FCC TEST REPORT
FOR THE
REES SCIENTIFIC CORPORATION
V2 CHIRPER WIRELESS
TEMPERATURE/HUMIDITY SENSOR
FCC ID: IFDRSCH

Prepared for:

Rees Scientific Corporation
1007 Whitehead Road Extension
Trenton, NJ 08638
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Submitted by:

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ACCREDITED

Rees Scientific Corporation
FCC Testing
At
Green Mountain Electromagnetics, Inc.

Unit: V2 Chirper, Wireless Temperature/Humidity Sensor FCC ID: IFDRSCH
Received: 1/24/13
Tested: January 28 - 31, & February 13-18, 2013

The units described in this report were measured for verification of compliance with "47 CFR, Part 15 – Radio Frequency Devices, Subpart C: Intentional Radiators," paragraphs 15.209, Radiated Emissions and 15.231, Periodic Operation in the Band 40.66 - 40.70 MHz and above 70 MHz. Measurement procedures were in accordance with ANSI C63.4, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2009)," and FCC OET Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields (Jan. 2001)."

Additionally, the units described in this report were measured for certification with the Code of Federal Regulations Chapter 47 – "Telecommunication, Part 2 – Frequency Allocations and Radio Treaty Matters: General Rules and Regulations, Subpart J – Equipment Authorization Procedures." Measurements required were per paragraphs 2.1046 RF Power Output, 2.1049 Occupied Bandwidth, 2.1053 Field Strength of Spurious Radiation, and 2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices.

II. Unit Tested:

The Rees Scientific Corporation, V2 Chirper Wireless Temperature and Humidity sensors are used for commercial monitoring and parameter indication. The Chirper units are read remotely via a PC connected to a receiver. The Chirper consists of the plastic enclosure, the battery power circuit, the internal electronics, the sensor with cable, and the 418 MHz transmitter circuit with an integral wire antenna. Rees "Wireless System Administrator" software was used to evaluate the unit.

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The table below describes the unit that was subjected to measurements determining compliance with applicable EMC standards:

Model	Manufacturer	Serial Number
V2 Chirper	Rees Scientific Corporation	ENG001

The following table describes the system physical and electrical properties:

Model	Volts	H/W/D in cm
V2 Chirper	3-VDC Battery Style CR2477	6/6/3

The following table describes the support equipment used during testing:

Product	Manufacturer	Model #	Serial Number
418-MHz Receiver	Rees	.V2-CH-BASE-NET	V2-NET-03599
Receiver Power Supply	Condor	HK-CPII-A075	n/a
Laptop PC	Dell	W200DA00	26916802737
PC Power Supply	Dell	LA65NE1	CN05K74V71615

Signal cables were used for testing and are supplied by the manufacturer. The following table describes the system cables:

Cable	Description	Agency Rating
Signal (Sensor)	Unshielded twisted pair	n/a
Signal (Communications)	Cat 5 Ethernet	UL E212964

III. Measurement Location:

The GME laboratory and Open Area Test Site (OATS) are located at 219 Blake Roy Road, Middlebury, VT. The OATS is a 10/3/1-meter site complete with antenna positioner, ground plane and motorized turntable. The OATS is constructed in accordance with ANSI C63.7-2005 and complies with the requirements for radiated emissions testing in ANSI C63.4-2009 and CISPR standards. GME is internationally accredited by the American Association for Laboratory Accreditation (A2LA) and meets the quality requirements in ISO/IEC 17025 (2005), "General Requirements for the Competence of Testing and Calibration Laboratories."

IV. Summary of Results:

The Rees Scientific Corporation, V2 Chirper Wireless Temperature and Humidity sensor complies with the requirements in FCC 47 CFR, Paragraphs 2 and 15. Section X contains the results summarized in the table below.

	Test	Mode/Port	CFR 47 Paragraph	Frequency or Range	Specified Values	Measured Values
1	RF Power Output	Transmit	**2.1046 15.231(e)**	418 MHz	72 dBuV (4133.3473 uV/m = 16.6667xF 2833.3333)	69 dBuV
2	Occupied Bandwidth	Transmit	**2.1049 15.231(c)**	20-dB down at 0.25% of Fundamental	1.045 MHz	0.1 MHz
3	Radiated and Spurious Emissions	Enclosure	**2.1053 15.209 15.231(e)**	30 – 88 MHz 88 – 216 MHz 216 – 960 MHz 960 – 4.2 GHz	40 dBuV/m 43.5 dBuV/m 46 dBuV/m 54 dBuV/m	Within 3m and 1m Limits
4	Exposure Evaluation	Enclosure	**2.1093**	418 MHz	0.08 W/kg Body 1.6 W/kg 1g Vol	Within All Limits

Exploratory measurements indicate maximum radiation is found when antenna polarization is aligned with the EUT antenna and when antenna is pointed directly at the EUT at scan heights >10% of EUT height.

Testing was performed by Kyle R. Kowalczyk, president, Green Mountain Electromagnetics and requested by:
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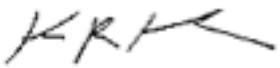
1007 Whitehead Road Extension
Trenton, NJ 08638
USA



Kyle R. Kowalczyk
2/19/13

V. Units of Measurement and Uncertainty:

Measurements of radiated electric fields were made in units of dB referenced to 1 microvolt per meter (dBuV/m). Limits appearing on the spectrum analyzer data were corrected for the appropriate antenna factor, cable loss, amplifier gain (when used) and measurement distances X_{std} and X_{site} in meters.

The following equation was employed:
Corrected Limit (dBuV) = Limit (dBuV/m) + 20 Log(X_{std}/X_{site}) + Amplifier Gain (dB) – Antenna Factor (dB/m) – Cable Loss (dB).

Sample calculation at 30 MHz (Vertical Polarization):
41.7 dBuV corrected limit = 40.0 dBuV/m limit + 20 log(3/3) dB distance + 20 dB amp gain – 17.3 dB/m AF – 1 dB cable loss.

Uncertainty
The uncertainty budgets in GME EMC measurements are identified as follows:

1. Field strength between 30 MHz and 26 GHz on an OATS using broadband antennas:

Contribution	Probability Distribution	Uncertainty (dB)
antenna factor calibration	normal k=2	0.5
cable loss calibration	normal k=2	0.5
analyzer specification	rectangular	1.5
distance variation	rectangular	0.6
height variation	rectangular	0.5
site imperfection	rectangular	2.0
mismatch	u-shaped	1.5
repeatability	standard deviation	0.5
combined uncertainty u(y)	normal	1.946
expanded uncertainty U	normal k=2	3.892

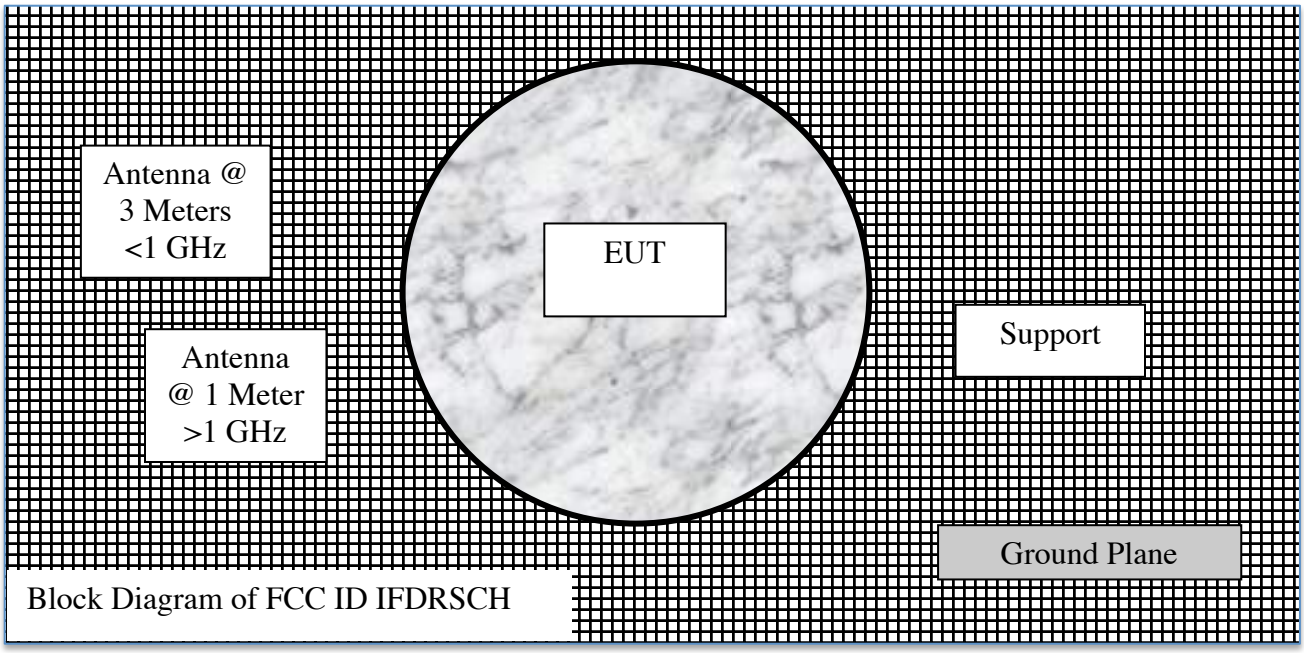
$$u(y) = \sqrt{(\frac{0.5}{2})^2 + (\frac{0.5}{2})^2 + \frac{1.5^2 + 0.6^2 + .5^2 + 2.0^2}{3} + \frac{1.5^2}{2} + 0.5^2}$$

