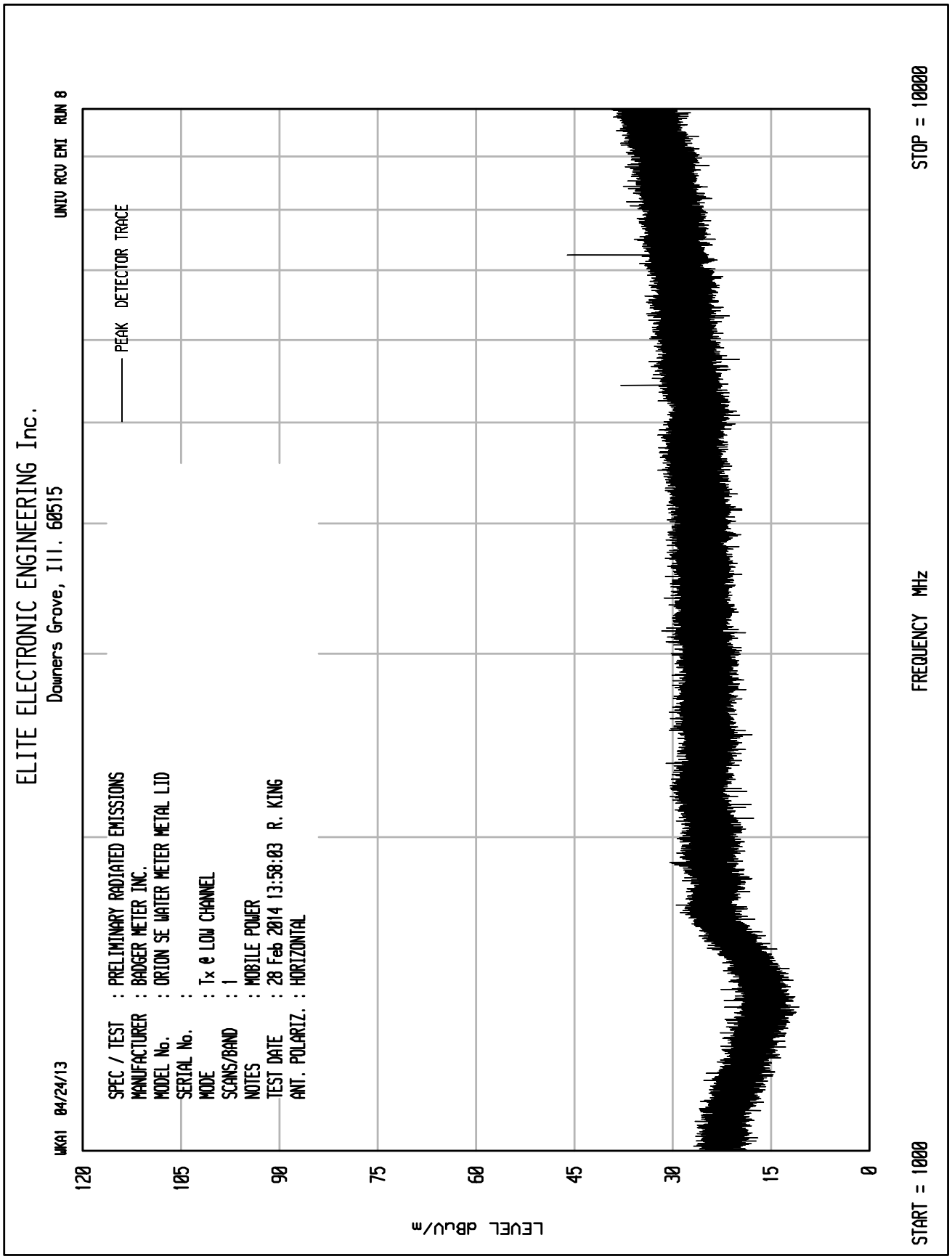

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 8
WKAI 04/24/13
SPEC / TEST : ANTENNA PORT CONDUCTED EMISSIONS
MANUFACTURER : BADGER METER INC
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER SETTING
TEST DATE : 7 Mar 2014 15:20:43 R. KING
Limit
PEAK DETECTOR TRACE
LEVEL dBm
30
15
0
-15
-30
-45
-60
-75
START = 30
100
1000
STOP = 10000
FREQUENCY MHz

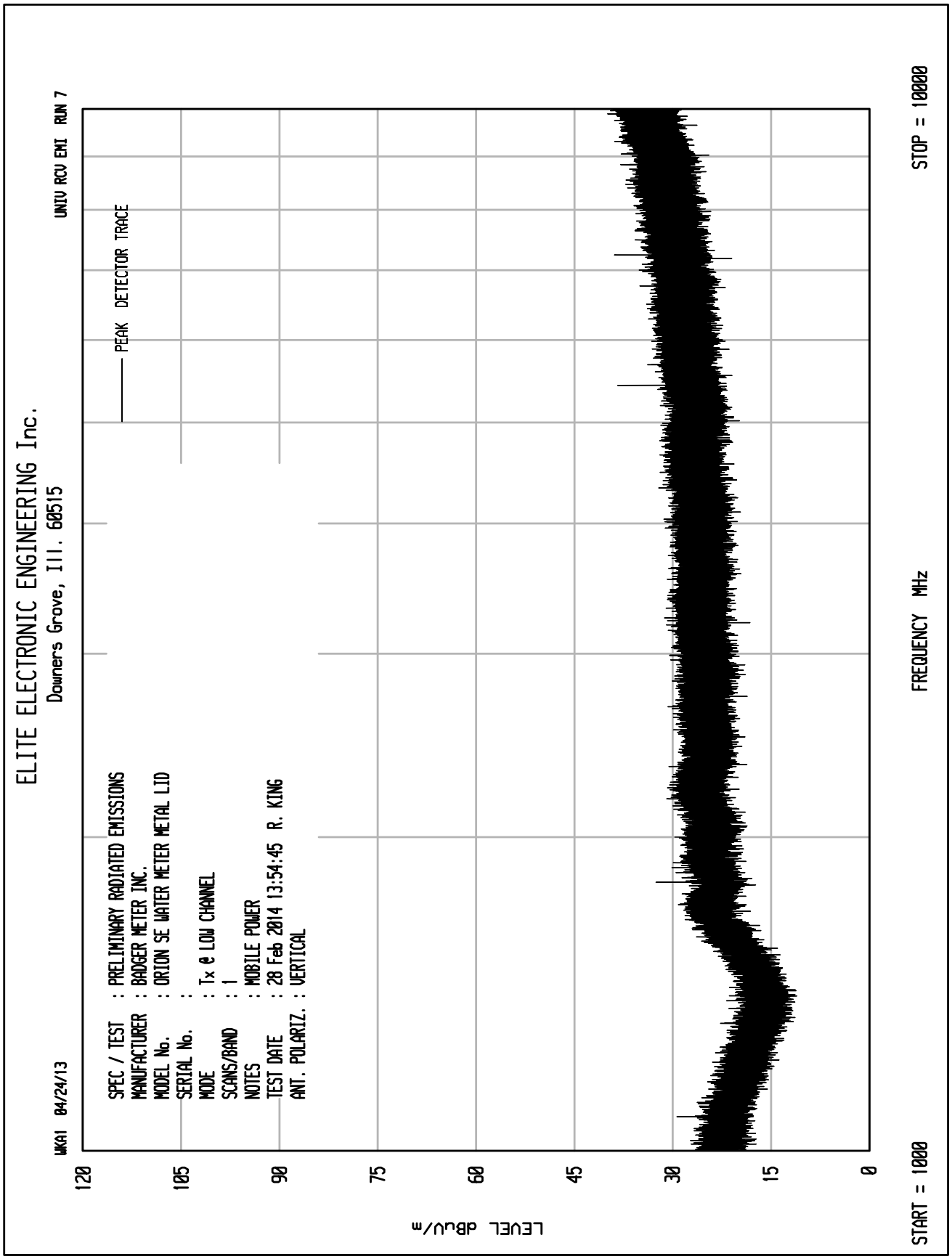

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 9
WKAI 04/24/13
SPEC / TEST : ANTENNA PORT CONDUCTED EMISSIONS
MANUFACTURER : BADGER METER INC
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER SETTING
TEST DATE : 7 Mar 2014 15:26:54 R. KING
Limit
PEAK DETECTOR TRACE
LEVEL dBm
30
15
0
-15
-30
-45
-60
-75
START = 30
100
1000
STOP = 10000
FREQUENCY MHz

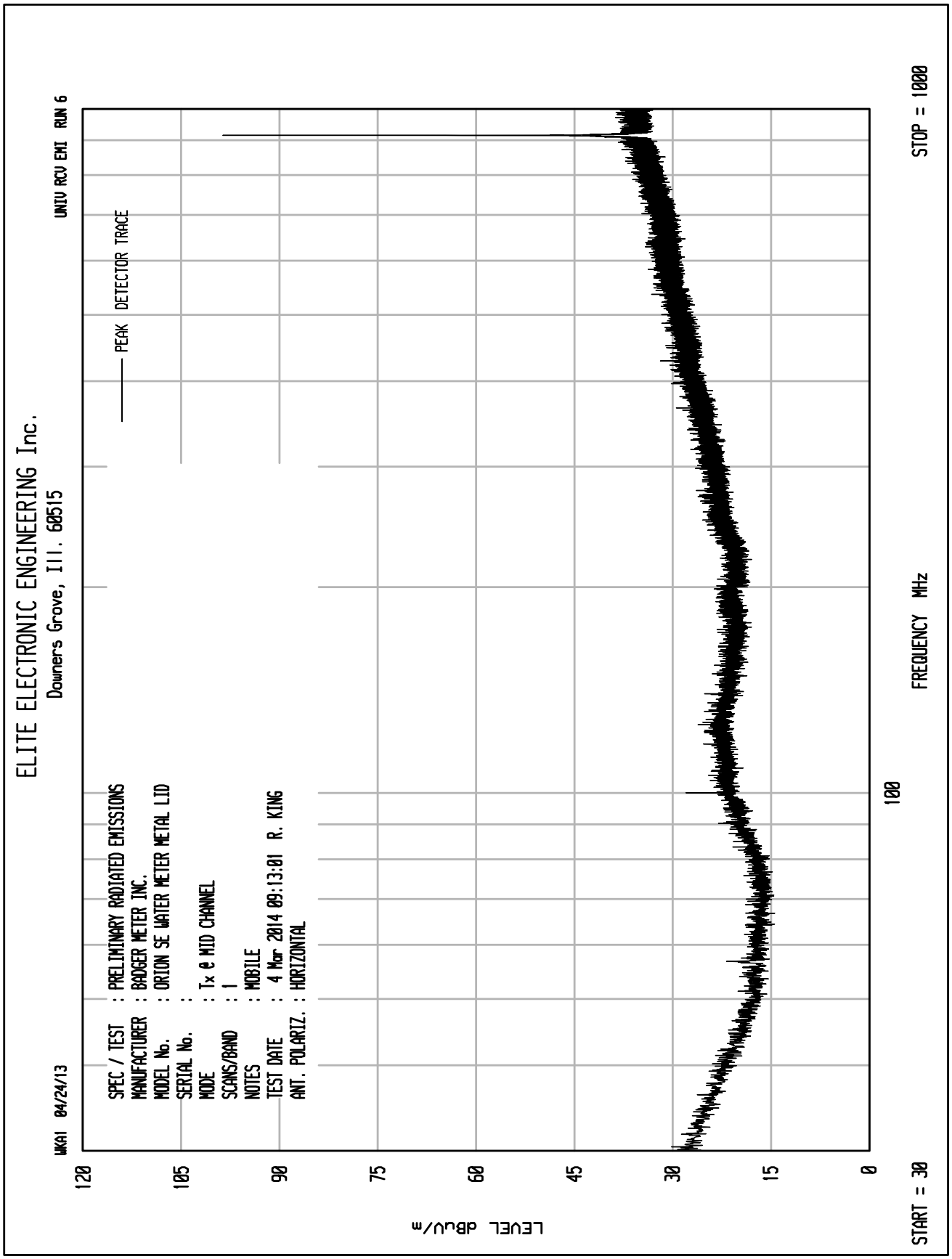

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 11
WKAI 04/24/13
SPEC / TEST : ANTENNA PORT CONDUCTED EMISSIONS
MANUFACTURER : BADGER METER INC
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER SETTING
TEST DATE : 7 Mar 2014 15:34:28 R. KING
Limit
PEAK DETECTOR TRACE
LEVEL dBm
30
15
0
-15
-30
-45
-60
-75
START = 30
100
1000
FREQUENCY MHz
STOP = 10000

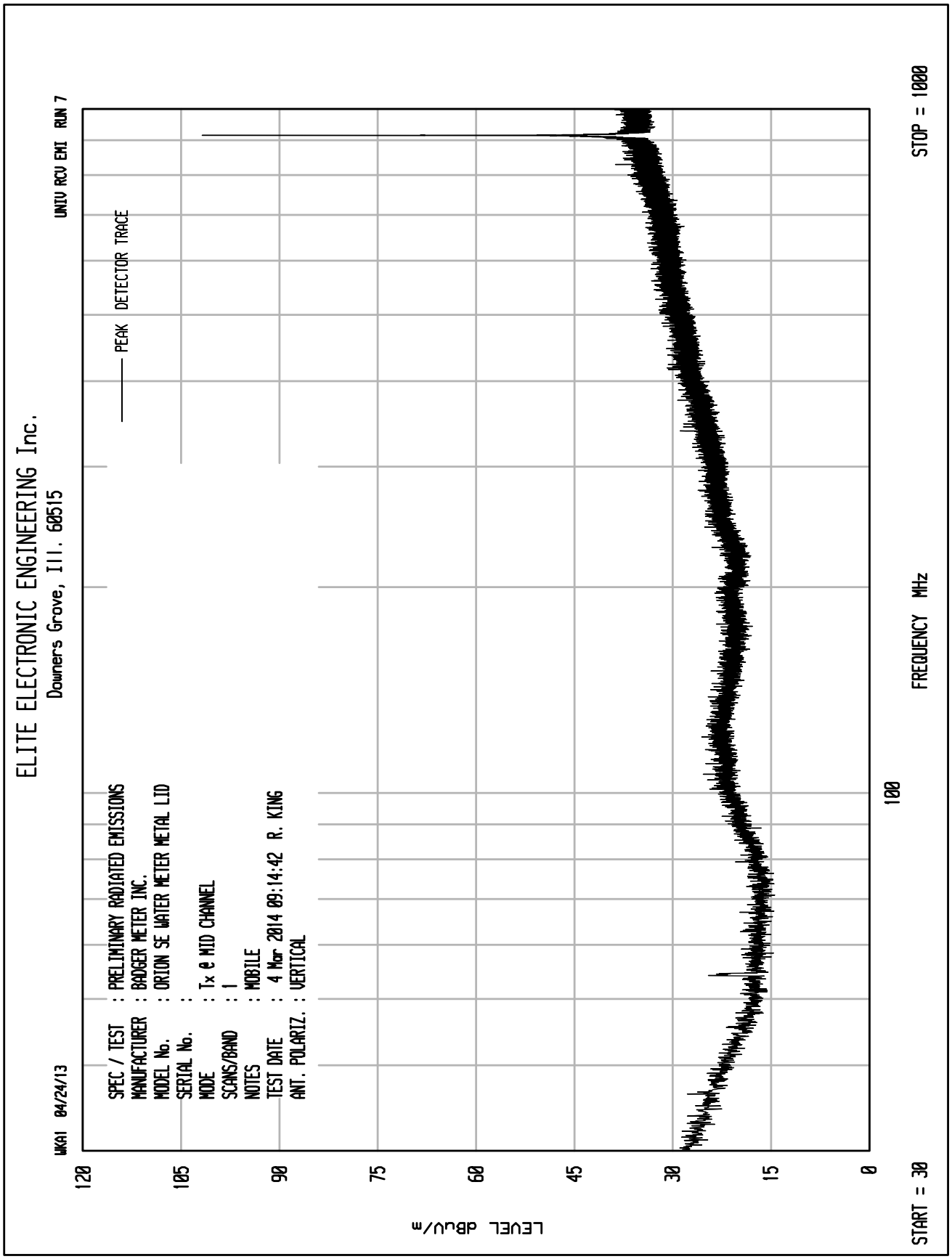

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKAI 04/24/13
PEAK DETECTOR TRACE
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. : :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : MOBILE
TEST DATE : 4 Mar 2014 08:43:10 R. KING
ANT. POLARIZ. : HORIZONTAL
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

