Class B Digital Device and Intentional Radiator
15.209 Certification

FCC ID: N94TS1

EMI TEST REPORT

on

TriScanner

Prepared For

Zircon
1580 Dell Ave.
Campbell, CA 95008
TEL: (408)746-2819

Prepared by

Electronic Compliance Laboratories, Inc.
1249 Birchwood Drive
Sunnyvale, CA 94089
408/747-1490

Test Report Number: A904003

Date of Test: December 28 and 29, 1998

Table of Contents

1.0 Certification of Compliance 3
2.0 General Information 4
3.0 Test Facility 5
4.0 Test equipment 5
5.0 Data Reporting Format 6
6.0 Detector Functions 6
7.0 Frequency Range of Investigation 6
8.0 FCC Class Types 7
9.0 FCC Limits 8
10.0 Test Methods 9
11.0 Labeling Requirements 11
12.0 Summary of Measurements 12
APPENDIX A Data Plots 14
APPENDIX B Radiated Emissions 18
APPENDIX C Test Set-up Photographs 20

1.0 Certification of Compliance

Model : **TriScanner**

Description: Handheld battery operated tool for finding wall studs and metallic objects. Also detects the presence of electrical wires

Applicant: ZIrcon

Type of Test: FCC-15, Class B (Certification) part 15.209

Date of Test: December 28 and 29, 1998

Tested By: Shawn McGuiness

The above equipment was tested by Electronic Compliance Laboratories, Inc. and found to be in compliance with the requirements set forth in the FCC Rules and Regulations, Part 15, Subpart C (15.203, 15.205, 15.209). The equipment, in the configuration described in this report, shows that the maximum emission levels emanating from this equipment are within the compliance requirements.

_____ _____

Chris Byleckie Date
Technical Director

2.0 General Information

Applicant:	Zircon Corporation 1580 Dell Ave. Campbell, CA 95008
Contact Person:	Greg Heironimus
Equipment Under Test:	TriScanner
FCC ID#:	**N94TS1**
Report Number:	A904003
Date of Test:	December 28 and 29, 1998
Manufacturer:	ZIrcon
Type of Test:	FCC part 15, Subpart C, (15.203, 15.205, 15.209), Class B Digital Device.
Frequency Range:	30 MHz to 1000 MHz - Radiated Emissions, Class B 80 kHz to 800 kHz

Summary

Pass/Fail: Passed

15.209 Radiated Emissions:

The TriScanner meet all the requirements for Part 15.209 Class B limit. **See Appendix A and B for Data Sheet and plots**.

3.0 Test Facility

Name: Electronic Compliance Laboratories

Location: 1249 Birchwood Drive
Sunnyvale, CA 94089

Site Filing: A site description is on file at the Federal Communications Commission
P.O. Box 429
Columbia, MD 21045

Types of Sites: Open Field Radiated and Indoor (Screen Room).
Line Conducted: All sites are constructed and calibrated to meet ANSI C63.4-1994 requirements.
Test facility is recognized by the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations.

NVLAP Code: 20089 effective through: March 31, 1999

4.0 Test Equipment

The following list contains equipment used at EC Laboratories, Inc. for compliance testing. The equipment conforms to the American National Standard Specifications for Electromagnetic Interference and Field Strength Instrumentation from 10 kHz to 1000 MHz.

Description	Manufacturer	S/N	Model No.	Cal. Due Date
EMI Receiver	HP	3325A00137	8456A	5/3/99
Pre-amp	HP	313A06829	8447F	5/10/99
Biconical Antenna	EM	677	EM-6912	3/3/99
Log-Periodic Antenna	EM	858	EM-6950	4/18/99
Active Rod Antenna	EM	168	RVA-30	3/31/99

HP = Hewlett Packard
EM = Electro Metrics

The antenna used at the time the data was taken is indicated on each data page. The antenna height and polarization are also noted on the data pages.