U = k u(y)

Other GME uncertainty values are available upon request. Note: "U" represents an expanded uncertainty expressed at an approximately 95% confidence level using a coverage factor of k=2.

VI. Equipment Configuration:

GME witnessed the unit in satisfactory condition for testing, however the manufacturer is responsible for ensuring that the equipment under test (EUT) represents the product line. The manufacturer is also responsible for the EMC test plan and for assuring that this report is consistent with that plan. The EUT configuration was arranged to produce maximum radiated emissions as shown in the block diagram below the procedure. The equipment was subjected to complete emissions tests per the manufacturer's test plan. The EUT was operating in a continuous mode utilizing and testing its functions. The EUT was also tested upon power up.



VII. Measuring Equipment:

The table below describes the instrumentation used by Green Mountain Electromagnetics to perform this testing:

Unit	Manufacturer	Model	Serial #	Last Cal.	Next Cal.
Spectrum Analyzer	GW Instek	GSP-830	E1180708	8/28/12	8/28/13
Spectrum Analyzer	Hewlett-Packard	8592 L	3624A00631	11/13/12	11/13/13
Broadband E-field Antenna	ARA	LPB-2526	1125	10/15/12	10/15/13
Horn Antenna	Electro-Metrics	RGA-60	6139	9/25/12	9/25/13
Pre-Amplifier	MiniCircuits	ZFL-2500VH+	041012	5/4/12	5/4/13
Weather Station	Davis Instruments	Perception II	PC30923A07	1/22/13	1/22/14
Plotter	HP	7550A	2444A05912	n/a	n/a

VIII. Measurement Procedures:

1. RF Power Output.

Specification: ≤72 dBuV/m (4133.3473 uV/m= 16.6667xF – 2833.3333) uV/m average

a. Set up EUT and test instrumentation in laboratory.
b. Verify spectrum analyzer and EUT operation.
   i. Spectrum analyzer uses peak detect and internal attenuators.
   ii. Set analyzer to carrier frequency and use zero span.
c. Operate EUT at normal power unmodulated.
d. Record level displayed on analyzer.

2. Occupied Bandwidth.

Specification: >20 dB at 0.25% of Fundamental (1.045 MHz at 418 MHz)

a. Set up EUT and test instrumentation in laboratory.
b. Verify analyzer and EUT operation.
   i. Spectrum analyzer uses internal attenuators.
   ii. Set analyzer to carrier frequency and use 418 MHz span.
c. Operate EUT with standard modulation.
d. Record signal displayed on analyzer.

3. Radiated Emissions.

Frequency range: 30 MHz to 88 MHz
Limit: 40 dBuV/m @ 3 meters
Frequency range: 88 kHz to 216 MHz
Limit: 43.5 dBuV/m @ 3 meters
Frequency range: 216 MHz to 960 MHz
Limit: 46 dBuV/m @ 3 meters
Frequency range: 960 MHz to 4.2 GHz
Limit: 54 dBuV/m @ 3 meters

a. Set up instrumentation at open area test site.
   i. Mount EUT on ground plane and broadband antenna on antenna positioner.
   ii. Observe temperature, humidity and atmospheric pressure.
   iii. Measurement distance is 3 meters <1 GHz/1 meter >1 GHz and antenna scan height is 1 to 4 meters. Use RF absorber on ground plane >1 GHz.
b. Verify spectrum analyzer and antenna operation.
   i. Spectrum analyzer is connected to antenna. Use broadband horn >1 GHz.
   ii. Preamplifier is inserted between antenna and analyzer to ensure analyzer noise threshold is at least 6 dB below specification limit.
c. Set up, power and operate EUT as in block diagram in Section VI.
d. Perform preliminary evaluation of equipment in the near field.
   i. Vary antenna height, antenna polarization, and antenna orientation to EUT.
   ii. Repeat step d.i. while evaluating radiation in the 30-MHz to 4.2-GHz spectrum.
   iii. Refer to ANSI C63.4-2009: for exploratory measurements >1 GHz.
e. Determine frequencies and equipment orientations that produce maximum radiation.
   i. Identify processor, clock and beat frequencies, and harmonics.
f. Perform final evaluation of unit by recording spectrum analyzer data on the plotter.
   i. Ensure the EUT is producing the maximum radiation found in step e.
   ii. Collect data over the entire frequency range.
   iii. Refer to ANSI C63.4-2009: for final measurements >1 GHz – Manually ensure measurement antenna is in cone of radiation for emission areas determined in steps d.-e. by adjusting in both azimuth an elevation positions. Polarization is oriented for maximum response.

4. Exposure Evaluation.

Frequency: 418 MHz
Limit: 0.8 W/kg and 1.6 W/kg

a. Set up instrumentation at open area test site.
   i. Mount EUT on table and isotropic probe or loop on antenna positioner.
   ii. Observe temperature, humidity and atmospheric pressure.

iii. Measurement distance is 1 meter and antenna scan height is varied over human body dimensions (0.1 to 2 meters).

b. Verify spectrum analyzer and antenna operation.
   i. Spectrum analyzer is connected to antenna.
   ii. Preamplifier is inserted between antenna and analyzer to ensure analyzer noise threshold is at least 6 dB below specification limit (not normally necessary below 30 MHz).

c. Set up, power and operate EUT as described in Section VI.

d. Perform preliminary evaluation of equipment in the near field.
   i. Vary antenna height, antenna polarization, and antenna orientation to EUT.
   ii. Repeat step d.i. while evaluating electromagnetic radiation at 418 MHz.
   iii. Ensure appropriate resolution bandwidth is set and less than or equal to VBW.
   iv. Near field measurements of unit emissions are made at ambient frequencies.

e. Determine equipment orientations that produce maximum radiation.
   i. Set peak hold on analyzer for 30 minutes while slowly varying antenna height.

f. Perform final evaluation of unit by recording spectrum analyzer data.
   i. Ensure the EUT is producing the maximum radiation found in step e.
   ii. Collect data over the entire frequency range.
   iii. Identify all ambient signals.

IX. Photographs of Measurement Setup:

The following pages are photographs of the equipment as it was tested.