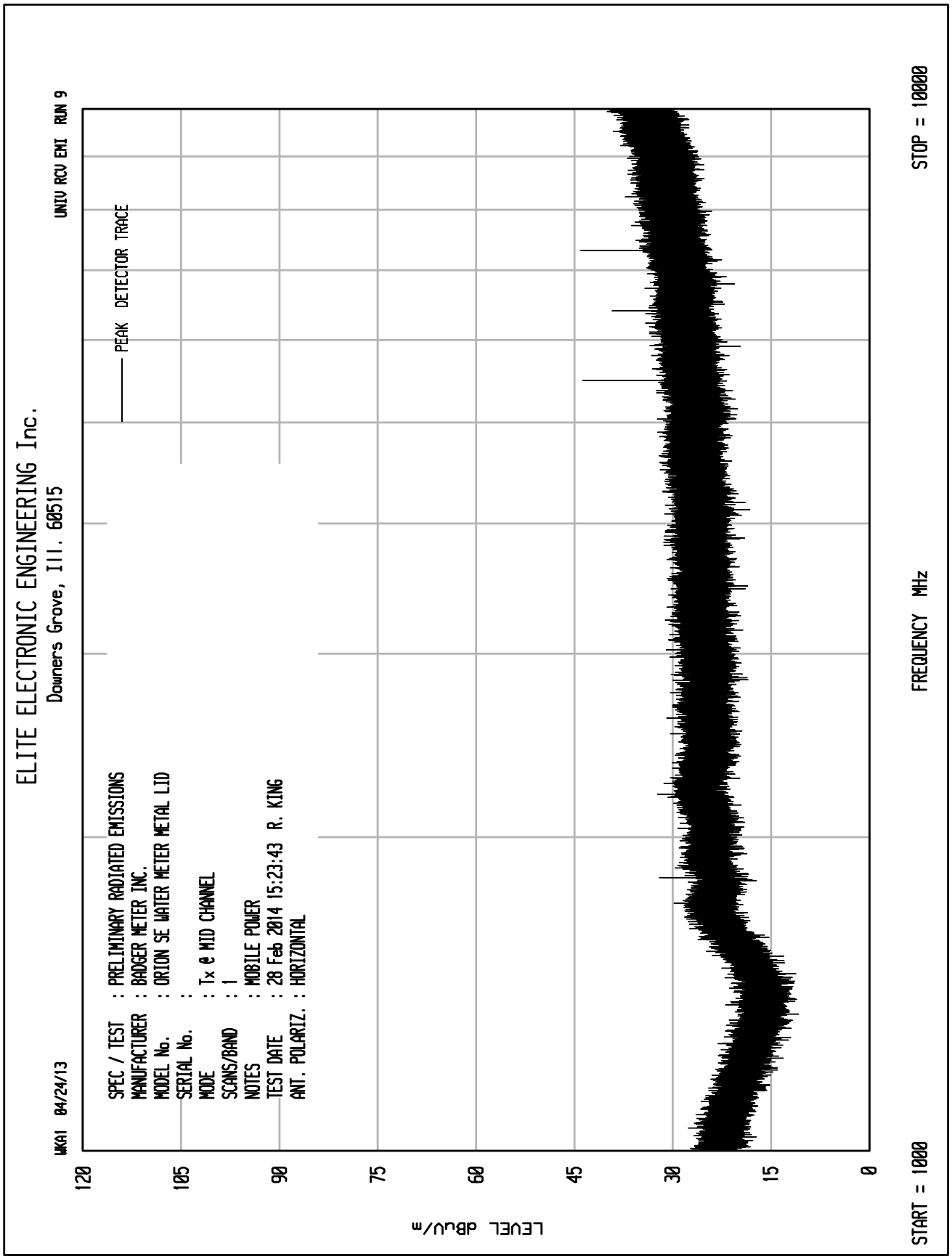

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKAI 04/24/13
PEAK DETECTOR TRACE
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. : :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : MOBILE
TEST DATE : 4 Mar 2014 08:41:39 R. KING
ANT. POLARIZ. : VERTICAL
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

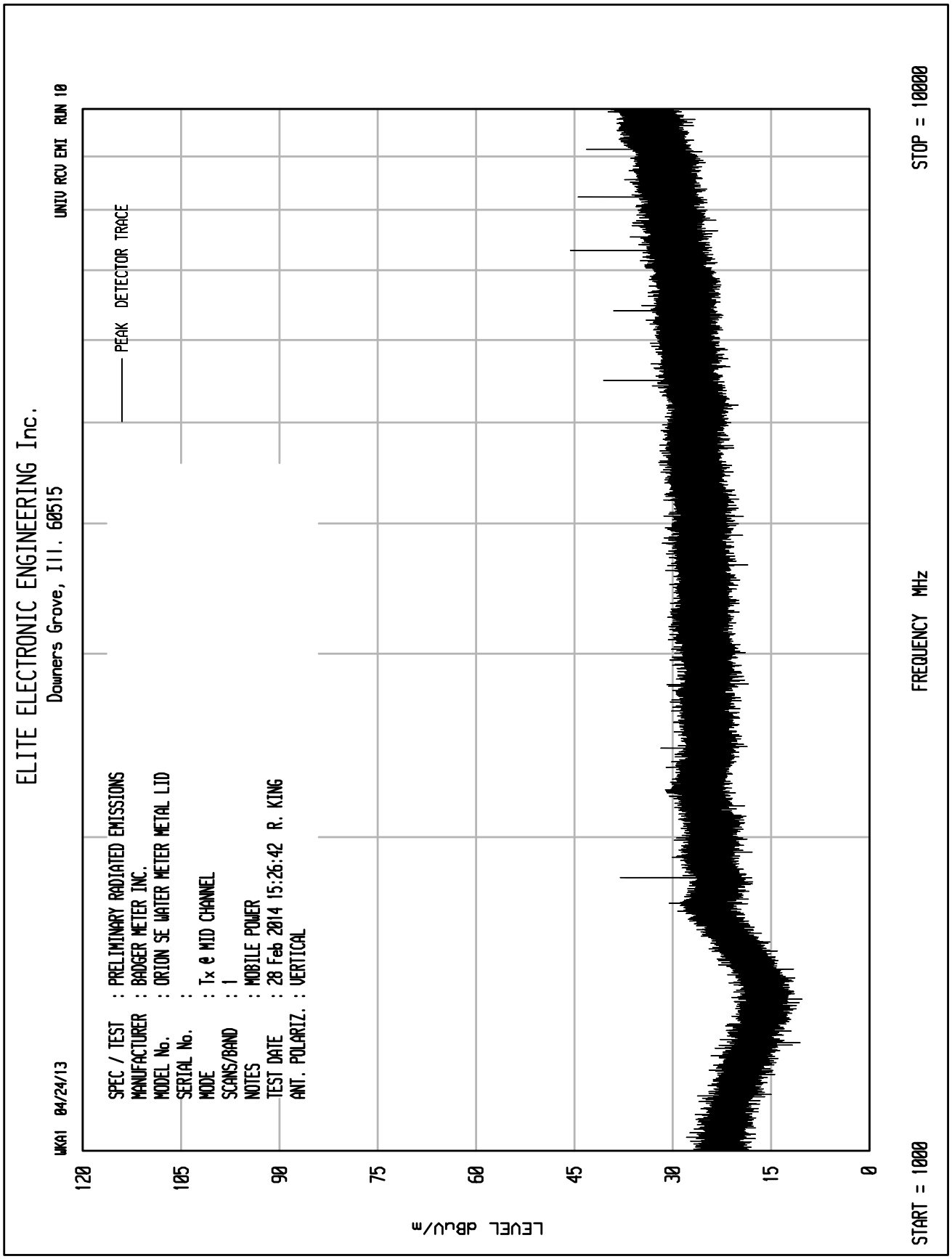

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 8
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER
TEST DATE : 28 Feb 2014 13:58:03 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

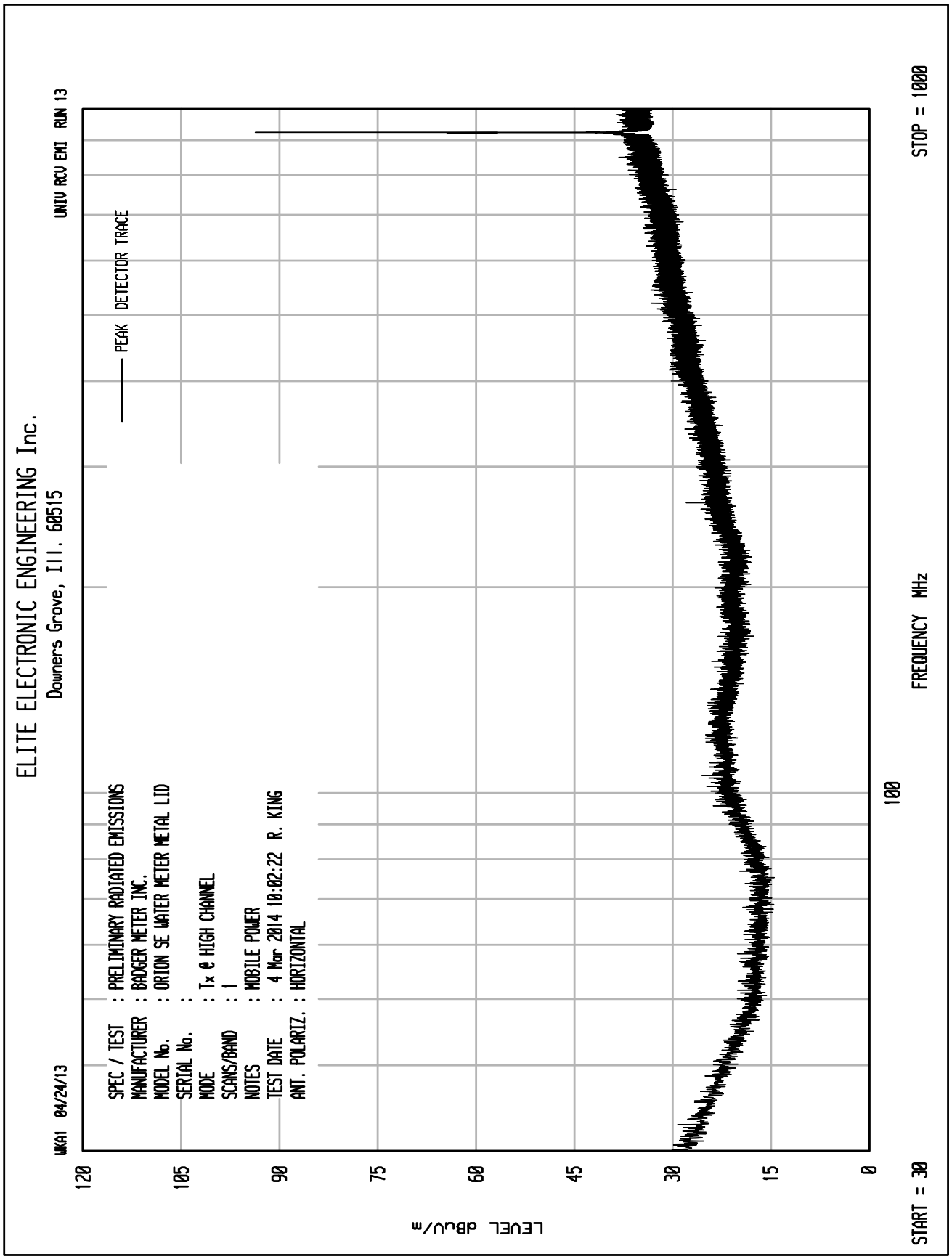

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 7
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER
TEST DATE : 28 Feb 2014 13:54:45 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

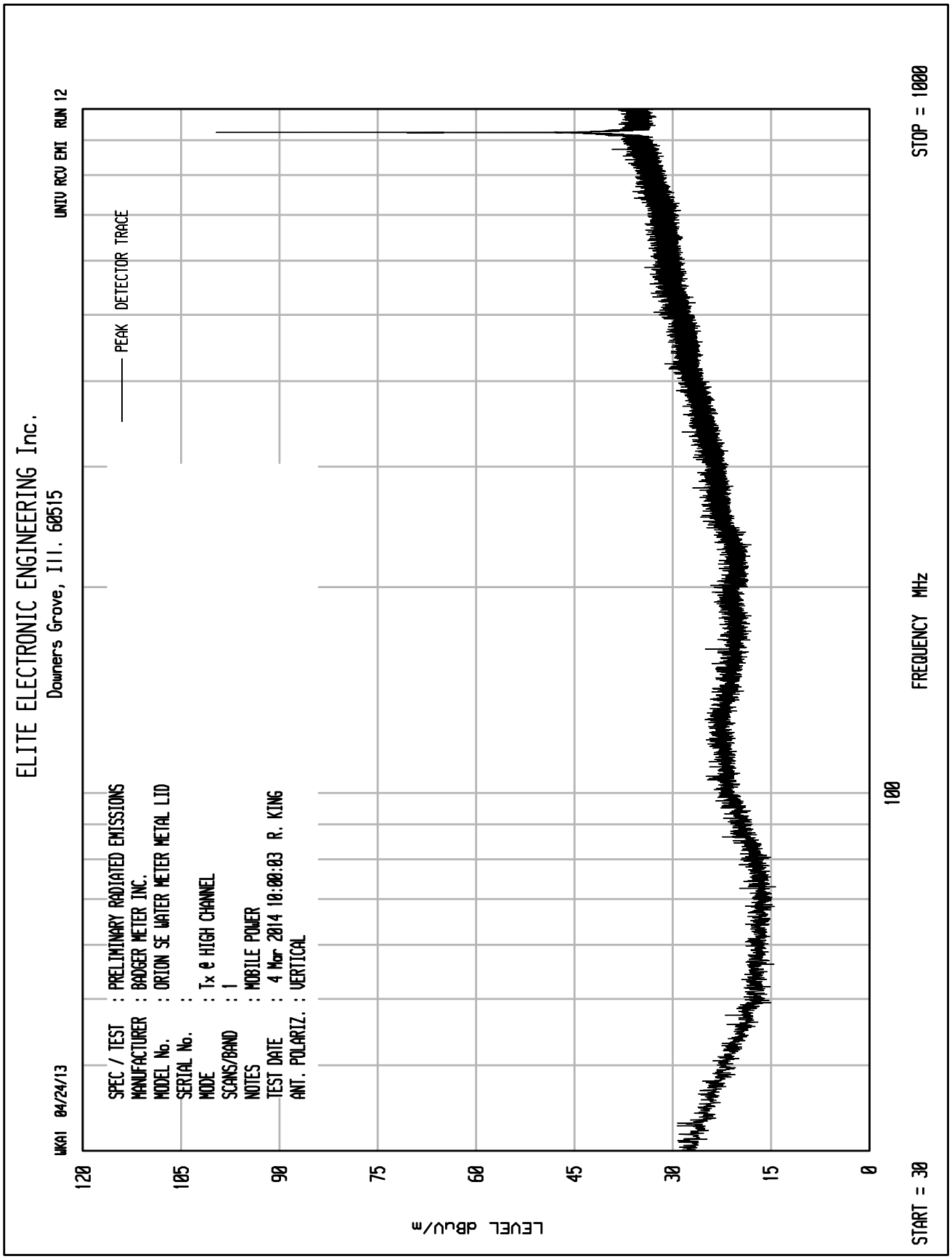

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 6
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. : :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : MOBILE
TEST DATE : 4 Mar 2014 09:13:01 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

