

FCC PART 15 SUB-PART B & C EMI TEST REPORT

on
5.8GHz Pulse RF Rangefinder

model name
Pulse RF Rangefinder

provided for evaluation by
Lawrence Livermore National Laboratory
7000 East Avenue
Livermore, California 94551, USA

evaluated and prepared by
International Technology Company (ITC)
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TEST RESULT SUMMARY

FCC PART 15 SUB-PART B & C

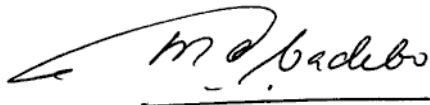
General Information

| | |
|--|--|
| Product Name | 5.8GHz Pulse RF Rangefinder |
| Model / Type | Pulse RF Rangefinder |
| Manufacturer's Name: Manufacturer's Address | Lawrence Livermore National Laboratory 7000 East Avenue Livermore, California 94551, USA Tel: (925) 424-2904 • Fax: (925) 423-1488 |
| Laboratory | International Technology Company (ITC) 9959 Calaveras Road, PO Box 543 Sunol, CA 94586-0543 Tel: (925) 862-2944 • Fax: (925) 862-9013 Email: itcemc@aol.com • Web Site: www.itcemc.com |
| Test Number | 1991007-1 |
| Test Report Number | 9910RS107-1/F |
| Test Date | October 11 - 14, 1999 |
| Project Technician | Bruce Gordon |

According to testing performed at International Technology Company (ITC); the above-mentioned unit is in compliance with the emissions requirements defined in FCC Part 15 B and C. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. Any modifications necessary for compliance made during testing on the above mentioned date(s) must be implemented in all production units for compliance to be maintained.

International Technology Company (ITC) as an independent testing laboratory, declares that the equipment tested as specified above conforms to the emissions requirements of FCC Part 15 B & C.

Test Date: October 11 - 14, 1999



Michael Gbadebo, PE
Reviewing Engineer

EMI Test Report

| | |
|---------------------------------|---|
| Product Type | 5.8GHz Pulse RF Rangefinder |
| Model | Pulse RF Rangefinder |
| Applicant / Manufacturer | Lawrence Livermore National Laboratory |
| Address | 7000 East Avenue Livermore, California 94551, USA |
| Client Contact | Tel: (925) 424-2904 • Fax: (925) 423-1488 Mr. Rexford Morey, L-395 |

| | | |
|---|--|---|
| Test Results | <input checked="" type="checkbox"/> Pass | <input type="checkbox"/> Fail |
| Total Number of Pages including Appendices | 34 Pages | |
| Test Report File No. | 9910RS107-1/F | Date of Issue: Friday October 15, 1999 |

AGENCY DECLARATION/DISCLAIMER

INTERNATIONAL TECHNOLOGY COMPANY (ITC) reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. International Technology Company (ITC) shall have no liability for any deductions, inferences or generalizations drawn by the client or others from International Technology Company (ITC) issued reports.

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International Technology Company (ITC) is:

Accepted by the Federal Communications Commission (FCC) for FCC Methods, CISPR Methods and AUSTEL Technical Standards (Ref: NVLAP Lab Code 200172-0)

Approved by the Industry Canada for Telecom Testing

Certified by Rockford Engineering Services GmbH for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001

Certified by Reg. TP for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001 for RES GmbH (DAR-Registration number: TTI-P-G 159/98-00)

Certified by the Voluntary Control Council for Interference by Information Technology Equipment (VCCI) for EMC testing, in accordance with the Regulations for Voluntary Control Measures, Article 8, Registration Numbers - Site 1: C-714 and R-696; Site 2: C-715 and R-697

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PART 1

GENERAL

1.1 Test Methodology

The electromagnetic interference tests which this report describes were performed by an independent electromagnetic compatibility consultant, International Technology Company, in accordance with the FCC test procedure ANSI C63.4-1992.

1.1.1 Test Facility

The open area test site, the conducted measurement facility, and the test equipment used to collect the emissions data is located in Sunol, California, and is fully described in site attenuation report. The approved site attenuation description is on file at the Federal Communications Commission.

1.1.2 Accuracy of Test Data

The test results contained in this report accurately represent the radiated, powerline conducted electromagnetic emissions, bandwidth and stability tests generated by the sample equipment under test.

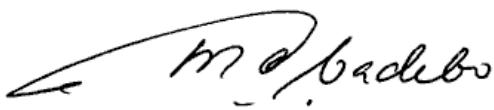
| | |
|----------------------------|--|
| <i>Equipment Tested</i> | 5.8GHz Pulse RF Rangefinder |
| <i>Date of Test</i> | October 11 - 14, 1999 |
| <i>Antenna Requirement</i> | The equipment meets the requirement of FCC test procedure 47 CFR §15.203 because the antenna is permanently attached |

Test Methodology.....

Tests Performed:

1. Radiated Emissions in a 3-meter open area site in accordance with the FCC test procedure 47 CFR §15.209 and §15.31(m). Part 2 of this report contains details.
2. Occupied bandwidth Test in accordance with the FCC test procedure 47 CFR §2.1049. Part 3 of this report contains details.
3. Frequency Stability Test requirements in accordance with 47CFR §2.1055. Part 4 of this report contains details.
4. Maximum Peak Output Power Test Requirement in accordance with 47 CFR §15.245. Part 5 of this report contains details.
5. Radiated Harmonic and Spurious Emissions in accordance with 47 CFR §2.1053 and §15.245. Part 6 of this report contains details.
6. Modulation Frequency Characteristics in accordance with 47 CFR §2.1047. Part 7 of this report contains compliance.