Photograph 1 – Radiated Emissions <1 GHz - FCC ID IFDRSCH

Photograph 2 – Radiated Emissions >1 GHz - FCC ID IFDRSCH

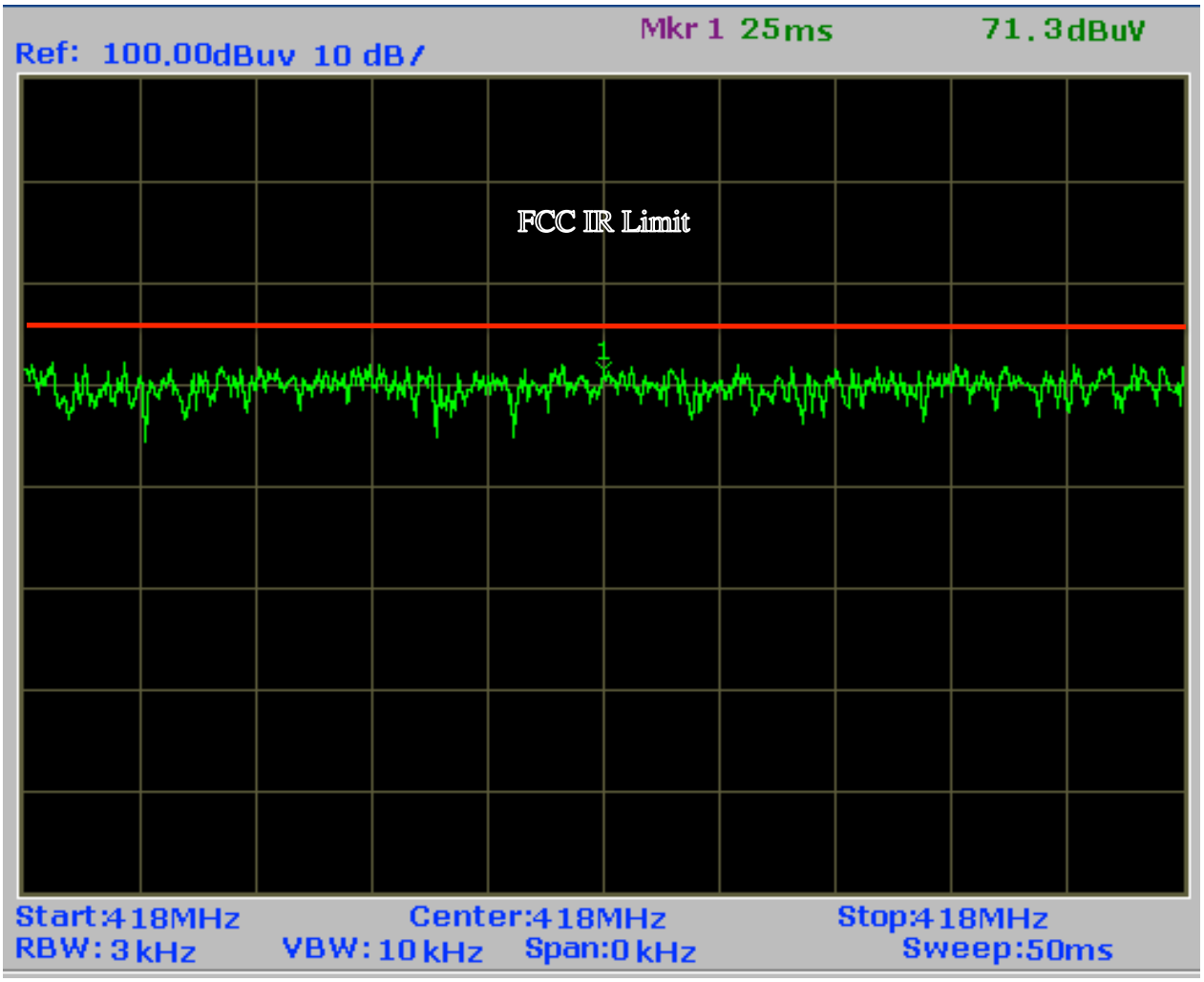
X. Measurement Results:

1. RF Power Output.

Specification uV/m	Specification dBuV/m	Amplifier dB	Antenna Factor dB	Cable Loss dB	Corrected Limit dBuV
4133.3473	72	20.0	15.0	1	76.0

Table 1 – Corrected Limit – RF-Power Output

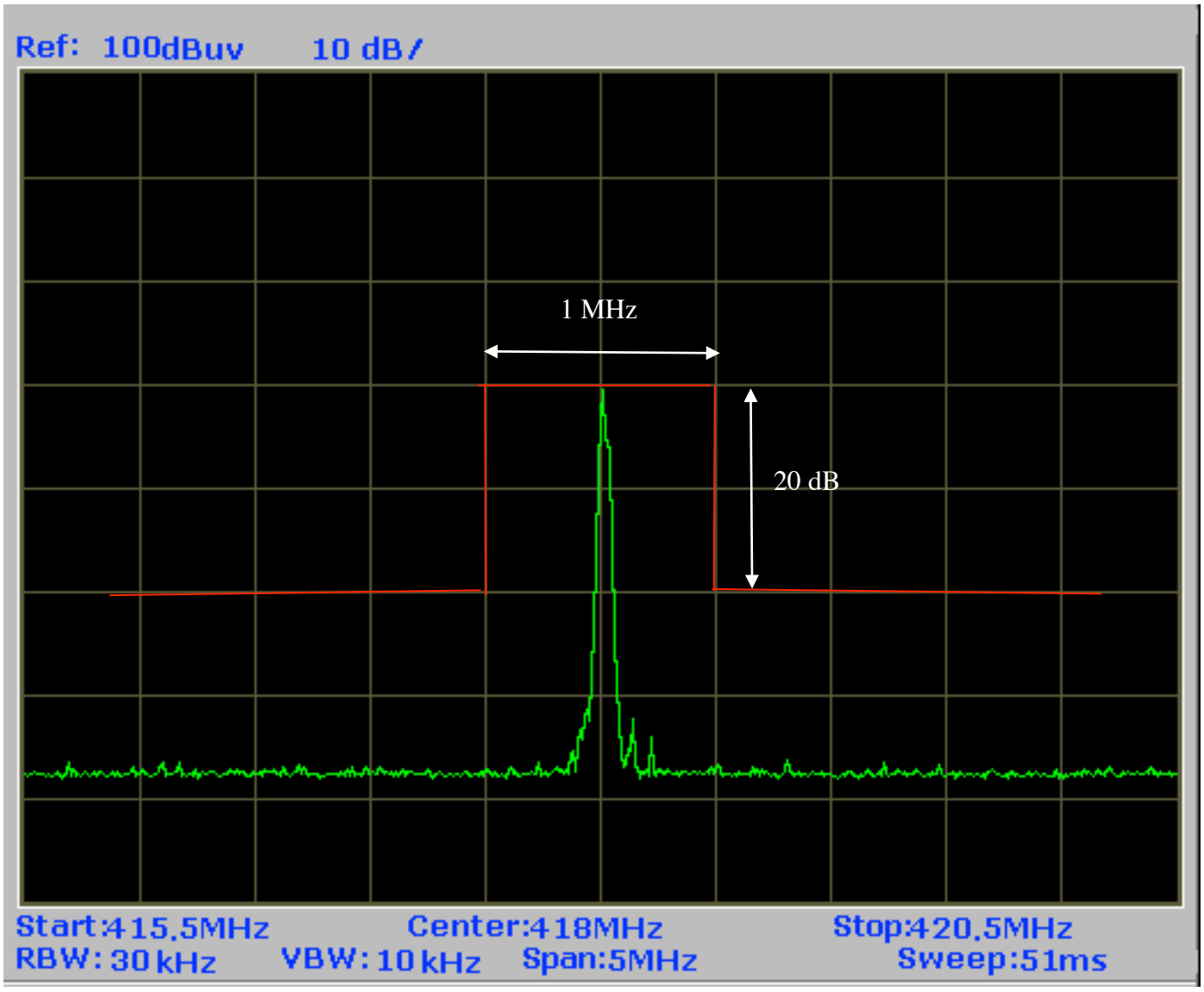
Corrected Limit (dBm) = Specification (dBuV/m) + Amplifier (dB) – Antenna Factor (dB/m) – Cable Loss (dB).
dBuV/m = 20 log (uV/m)



X. Measurement Results Cont'd:

2. Occupied Bandwidth.

Measured 0.1 MHz; Limit <1.045 MHz @ 20-dB down.