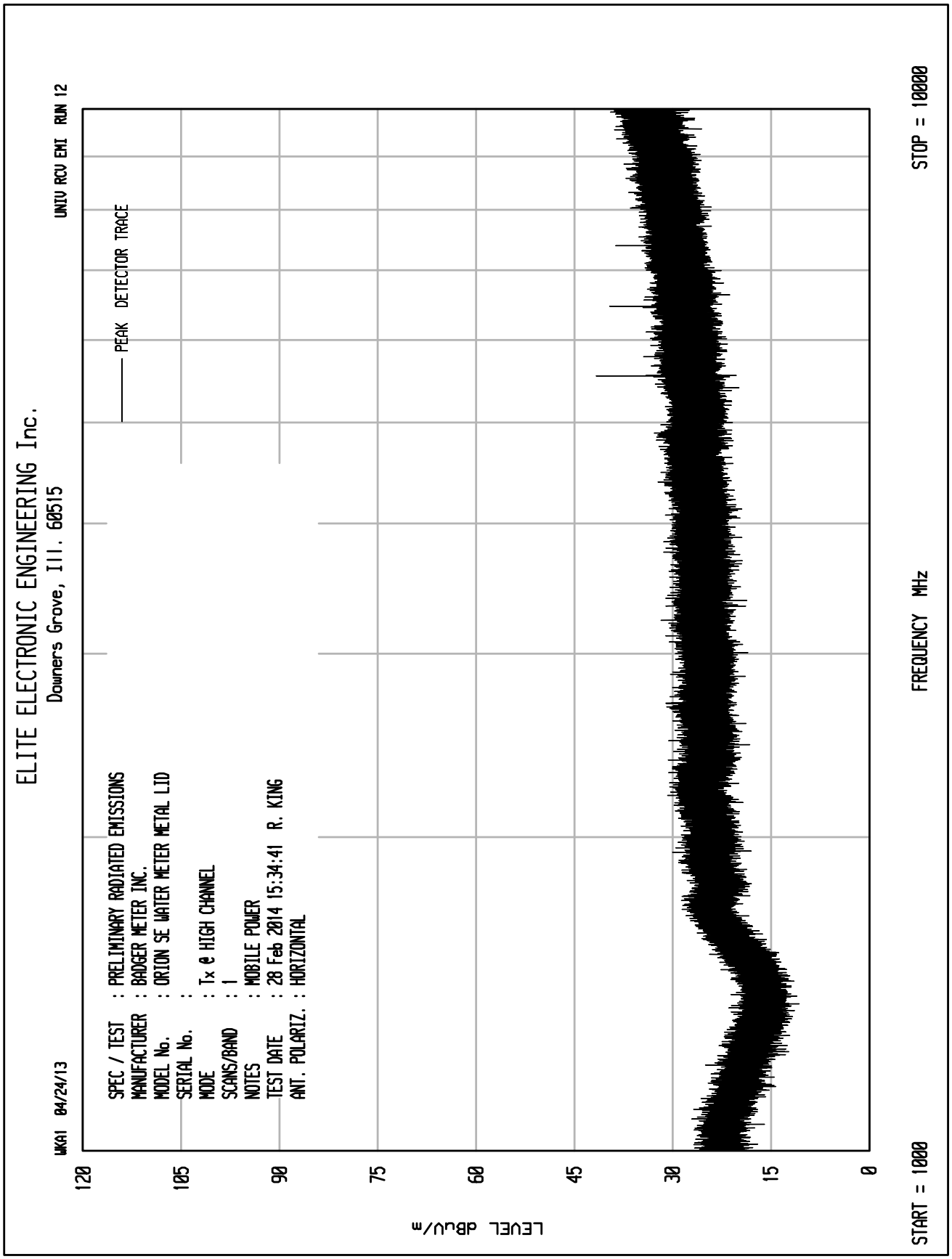

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 7
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. : :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : MOBILE
TEST DATE : 4 Mar 2014 09:14:42 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

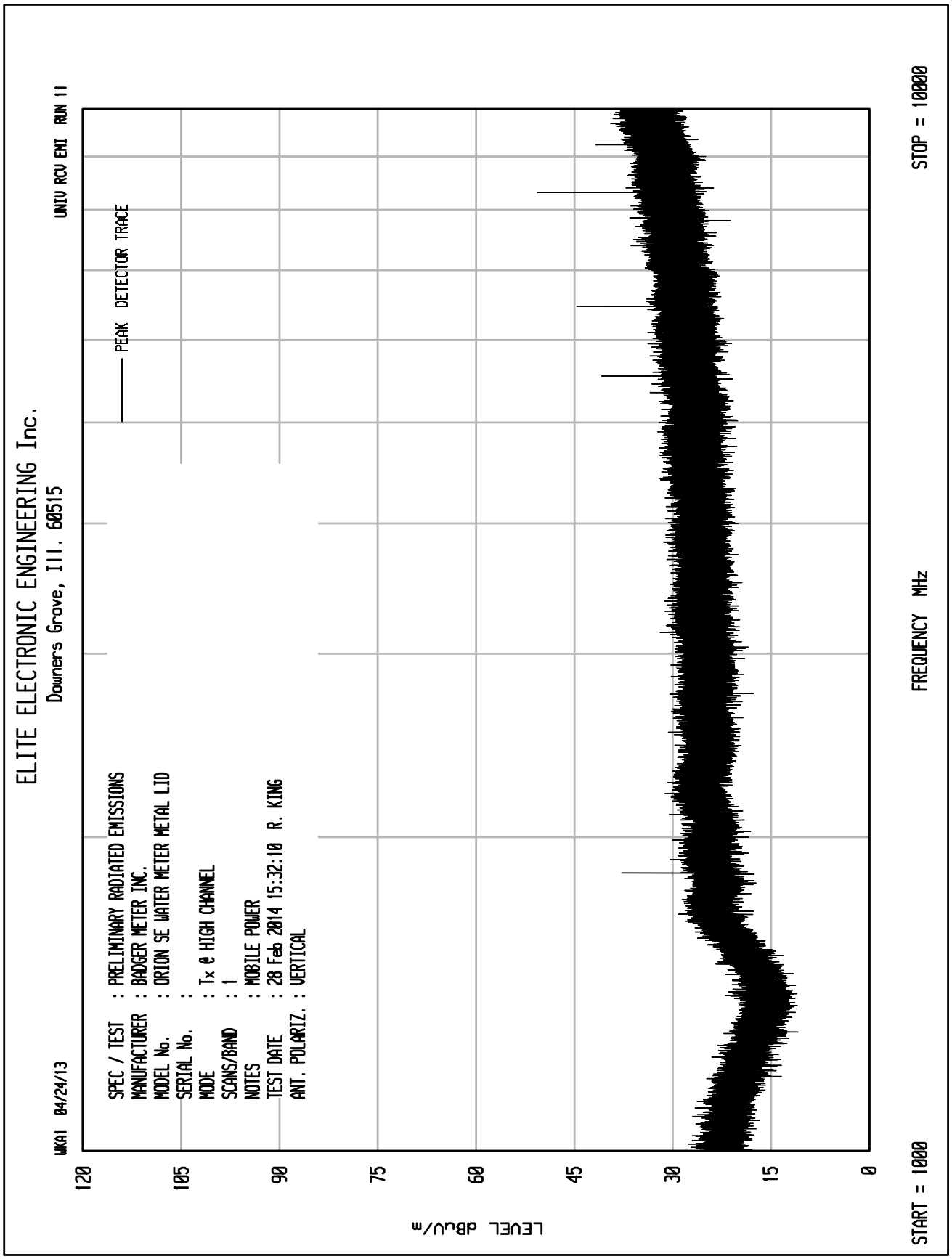

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 9
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER
TEST DATE : 28 Feb 2014 15:23:43 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

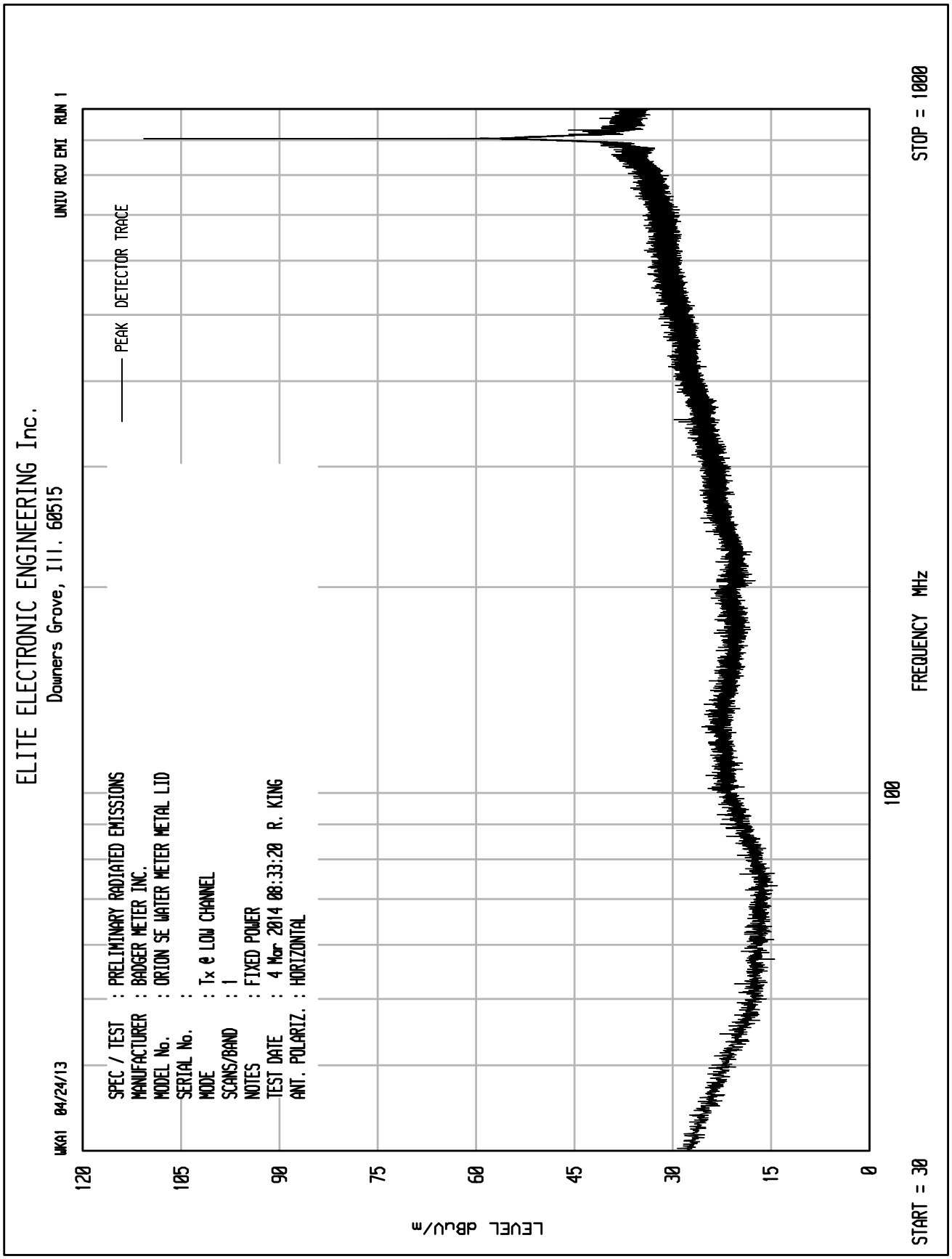

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 10
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER
TEST DATE : 28 Feb 2014 15:26:42 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

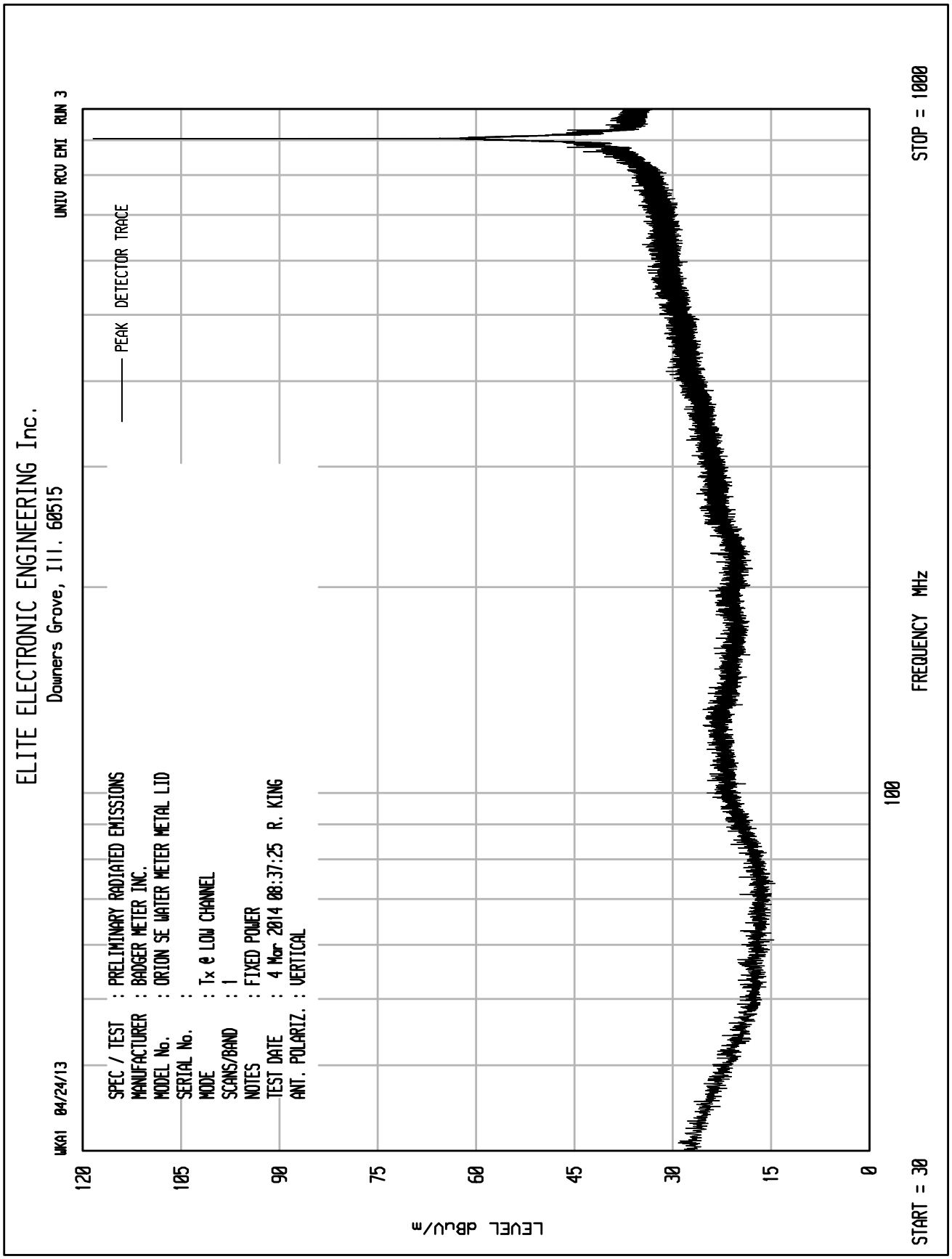

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 13
WKAI 04/24/13
PEAK DETECTOR TRACE
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. : :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER
TEST DATE : 4 Mar 2014 10:02:22 R. KING
ANT. POLARIZ. : HORIZONTAL
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

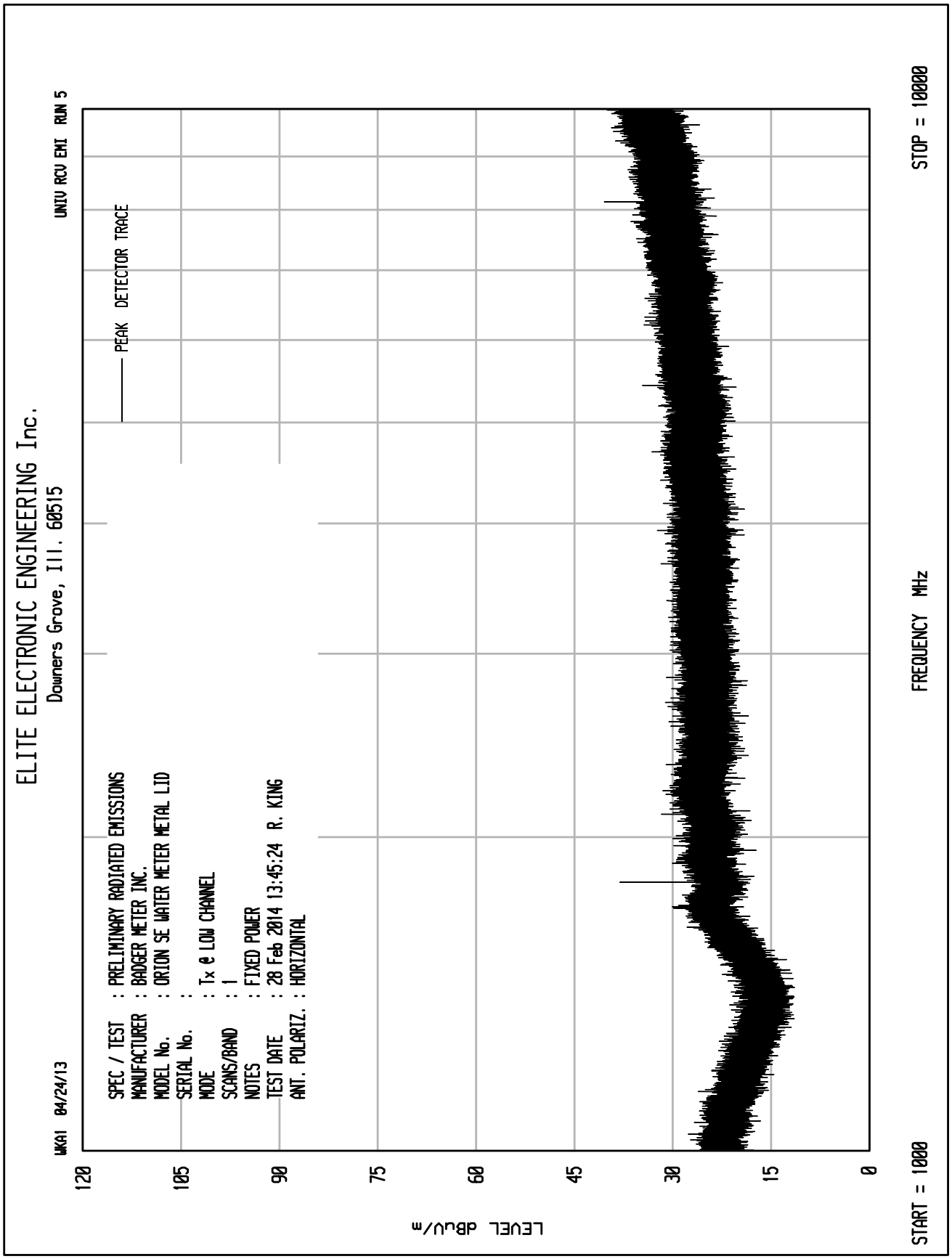

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 12
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER
TEST DATE : 4 Mar 2014 10:00:03 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