The calibration of the measuring instruments, including any accessories that may effect such calibration, are checked frequently to assure their accuracy. Adjustments are made and correction factors applied in accordance with instructions contained in the manual for the measuring instrument.

5.0 Data Reporting Format

The measurement results are expressed in accordance with FCC Part-15, Subpart B Class B limits, where applicable, are presented in tabular or graphical form.

6.0 Detector Functions

On any frequency or frequencies below or equal to 1000 MHz, the limits shown below are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths.

On any frequency or frequencies above 1000 MHz, the radiated limits shown below are based on the use of measuring equipment employing an average detector function.

EC Laboratories uses the Peak detection mode for normal testing and initial screening of the EUT. The Peak detection mode will produce a measurement value that is always greater than, or equal to, the quasi-peak or average detection mode. Whenever the measurement value is 6 dB below the applicable limit or greater, the appropriate detector function will be employed and recorded.

7.0 Frequency Range of Investigation

The spectrum was investigated up to the frequency specified in the following table according to the highest clock frequency generated in the device.

Highest Frequency Used (Clock)	Upper Limit of Range Measured
Below 1.705 MHz	30 MHz
1.705 to 108 MHz	1000 MHz
108 to 500 MHz	2000 MHz
500 to 1000 MHz	5000 MHz
Above 1000 MHz	5th Harmonic or 40 GHz (Whichever is Lower)

8.0 FCC Class Types

Class A Digital Device

A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

Class B Digital Device

A digital device that is marketed for use in a residential environment notwithstanding use in a commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

Note: The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as a Class B device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a devices a Class B digital device, regardless of its intended use.
(Code of Federal Regulations, 47, Part 15, Subpart A, Sect. H&I)
(CFR 47, Parts 0 TO 19, Revised as of October 1,1990)

9.0 FCC Limits

9.1 Conducted Emission Limits

For a digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back into the AC power line on any frequency or frequencies within the band 450 kHz to 30 MHz shall not exceed the limits in the following table for the appropriate class. Compliance shall be based on the measurement of the Radio Frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

Frequency (MHz)	Class A Limit (µV)	Class A Limit (dBµV)	Class B Limit (µV)	Class B Limit (dBµV)
0.45 to 1.705	1000	60.0	250	48.0
1.705 to 30.0	3000	69.5	250	48.0

9.2 Radiated Emission Limits

The field strength of radiated emissions for a Class A Digital Device, when measured at a distance of 10 meters, shall not exceed the limits given in the table below. The lower limit applies at the band edge.

The field strength of radiated emissions for a Class B Digital Device, when measured at a distance of 3 meters, shall not exceed the limits given in the table below. The lower limit applies at the band edge.

Frequency (MHz)	Class A (3m) Limit (µV/m)	Class A (3m) Limit (dBµV/m)	Class A (10m) Limit (µV/m)	Class A (10m) Limit (dBµV/m)	Class B (3m) Limit (µV/m)	Class B (3m) Limit (dBµV/m)
30-88	300	49.6	90	39.1	100	40.0
88-216	500	54.0	150	43.5	150	43.5
216-960	700	56.0	210	46.4	200	46.0
Above 960	1000	60.0	300	49.5	500	54.0

10.0 Test Methods

10.1 Line Conducted Emissions Test Procedure

1. EUT and any other equipment and cables were placed on a wood table one meter above a ground screen.
2. The EUT's Input Power line cord was connected to a Line Impedance Stabilization Network (LISN) under the table.
3. All other (Non-EUT) equipment received power from a separate AC Power Source. The LISN assembly has two monitoring points: Line 1 (AC-Hot) and Line 2 (AC-Neutral). Each monitoring point was scanned by the measuring equipment (the other point was terminated in 50 ohms) over the frequency range of 450 kHz to 30 MHz for conducted emissions.
4. When an emission is found, the following takes place:
   a. The emission levels are maximized by equipment/cable placement.
   b. Frequency and emission level data are entered into computer in dBm.
   c. The monitoring point (Line 1 or 2) is entered into the computer.
   d. The computer converts dBm to micro volts and uses a look-up table to find cable losses (in dB) at that frequency, calculates a corrected emission level, and compares the corrected emission level to the appropriate limit. The data is then printed out in tabular form.