X. Measurement Results Cont'd:

3. Radiated Emissions.

Vertical Polarization

The table below describes the correction factors necessary to apply the limit to the spectrum analyzer output. The following pages contain the spectrum analyzer output with the corrected specification limits superimposed. The green trace is the ambient condition, and the orange trace identifies EUT emissions. Maximum amplitudes of vertical polarization are shown in the results below.

Frequency MHz	IR limit @ 3m dBuV	Amp Gain dB	Antenna Factor dB	Cable Loss dB	Corrected Limit dBuV
30	40	20	17.3	1	41.7
50	40	20	13.1	1	45.9
88	40	20	8.3	1	50.7
89	43.5	20	8.3	1	54.2
108	43.5	20	8.9	2	52.6
125	43.5	20	9.8	2	51.7
150	43.5	20	8.2	3	52.3
216	43.5	20	11.6	3	48.9
217	46	20	11.6	3	51.4
300	46	20	13.5	3	49.5
500	46	20	17.2	4	44.8
960	46	20	22.9	4	39.1
961	54	20	22.9	4	47.1

Table 2 – Corrected Limit - Vertical Polarization

X. Measurement Results Cont'd:

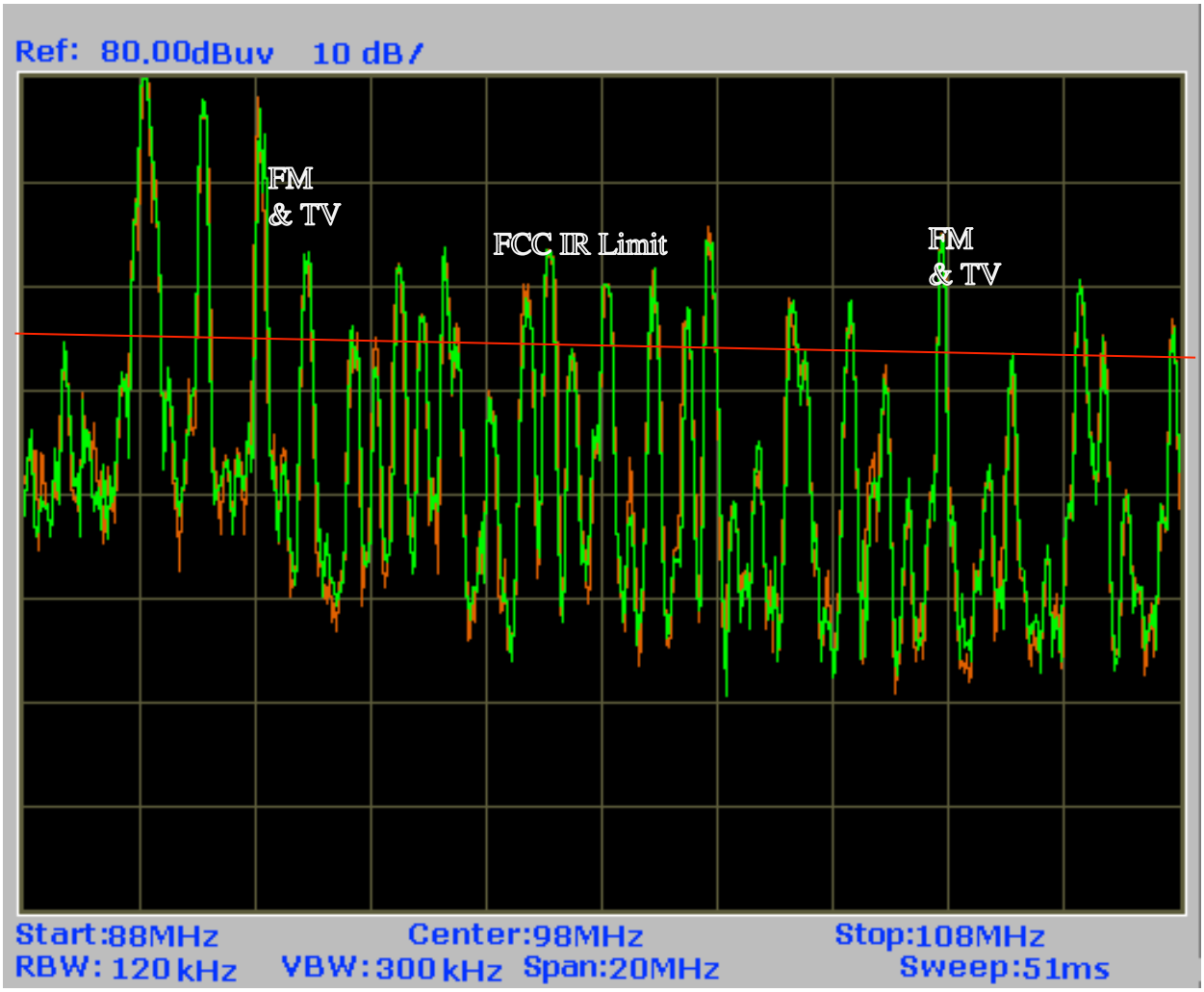
3. Radiated Emissions.

Maximum of Vertical Polarization

X. Measurement Results Cont'd:

3. Radiated Emissions.

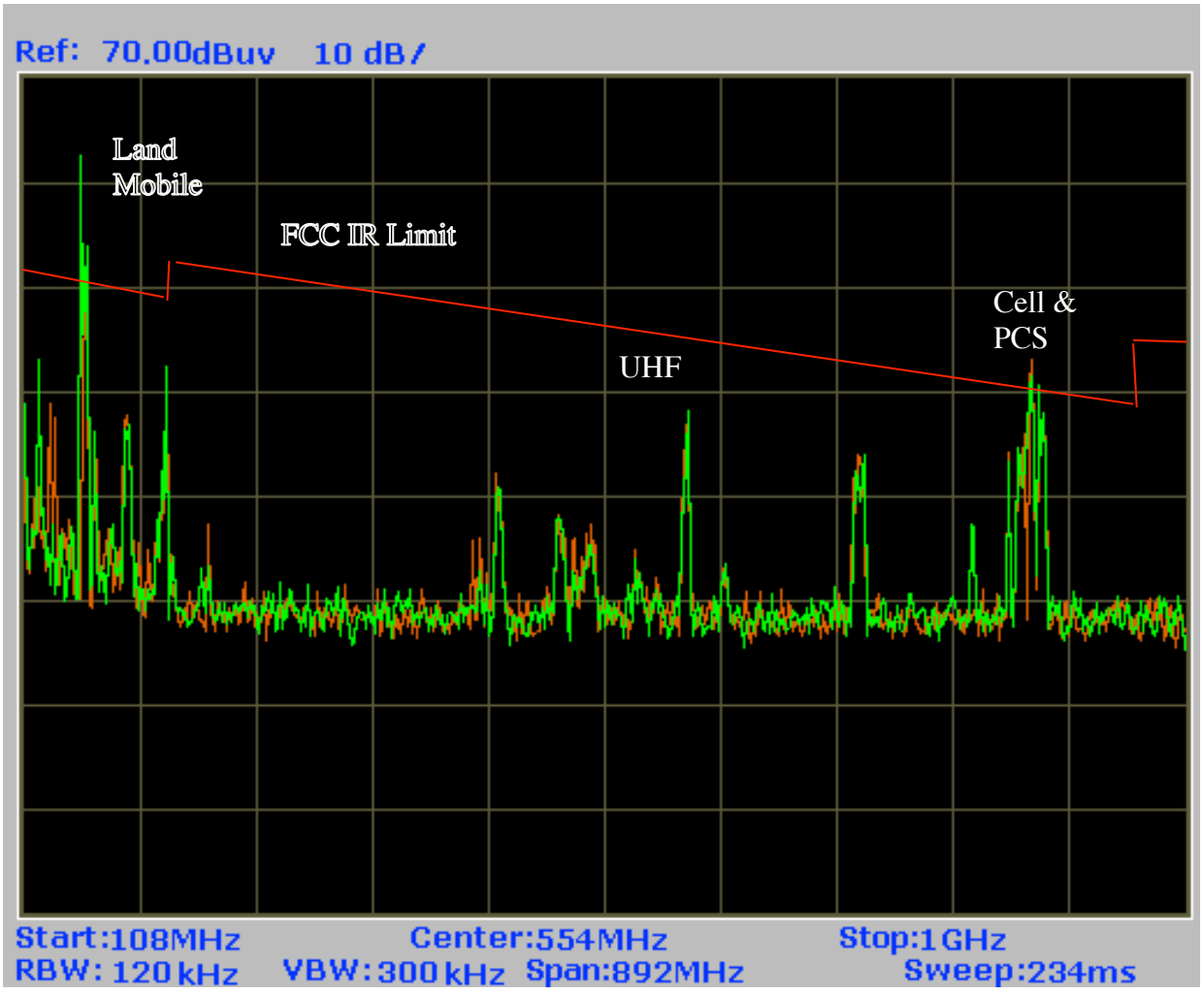
Maximum of Vertical Polarization
All Ambient – No Discernible Emissions