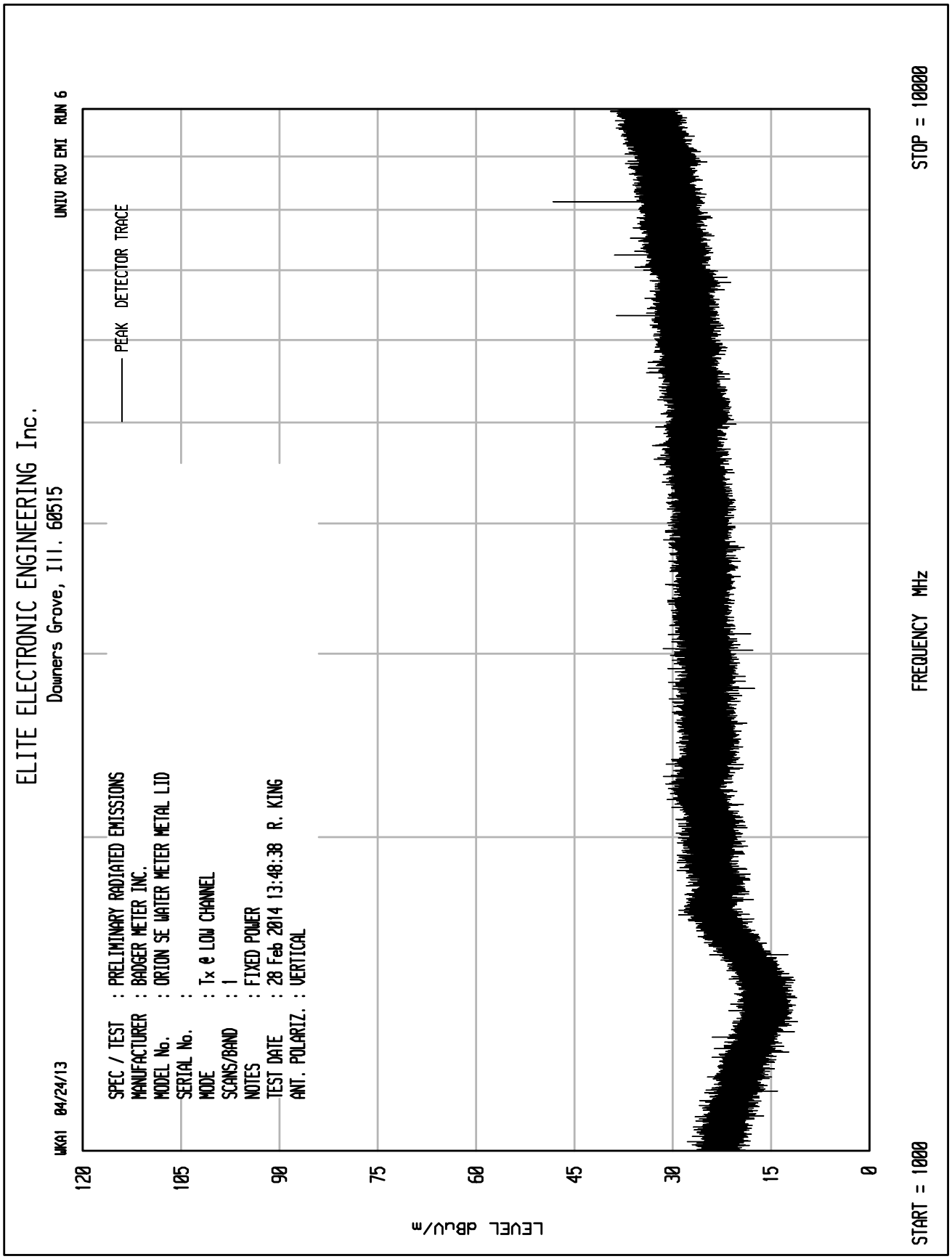

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 12
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER
TEST DATE : 28 Feb 2014 15:34:41 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

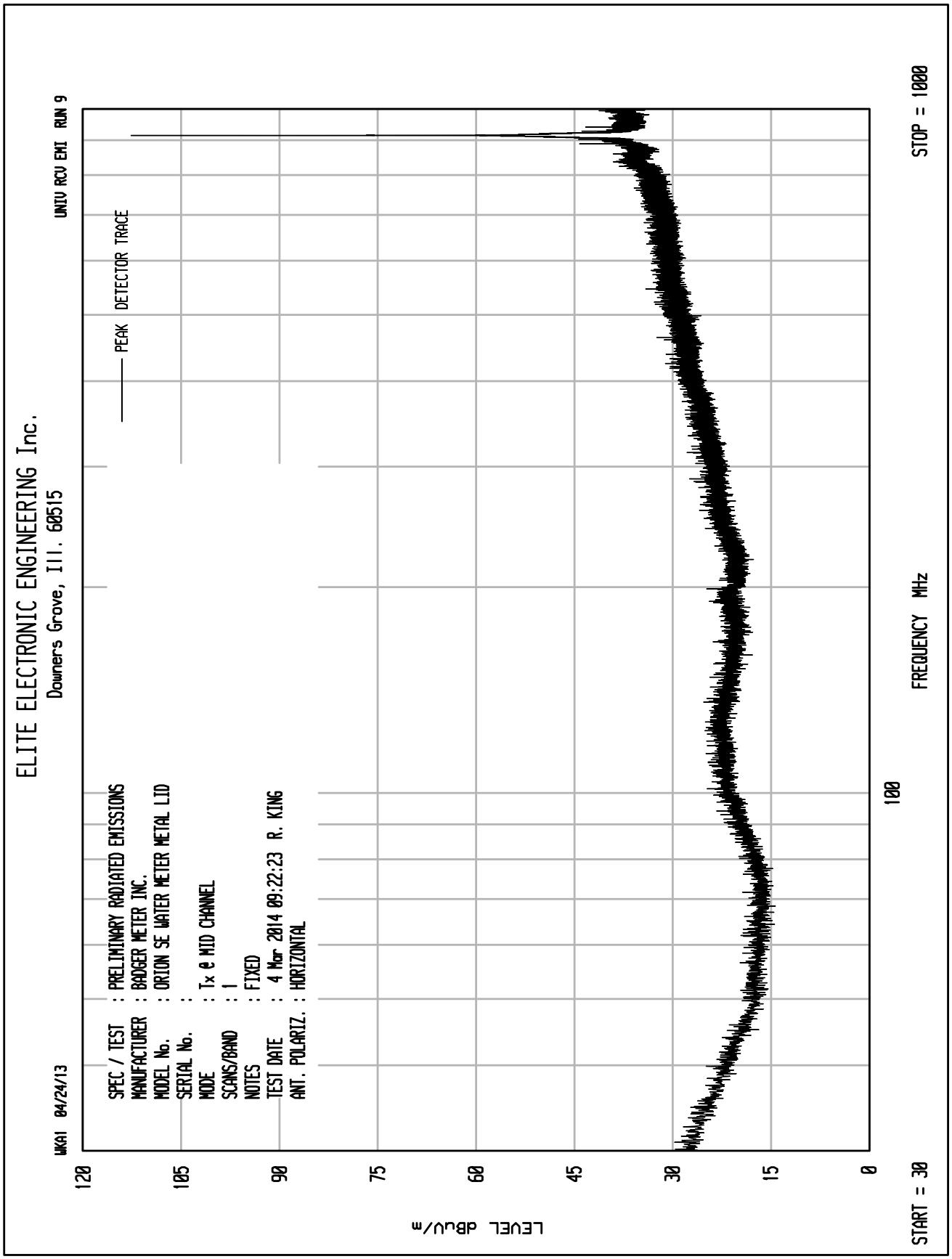

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 11
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : MOBILE POWER
TEST DATE : 28 Feb 2014 15:32:10 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

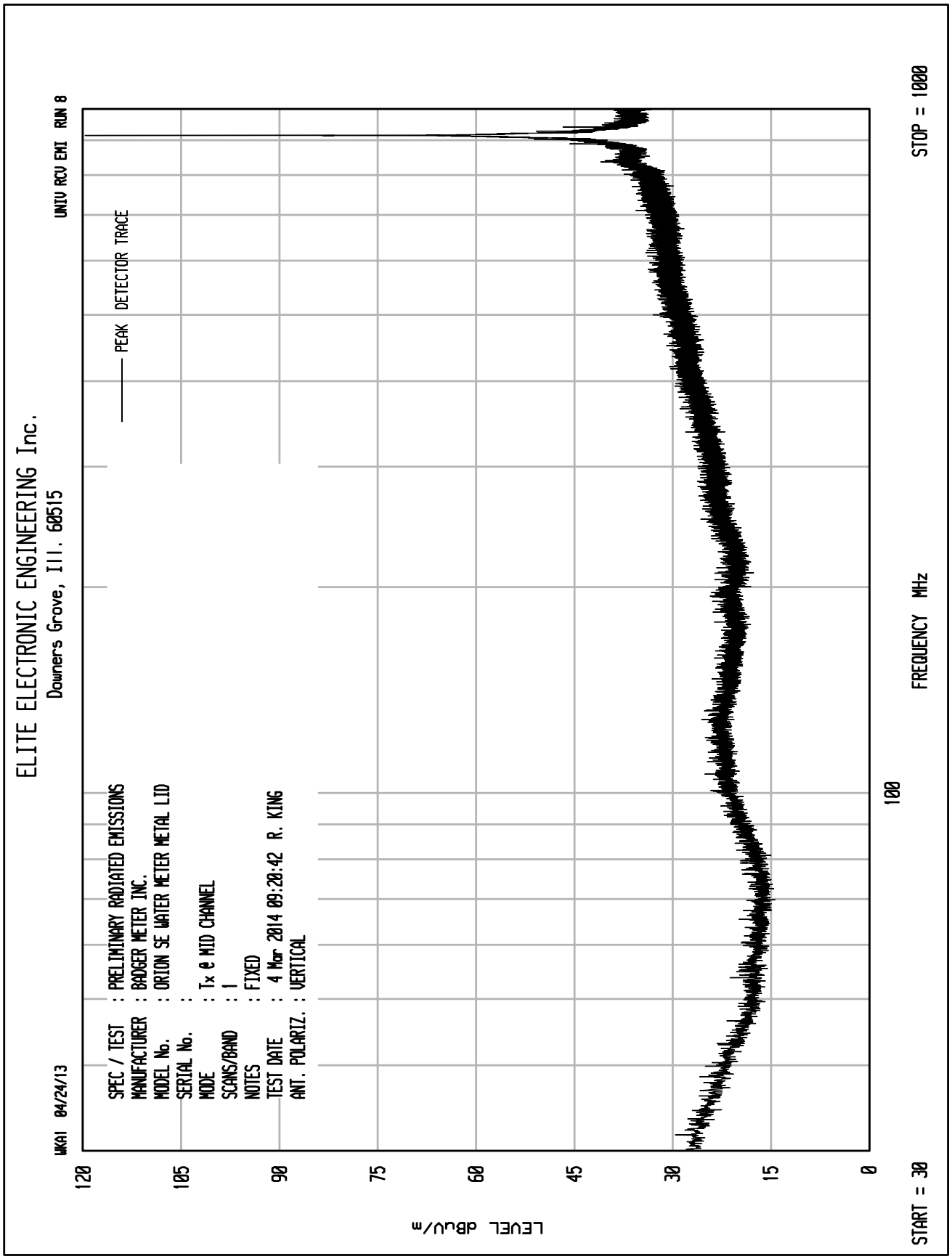

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 1
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER
TEST DATE : 4 Mar 2014 08:33:20 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

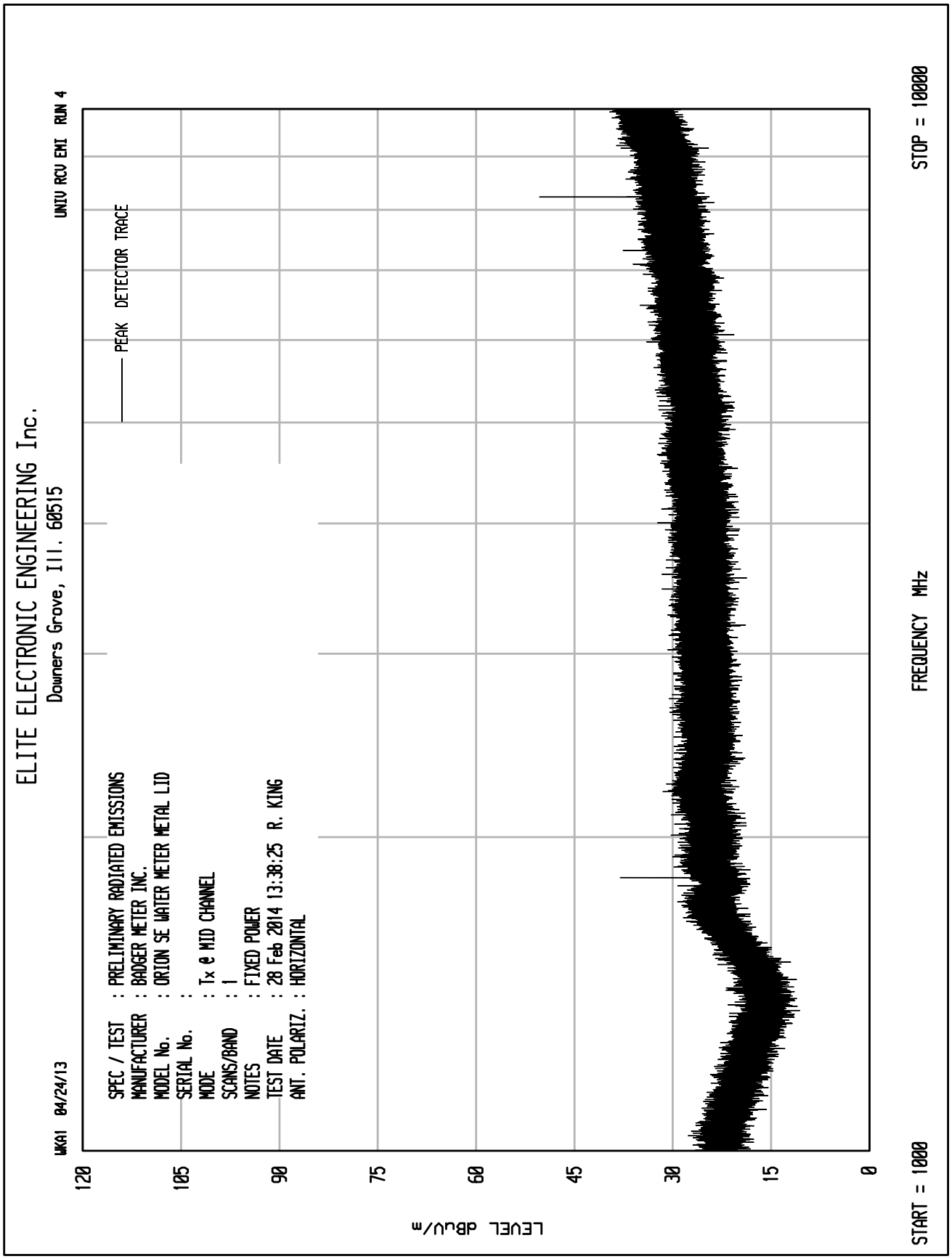

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER
TEST DATE : 4 Mar 2014 08:37:25 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