The results show that the sample equipment tested as described in this report is in compliance with the FCC Rules Part 15, SubPart B Radiated Emissions. Occupied Bandwidth, Frequency Stability, Maximum Peak Output Power, Fundamental/Harmonics and Modulation Frequency Characteristics test requirement limits of, FCC Part 15 SubPart C.



Michael Gbadebo, PE
Chief Engineer

1.2 Summary

1.2.1 Description of Equipment Under Test (EUT)

See Appendix D for more information

Model Name(s): Pulse RF Rangefinder

Applicant: Lawrence Livermore National Laboratory

Address: 7000 East Avenue
Livermore, California 94551, USA
• Tel: (925) 424-2904
• Fax: (925) 423-1488

Client Contact: Mr. Rexford Morey, L-395

Test Technician: Bruce Gordon

Test Number: 1991007-1

File Number: 9910RS107-1/F

PART 2

OPEN FIELD RADIATED EMISSIONS

per FCC PART 15 SUBPART B SECTION 47 CFR §15.209 & 47 CFR §15.31(m)

2.1 Configuration and Procedure

2.1.1 EUT Configuration

Pre-scan measurements are first performed by collecting data with a spectrum analyzer. Significant peaks are marked and then quasi-peaked. Measurement range investigated was from 30 MHz to 1 GHz. The EUT was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was a receiver with bandwidth parameters as stipulated in ANSI C63.4-1992. The Pulse RF Rangefinder was set up on a wooden non conductive table top, 80 cm above the ground reference plane, in a shielded room. It transmitted continuously. The dimension of the table was 1.5m x 1.0m. EUT was powered by eight (8) D cell 1.5 Vdc batteries providing a total of 12 Vdc.

2.1.2 Test Procedure

The EUT was set up as described above, in live functional modes. The EUT was rotated 360 degrees azimuth and the search antenna height varied 1 to 4 m in order to maximize the emissions from the EUT. The highest emissions were also analyzed in detail by operating the spectrum analyzer in fixed tuned mode to determine the precise amplitude of the emissions. While doing so, interconnecting cables were moved around to maximize the emissions.

Configuration and Procedure.....

2.1.3 Data Table Legend and Field Strength Calculation

'Margin' indicates the degree of compliance with the applicable limit. For example, a margin of -8 dB means that the emissions are 8 dB below the limit (in compliance); +a margin of +4 dB means that the emission is 4 dB over the limit (out of compliance). The margin calculated as follows:

Margin = Corrected Amplitude - Limit, where Corrected Amplitude = Amplitude + Antenna Correction Factor + Cable Loss - Distance Factor, measured in quasi peak mode.

2.1.4 Spectrum Analyzer Configuration (during swept frequency scans)

Start Frequency 30MHz
Stop Frequency 1000MHz
Sweep Speed Manual

Measurements below 1GHz

RES Bandwidth..... 100 KHz
Video Bandwidth..... 100 KHz
Quasi Peak Adapter Mode..... Normal
Quasi peak Adapter Bandwidth..... 120 KHz

Measurements above 1GHz (unless stated otherwise)

Analyzer Mode Video Filter
RES Bandwidth..... 1MHz
Video Bandwidth..... 1MHz
Freq. Span..... 3MHz
Offset..... 0dB
Quasi Peak Adapter Mode..... Disabled

2.2 Open Field Radiated Emissions per FCC Part 15 SubPart B

2.2.1 Administrative Details

Date(s) of Test: October 12, 1999
 Emission Limits: Class B
 Temperature/Humidity: 19.8°C / 64%
 ATM Pressure: 1010 Mbar
 Test Technician(s): Bruce Gordon
 Antenna Used: Biconical Antenna, model # 3104, S/N 3459 and Log Periodic Antenna, model # 3146, S/N 2075 (calibrated June 25, 1999, next calibration due date is June 25, 2000)

2.2.2 Test Results

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarization, and EUT orientations.