X. Measurement Results Cont'd:

3. Radiated Emissions.

Maximum of Vertical Polarization



X. Measurement Results Cont'd:

3. Radiated Emissions.

Horizontal Polarization

The table below describes the correction factors necessary to apply the limit to the spectrum analyzer output. The following pages contain the spectrum analyzer output with the corrected specification limits superimposed. The green trace is the ambient condition, and the orange trace identifies EUT emissions. Maximum amplitudes of horizontal polarization are shown in the results below.

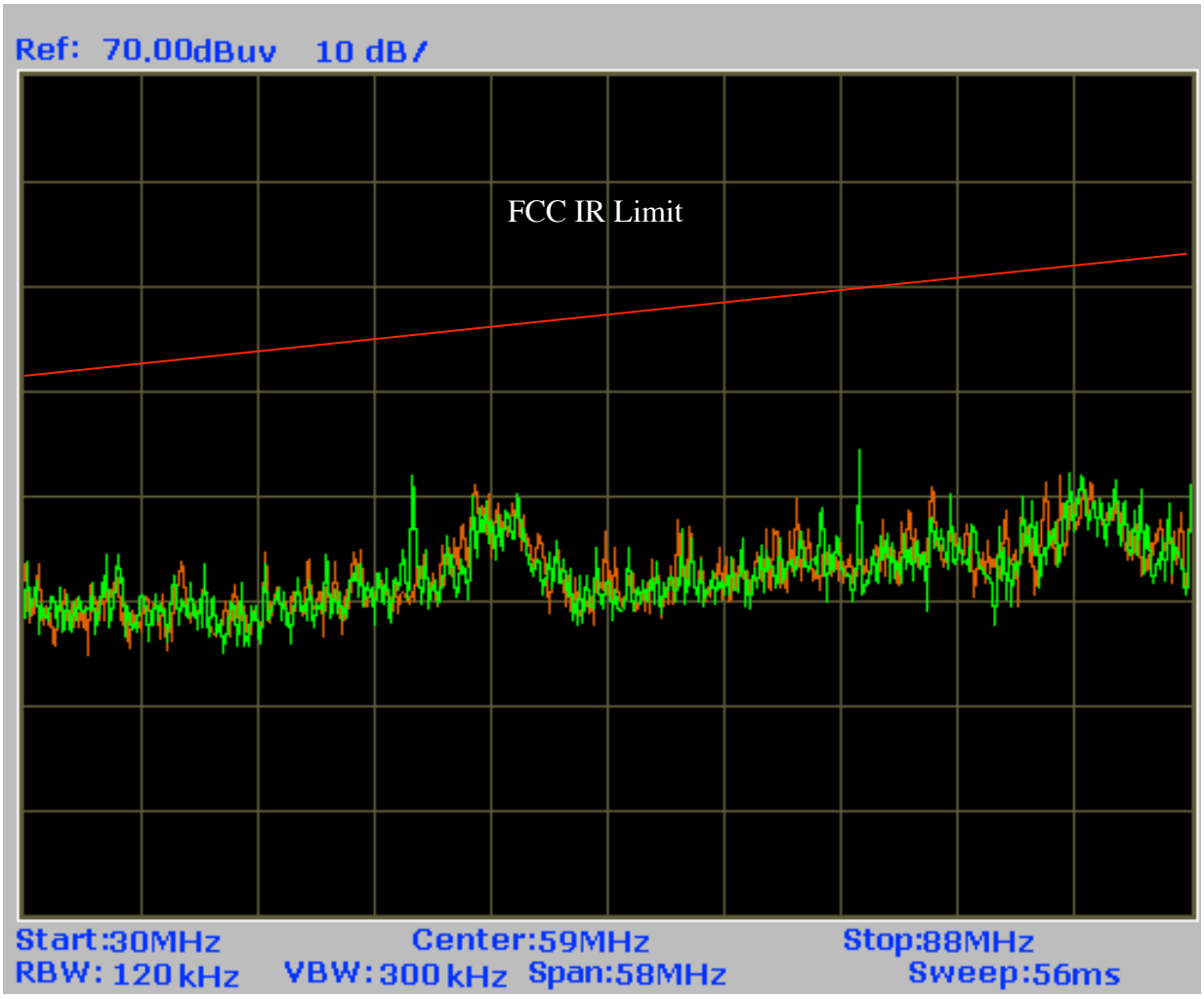
Frequency MHz	IR limit @ 3m dBuV	Amp Gain dB	Antenna Factor dB	Cable Loss dB	Corrected Limit dBuV
30	40	20	17.8	1	41.2
50	40	20	14.3	1	44.7
88	40	20	8.1	1	50.9
89	43.5	20	8.1	1	54.4
108	43.5	20	10.1	2	51.4
125	43.5	20	10.6	2	50.9
150	43.5	20	8.4	3	52.1
216	43.5	20	11.8	3	48.7
217	46	20	11.8	3	51.2
300	46	20	13.0	3	50.0
500	46	20	16.8	4	45.2
960	46	20	22.7	4	39.3
961	54	20	22.7	4	47.3