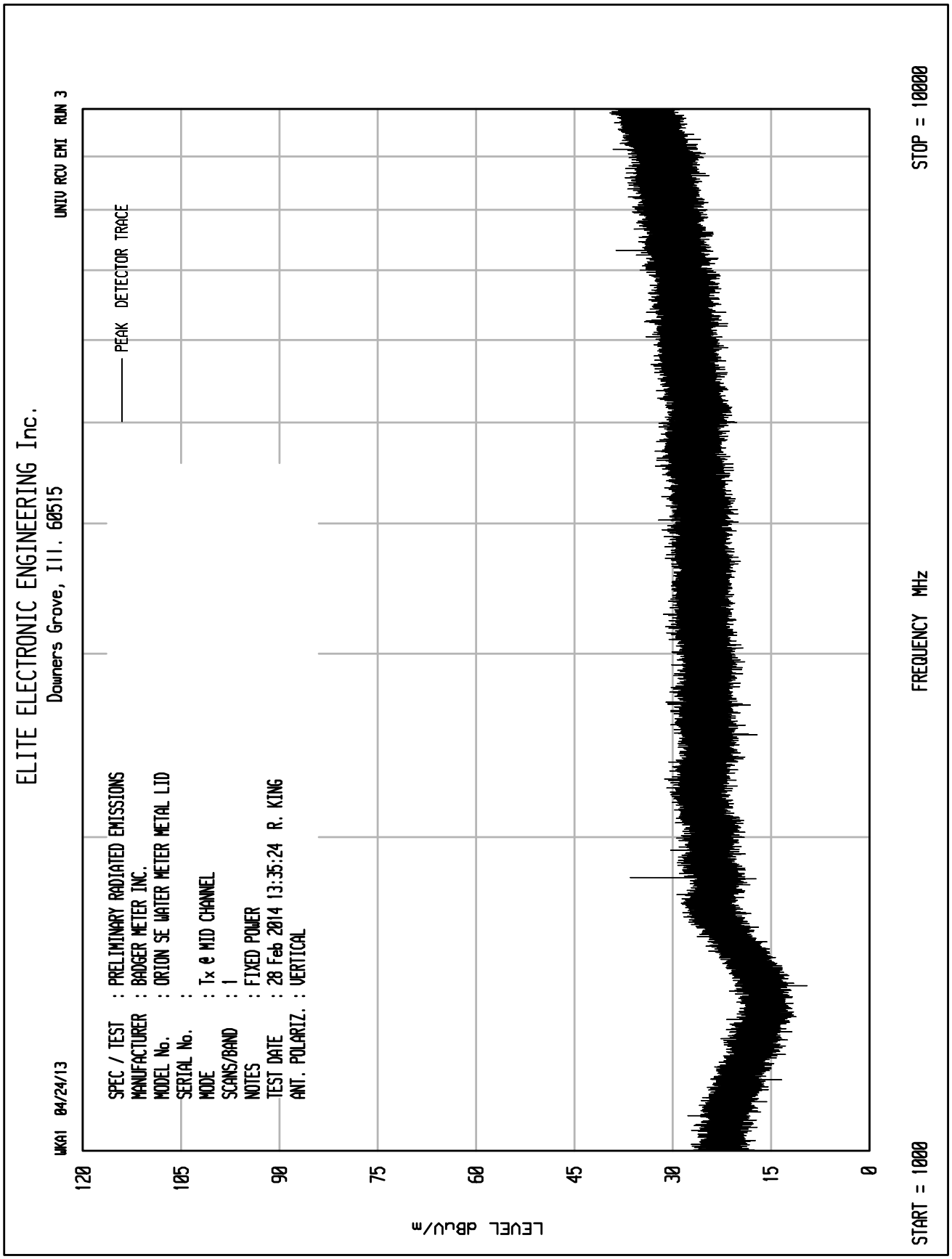

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 5
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER
TEST DATE : 28 Feb 2014 13:45:24 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

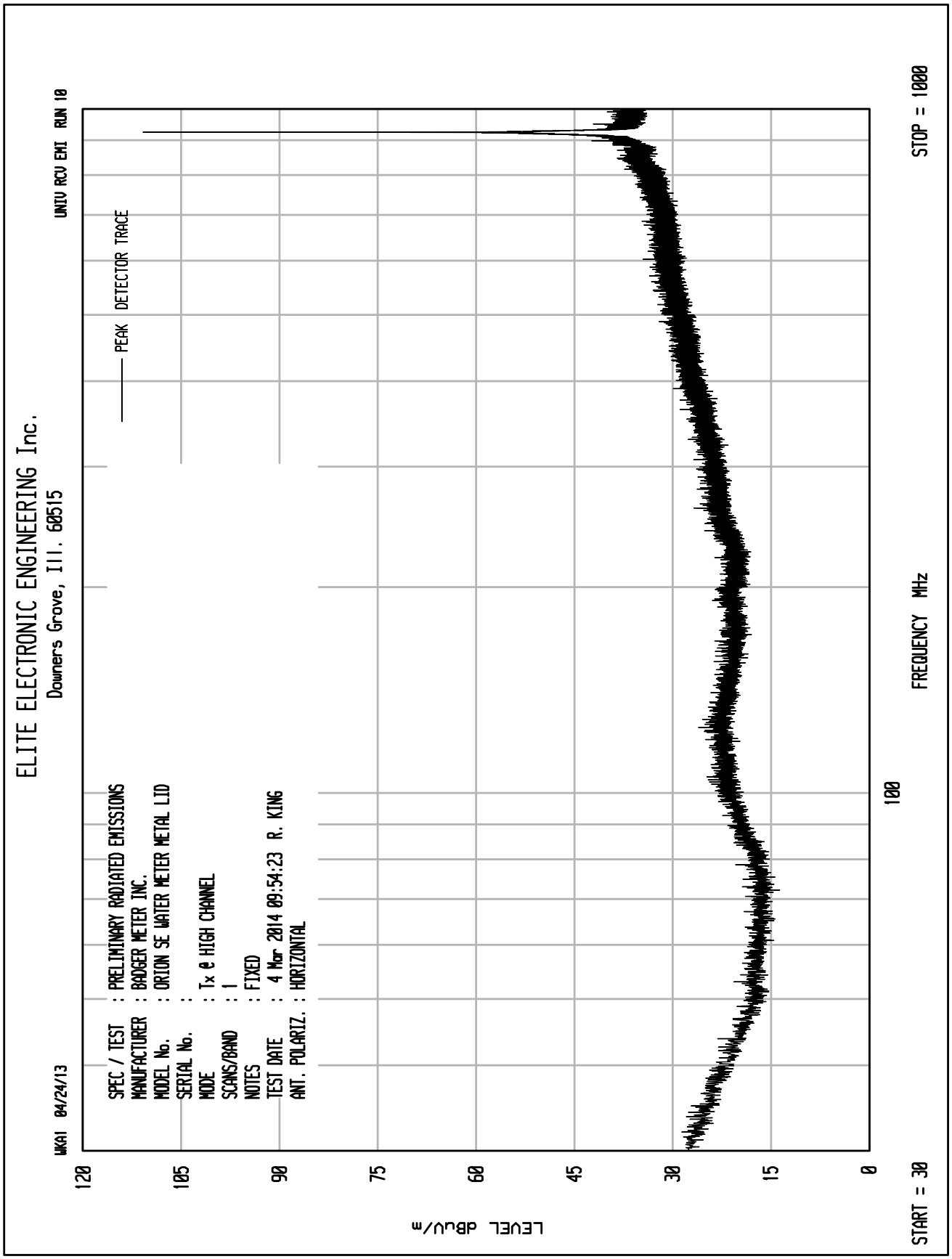

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 6
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ LOW CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER
TEST DATE : 28 Feb 2014 13:48:38 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

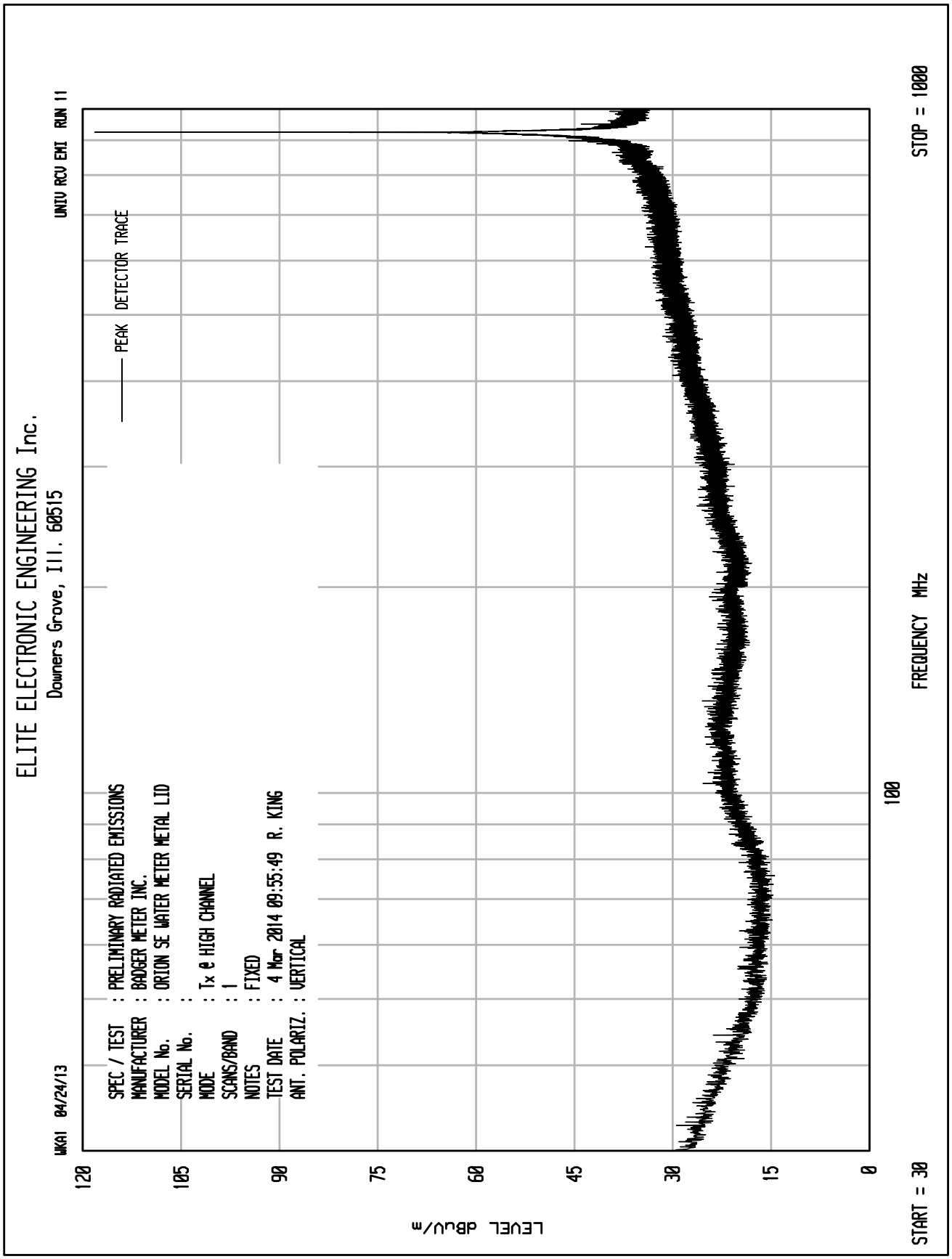

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 9
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : FIXED
TEST DATE : 4 Mar 2014 09:22:23 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

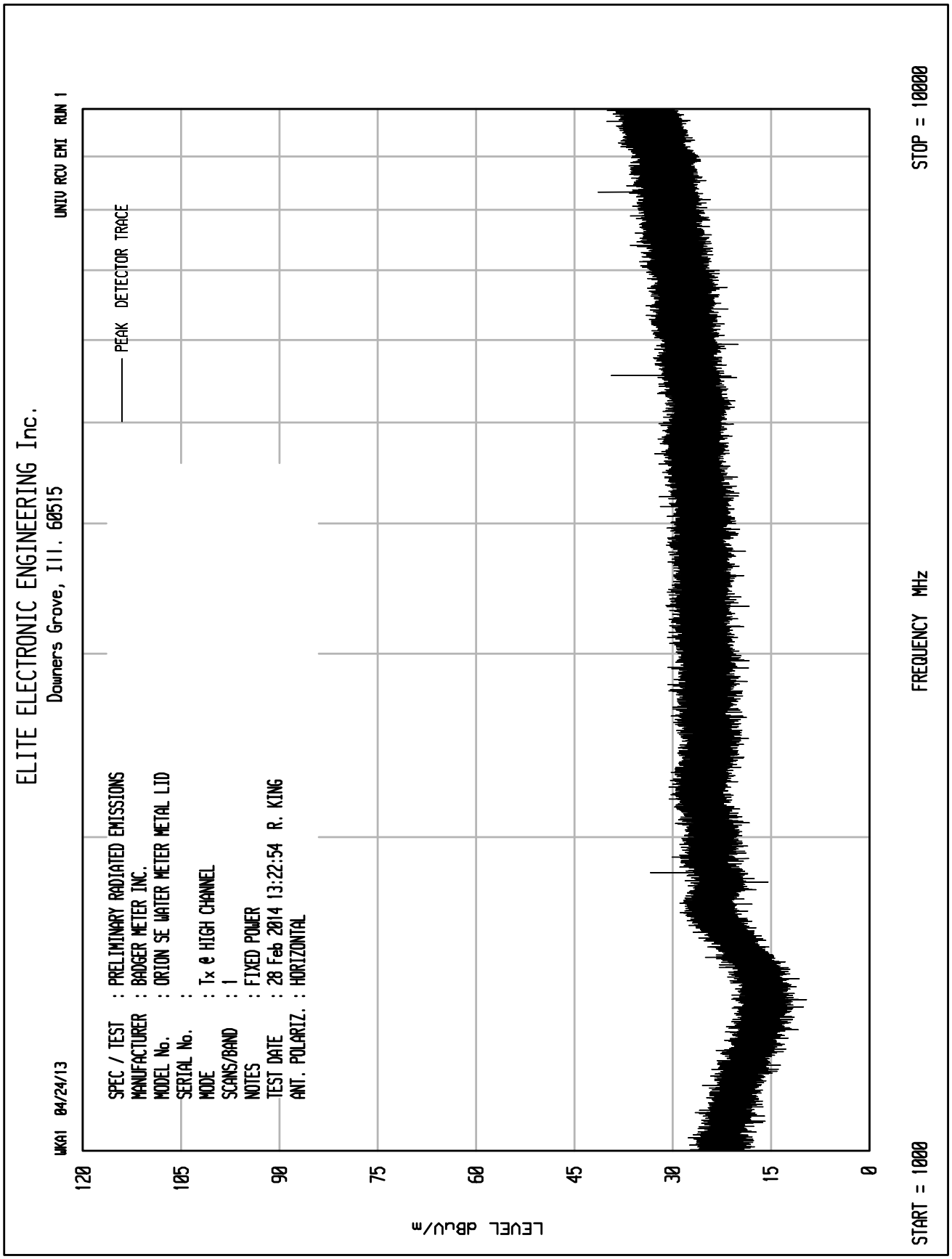

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 8
WKAI 04/24/13
PEAK DETECTOR TRACE
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : FIXED
TEST DATE : 4 Mar 2014 09:20:42 R. KING
ANT. POLARIZ. : VERTICAL
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000

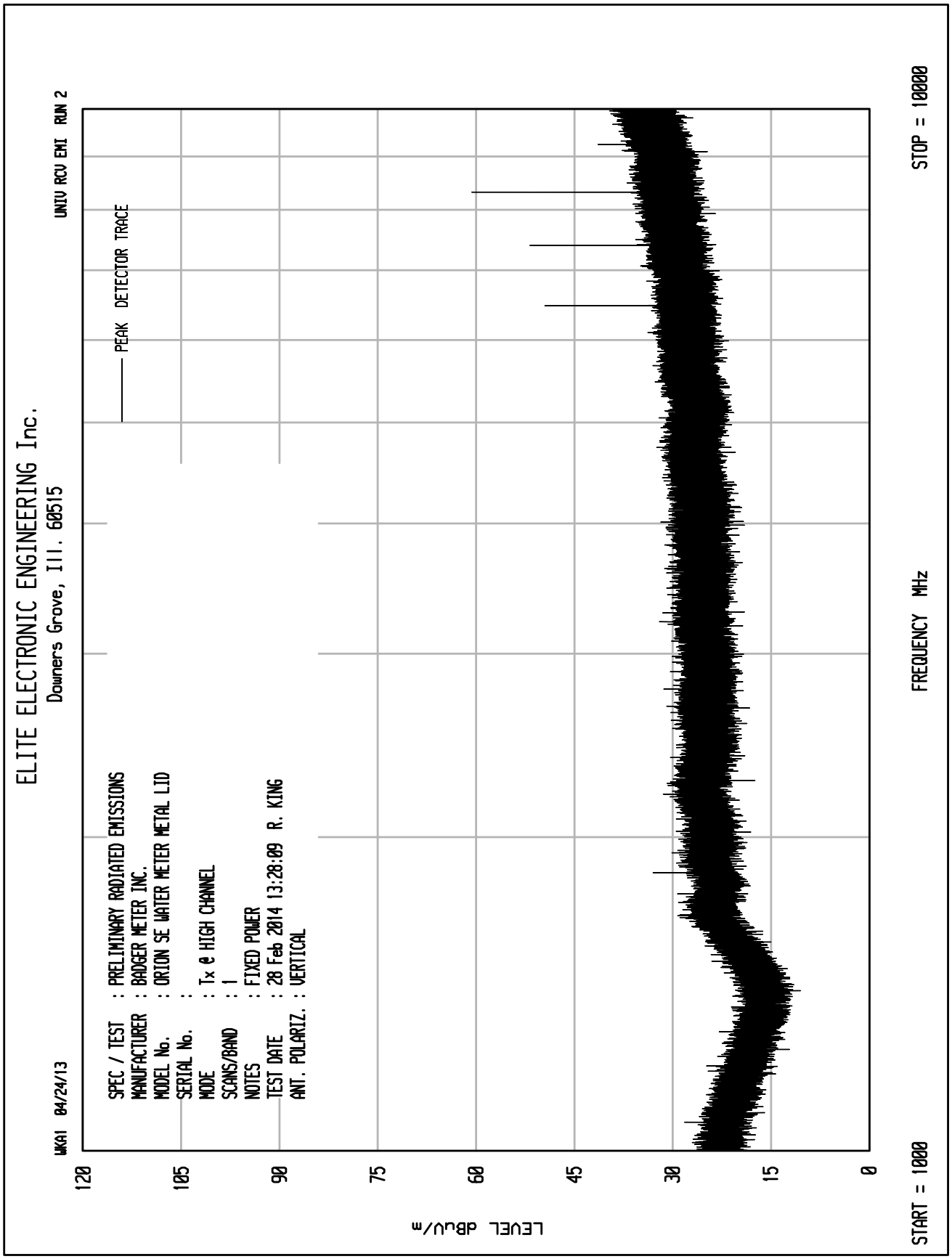

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 4
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER
TEST DATE : 28 Feb 2014 13:38:25 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 3
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ MID CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER
TEST DATE : 28 Feb 2014 13:35:24 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 10
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. : :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : FIXED
TEST DATE : 4 Mar 2014 09:54:23 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 11
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. : :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : FIXED
TEST DATE : 4 Mar 2014 09:55:49 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 30
100
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 1
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER
TEST DATE : 28 Feb 2014 13:22:54 R. KING
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
UNIV RCV EMI RUN 2
WKAI 04/24/13
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : BADGER METER INC.
MODEL No. : ORION SE WATER METER METAL LID
SERIAL No. :
MODE : Tx @ HIGH CHANNEL
SCANS/BAND : 1
NOTES : FIXED POWER
TEST DATE : 28 Feb 2014 13:28:09 R. KING
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 10000