An example of the printout and definitions follows below.

10.1 Line Conducted Emissions Test Example

	Site	FCC Limit		EUT Level (L1)	
Freq	**Reading**	**A**	**B**	**A**	**B**
(MHz)	**(dBµV)**	**(dBµV)**		**(dB)**	
1.85	-57	69.5	48.0	-4.5	+17

Freq. = Frequency of emission in MHz
Reading dBµV = Reading at Spectrum Analyzer (Uncorrected)
FCC Limit A/B = Conducted Emission level limit in dBµV
EUT Level A* = Emission relative to the FCC Class A Limit
EUT Level B* = Emission relative to the FCC Class B Limit

Note = L1 is AC-Hot, L2 is AC-Neutral
QP is a Quasi-Peak value
AV is an average value

*A negative value indicates that the emission is below (or meets) the limit and a positive value indicates that the emission is above (or exceeds) the limit.

10.3 Radiated Emissions Test Procedure

1. EUT and any other equipment and cables used with the EUT were placed on a wood table one-meter above a ground screen.
2. The EUT receives the normal AC Power at the base of the table.
3. All equipment and cables are placed in a manner which tends to maximize their emission characteristics in a typical application.
4. The table was rotated 360 degrees to determine the maximum radial emissions.
5. The antenna was varied in height between 1 meter and 4 meters above the ground plane to determine the maximum emissions. Various antennas are used during the test in both the vertical and horizontal polarization.
6. The Spectrum Analyzer is scanned from 30 MHz to 1000 MHz for emissions. The applicable spectrum analyzer settings are:
   a. Resolution Bandwidth = 100 kHz,
   b. Normal Detector Mode = Peak (The Quasi-Peak is used when the emissions are near, or over the limit).
7. When an emission is found and maximized, the following actions are performed:
   a. The emission frequency is entered into the computer.
   b. The emission level is read from the spectrum analyzer in dBm and entered into the computer.
   c. The antenna polarization is entered into the computer.
   d. The computer converts the level in dBm to dBµV and uses lookup tables to determine the coax cable loss, antenna factor, and pre-amp gain. A site correction factor is calculated for that particular frequency, and the data is printed out in tabular form.

10.4 Radiated Test Example

	Site	FCC Limit		EUT Level (QP)	
Freq	**Reading**	**A**	**B**	**A**	**B**
(MHz)	**(dBµV)**	**(dBµV)**		**(dB)**	
65.4	-58	39.1	40.0	-4.6	-5.5

Freq. = Frequency of emission in MHz.
Reading dBµV = Reading at Spectrum Analyzer (Uncorrected)
FCC Limit A/B = Limit in dBµV as stated in Part-15, Subpart B
EUT Level A* = Emission level relative to the FCC Class A limit
EUT Level B* =Emission level relative to the FCC Class B limit.

Note = V/H is the antenna polarization (Vertical or Horizontal)
PK indicates a Peak Value
QP indicates the Quasi-Peak value.

*A negative value indicates that the emission is below (or meets) the limit and a positive value indicates that the emission is above (or exceeds) the limit.

11.0 Labeling Requirements

EUT LABEL REQUIREMENTS - Class B Digital Device

A CLASS B Digital Device subject to Certification by the FCC shall bear the following statement in a conspicuous location on the device.

> This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The label is to be located in a "conspicuous location". This is any location readily visible to the user of the device without the use of tools.

The label is to be permanently attached to the equipment in such a manner that the label can normally be expected to remain fastened and legible during the equipment's expected useful life.

Where the device is constructed in two or more sections connected by wires and marketed together, the statement specified in this section is required to be affixed only to the main control unit.