Table 3 – Corrected Limit - Horizontal Polarization

X. Measurement Results Cont'd:

3. Radiated Emissions.

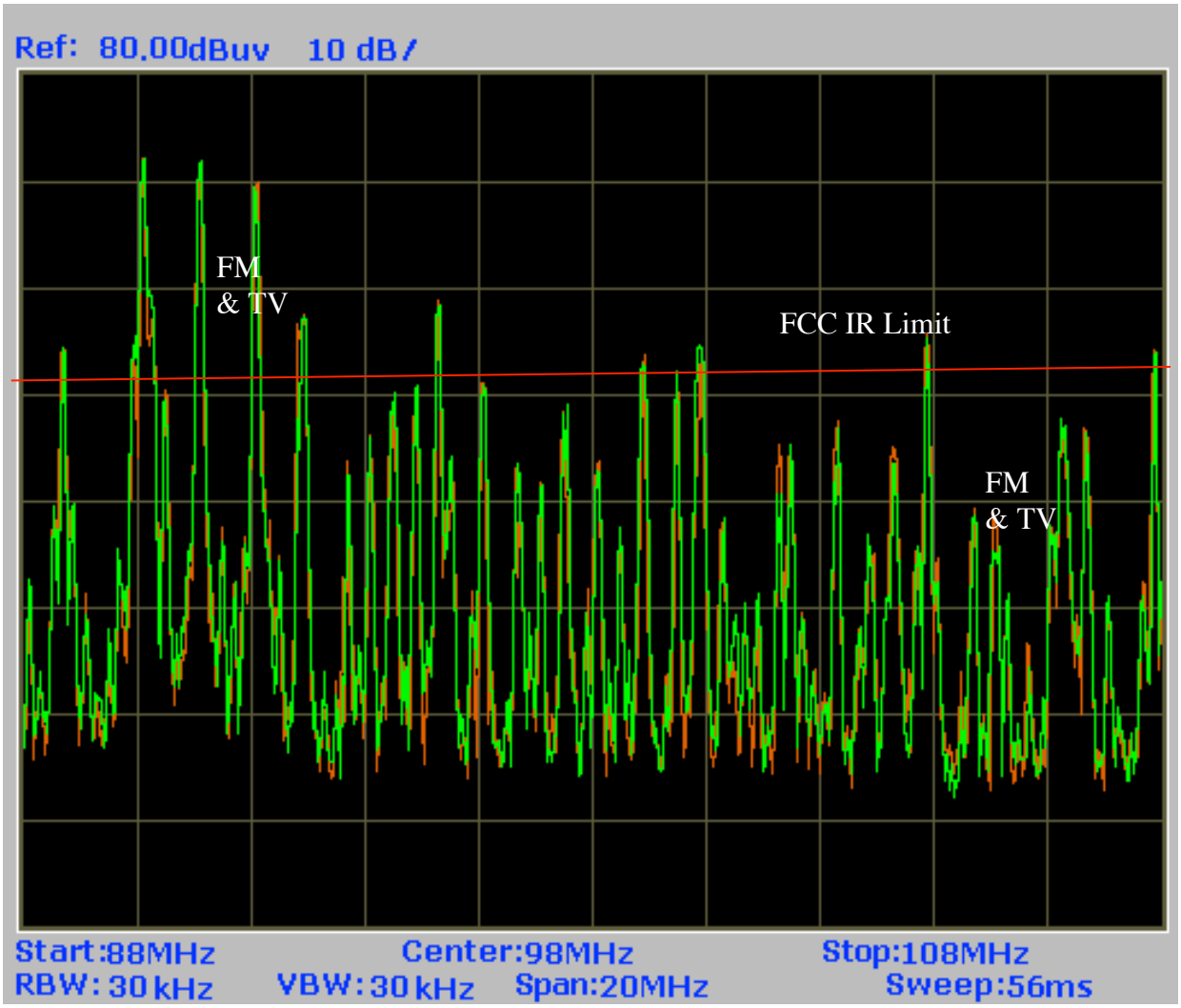
Maximum of Horizontal Polarization



X. Measurement Results Cont'd:

3. Radiated Emissions.

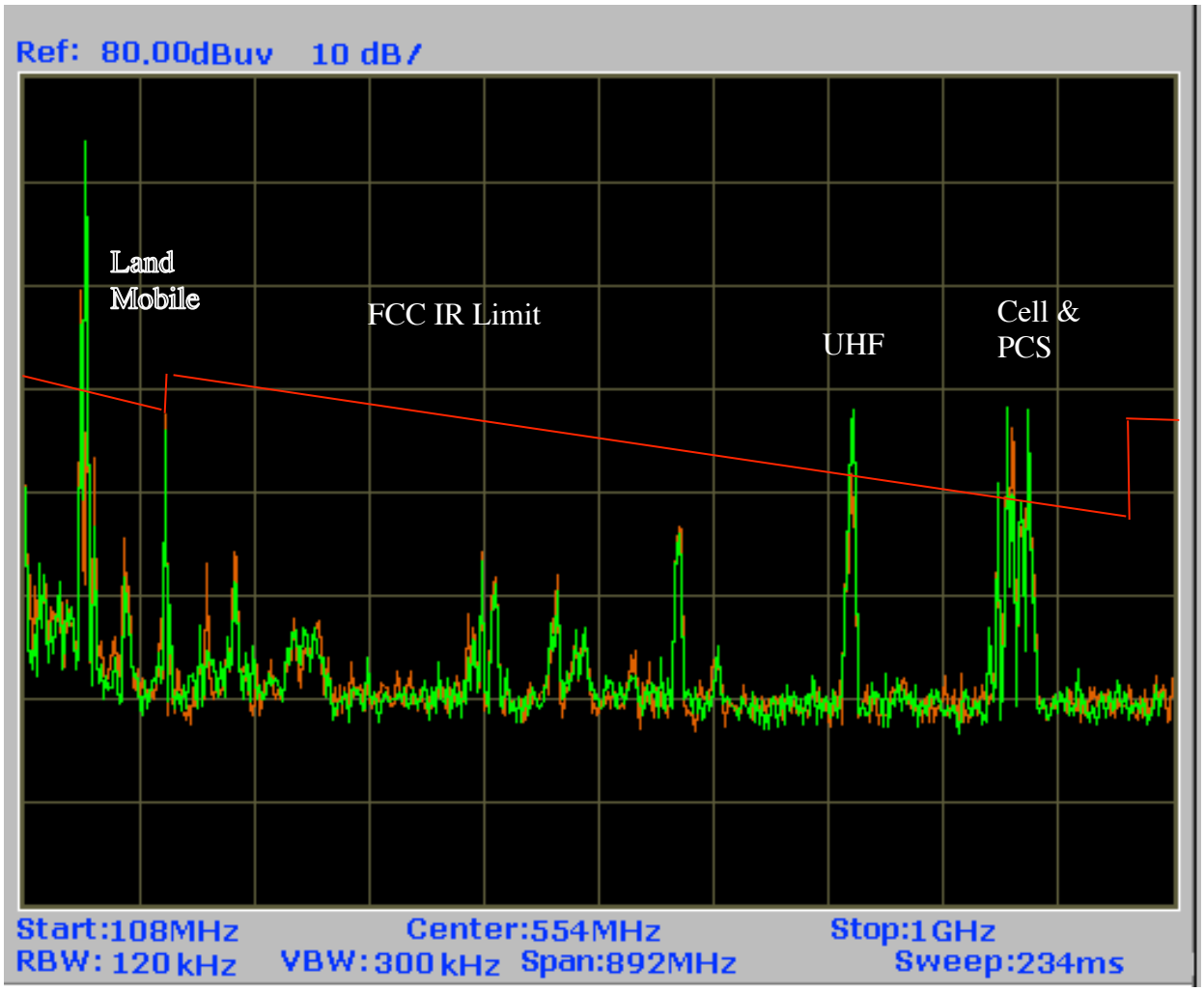
Maximum of Horizontal Polarization
All Ambient – No Discernible Emissions



X. Measurement Results Cont'd:

3. Radiated Emissions.

Maximum of Horizontal Polarization



X. Measurement Results Cont'd:

3. Radiated Emissions.

Vertical & Horizontal Polarization >1 GHz.

The table below describes the correction factors necessary to apply the limit to the spectrum analyzer output. The following pages contain the spectrum analyzer output with the corrected specification limits superimposed. The green trace is the ambient condition, and the orange trace identifies EUT emissions. Maximum amplitudes of both polarizations are shown in the results below.