| INDICATED FREQ MHz | AMPL dBuV/m | CORRECTN ANT dB | CORR CAB dB | AMPL dBuV/m | T/TAB ANG DEG | ANT HT m | FCC 15 POL | CLASS B LIMIT dBuV/m | CLASS B MARG dB |
|--------------------------|----------------|-----------------------|-------------------|----------------|---------------------|----------------|---------------|----------------------------|-----------------------|
| 123.81 | 8.4 | 13.4 | 4.2 | 25.9 | 0 | 1.0 | HB | 43.0 | -17.1 |
| 126.35 | 24.2 | 12.7 | 4.2 | 41.4 | 0 | 1.0 | VB | 43.0 | -1.9 |
| 208.77 | 11.6 | 9.3 | 5.4 | 26.3 | 0 | 1.0 | VL | 43.0 | -16.7 |
| 208.77 | 12.1 | 9.3 | 5.4 | 26.8 | 0 | 1.5 | HL | 43.0 | -16.2 |
| 241.32 | 22.8 | 11.4 | 5.7 | 39.9 | 0 | 1.0 | HL | 46.0 | -6.1 |
| 269.76 | 22.1 | 11.9 | 6.3 | 40.3 | 0 | 1.0 | VL | 46.0 | -5.7 |
| 276.48 | 23.1 | 11.9 | 6.4 | 41.4 | 0 | 1.0 | VL | 46.0 | -4.6 |
| 342.80 | 11.7 | 12.5 | 7.4 | 31.7 | 0 | 1.0 | HL | 46.0 | -14.3 |
| 348.70 | 12.3 | 12.5 | 7.5 | 32.3 | 0 | 2.0 | VL | 46.0 | -13.7 |
| 396.30 | 9.6 | 12.9 | 7.9 | 30.4 | 0 | 2.0 | VL | 46.0 | -15.6 |
| 562.00 | 4.0 | 15.0 | 9.7 | 28.8 | 0 | 1.0 | VL | 46.0 | -17.2 |
| 589.30 | 6.9 | 15.4 | 10.1 | 32.2 | 0 | 1.0 | VL | 46.0 | -13.8 |
| 796.40 | 0.1 | 19.3 | 12.4 | 31.8 | 0 | 1.0 | VL | 46.0 | -14.2 |
| 969.60 | 1.4 | 22.5 | 13.3 | 37.2 | 0 | 2.0 | VL | 54.0 | -16.8 |
| 1496.00 | 39.5 | 25.5 | 3.0 | 38.0 | 0 | 1.0 | VH | 54.0 | -16.0 |
| 2330.00 | 30.7 | 28.6 | 6.0 | 35.3 | 0 | 1.0 | VH | 54.0 | -18.7 |
| 2630.00 | 35.7 | 29.2 | 6.3 | 41.2 | 0 | 1.0 | VH | 54.0 | -12.8 |
| 5939.00 | 28.0 | 35.5 | 7.5 | 41.0 | 0 | 1.0 | VH | 54.0 | -13.0 |
| 11865.80 | 17.0 | 41.9 | 20.8 | 49.7 | 0 | 1.0 | VH | 54.0 | -4.3 |

Table 2.2.2 Open Field Radiated Emissions

No emissions of significant levels were observed between 30 MHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequency shown in the above data and 60.329 GHz.

Conclusion: The 5.8GHz Pulse RF Rangefinder meets the requirements of the test reference for Open Field Radiated Emissions.

Applicant: Lawrence Livermore National Laboratory
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5.8GHz Pulse RF Rangefinder
Model Pulse RF Rangefinder

Rev. No 1.0

FCC Part 15 SubPart B & C

PART 3

OCCUPIED BANDWIDTH

per FCC PART 2 SECTION 47 CFR §2.1049

3.1 Configuration and Procedure

3.1.1 EUT Configuration

The EUT is set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was an Hewlett Packard 8566B Spectrum Analyzer with detector and bandwidth parameters as stipulated in C63.4-1992. EUT was 12 Vdc powered.

3.1.2 Test Procedure

The Transmitter was placed on the test table. The EUT was configured for maximum response and was set up as described above and configured to transmit continuously. Signal was monitored with an HP 8566B Spectrum Analyzer, using the EMCO Double-Ridged Waveguide Horn Antenna, model #3115. Unless stated otherwise, the antenna to EUT distance was 1 meter.

3.1.3 Spectrum Analyzer Configuration (During Swept Frequency Scans)

| | |
|-----------------------------------|------------|
| Start Frequency | 5.8329 GHz |
| Stop Frequency | 6.0329 GHz |
| Sweep Speed | Manual |
| RES Bandwidth..... | 100 kHz |
| Video Bandwidth..... | 100 kHz |
| Quasi Peak Adapter Mode..... | Bypass |
| Quasi Peak Adapter Bandwidth..... | Disabled |

3.2 Bandwidth Test
per FCC Part 2 Section 47CFR §2.1049

6dB Bandwidth Plot Performed at 1 Meter Distance

Applicant: Lawrence Livermore National Laboratory
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5.8GHz Pulse RF Rangefinder
Model Pulse RF Rangefinder

Rev. No 1.0

FCC Part 15 SubPart B & C

PART 4

FREQUENCY STABILITY TEST

per FCC PART 2 SECTION 47 CFR §2.1055

4.1. Configuration and Procedure

4.1.1 EUT Configuration

The EUT is set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was an Hewlett Packard 8569A Spectrum Analyzer with detector and bandwidth parameters as stipulated in C63.4-1992. EUT was powered by a dc power supply.

4.1.2 Test Procedure

The Transmitter was placed in the temperature control chamber. The EUT was configured for maximum response and was set up as described above and configured to transmit continuously. For frequency stability with respect to temperature, the temperature in the chamber was varied from -20 degrees Centigrade to +50 degrees Centigrade. Frequency stability was monitored with the HP 8569A Spectrum Analyzer, below and above the center frequencies using an appropriate receiving antenna.