When the device is so small or for such use that it is not practicable to place the statement specified above on it, this required information shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier must be displayed on the device.

USERS MANUAL REQUIREMENTS - Class B Digital Device

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the user's operation manual.

NOTE: This equipment has been tested and found to comply with the limits for Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio and television reception, which can be determined by Turning the equipment off and on, the user is encouraged to try to correct the

- Re-orient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit, different from that which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For systems incorporating several digital devices, the statement shown above, needs to be contained only in the instruction manual for the main control unit.

Where special accessories, such as shielded cables, are required in order to meet FCC emission limits, appropriate instructions regarding the need to use such accessories must be contained in the operator's manual.

The operators manual must caution the user that changes or modifications not expressly approved by the manufacturer could void their right to operate the equipment.

The above radio interference statement is to be bound in the same manner as the operators manual. A loose-leaf insert page in a bound manual would not meet this requirement.

12.0 Summary of Measurements

CFR Title 47, Part 15.209

Manufacturer: ZIrcon.
1580 Dell Ave.
Campbell, CA 95008
Contact: Greg Heironimus
FCC ID: N94TS1
Test Report Number: A904003

The VideoScanner and the TriScanner are hand held, battery operated devices used to detect studs or metallic objects in walls. Both devices use the same circuitry to generate the 80 kHz signal used in detecting metal. Since both products do have the same transmitter the will both have the same FCC ID.

Intentional radiator operating below 1.705 kHz

15.209 Radiated Emissions

The TriScanner were operating normally during this test. The EUT was placed near one edge of a wooden table resting on a turntable. The wooden table was approximately 1 meter above the groundplane of the 3 meter test site. Due to the extremely low output power of the EUT the search antenna was located at 1 meter. Measurements were made in accordance with ANSI C63.4-1994.

There were no emissions visible above the noise floor. The product was then moved indoors and the intientional emissions were measured using a near filed probe. In order to see the emissi**Test Data is in Appendix C**.

15.205 Restricted Bands - Emissions Within Restricted Bands

The TriScanner has no emissions in the restricted bands.

15.203 Antenna Connector

The TriScanner do not use an antenna. The closest part to an antenna would be the inductor sensor coil that is part of the LC oscillator circuit. **See the TS Metal Theory documants for details.**