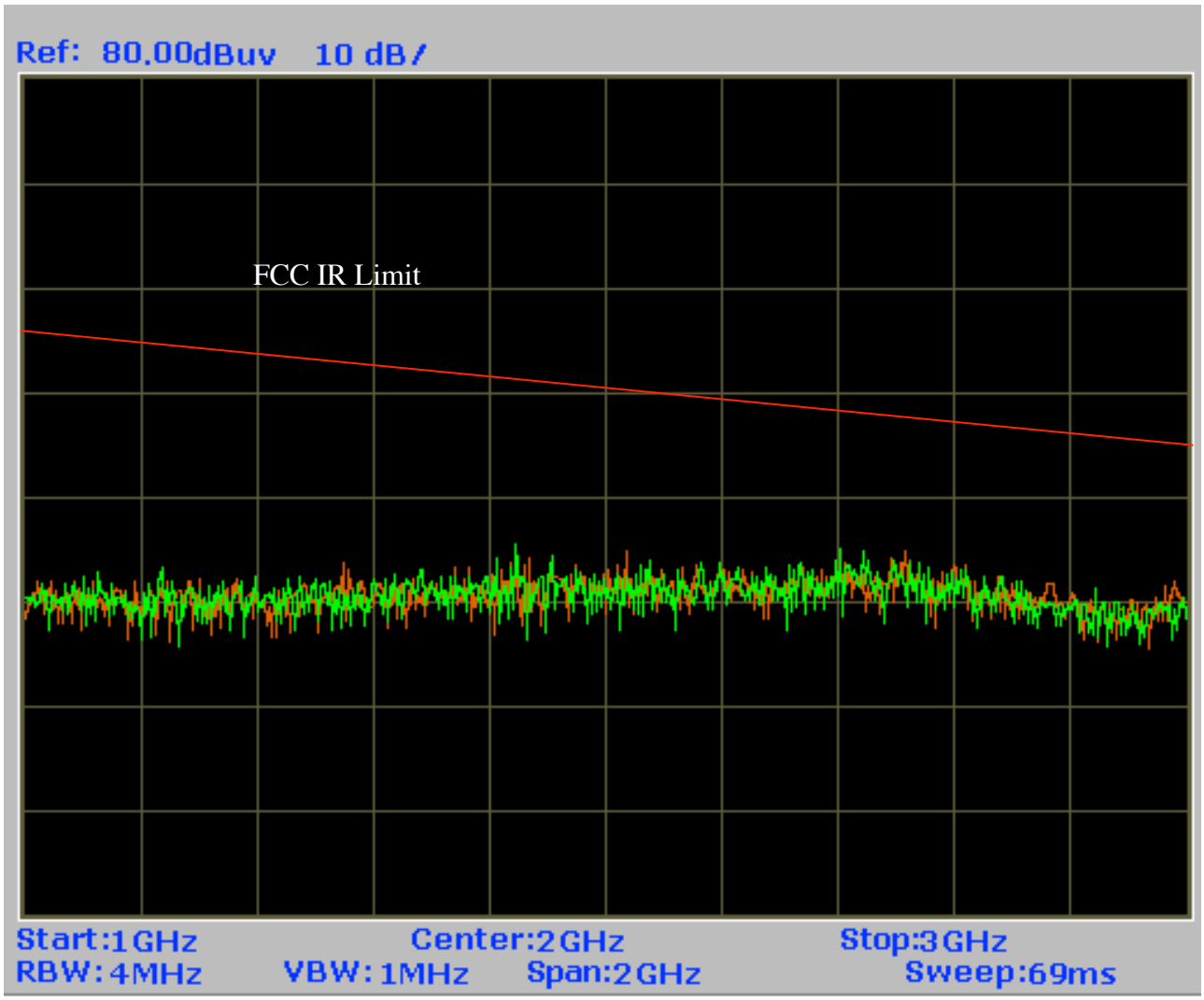
Frequency	IR limit @ 1m	Amp Gain	Antenna Factor	Cable Loss	Corrected Limit
MHz	dBuV	dB	dB	dB	dBuV
1000	54	30	24	3	57
1900	54	30	26	4	54
2399	54	30	28	5	51
2484	54	30	28	6	50
3000	54	30	31	7	46

Table 4 – Corrected Limit - >1 GHz

X. Measurement Results Cont'd:

3. Radiated Emissions.

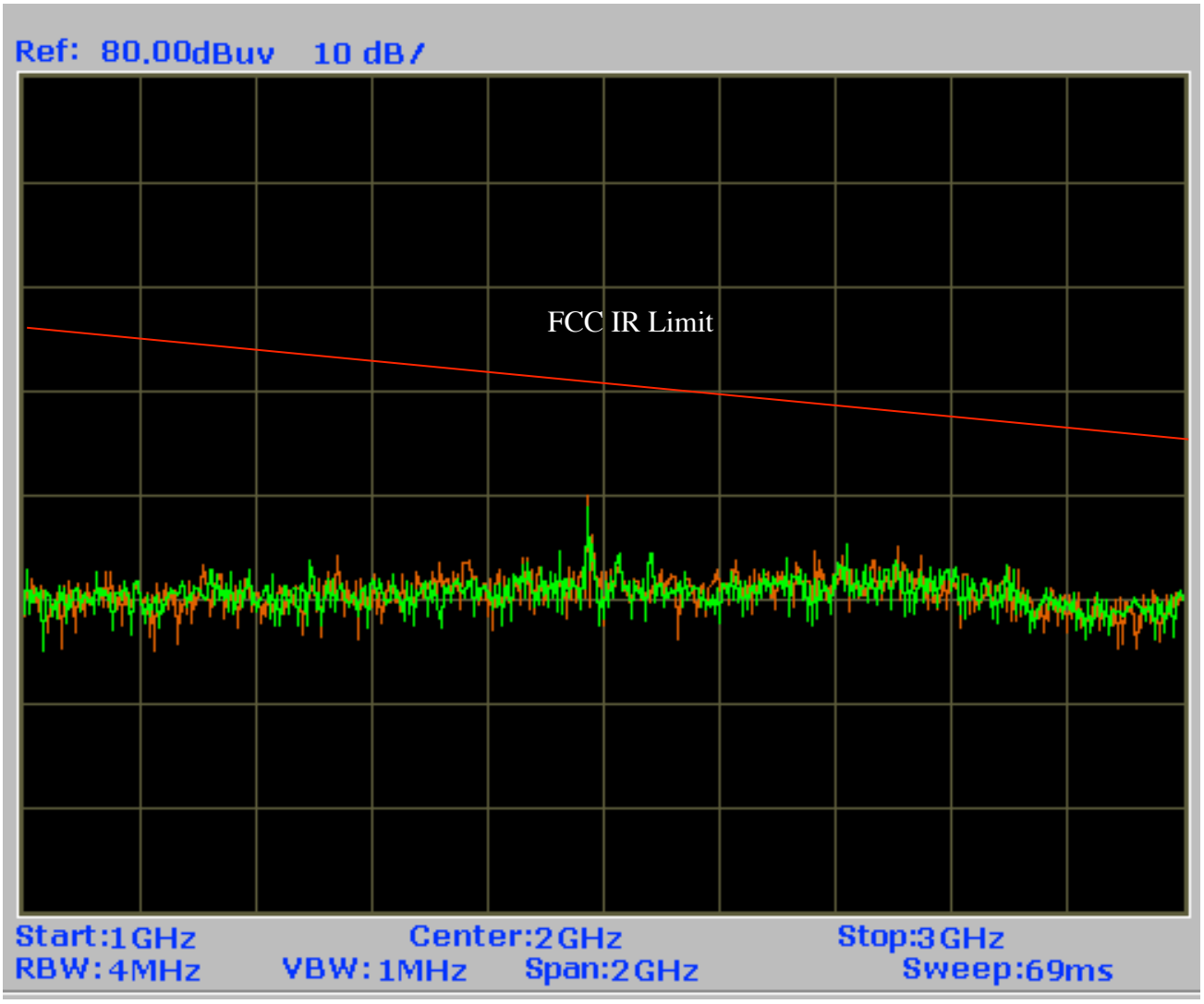
Maximum of Horizontal
Polarization



X. Measurement Results Cont'd:

3. Radiated Emissions.

Maximum of Vertical
Polarization



X. Measurement Results Cont'd:

3. Radiated Emissions.

Vertical & Horizontal Polarization >3 GHz.