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 904.9MHz
Power Setting : Mobile
Test Distance : 3 meters
Notes : Peak Detector
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2714.70	H	46.2	2.8	32.7	-40.3	41.3	116.4	5000.0	-32.7
2714.70	V	47.8	2.8	32.7	-40.3	43.0	140.7	5000.0	-31.0
3619.60	H	46.9	3.2	33.5	-40.1	43.5	149.8	5000.0	-30.5
3619.60	V	46.2	3.2	33.5	-40.1	42.7	136.9	5000.0	-31.2
4524.50	H	47.1	3.6	34.5	-40.0	45.2	181.4	5000.0	-28.8
4524.50	V	46.4	3.6	34.5	-40.0	44.5	168.4	5000.0	-29.5
5429.40	H	50.5	3.9	34.9	-40.1	49.2	287.6	5000.0	-24.8
5429.40	V	52.2	3.9	34.9	-40.1	50.9	352.6	5000.0	-23.0
8144.10	H	47.7	4.9	35.9	-39.6	48.9	279.3	5000.0	-25.1
8144.10	V	48.0	4.9	35.9	-39.6	49.3	290.5	5000.0	-24.7
9049.00	H	52.2	5.0	36.2	-39.1	54.3	516.1	5000.0	-19.7
9049.00	V	48.9	5.0	36.2	-39.1	51.0	353.8	5000.0	-23.0

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 904.9MHz
Power Setting : Mobile
Test Distance : 3 meters
Notes : Average Readings in Restricted Bands
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2714.70	H	32.79	2.8	32.7	-40.3	-19.7	8.3	2.6	500.0	-45.7
2714.70	V	33.0	2.8	32.7	-40.3	-19.7	8.5	2.7	500.0	-45.5
3619.60	H	33.5	3.2	33.5	-40.1	-19.7	10.4	3.3	500.0	-43.6
3619.60	V	32.9	3.2	33.5	-40.1	-19.7	9.8	3.1	500.0	-44.2
4524.50	H	32.7	3.6	34.5	-40.0	-19.7	11.2	3.6	500.0	-42.8
4524.50	V	32.8	3.6	34.5	-40.0	-19.7	11.2	3.6	500.0	-42.8
5429.40	H	44.4	3.9	34.9	-40.1	-19.7	23.5	14.9	500.0	-30.5
5429.40	V	45.1	3.9	34.9	-40.1	-19.7	24.1	16.1	500.0	-29.9
8144.10	H	36.3	4.9	35.9	-39.6	-19.7	17.8	7.8	500.0	-36.1
8144.10	V	35.9	4.9	35.9	-39.6	-19.7	17.5	7.5	500.0	-36.5
9049.00	H	43.9	5.0	36.2	-39.1	-19.7	26.3	20.7	500.0	-27.6
9049.00	V	34.2	5.0	36.2	-39.1	-19.7	16.6	6.7	500.0	-37.4

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 914.5MHz
Power Setting : Mobile
Test Distance : 3 meters
Notes : Peak Detector
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2743.35	H	45.9	2.8	32.8	-40.4	41.1	113.6	5000.0	-32.9
2743.35	V	46.3	2.8	32.8	-40.4	41.5	119.0	5000.0	-32.5
3657.80	H	46.3	3.3	33.5	-40.1	42.9	140.3	5000.0	-31.0
3657.80	V	45.8	3.3	33.5	-40.1	42.4	132.0	5000.0	-31.6
4572.25	H	46.4	3.6	34.5	-40.0	44.5	168.4	5000.0	-29.5
4572.25	V	46.3	3.6	34.5	-40.0	44.4	165.9	5000.0	-29.6
7315.60	H	45.2	4.7	35.6	-39.8	45.8	194.1	5000.0	-28.2
7315.60	V	45.1	4.7	35.6	-39.8	45.6	191.2	5000.0	-28.3
8230.05	H	47.9	4.9	35.9	-39.6	49.3	290.3	5000.0	-24.7
8230.05	V	49.3	4.9	35.9	-39.6	50.6	339.9	5000.0	-23.4
9144.50	H	48.2	5.0	36.2	-39.0	50.3	326.6	5000.0	-23.7
9144.50	V	51.7	5.0	36.2	-39.0	53.8	490.3	5000.0	-20.2

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 914.5MHz
Power Setting : Mobile
Test Distance : 3 meters
Notes : Average Readings in Restricted Bands
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2743.35	H	32.70	2.8	32.8	-40.4	-19.7	8.3	2.6	500.0	-45.7
2743.35	V	33.1	2.8	32.8	-40.4	-19.7	8.7	2.7	500.0	-45.3
3657.80	H	34.1	3.3	33.5	-40.1	-19.7	11.1	3.6	500.0	-42.9
3657.80	V	33.3	3.3	33.5	-40.1	-19.7	10.3	3.3	500.0	-43.7
4572.25	H	32.1	3.6	34.5	-40.0	-19.7	10.6	3.4	500.0	-43.4
4572.25	V	32.4	3.6	34.5	-40.0	-19.7	10.9	3.5	500.0	-43.1
7315.60	H	33.0	4.7	35.6	-39.8	-19.7	13.9	4.9	500.0	-40.1
7315.60	V	32.1	4.7	35.6	-39.8	-19.7	13.0	4.4	500.0	-41.0
8230.05	H	34.5	4.9	35.9	-39.6	-19.7	16.1	6.4	500.0	-37.9
8230.05	V	36.6	4.9	35.9	-39.6	-19.7	18.2	8.2	500.0	-35.8
9144.50	H	33.9	5.0	36.2	-39.0	-19.7	16.4	6.6	500.0	-37.6
9144.50	V	40.8	5.0	36.2	-39.0	-19.7	23.3	14.7	500.0	-30.7

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 923.7MHz
Power Setting : Mobile
Test Distance : 3 meters
Notes : Peak Detector
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2771.04	H	46.7	2.8	32.8	-40.4	42.0	125.4	5000.0	-32.0
2771.04	V	46.2	2.8	32.8	-40.4	41.4	118.1	5000.0	-32.5
3694.72	H	45.2	3.3	33.5	-40.1	42.0	125.4	5000.0	-32.0
3694.72	V	46.0	3.3	33.5	-40.1	42.8	137.5	5000.0	-31.2
4618.40	H	45.0	3.6	34.6	-40.0	43.1	143.2	5000.0	-30.9
4618.40	V	45.1	3.6	34.6	-40.0	43.3	145.8	5000.0	-30.7
7389.44	H	48.3	4.7	35.7	-39.8	48.9	278.4	5000.0	-25.1
7389.44	V	48.7	4.7	35.7	-39.8	49.3	290.2	5000.0	-24.7
8313.12	H	48.8	4.9	35.9	-39.5	50.1	321.6	5000.0	-23.8
8313.12	V	48.7	4.9	35.9	-39.5	50.0	316.8	5000.0	-24.0
7389.60	H	47.0	4.7	38.9	-39.3	51.3	366.5	5000.0	-22.7
7389.60	V	48.8	4.7	38.9	-39.3	53.1	452.5	5000.0	-20.9
8313.30	H	45.1	4.9	39.2	-39.4	49.9	312.0	5000.0	-24.1
8313.30	V	44.4	4.9	39.2	-39.4	49.2	288.5	5000.0	-24.8

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 923.7MHz
Power Setting : Mobile
Test Distance : 3 meters
Notes : Average Readings in Restricted Bands
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2771.04	H	32.8	2.8	32.8	-40.4	-19.7	8.4	2.6	500.0	-45.6
2771.04	V	34.0	2.8	32.8	-40.4	-19.7	9.7	3.0	500.0	-44.3
3694.72	H	35.8	3.3	33.5	-40.1	-19.7	12.9	4.4	500.0	-41.1
3694.72	V	32.4	3.3	33.5	-40.1	-19.7	9.5	3.0	500.0	-44.5
4618.40	H	32.5	3.6	34.6	-40.0	-19.7	10.9	3.5	500.0	-43.0
4618.40	V	32.5	3.6	34.6	-40.0	-19.7	11.0	3.5	500.0	-43.0
7389.44	H	36.1	4.7	35.7	-39.8	-19.7	17.0	7.1	500.0	-36.9
7389.44	V	38.8	4.7	35.7	-39.8	-19.7	19.8	9.7	500.0	-34.2
8313.12	H	40.0	4.9	35.9	-39.5	-19.7	21.7	12.2	500.0	-32.3
8313.12	V	38.7	4.9	35.9	-39.5	-19.7	20.3	10.4	500.0	-33.6

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 904.9MHz
Power Setting : Fixed
Test Distance : 3 meters
Notes : Peak Detector
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2714.70	H	46.7	2.8	32.7	-40.3	41.8	123.5	5000.0	-32.1
2714.70	V	50.3	2.8	32.7	-40.3	45.5	187.8	5000.0	-28.5
3619.60	H	46.0	3.2	33.5	-40.1	42.6	134.9	5000.0	-31.4
3619.60	V	44.6	3.2	33.5	-40.1	41.1	113.9	5000.0	-32.8
4524.50	H	50.5	3.6	34.5	-40.0	48.6	268.1	5000.0	-25.4
4524.50	V	46.3	3.6	34.5	-40.0	44.4	165.9	5000.0	-29.6
5429.40	H	48.1	3.9	34.9	-40.1	46.8	219.4	5000.0	-27.2
5429.40	V	48.2	3.9	34.9	-40.1	46.9	221.2	5000.0	-27.1
8144.10	H	49.9	4.9	35.9	-39.6	51.2	361.1	5000.0	-22.8
8144.10	V	54.2	4.9	35.9	-39.6	55.5	593.8	5000.0	-18.5
9049.00	H	46.7	5.0	36.2	-39.1	48.7	273.0	5000.0	-25.3
9049.00	V	46.1	5.0	36.2	-39.1	48.2	256.6	5000.0	-25.8

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 904.9MHz
Power Setting : Fixed
Test Distance : 3 meters
Notes : Average Readings in Restricted Bands
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2714.70	H	36.5	2.8	32.7	-40.3	-4.7	26.9	22.2	500.0	-27.0
2714.70	V	44.5	2.8	32.7	-40.3	-4.7	35.0	56.2	500.0	-19.0
3619.60	H	32.4	3.2	33.5	-40.1	-4.7	24.3	16.3	500.0	-29.7
3619.60	V	32.5	3.2	33.5	-40.1	-4.7	24.4	16.6	500.0	-29.6
4524.50	H	44.2	3.6	34.5	-40.0	-4.7	37.6	75.6	500.0	-16.4
4524.50	V	32.6	3.6	34.5	-40.0	-4.7	26.0	19.9	500.0	-28.0
5429.40	H	41.0	3.9	34.9	-40.1	-4.7	35.0	56.5	500.0	-18.9
5429.40	V	42.1	3.9	34.9	-40.1	-4.7	36.1	63.8	500.0	-17.9
8144.10	H	44.2	4.9	35.9	-39.6	-4.7	40.7	108.9	500.0	-13.2
8144.10	V	50.4	4.9	35.9	-39.6	-4.7	46.9	222.4	500.0	-7.0
9049.00	H	36.5	5.0	36.2	-39.1	-4.7	33.9	49.5	500.0	-20.1
9049.00	V	33.7	5.0	36.2	-39.1	-4.7	31.0	35.5	500.0	-23.0

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 914.5MHz
Power Setting : Fixed
Test Distance : 3 meters
Notes : Peak Detector
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2743.35	H	44.7	2.8	32.8	-40.4	39.9	99.1	5000.0	-34.1
2743.35	V	46.6	2.8	32.8	-40.4	41.8	122.8	5000.0	-32.2
3657.80	H	43.9	3.3	33.5	-40.1	40.5	106.0	5000.0	-33.5
3657.80	V	44.1	3.3	33.5	-40.1	40.8	109.3	5000.0	-33.2
4572.25	H	44.9	3.6	34.5	-40.0	43.0	140.9	5000.0	-31.0
4572.25	V	45.2	3.6	34.5	-40.0	43.3	145.8	5000.0	-30.7
7315.60	H	46.0	4.7	35.6	-39.8	46.5	212.3	5000.0	-27.4
7315.60	V	54.6	4.7	35.6	-39.8	55.1	567.6	5000.0	-18.9
8230.05	H	52.3	4.9	35.9	-39.6	53.7	482.3	5000.0	-20.3
8230.05	V	58.8	4.9	35.9	-39.6	60.1	1015.9	5000.0	-13.8
9144.50	H	44.9	5.0	36.2	-39.0	47.1	225.4	5000.0	-26.9
9144.50	V	46.4	5.0	36.2	-39.0	48.5	267.0	5000.0	-25.4

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 914.5MHz
Power Setting : Fixed
Test Distance : 3 meters
Notes : Average Readings in Restricted Bands
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2743.35	H	32.61	2.8	32.8	-40.4	-4.7	23.1	14.3	500.0	-30.8
2743.35	V	38.1	2.8	32.8	-40.4	-4.7	28.6	26.9	500.0	-25.4
3657.80	H	31.5	3.3	33.5	-40.1	-4.7	23.5	14.9	500.0	-30.5
3657.80	V	31.6	3.3	33.5	-40.1	-4.7	23.5	15.0	500.0	-30.5
4572.25	H	32.1	3.6	34.5	-40.0	-4.7	25.5	18.8	500.0	-28.5
4572.25	V	32.4	3.6	34.5	-40.0	-4.7	25.8	19.5	500.0	-28.2
7315.60	H	34.8	4.7	35.6	-39.8	-4.7	30.7	34.2	500.0	-23.3
7315.60	V	50.8	4.7	35.6	-39.8	-4.7	46.6	214.1	500.0	-7.4
8230.05	H	47.2	4.9	35.9	-39.6	-4.7	43.8	155.5	500.0	-10.1
8230.05	V	55.7	4.9	35.9	-39.6	-4.7	52.3	411.0	500.0	-1.7
9144.50	H	30.6	5.0	36.2	-39.0	-4.7	28.0	25.3	500.0	-25.9
9144.50	V	33.5	5.0	36.2	-39.0	-4.7	31.0	35.3	500.0	-23.0

Checked BY Richard E. King :

Richard E. King

DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 924.5MHz
Power Setting : Fixed
Test Distance : 3 meters
Notes : Peak Detector
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2773.50	H	49.3	2.8	32.8	-40.4	44.6	170.2	5000.0	-29.4
2773.50	V	46.9	2.8	32.8	-40.4	42.2	129.3	5000.0	-31.8
3698.00	H	45.2	3.3	33.5	-40.1	42.0	125.5	5000.0	-32.0
3698.00	V	45.5	3.3	33.5	-40.1	42.2	129.4	5000.0	-31.7
4622.50	H	45.9	3.6	34.6	-40.1	44.0	159.3	5000.0	-29.9
4622.50	V	46.3	3.6	34.6	-40.1	44.4	166.8	5000.0	-29.5
7396.00	H	47.6	4.7	35.7	-39.8	48.2	257.0	5000.0	-25.8
7396.00	V	54.2	4.7	35.7	-39.8	54.8	550.7	5000.0	-19.2
8320.50	H	56.8	4.9	35.9	-39.5	58.2	810.3	5000.0	-15.8
8320.50	V	59.7	4.9	35.9	-39.5	61.1	1130.2	5000.0	-12.9

