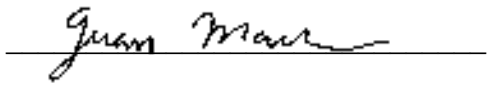
Electromagnetic Emissions Test Report In Accordance With Industry Canada Radio Standards Specification 133 & FCC Part 24 Subpart E on the Repeater Amplifier Model: RC19-2X15

GRANTEE:	Repeater Technologies 1150 Morse Avenue Sunnyvale, CA 94089-1605
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Ave Sunnyvale, CA 94086
REPORT DATE:	April 01, 2002
FINAL TEST DATE:	March 25, 2002
AUTHORIZED SIGNATORY:	

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FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part 2, Subpart J, Section 2.1033(C) & to Industry Canada RSP-100.

2.1033(c)(1) Applicant: Repeater Technologies
1150 Morse Avenue
Sunnyvale, CA 94089-1605

2.1033(c)(2) & RSP-100 (4) FCC ID: EK2RC1930C
Industry Canada Certification Number: IC: 2884-RC1930C

2.1033(c)(3) & RSP-100 (7.2(a)) Instructions/Installation Manual

Please refer to Exhibit 7: User Manual, Theory of Operation

2.1033(c)(4) & RSP-100 (7.2(b)(iii)) Type of emissions

1M24F9W

2.1033(c)(5) & RSP-100 (7.2(a)) Frequency Range

Forward: 1931.25 – 1988.75 MHz
Main and Diversity Reverse: 1851.25 – 1908.75 MHz

2.1033(c)(6) & RSP-100 (7.2(a)) Range of Operation Power

Forward: 15.1 Watts (41.8 dBm)
Reverse: 0.1 Watt (20 dBm)

2.1033(c)(7) & RSP-100 (7.2(a)) Maximum FCC & IC Allowed Power Level

24.232(a) & RSS-133 (6.2): In no case may the peak output power of a base station transmitter exceed 100 watts.

24.235(b) & RSS-133 (6.2): Mobile/portable stations are limited to 2 watts E.I.R.P. peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

2.1033(c)(8) & RSP-100 (7.2(a)) Applied voltage and currents into the final transistor elements

5Vdc, 2 amps

2.1033(c)(9) & RSP-100 (7.2(a)) Tune-up Procedure

Tune-Up Procedure is located in the Exhibit 7: User Manual Chapter 7

2.1033(c)(10) & RSP 100 (7.2(a)) Schematic Diagram of the Transmitter

Refer to Exhibit 6. The schematic diagram

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Frequency Stabilization

Part location is Y1, TXCO stability clock provides a 9.6 MHz reference clock that has a +/- 2 ppm stability, Schematics (S87-1039-10) Page 1 of 7.

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Suppression of Spurious radiation

For more information please refer to Exhibit 7: Theory of Operation and Schematics (S87-1039-10) Page 2 of 7

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Limiting Modulation

For more information please refer to Exhibit 7: Theory of Operation.

2.1033(c)(10) & RSP-100 (7.2(a)) Means for Limiting Power

Power is limited by Software means. Please refer to Exhibit 7: User Manual page 5-1 to 5-15.

2.1033(c)(11) & RSP-100 (7.2(g)) Photographs or Drawing of the Equipment Identification Plate or Label

Refer to Exhibit 4

2.1033(c)(12) & RSP-100 (7.2(c)) Photographs of equipment

Refer to Exhibit 5

2.1033(c)(13) & RSP-100 (7.2(a)) Equipment Employing Digital Modulation

The repeater does not produce the CDMA internally. The repeater will only provide amplification for the transmission of CDMA modulation.

2.1033(c)(14) & RSP-100 (7.2(b)(ii)) Data taken per Section 2.1046 to 2.1057 and RSS-133 issue 2, Rev. 1.