4.1.3 Data Table Legend and Field Strength Calculation

'Margin' indicates the degree of compliance with the applicable limit. For example, a margin of -8 dB means that the emissions is 8 dB below the limit (in compliance); a margin of +4 dB means that the emission is 4 dB over the limit (out of compliance). The margin calculated as follows:

Margin = Corrected Amplitude - Limit; where Corrected Amplitude = Amplitude + Antenna Correction Factor + Cable Loss

A = Average

P = Peak

Q = Quasi Peak

4.1.4 Spectrum Analyzer Configuration (During Swept Frequency Scans)

| | |
|------------------------------|------------|
| Start Frequency | 5.8329 GHz |
| Stop Frequency | 6.0329 GHz |
| Sweep Speed | Manual |
| RES Bandwidth..... | 100 kHz |
| Video Bandwidth..... | 100 kHz |
| Quasi Peak Adapter Mode..... | Bypass |

Applicant: Lawrence Livermore National Laboratory
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File No. : 9910RS107-1/F

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5.8GHz Pulse RF Rangefinder
Model Pulse RF Rangefinder

Rev. No 1.0

FCC Part 15 SubPart B & C

4.2 Frequency Stability Test per FCC Part 2 Section 47 CFR §2.1055

4.2.1 Administrative Details

Date(s) of Test: October 13, 1999
Emission Limits: Class C
Test Technician(s): Bruce Gordon

4.2.2 Test Results

| Temperature | -20°C | -20°C | -20°C | -20°C |
|----------------|----------|-----------|-----------|------------|
| Time | Start Up | 2 minutes | 5 minutes | 10 minutes |
| Frequency(GHz) | 5.9360 | 5.9361 | 5.9361 | 5.9361 |
| Temperature | -10°C | -10°C | -10°C | -10°C |
| Time | Start Up | 2 minutes | 5 minutes | 10 minutes |
| Frequency(GHz) | 5.9361 | 5.9361 | 5.9361 | 5.9361 |
| Temperature | 0°C | 0°C | 0°C | 0°C |
| Time | Start Up | 2 minutes | 5 minutes | 10 minutes |
| Frequency(GHz) | 5.9360 | 5.9360 | 5.9360 | 5.9360 |
| Temperature | 10°C | 10°C | 10°C | 10°C |
| Time | Start Up | 2 minutes | 5 minutes | 10 minutes |
| Frequency(GHz) | 5.9360 | 5.9360 | 5.9360 | 5.9360 |
| Temperature | 20°C | 20°C | 20°C | 20°C |
| Time | Start Up | 2 minutes | 5 minutes | 10 minutes |
| Frequency(GHz) | 5.9360 | 5.9360 | 5.9360 | 5.9360 |
| Temperature | 30°C | 30°C | 30°C | 30°C |
| Time | Start Up | 2 minutes | 5 minutes | 10 minutes |
| Frequency(GHz) | 5.9360 | 5.9360 | 5.9360 | 5.9360 |
| Temperature | 40°C | 40°C | 40°C | 40°C |
| Time | Start Up | 2 minutes | 5 minutes | 10 minutes |
| Frequency(GHz) | 5.9360 | 5.9361 | 5.9361 | 5.9361 |
| Temperature | 50°C | 50°C | 50°C | 50°C |
| Time | Start Up | 2 minutes | 5 minutes | 10 minutes |
| Frequency(GHz) | 5.9361 | 5.9361 | 5.9361 | 5.9361 |

Frequency Stability Test
per FCC Part 2 Section 47 CFR §2.1055.....

Test Results.....

| <i>Voltage</i> | 12 Vdc | 12 Vdc | 12 Vdc | 12 Vdc |
|-----------------------|-----------------|-----------------|-----------------|-----------------|
| <i>Time</i> | Start Up | 2 minutes | 5 minutes | 10 minutes |
| <i>Frequency(GHz)</i> | 5.9360 | 5.9360 | 5.9360 | 5.9360 |
| <i>Voltage</i> | 10.2 Vdc | 10.2 Vdc | 10.2 Vdc | 10.2 Vdc |
| <i>Time</i> | Start Up | 2 minutes | 5 minutes | 10 minutes |
| <i>Frequency(GHz)</i> | 5.9360 | 5.9360 | 5.9360 | 5.9360 |
| <i>Voltage</i> | 13.8 Vdc | 13.8 Vdc | 13.8 Vdc | 13.8 Vdc |
| <i>Time</i> | Start Up | 2 minutes | 5 minutes | 10 minutes |
| <i>Frequency(GHz)</i> | 5.9360 | 5.9360 | 5.9360 | 5.9360 |

Stability Test for Pulse RF Rangefinder

Conclusion: The 5.8GHz Pulse RF Rangefinder meets the requirements of the test reference for Frequency Stability.

PART 5

MAXIMUM PEAK OUTPUT POWER & TRANSMITTED POWER DENSITY

per FCC PART 15 SECTION 47 CFR §15.245

5.1. Configuration and Procedure

5.1.1 EUT Configuration

The EUT is set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was an Hewlett Packard 8569A Spectrum Analyzer with detector and bandwidth parameters as stipulated in C63.4-1992. EUT was 12 Vdc powered.