Checked BY Richard E. King :

Richard E. King

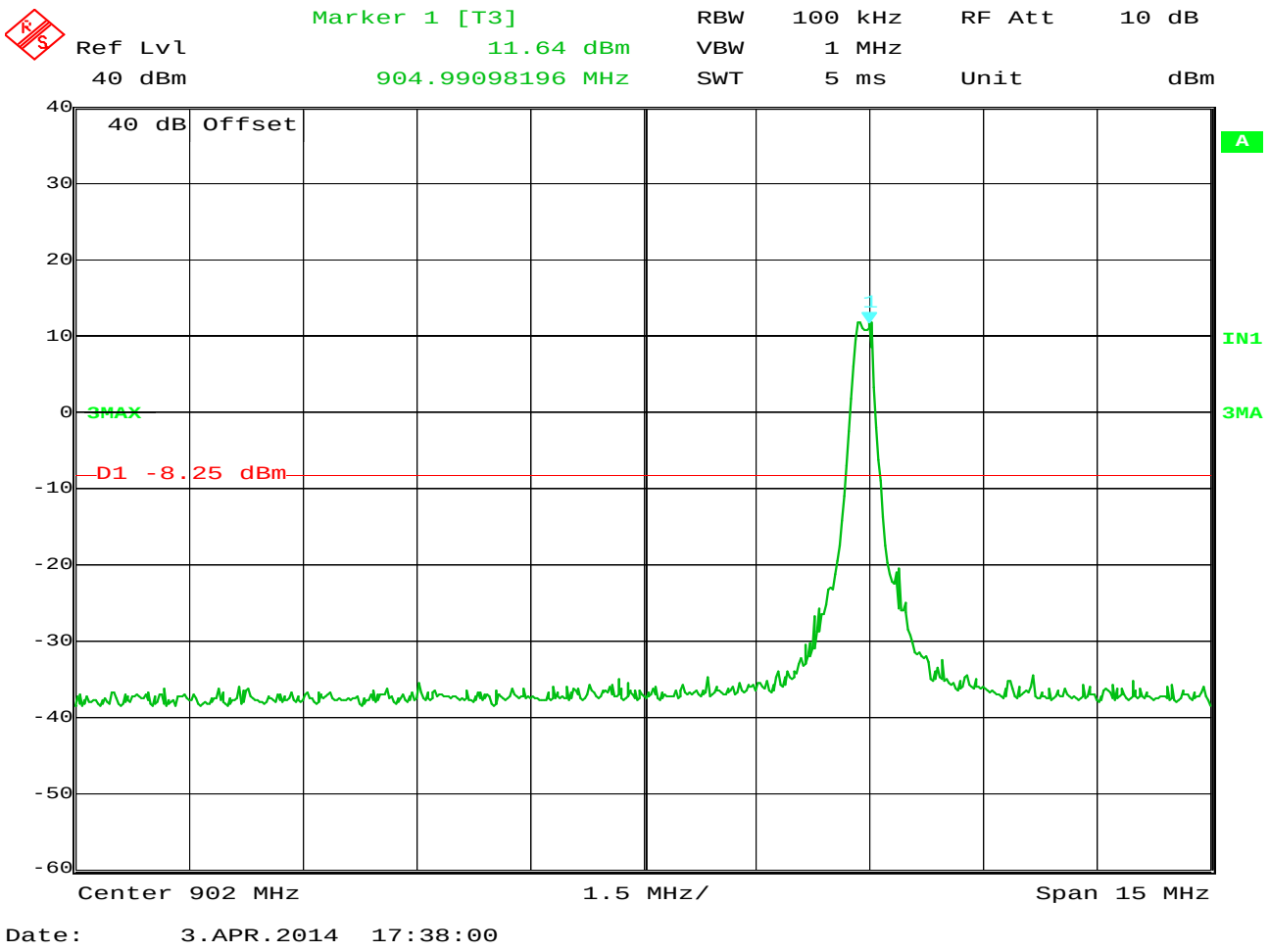
DATA PAGE

Manufacturer : Badger Meter, Incorporated
Model No. : Orion SE Water Meter with Metal Lid
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions
Date : Feburary 28, 2014
Mode : Transmit @ 924.5MHz
Power Setting : Fixed
Test Distance : 3 meters
Notes : Average Readings in Restricted Bands
: Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain + Duty Cycle Factor

Freq (MHz)	Ant Pol	Meter Reading (dBuV)	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)
2773.50	H	32.3	2.8	32.8	-40.4	-4.7	22.8	13.8	500.0	-31.2
2773.50	V	33.7	2.8	32.8	-40.4	-4.7	24.3	16.4	500.0	-29.7
3698.00	H	31.8	3.3	33.5	-40.1	-4.7	23.8	15.5	500.0	-30.2
3698.00	V	31.8	3.3	33.5	-40.1	-4.7	23.8	15.5	500.0	-30.2
4622.50	H	32.3	3.6	34.6	-40.1	-4.7	25.8	19.4	500.0	-28.2
4622.50	V	32.5	3.6	34.6	-40.1	-4.7	26.0	19.9	500.0	-28.0
7396.00	H	33.9	4.7	35.7	-39.8	-4.7	29.8	31.0	500.0	-24.2
7396.00	V	50.3	4.7	35.7	-39.8	-4.7	46.2	204.1	500.0	-7.8
8320.50	H	54.2	4.9	35.9	-39.5	-4.7	50.8	346.5	500.0	-3.2
8320.50	V	56.9	4.9	35.9	-39.5	-4.7	53.5	475.5	500.0	-0.4

Checked BY Richard E. King :

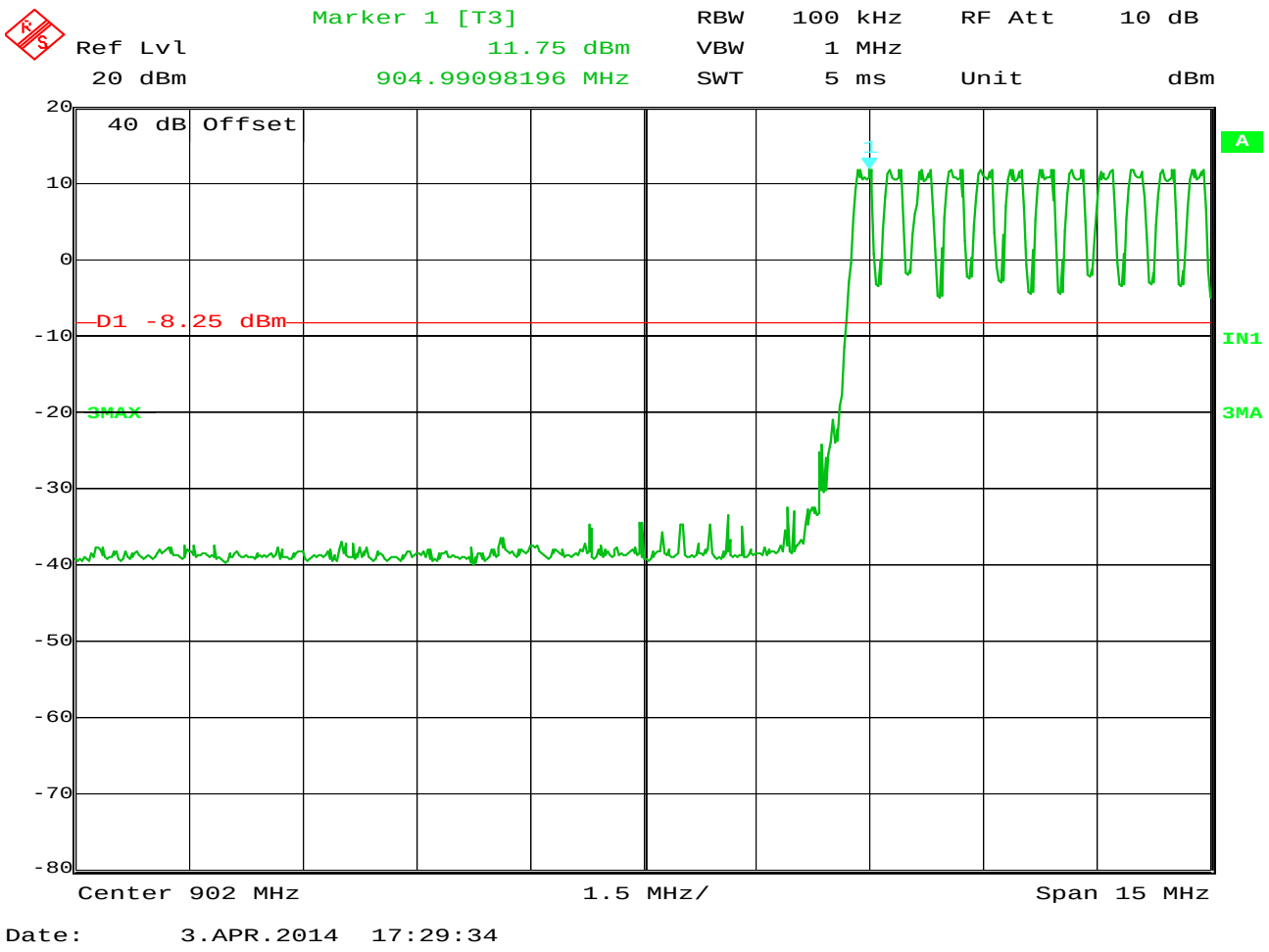
Richard E. King



FCC 15.247 Bandedge Compliance

MANUFACTURER : Badger Meter Inc.
MODEL NUMBER : Orion SE Water Metal Lid Antenna
POWER LEVEL : Mobile
TEST MODE : Tx @ Low Channel
NOTES :

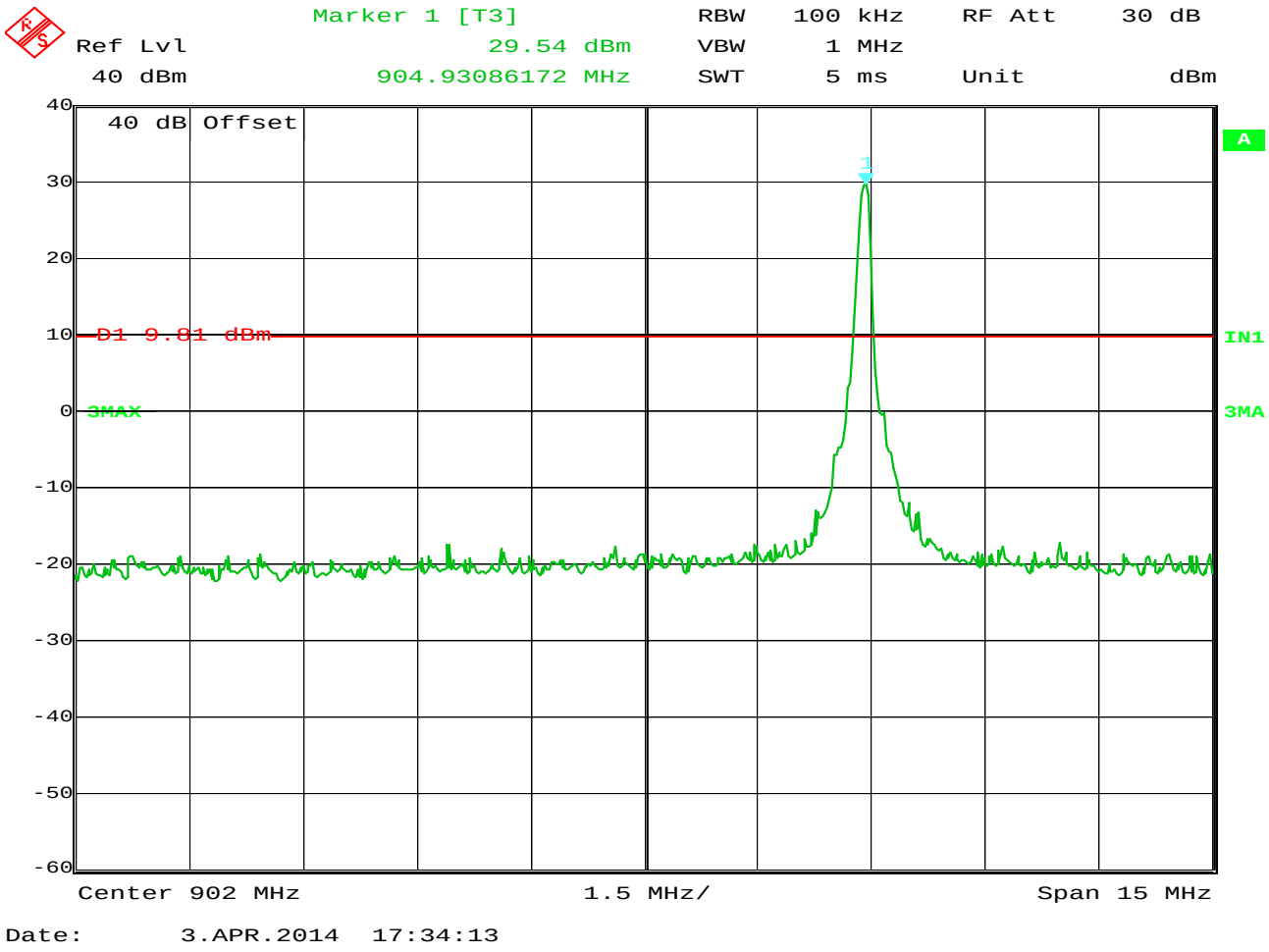
NOTES



FCC 15.247 Bandedge Compliance

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Mobile
TEST MODE	:	Hopping Enabled
NOTES	:	

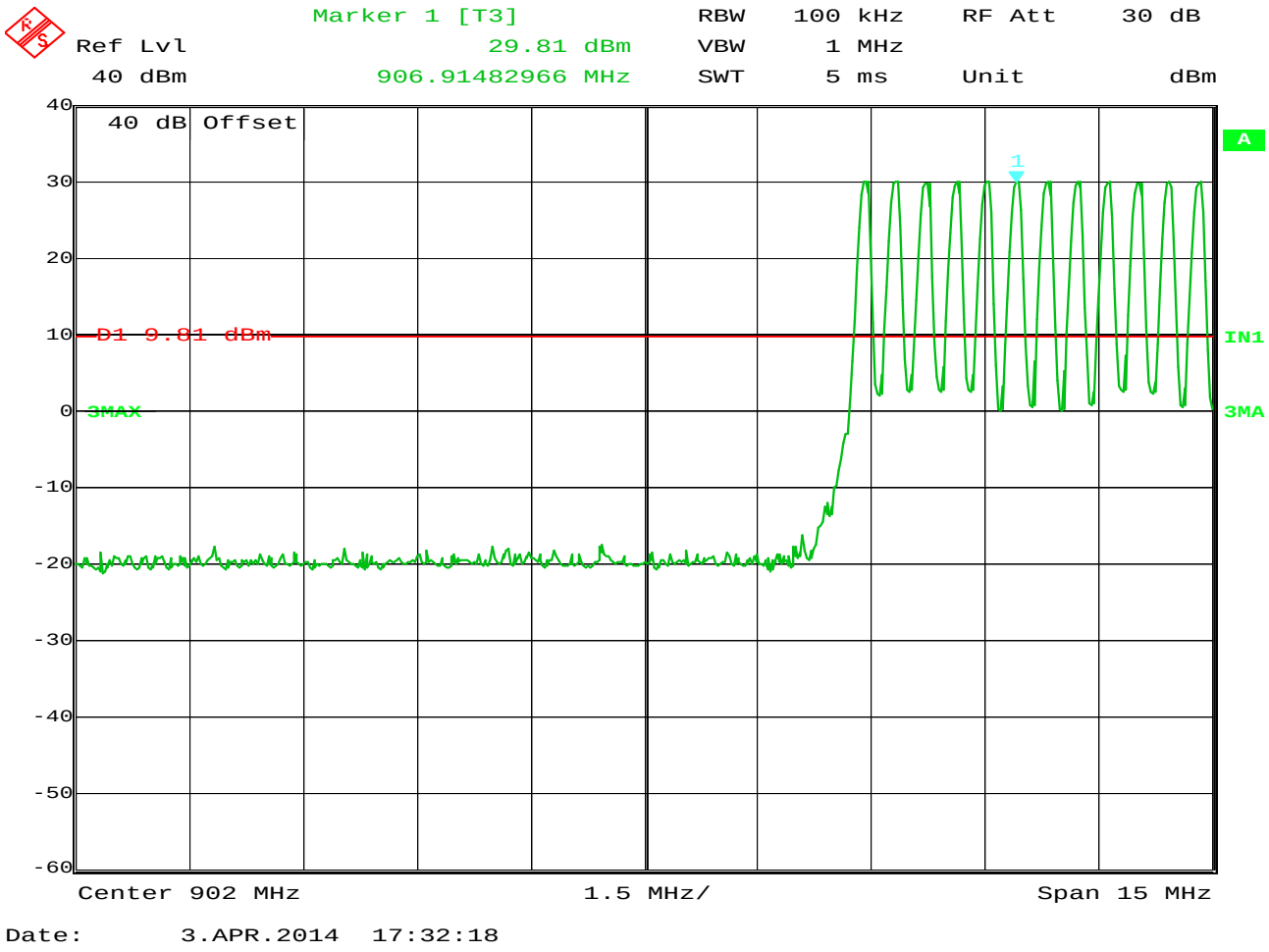
NOTES



FCC 15.247 Bandedge Compliance

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Fixed
TEST MODE	:	Tx @ Low Channel
NOTES	:	