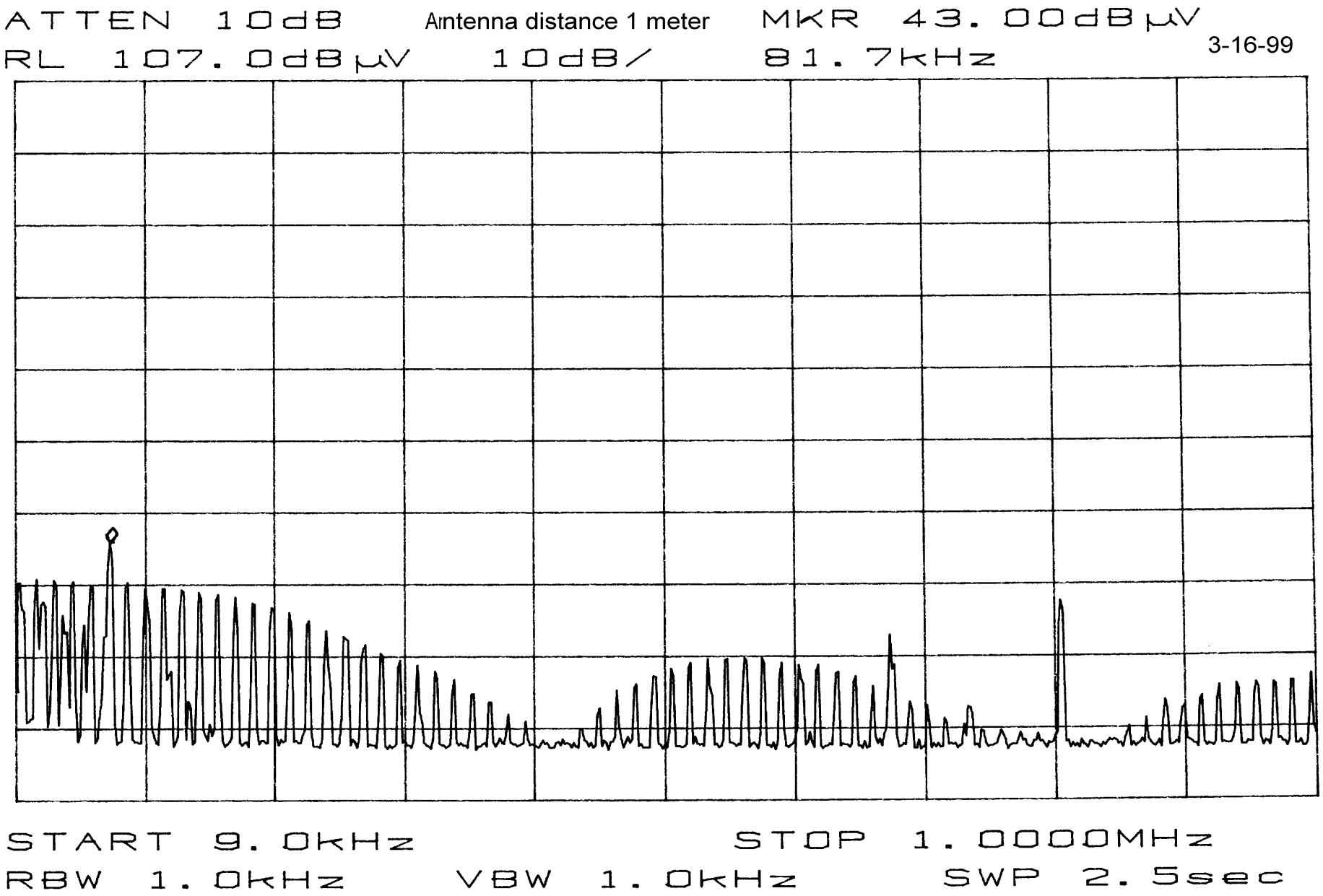
APPENDIX A
Transmitter Data Sheet

FCC RADIATED DATA SHEET

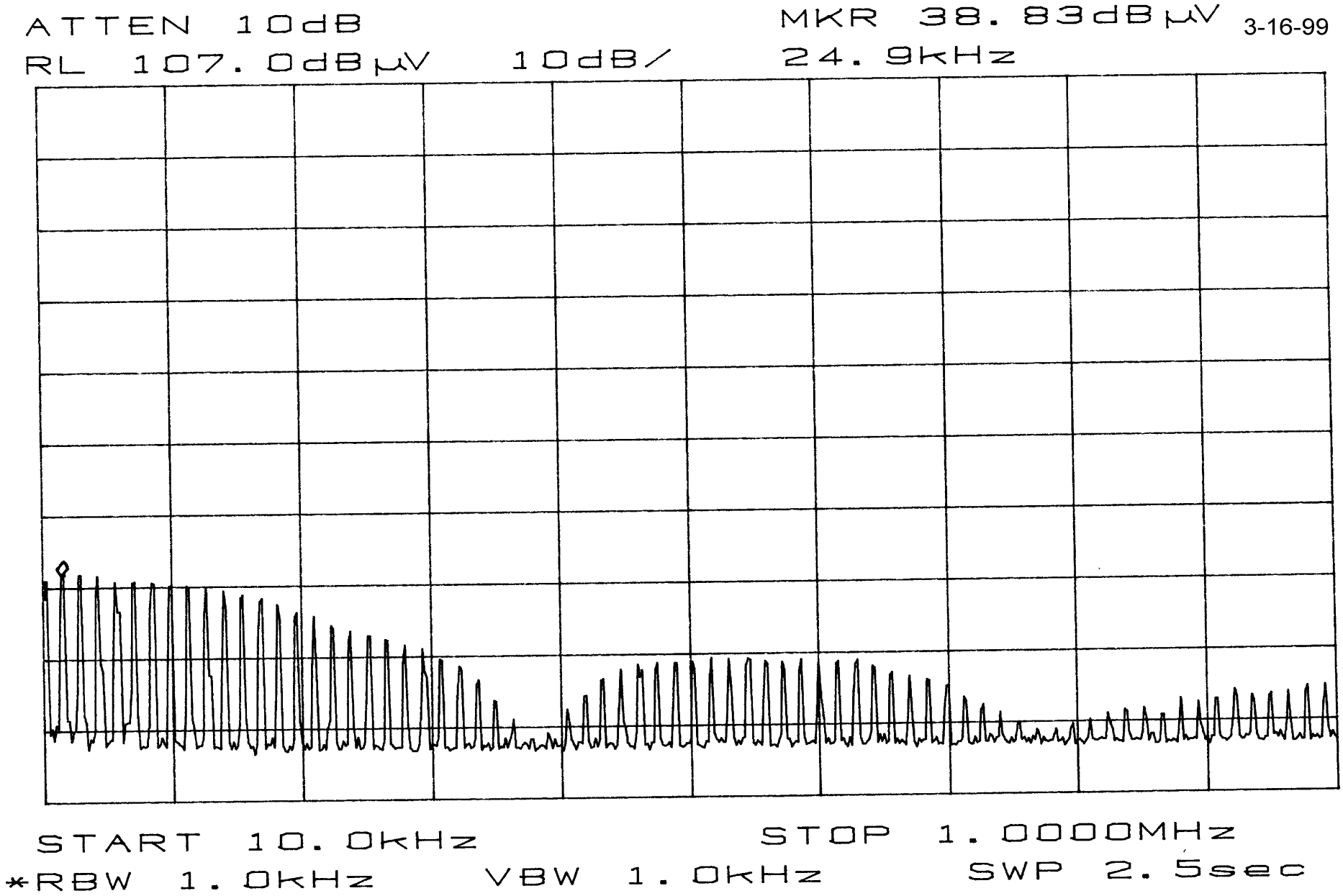
		DATE:	3/16/99
EUT:	Triscanner	**CUSTOMER NAME:**	Zircon
Rule Part:	15.209	**WORK ORDER:**	81220202Aa
		FILE:	8122202Aa.xls
Antenna:	Rod	**ATTN dB:**	0.0
Modulation Type:		**DUTY dB:**	0.0
Tested By:	Chris	**HP IL dB:**	0.0
Comments:	1 meter antenna distance	**DIST dB:**	50 from .009 to .490MHz

FREQ. MHz	READING dB(uV)	Pk, QP, or Av	A.F. dB	Cable loss dB	AMP dB	O.C.F. dB	TOTAL, dB(uV/m)	LIMIT dB(uV/m)	DELTA dB
0.082	43.0	PK	17.5	0.1	0.0	50.0	10.62	29.5	-18.9

Zircon N94TS Triscanner Fundamental Mesurement



Ambient signal during N94TS measurements



APPENDIX B

15.209 Radiated Emissions Data

Electronic Compliance Laboratories, Inc.
1249 Birchwood Ave.
Sunnyvale, CA

Radiated Emissions
Frequency range: 30MHz-1000MHz

3 Meter Open Site
Site Calibrated: June 1997

Government Agency and Limit: FCC Class B

QP = Quasi-Peak Note: Ignore peak readings when Quasi-Peak reading exists
PK = Peak

Customer:	ZIRCON	Operator:	SHAWN
Date:	12-23-1998	Time:	11:21:25
Temperature Range:	50 Deg F	Percent Humidity:	50
E.U.T.:	TRISCANNER		
Serial Number:	PROTO		
Modifications:	None		
Report File Name:	F:\TESTDATA\8122202A.RF		