5.1.2 Test Procedure

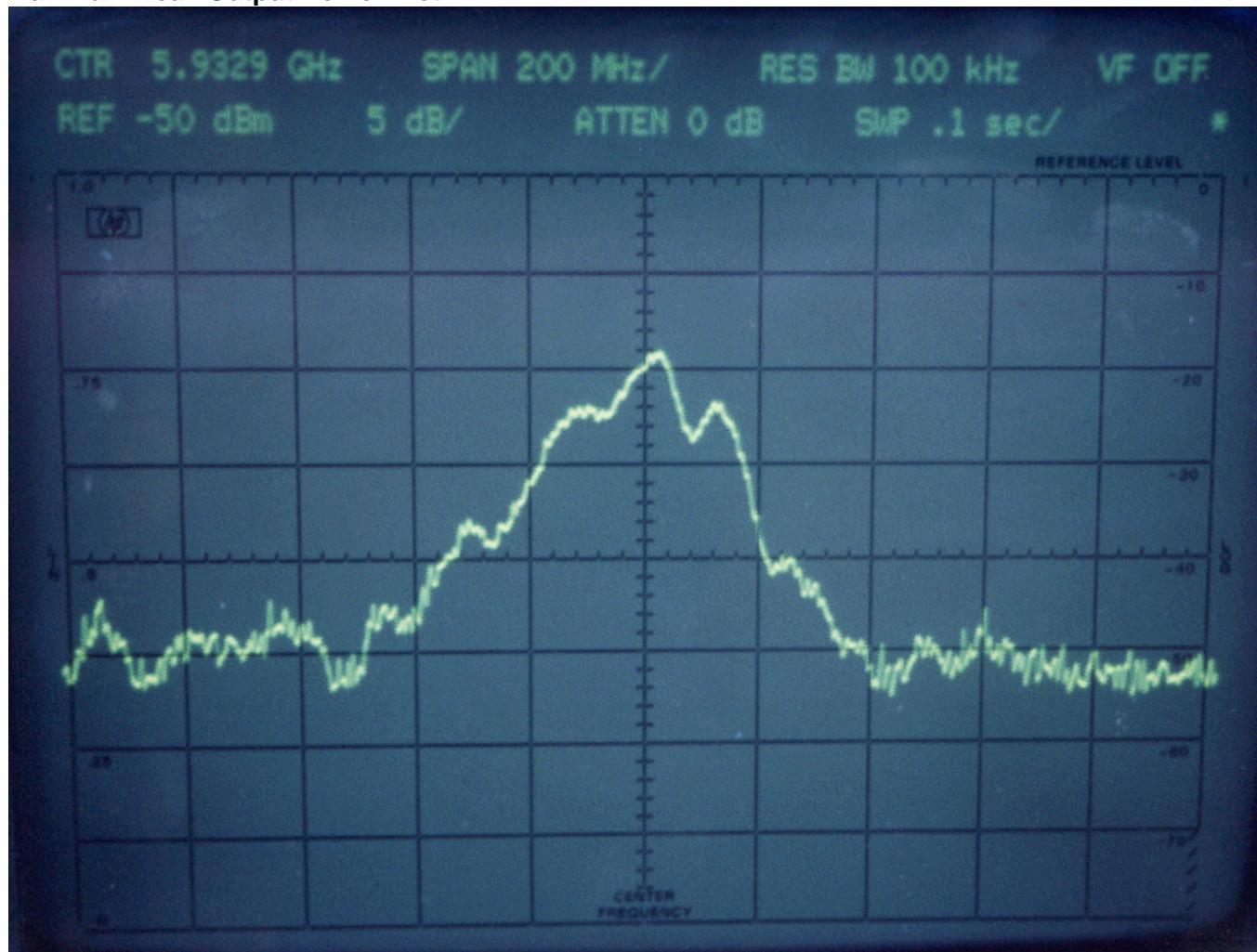
The Transmitter was placed on the test table. The EUT was configured for maximum response and was set up as described above and configured to transmit continuously. Signal was monitored with an HP 8569A Spectrum Analyzer, using the EMCO Double-Ridged Waveguide Horn Antenna, model 3115. Unless stated otherwise, the antenna to EUT distance was 1 meter. The RF power output = Measured value - distance correction + antenna correction - pre-amplifier gain + cable correction, or $-40.5 \text{ dBm} - 10.5 \text{ dB} + 35.5 \text{ dB} - 30.0 + 0.0 \text{ dB} = -45.5 \text{ dBm}$

5.1.3 Spectrum Analyzer Configuration (During Swept Frequency Scans)

| | |
|-----------------------------------|------------|
| Start Frequency | 5.8329 GHz |
| Stop Frequency | 6.0329 GHz |
| Sweep Speed | Manual |
| RES Bandwidth..... | 100 kHz |
| Video Bandwidth..... | 100 kHz |
| Quasi Peak Adapter Mode..... | Bypass |
| Quasi peak Adapter Bandwidth..... | Disabled |

5.2 Maximum Peak Output Power
per FCC Part 15 Section 47 CFR §15.245

Maximum Peak Output Power Plot



PART 6

OPEN FIELD RADIATED HARMONIC & SPURIOUS EMISSIONS

per FCC PART 2 SECTION 47 CFR §2.1053 & PART 15 SECTION 47 CFR §15.245

6.1. Configuration and Procedure

6.1.1 EUT Configuration

The EUT is set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was an Hewlett Packard 8566B and 8569A Spectrum Analyzers with detector and bandwidth parameters as stipulated in C63.4-1992. At frequencies above 1GHz, average measurements, if necessary, were made using the video filter method and quasi peak detector and preselector functions were disabled. The EUT was powered by a 12 Vdc adapter.