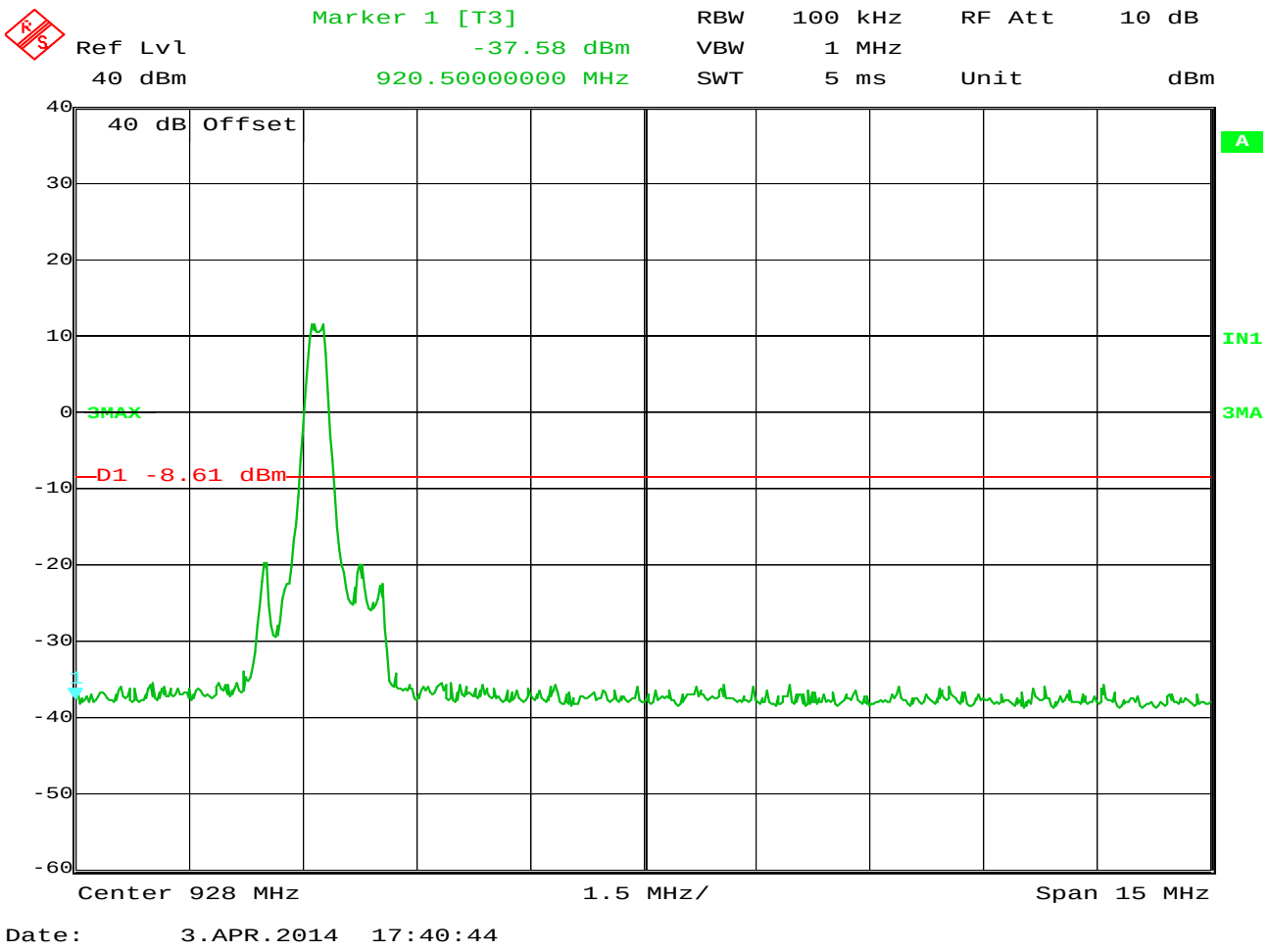
NOTES



FCC 15.247 Bandedge Compliance

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Fixed
TEST MODE	:	Hopping Enabled
NOTES	:	

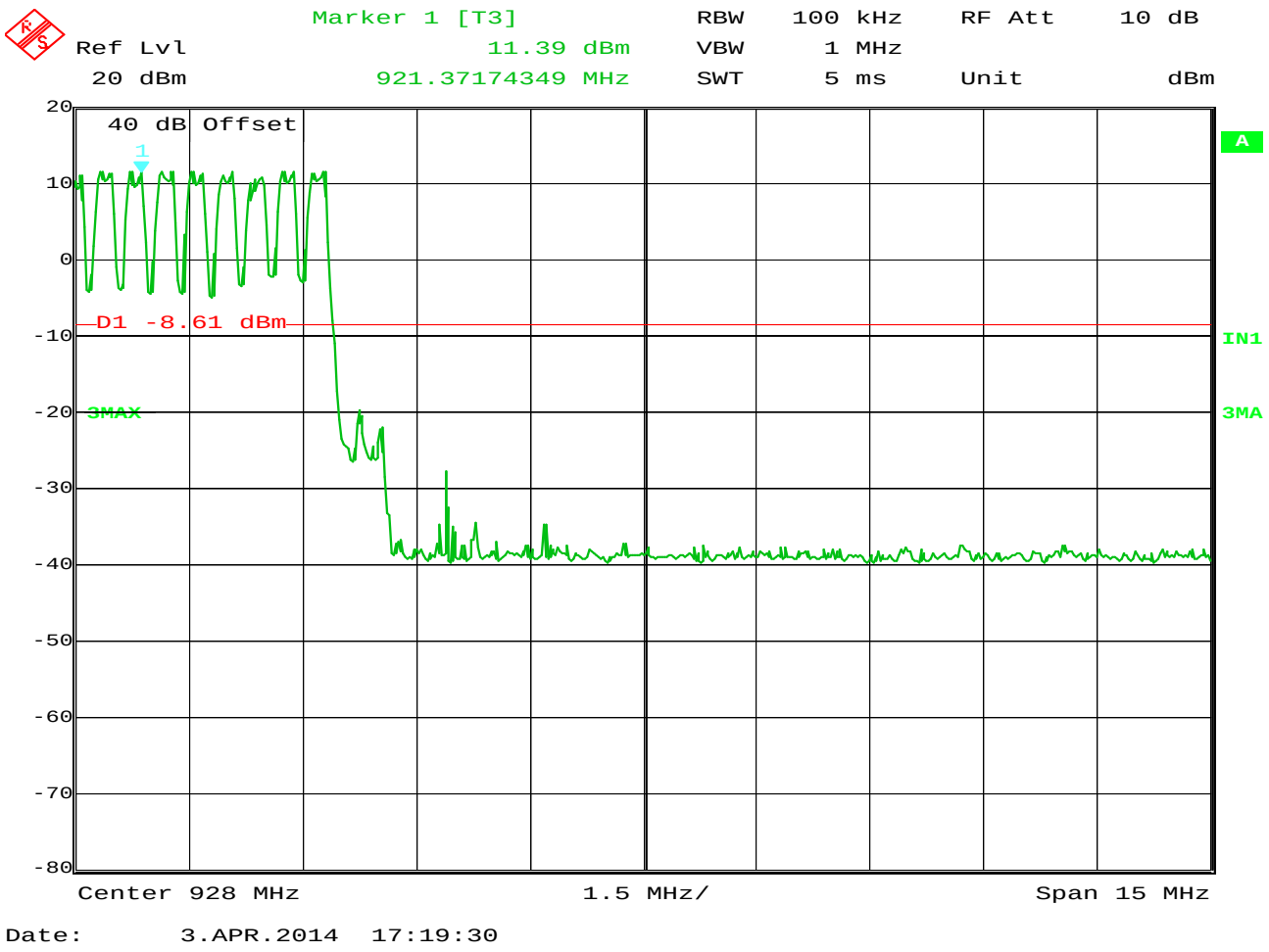
NOTES



FCC 15.247 Bandedge Compliance

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Mobile
TEST MODE	:	Tx @ High Channel
NOTES	:	

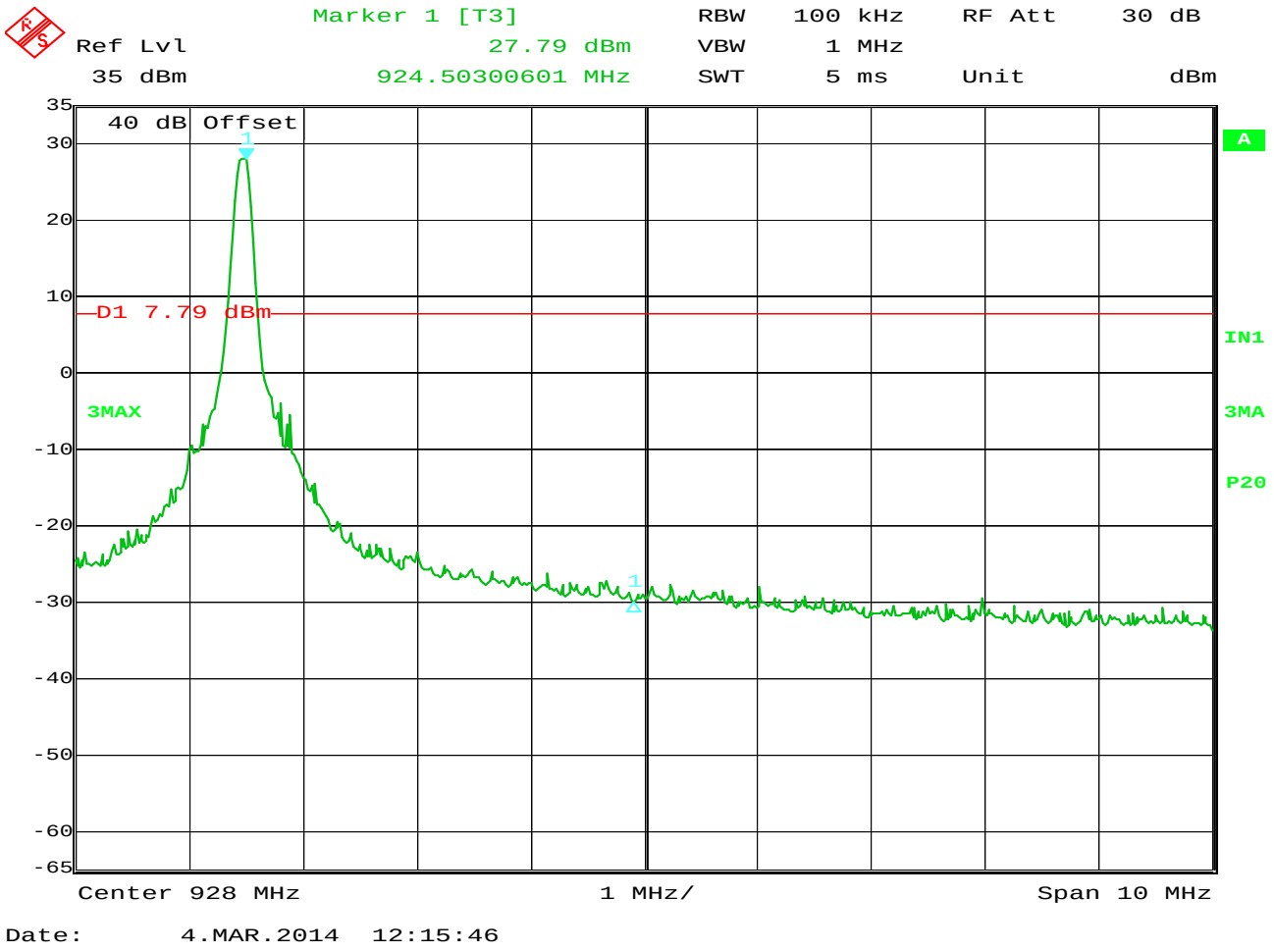
NOTES



FCC 15.247 Bandedge Compliance

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Mobile
TEST MODE	:	Hopping Enabled
NOTES	:	

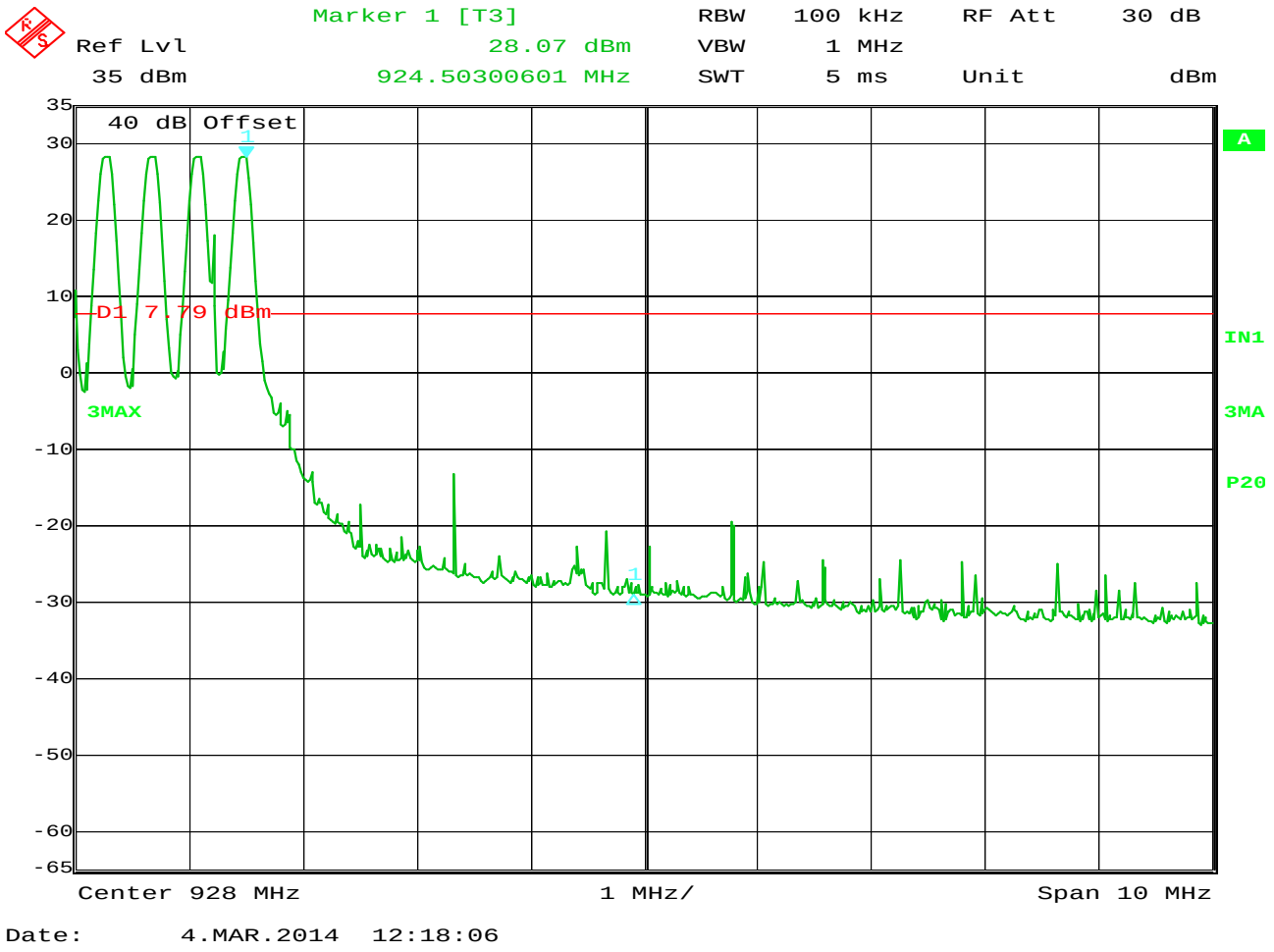
NOTES



FCC 15.247 Bandedge Compliance

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Fixed
TEST MODE	:	Tx @ 924.5MHz
NOTES	:	

NOTES



FCC 15.247 Bandedge Compliance

MANUFACTURER	:	Badger Meter Inc.
MODEL NUMBER	:	Orion SE Water Metal Lid Antenna
POWER LEVEL	:	Fixed
TEST MODE	:	Hopping Enabled
NOTES	:	

NOTES