Refer to Exhibit 2

SCOPE

FCC Part 24 Subpart E & IC RSS-133 testing was performed for the equipment mentioned in this report. The equipment was tested in accordance with the procedures specified in Sections 2.1046 to 2.1057 of the FCC Rules & in IC RCC-133. TIA-603 was also used as a test procedure guideline to perform some of the required tests.

The intentional radiator above was tested in a simulated typical installation to demonstrate compliance with the relevant FCC & RSS performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the FCC Rules part 24 Subpart E & IC RSS-133. Certification of these devices is required as a prerequisite to marketing as defined in Section 2.1033 & RSP-100.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to FCC & Industry Canada. FCC & Industry Canada issues a grant of equipment authorization and a certification number upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product that may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

Section 2.1046: RF Power Output
RSS-133 (6.2): RF Power Output

The RF Power Output was tested to Section 24.213(a) & (b) and RSS-133 (6.2)

The following modulations were tested: CDMA

Procedure used: **B**

Result: Maximum Forward Power is 41.8 dBm. Maximum Reverse Power is 20.0 dBm

Refer to Setup Photo# 1 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1047: MODULATION CHARACTERISTICS

Section 2.1047 (d) Other types of equipment.

Other types of modulations were tested to Section 24.238 (b).

The following modulations were tested: CDMA

Procedure used: **H & C**

Result: 1.24 MHz for the output.

Refer to Setup Photo# 1 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1049: OCCUPIED BANDWIDTH
RSS-133 (5.6): Definition of Bandwidth

The Occupied Bandwidth was tested to Section 24.238 (b) and RSS-133(5.6).

The following modulations were tested: CDMA

Procedure used: **D & C**

Result: 1.24 MHz Wide

Refer to Setup Photo# 1 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1051: SPURIOUS EMISSION AT ANTENNA TERMINAL.
RSS-133 (6.3): Unwanted Emission

The Spurious Emission at the Antenna terminal was tested to Section 24.232(a)(b) & (c) and RSS-133 (6.3)

The following modulations were tested: CDMA

Procedure used: **I & J**

Result: The worst-case measured Bandedge value is –14.5 dBm. The worst-case measured value for the Out-of-Band is –18.67 dBm.

Refer to Setup Photo# 1 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1053: FIELD STRENGTH OF SPURIOUS RADIATION.
RSS-133 (6.3): FIELD STRENGTH OF SPURIOUS RADIATION.

The Field Strength was tested to Section FCC 24.238(a) and RSS-133 (6.3)

Procedure used: **N**

Result: -25.7 dB @ 11,625 MHz

Refer to Setup Photo# 2 in Exhibit 3 and the test data in Exhibit 2: Test Measurement Data for full details.

SECTION 2.1055: FREQUENCY STABILITY
RSS-133 (7): FREQUENCY STABILITY

The Repeater contains a +/- 2-ppm stability clock

FCC 24.235 & RSS-133 (7) states: "The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block."

The carrier is 1.25 MHz wide centered at these frequencies (Forward: 1931.25 to 1988.75 MHz; Reverse: 1851.25 to 1908.75 MHz. IE 1931.25 MHz would have the f_c centered at 1931.25 MHz with a band width of 1.25Mhz or 1930 to 1932.5 MHz. This provides a guard band of 1.25 MHz (1931.25 MHz - 1930 MHz).

The RC19-2X15 is designed with a +/- 2-ppm XTAL over temperature. Based on the tolerance of the XTAL and the 1.25 MHz guard band for both 1930 and 1990 MHz, bandedges, the device will maintain emissions within the PCS bands under normal operating conditions.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on March 28, 2002 at the Elliott Laboratories Open Area Test Site # 4 located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to Section 2.948 of the FCC Rules, construction, calibration, and equipment data has been filed with the Commission.

Departmental Acknowledgement Number: IC2845 **SV4,** Dated July 19, 2001

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing are performed in conformance with Section 2 of FCC Rules. Measurements are made with the EUT connected to a spectrum analyzer through an attenuator to prevent overloading the analyzer.