6.1.2 Test Procedure

The Transmitter was placed on the test table. The EUT was configured for maximum response and was set up as described above and configured to transmit continuously. Signal strength were monitored at an HP 8566B and 8569A Spectrum Analyzers, below and above the center frequencies using an appropriate receiving antenna. Maximum emissions was obtained by varying the height of the antennas and then orienting the turntable in 360-degree turns with the analyzer in the manual mode. Unless stated otherwise, the antenna to EUT distance was 3 meters. Any multiple entries cover the two orientations of the transmitters and cover all three axes due to rotation of the test table and EUT and are the maximum signals resulting from rotation and height search at each frequency. The measurements are quasi-peak measurements below 1000MHz and average measurements above 1,000 MHz.

6.1.3 Spectrum Analyzer Configuration (During Swept Frequency Scans)

| | |
|------------------------------|--|
| Start Frequency | 30 MHz |
| Stop Frequency | 58.990 GHz |
| Sweep Speed | Auto |
| RES Bandwidth..... | 100KHz below 1000MHz 1 MHz above 1,000 MHz |
| Video Bandwidth..... | 100 KHz below 1,000 MHz 1 MHz above 1,000 MHz |
| Quasi Peak Adapter Mode..... | Normal below 1,000 MHz |

Bypass above 1,000 MHz
Quasi peak Adapter Bandwidth.....Auto

Applicant: Lawrence Livermore National Laboratory
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5.8GHz Pulse RF Rangefinder
Model Pulse RF Rangefinder

Rev. No 1.0

FCC Part 15 SubPart B & C

6.2 Open Field Radiated Harmonic & Spurious Emissions
 per FCC Part 2 Section 47 CFR §2.1053 & Part 15 Section
 47 CFR §15.245

6.2.1 Administrative Details

Date(s) of Test: October 13-14, 1999
Emission Limits: Class C
Test Technician(s): Bruce Gordon

6.2.2 Test Results

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarizations, and EUT orientations.

| INDICATED | CORRECTION | | CORR | T/TAB | ANT | FCC 15 | MARG | | |
|-----------|------------|------|------|--------|-----|--------|------|--------|-------|
| FREQ | AMPL | ANT | CAB | AMPL | ANG | HT | POL | LIMIT | dB |
| MHz | dBuV/m | dB | dB | dBuV/m | DEG | m | - | dBuV/m | dB |
| 123.81 | 8.4 | 13.4 | 4.2 | 25.9 | 0 | 1.0 | HB | 43.0 | -17.1 |
| 126.35 | 24.2 | 12.7 | 4.2 | 41.1 | 0 | 1.0 | VB | 43.0 | -1.9 |
| 208.77 | 11.6 | 9.3 | 5.4 | 26.3 | 0 | 1.0 | VL | 43.0 | -16.7 |
| 208.77 | 12.1 | 9.3 | 5.4 | 26.8 | 0 | 1.5 | HL | 43.0 | -16.2 |
| 241.32 | 22.8 | 11.4 | 5.7 | 39.9 | 0 | 1.0 | HL | 46.0 | -6.1 |
| 269.76 | 22.1 | 11.9 | 6.3 | 40.3 | 0 | 1.0 | VL | 46.0 | -5.7 |
| 276.48 | 23.1 | 11.9 | 6.4 | 41.4 | 0 | 1.0 | VL | 46.0 | -4.6 |
| 342.80 | 11.7 | 12.5 | 7.4 | 31.7 | 0 | 1.0 | HL | 46.0 | -14.3 |
| 348.70 | 12.3 | 12.5 | 7.5 | 32.3 | 0 | 2.0 | VL | 46.0 | -13.7 |
| 396.30 | 9.6 | 12.9 | 7.9 | 30.4 | 0 | 2.0 | VL | 46.0 | -15.6 |
| 562.00 | 4.0 | 15.0 | 9.7 | 28.8 | 0 | 1.0 | VL | 46.0 | -17.2 |
| 589.30 | 6.9 | 15.4 | 10.0 | 32.2 | 0 | 1.0 | VL | 46.0 | -13.8 |
| 796.40 | 0.1 | 19.3 | 12.4 | 31.8 | 0 | 1.0 | VL | 46.0 | -14.2 |
| 969.60 | 1.4 | 22.5 | 13.3 | 37.2 | 0 | 2.0 | VL | 54.0 | -16.8 |
| 1496.00 | 39.5 | 25.5 | 3.0 | 38.0 | 0 | 1.0 | VH | 54.0 | -16.0 |
| 2330.00 | 30.7 | 28.6 | 6.0 | 35.3 | 0 | 1.0 | VH | 54.0 | -18.7 |
| 2630.00 | 35.7 | 29.2 | 6.3 | 41.2 | 0 | 1.0 | VH | 54.0 | -12.8 |
| 5830.00 | 72.0 | 35.5 | 0.0 | 107.5 | 0 | 1.0 | VH | 114.0 | -6.5 |
| 5830.00 | 50.0 | 35.5 | 0.0 | 85.5 | 0 | 1.0 | VH | 94.0 | -8.5 |
| 11865.80 | 17.0 | 41.9 | 20.8 | 49.7 | 0 | 1.0 | VH | 54.0 | -4.3 |