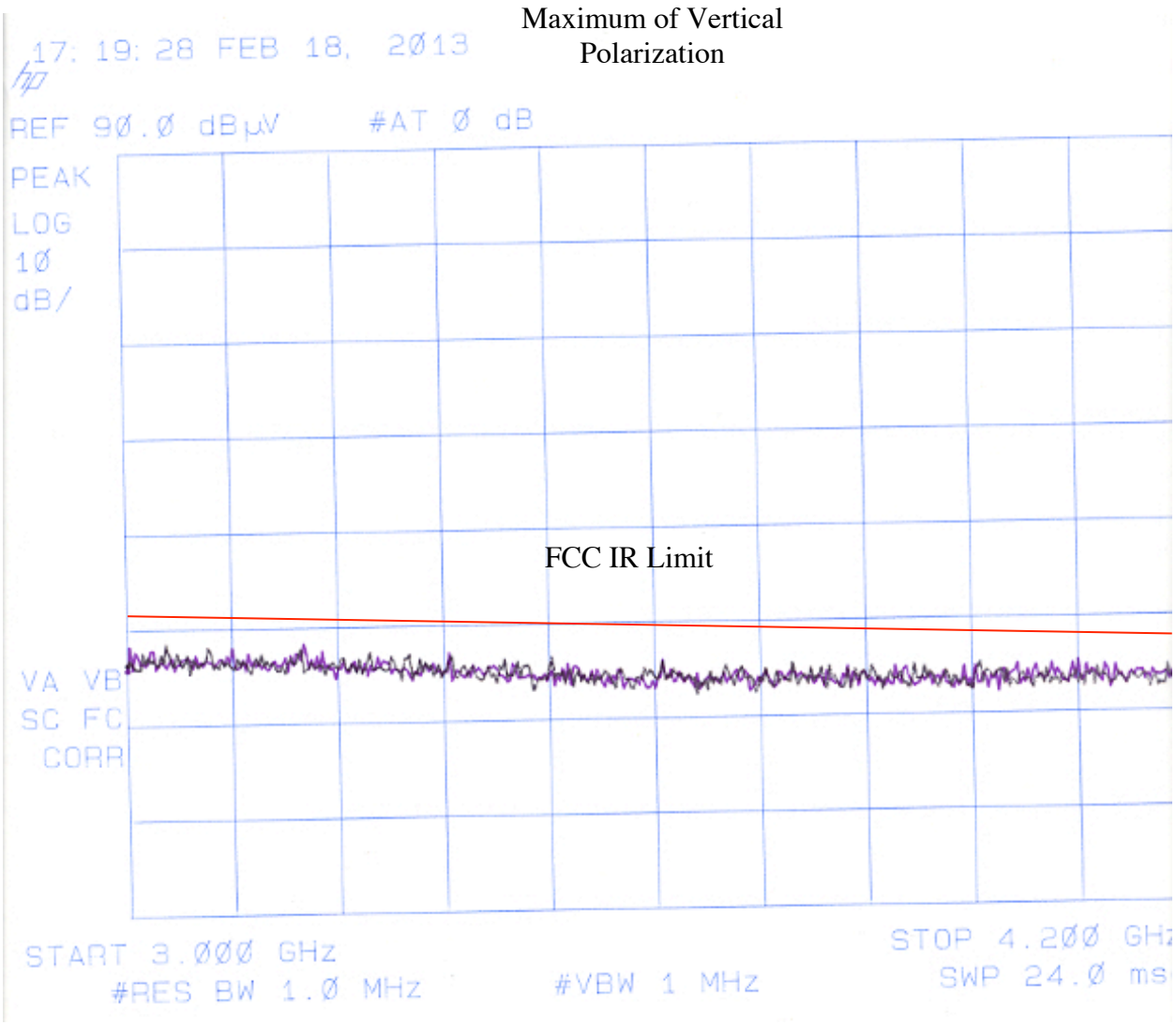
The table below describes the correction factors necessary to apply the limit to the spectrum analyzer output. The following pages contain the spectrum analyzer output with the corrected specification limits superimposed. The black trace is the ambient and the other color identifies EUT emissions. Maximum amplitudes of both polarizations are shown in the results below.

Frequency	IR limit @ 1m	Amp Gain	Antenna Factor	Cable Loss	Corrected Limit
MHz	dBuV	dB	dB	dB	dBuV
3000	54	30	35.0	8	41
4200	54	30	38.0	9	37

Table 5 – Corrected Limit - >3 GHz

X. Measurement Results Cont'd:

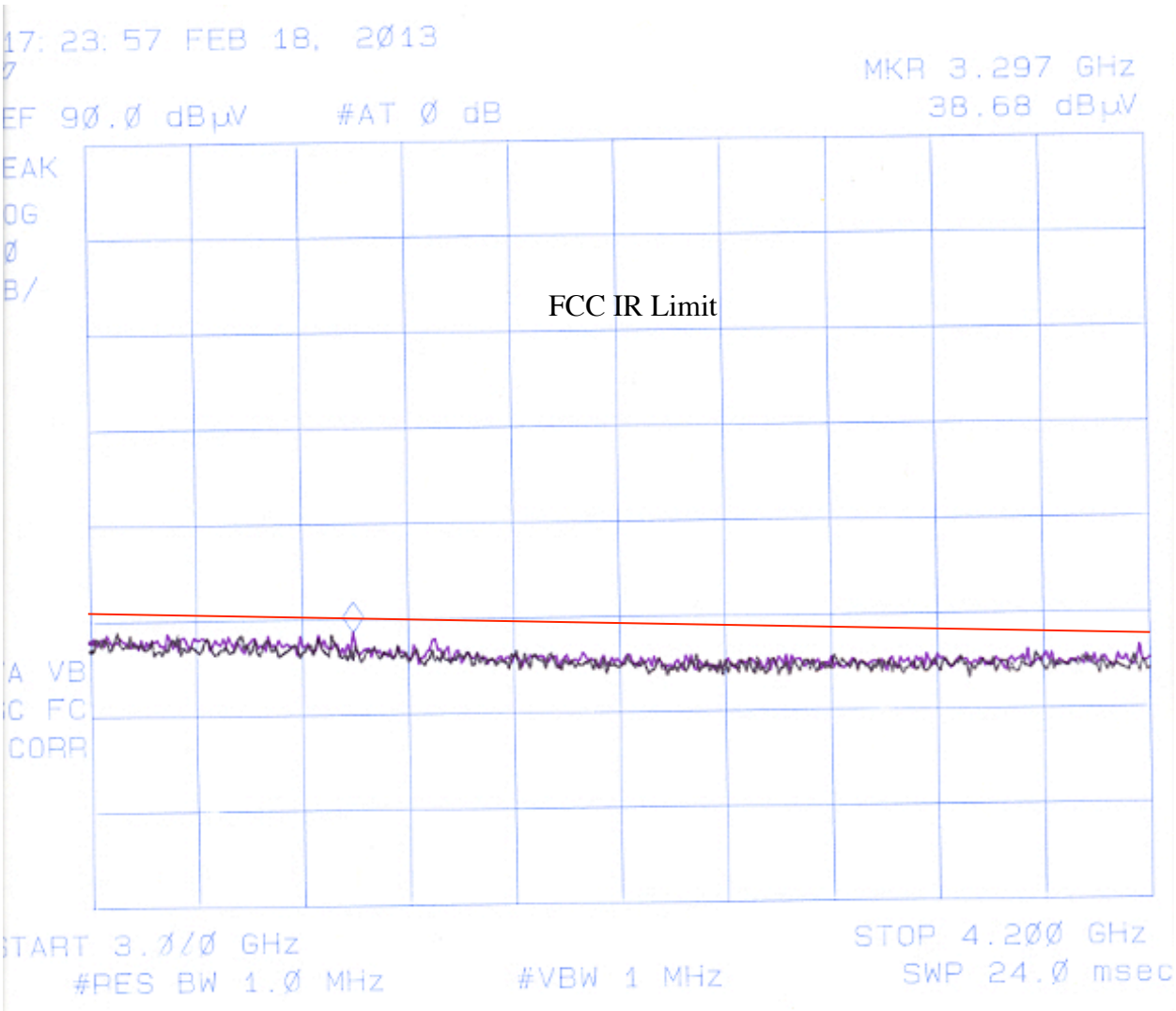
3. Radiated Emissions.



X. Measurement Results Cont'd:

3. Radiated Emissions.

Maximum of Horizontal Polarization



X. Measurement Results Cont'd:

4. Exposure Evaluation.

The analysis below compares the measured power to the maximum permissible exposure limit for general population with uncontrolled access. The V2 Chirper can be used continuously; no special averaging time or limit relaxations are employed. Maximum peak available power is used in calculations.

Unit Frequency: 418 MHz
Unit Maximum Average Power .001 Watt available (0 dBm from design)
Standard User Weight: 100 kg

Specific Absorption Rate (SAR) Limit for whole-body: 0.08 W/kg
Specific Absorption Rate (SAR) Limit for one-gram tissue volume: 1.6 W/kg

SAR Whole body = .001 W/100 kg = 0.00001 W/kg for Chirper
SAR 1g tissue = .001 W/001 kg * = 1 W/kg for Chirper

In addition per IEEE C95.1 paragraph 6.10 (2): low power devices are unlikely to expose users in excess of the criteria when power is less than or equal to:
Pmax = 1.4 * (450/f) Watts where f is in MHz.
Pmax is significantly greater than the power available at the Chirper
Pmax = 1.4 * (450/418) = 1.5 W.

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