RADIATED EMISSIONS CONSIDERATIONS

Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR 16-1 defined elliptical area.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers are capable of measuring over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the particular detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. If average measurements above 1000MHz are performed, the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz is used.

INSTRUMENT CONTROL COMPUTER

A personal computer is utilized to record the receiver measurements of the field strength at the antenna, which is then compared directly with the appropriate specification limit. The receiver is programmed with appropriate factors to convert the received voltage into filed strength at the antenna. Results are printed in a graphic and/or tabular format, as appropriate.

The test receiver also provides a visual display of the signal being measured.

POWER METER

A power meter and thermister mount may be used for output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or EUT and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transmitters and transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

The requirements of ANSI C63.4 were used for configuration of the equipment turntable. It specifies that the test height above ground for table-mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An appendix of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

General: For Transmitters with detachable antenna, direct measurements for output power, modulation characterization, occupied bandwidth, and frequency stability are performed with the antenna port of the EUT connected to either the power meter, modulation analyzer, or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the transmitter fundamental will not overload the front end of the measurement instrument.

Procedure B – Power Measurement (Conducted Method): The following procedure was used for transmitters that do use external antennas.

1) Set the EUT to maximum power and to the lowest channel.
2) Either a power meter or a spectrum analyzer was used to measure the power output.
3) If a spectrum analyzer was used a resolution and video bandwidth 1MHz was used to measure the power output. Corrected for any external attenuation used for the protection of the input of analyzer. In addition, For CDMA or TDMA modulations set spectrum analyzer resolution to 1MHz and video to 30 kHz. Use video averaging with a 100 sample rate.
4) If a power meter was used, corrected for any external attenuation used for the protection of the input of the sensor head. Also set the power sensor correction by setting up the frequency range that will be measured.
5) Repeat this for the high channel and all modulations that will be used and all output ports used for transmission

Procedure C – Amplifier Bandwidth (Conducted Method): If the EUT is an amplification device the following procedure was performed:

1) Set the EUT to maximum power and to the lowest channel. Set the Resolution and Video Bandwidth to 30 kHz, with no averaging. These settings were used to show the true representation of the signal bandwidth.
2) Made a plot of the EUT output port and label it "Output"
3) With the same setting on the spectrum analyzer connect the cable that was connected to the input port of the amplifier to the analyzer. Made a plot and label it "Input"
4) Repeat this for the high channel and all modulations that will be used and all output ports used for transmission

Procedure D - Occupied Bandwidth (Conducted Method): Either for analog, digital, or data modulations, occupied bandwidth was performed. The EUT was set to transmit the appropriate modulation at maximum power. The bandwidth was measured using following methods:

1) The built-in 99% function of the spectrum analyzer was used.
2) If the built-in 99% is not available then the following method is used:

   26-dB was subtracted to the maximum peak of the emission. Then the display line function was used, in conjunction with the marker delta function, to measure the emissions bandwidth.

3) For the above two methods a resolution and video bandwidth of 30 kHz was used to measure the emission's bandwidth.

Procedure H - Other Types of Equipment: Either digital or data modulated signals were simulated, by software or external sources, to performed the required tests. The EUT was set to transmit the appropriate digital modulation.

Procedure I – Bandedge: Where Bandedge measurements are specified the following procedure was performed:

1) Set the transmitting signal as close as possible to the edge of the frequency band/block per 24.232(a)(b) & (c). Power is set to maximum
2) Set the spectrum analyzer display line function to –13 dBm.
3) Set the spectrum analyzer bandwidth to 30 kHz. Which is the minimum 1 % of the emission bandwidth. Per FCC, if a resolution, less then the calculate 1% is used, for the Bandedge measurement, then the following formula is to be used to correct the measured value (10*log (1% RB / RB used)).
4) Set the marker function to the FCC specified frequency band/block.
5) Set the spectrum analyzer span to show any emission within 2 MHz above or below the frequency band/block. All spurious or intermodulation emission must not exceed the –13 dBm limit.
6) Steps 1 to 3 were repeated for all modulations and output ports that will be used for transmission..