Table 6.2.2 Open Field Spurious and Harmonic Emissions

No emissions of significant levels were observed between 9KHz and the lowest frequencies shown in the above data.
 No emissions of significant levels were observed between the highest frequency shown in the above data and 58.900 GHz

6.2 Open Field Radiated Harmonic & Spurious Emissions
per FCC Part 2 Section 47 CFR §2.1053 & Part 15 Section
47 CFR §15.245

The Emission at 5.830GHz was Calculated as Follows:

The PDF for line spectrum is $20\log [RF\ pulse\ width / PRF]$, so $20\log [4\ \text{nanoseconds} / 800\ \text{nanoseconds}] = -46\text{dB}$.

The Tabular Data is Calculated

The measurement was performed at a distance of 1 meter, so the distance correction factor is 10.5 dB. The measurement as seen by the display is -40.5 dBm/m = 66.5 dBuV/m. The antenna was connected directly to the pre-amplifier, so the cable loss is 0 dB. Therefore, the measurement for the Ampl column is calculated as follows.
Peak Measurement - Distance factor + PDF - Pre-amplifier gain, or $66.5\ \text{dBuV/m} - 10.5\ \text{dB} + 46\ \text{dB} - 30\ \text{dB} = 72.0\ \text{dBuV/m}$.

Conclusion: The 5.8GHz Pulse RF Rangefinder meets the requirements of the test reference for Radiated Spurious and Harmonic Emissions.

PART 7

MODULATION FREQUENCY CHARACTERISTICS

per FCC PART 2 SECTION 47 CFR §2.1047

The equipment meets the general requirements for modulation frequency characteristics.

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Prepared By: International Technology Company (ITC)
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5.8GHz Pulse RF Rangefinder
Model Pulse RF Rangefinder

Rev. No 1.0

FCC Part 15 SubPart B & C

TEST SETUP PHOTOGRAPHS

Figure 1

EUT (the 5.8 GHz Pulse RF Rangefinder) and test oscilloscope before open field Radiation Testing. The oscilloscope is removed during emissions testing.

TEST SETUP PHOTOGRAPHS

Figure 2.

Test setup for Open Field Radiated Emissions testing. The Rangefinder is on the table in the foreground and the calibrated horn antenna is in the background.

EUT PHOTOGRAPH

Rangefinder

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EUT PHOTOGRAPH

Rangefinder

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EUT PHOTOGRAPH

RF Circuit

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APPENDIX A

MEASUREMENT PROCEDURES

Radiated Emissions

The EUT is set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992.

The EUT and support equipment are set up on the turntable of an open field site. Desktop EUT are set up on a wooden stand (test table), 80 cm above the ground plane. All items on the table are placed at least 10 cm apart. Interconnecting cables which hang closer than 40 cm to the ground plane are folded back and forth to form a 30 cm by 40 cm long bundle, hanging approximately between the ground plane and table.

The highest emissions are also analyzed, in detail, by operating the spectrum analyzer in fixed tuned quasi-peak mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables are moved around and at the highest amplitudes observed, the EUT is rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the reading. Once the maximum reading is obtained, the antenna elevation and polarization will be varied between specified limits to maximize the readings. The position of the peripheral devices are interchanged to check for any changes in emissions.

APPENDIX B

DESCRIPTION OF OPEN FIELD TEST SITE

The open field test site is located on a 5.5 acre parcel, in the agriculturally zoned section of the city of Sunol, California. It is situated adjacent to Highway 680 on the West side, and adjacent to Calaveras Road in the South East. Distance of the site to each of these roads is a minimum of 200 feet. The north end of the site is surrounded by hills measuring up to 150 ft. high. The distance of the site to the hills is approximately 200 ft.

Supporting structures used to support device being measured and test instrumentation include the following:

- a. Test Platform measuring 50 ft by 100 ft. The platform is located on top of a very large ground screen, to enhance a homogeneous reflective surface.
- b. Test Site building measures approx. 5000 Sq. ft. This building houses the test laboratory, the shielded room, for performing Line Conducted test, test personnel and other support staff. The test building is an all wooden building, constructed using 2 by 4 inch studs. It also contains all necessary electrical wiring and utilities.

The International Technology Company (ITC) RFI test site described above has been approved for conducting contract RFI measurement work for client companies following the procedures stated in FCC/OET ANSI C63.4-1992, EN 55011, EN 55022 Vfg. 243/1991 and VDE-0877. The site attenuation characteristics are routinely measured and recorded every three months.

Test site approved by VDE, File # F-R HF-MK.

Test site approved by FCC, Registration # 31010/SIT/ ITC.

Test site approved by VCCI, Membership # 242.

Test site approved by the Industry Canada, Registration # DEB 5072-7, DEB 90-3008.