Antenna Type: BICONICAL

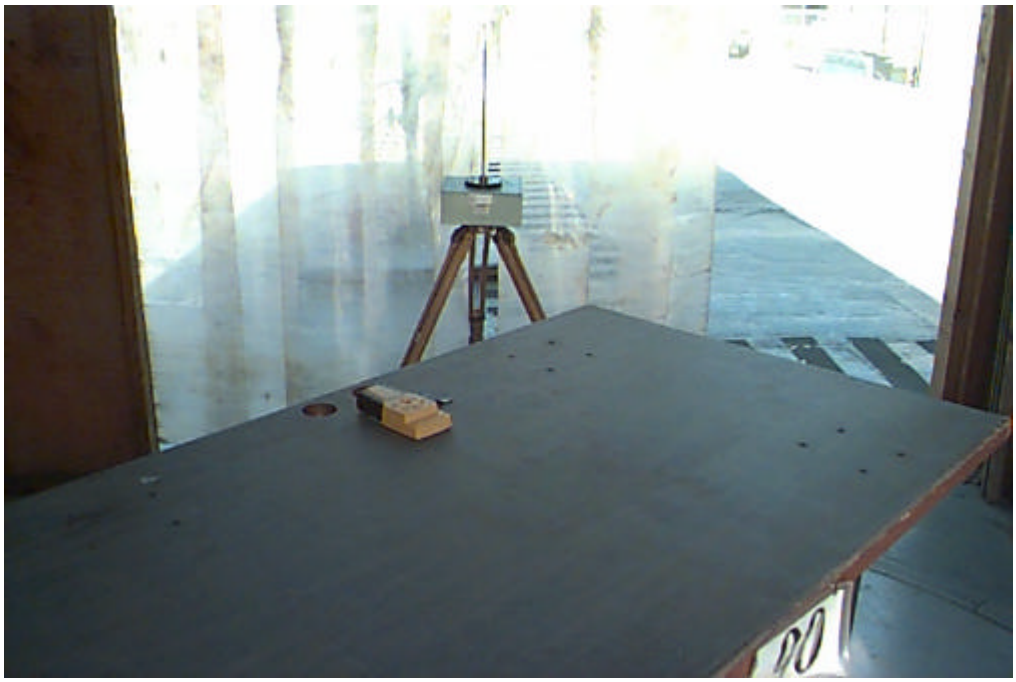
TEST FREQ	TEST dBuV	ACTUAL dBuV/m	CLASS B LIMIT	VERSUS B LIMIT	TABLE DEGREES	ANTENNA HEIGHT	POLAR-IZATION	DETECTOR Type
35.800	40.3	31.5	40.0	-8.5	45	2.0	V	PK
45.420	41.3	29.2	40.0	-10.8	0	2.0	V	PK
50.330	44.8	31.0	40.0	-9.0	45	2.0	V	PK
60.500	42.2	25.7	40.0	-14.3	45	2.0	V	PK
144.800	42.3	32.7	43.5	-10.8	45	2.0	V	PK
178.600	36.6	27.9	43.5	-15.6	180	2.0	V	PK
228.200	31.3	23.7	46.0	-22.3	90	1.5	H	PK
144.800	38.0	28.4	43.5	-15.1	90	2.0	H	PK
114.800	38.3	26.8	43.5	-16.7	180	1.5	H	PK
		CHANGED ANTENNA TO LOG PERIODIC						
315.500	32.0	22.9	46.0	-23.1	90	2.0	V	PK
336.300	32.0	23.0	46.0	-23.0	90	1.5	V	PK
336.450	29.6	20.6	46.0	-25.4	180	1.5	H	PK

APPENDIX C

Test Set-up Photographs

TriScanner

15.209 Radiated Emissions



15.205 Restricted Band