Procedure J – Antenna Conducted Emissions: For spurious emission measurements at the antenna terminal the following procedure was performed:

1) Set the transmitting signal as close as possible to the edge of the frequency band/block per 24.232(a)(b) & (c). Power is set to maximum
2) Set the spectrum analyzer display line function to –13-dBm.
3) Set the spectrum analyzer bandwidth to 1 MHz.
4) For the spectrum analyzer, the start frequency was set to 30 MHz and the stop frequency set to 20 GHz. All spurious or intermodulation emission must not exceed the –13 dBm limit.
5) Steps 1 to 3 were repeated for all modulations and output ports that will be used for transmission.

Procedure N - Field Strength Measurement: The EUT was set on the turntable and the search antenna position 3 meters away. The output antenna terminal was terminated with a 50-ohm terminator. The EUT was set at the middle of the frequency band and set at maximum output power.

For the first scan, a pre-liminary measurement is performed. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. One or more of these is with the antenna polarized vertically while the one or more of these are with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

For the final measurement, Substitution method is performed on spurious emissions not being 20-dB below the calculated radiated limit. Substitution method is performed by replacing the EUT with a horn antenna, which factors can be reference to a half-wave dipole, and with a signal generator. The signal generator power level was adjusted until a similar level, which was measured on the first scan, is achieved on the spectrum analyzer. The level on the signal generator is than added to the antenna factor, in dBi, which will give the corrected value.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

RADIATED EMISSIONS SPECIFICATION LIMITS

The limits for radiated emissions are based on the power of the transmitter at the operating frequency. Data is measured in the logarithmic form of decibels relative to one milliwatt (dBm) or one microvolt/meter (dBuV/m,). The field strength of the emissions from the EUT is measured on a test site with a receiver.

Below is a formula example used to calculate the attenuation requirement, relative to the transmitters power output, in dBuV/m. For this example an operating power range of 3 watts is used. The radiated emissions limit for spurious signals outside of the assigned frequency block is $43+10\text{Log}_{10}$ (mean output power in watts) dB below the measured amplitude at the operating power.

CALCULATIONS – EFFECTIVE RADIATED POWER

$$E(V/m) = \frac{\sqrt{30 * P * G}}{d}$$

E= Field Strength in V/m
P= Power in Watts (for this example we use 3 watts)
G= Gain of antenna in numeric gain (Assume 1.64 for ERP)
d= distance in meters

$$E(V/m) = \frac{\sqrt{30 * 3 \text{ watts} * 1.64 \text{ dB}}}{3 \text{ meters}}$$

20 * log (4.049 V/m * 1,000,000) = 132.14 dBuV/m @ 3 meters

FCC Rules request an attenuation of 43 + 10 log (3) or 47.8 dB for all emissions outside the assigned block, the limit for spurious and harmonic emissions is:

132.1 dBuV/m – 47.8 dB = 84.3 dBuV/m @ 3 meter.

Note: Substitution Method is performed for spurious emission not being 20-dB below the calculated field strength.

EXHIBIT 1: Test Equipment Calibration Data

EXHIBIT 2: Test Measurement Data

The following data includes conducted and radiated emission measurements of the Repeater Technologies, Model No: RC19-2X15.

T46670 23Pages

EXHIBIT 3: Photographs of Test Configuration

EXHIBIT 4: FCC ID Label and Location

2 pages

EXHIBIT 5: Internal and External Photos

External Photographs	4 Pages
Internal Photographs	9 Pages

EXHIBIT 6: Schematics

5 files

EXHIBIT 7: User Manual, Theory of Operation, and Tune-Up procedure