APPENDIX C

TEST EQUIPMENT

Some or all of the following test equipment is currently used to measure the conducted and/or radiated emissions from the equipment under test:

| <i>Test Equipment</i> | <i>Model</i> | <i>Serial Number</i> |
|--|--------------------------|----------------------|
| Spectrum Analyzer | Hewlett Packard 8590A | 2752 A02715 |
| Spectrum Monitor | Rhode & Schwarz EZM | 881 334/025 |
| Test Receiver (9 KHz - 30 MHz) | Rhode & Schwarz ESH3 | RES 0753 |
| Test Receiver (20-1300 MHz) | Rhode & Schwarz ESVP | RES 0749 |
| Spectrum Analyzer | Hewlett-Packard 8566B | 2618A02909 |
| Spectrum Analyzer | Hewlett-Packard 8567A | 2602A00239 |
| Spectrum Analyzer Display (Site 1) | Hewlett-Packard 8590A | 2542A11954 |
| Spectrum Analyzer Display (Site 2) | Hewlett-Packard 85662A | 2542A12593 |
| Quasi Peak Adapter (Site 1) | Hewlett-Packard 85650 | 2521A00871 |
| Quasi Peak Adapter (Site 2) | Hewlett-Packard 85650A | 2521A00737 |
| Preselector (Site 1) | Hewlett-Packard 85685A | 2620A00265 |
| Preselector (Site 2) | Hewlett-Packard 85685A | 2648A00462 |
| Preamp | Hewlett-Packard 8447D | 2648A04855 |
| Preamp | Hewlett-Packard 8449B | 3008A00101 |
| Computer | Hewlett-Packard 9000/300 | RES 449 |
| Absorbing Clamp | MDS21 | 891 092/025 |
| Antenna Cable (OPTK45) | RG8/u | - |
| Antenna System | EMCO 3230 | - |
| Biconical Antenna (Site 1) | EMCO 3104 | 3549 |
| Biconical Antenna (Site 2) | EMCO 3104C | 9111-4463 |
| Log Periodic Antenna (Site 1) (200-1000 MHz) | EMCO 3146 | 2075 |
| Log Periodic Antenna (Site 2) (200-1000 MHz) | EMCO 3146 | 9510-4202 |
| Adj. Element Dipole Antenna (28 MHz-1 GHz) | EMCO 3120 | 2632 |
| Horn Antenna | Eaton 96001 | 2632 |
| LISN (25 Amp) | EMCO 38825/2 | 9210-2008 |
| LISN (100 Amp) | Solar 8610-50-TS-100N | |
| LISN | EMCO 3825/2R | 1188/1001 |

Test Equipment.....

| <i>Test Equipment</i> | <i>Model</i> | <i>Serial Number</i> |
|--|--------------------------|----------------------|
| Remote Controlled 8 ft Rotating Table | RES RT1 | |
| Remote Controlled 25 ft Rotating Table | RES RT2 | |
| Remote Controlled 4 ft Rotating Table | RES RT3, RT4, RT5 | |
| Remote Controlled 4 m Antenna Mast | RES AM1 | |
| Remote Controlled 6 m Antenna Mast | RES AM2, RES AM3 | |
| 3 Phase 220 VAC/50 Hz Generator | - | DB7130B40 |
| Oscilloscope (300 MHz) | Tektronix 2465 | |
| Digital Scope | Hitachi VC-6075 | |
| Power Analyzer | Valhalla Scientific/2101 | RES 574 |
| Digital Thermometer | Omega 440 | |
| DC Power Supply | Kepco JQE 150-1.5m | H177085 |

The spectrum analyzers are self-calibrated before every test and are calibrated to NIST standards annually. All of the other EMI equipment is calibrated on a monthly basis using the spectrum analyzers as standards. Calibration dates of equipment are June 25, 1999. Next calibration is due on June 25, 2000.

APPENDIX D

EUT TECHNICAL DESCRIPTION

| | |
|---------------------------------|--|
| Applicant / Manufacturer | Lawrence Livermore National Laboratory |
| Functional Description | 5.8GHz Pulse RF Rangefinder |
| Model Name | Pulse RF Rangefinder |
| Specification | See Manufacturer's manual |

APPENDIX E

MODIFICATION LETTER

To Whom it May Concern:

This is to certify that the following modifications were necessary for:

5.8GHz Pulse RF Rangefinder, model Pulse RF Rangefinder

to comply with:

1. Radiated Emissions in a 3-meter open area site in accordance with the FCC test procedure 47 CFR §15.209 and §15.31(m).
2. Occupied bandwidth Test in accordance with the FCC test procedure 47 CFR §2.1049.
3. Frequency Stability Test requirements in accordance with 47CFR §2.1055.
4. Maximum Peak Output Power Test Requirement in accordance with 47 CFR §15.245.
5. Radiated Harmonic and Spurious Emissions in accordance with 47 CFR §2.1053 and §15.245.
6. Modulation Frequency Characteristics in accordance with 47 CFR §2.1047.

The results show that the sample equipment tested as described in this report is in compliance with the FCC Rules Part 15, SubPart B Radiated Emissions. Occupied Bandwidth, Frequency Stability, Maximum Peak Output Power, Fundamental/Harmonics and Modulation Frequency Characteristics test requirement limits of, FCC Part 15 SubPart C.

1. **The pulse-forming network was modified to increase the RF pulse width from 2 1/2 nanoseconds to 3 1/2 nanoseconds.**
2. **The output-coupling resonator was deleted and replaced with a capacitor.**

For further information, please contact the manufacturer at

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Attention: Mr. Rexford Morey, L-395