EXHIBIT T – Technical Report

FCC ID# PURRFU7

Measurement/Technical Report

RadioFrame Networks™, Inc., iDEN RadioBlade

FCC ID: PURRFU7

August 22, 2001

This report concerns (check one):	Original Grant__x_ Class II Change_____
Equipment Type Licensed, Non-Broadcast Station Transmitter	Rule Part: 90.691
Deferred grant requested per 47 CFR 0.457 (d)(1)(ii)?	yes_____ no__X__
If yes, defer until:	_____N/A_____ date
RadioFrame Networks™, Inc. agrees to notify the Commission by:	_____N/A_____ date
of the intended date of announcement of the product so that the grant can be issued on that date.	
Report prepared by:	Northwest EMC, Inc. 22975 NW Evergreen Parkway, Suite 400 Hillsboro, OR 97124 (503) 844-4066 fax: (503) 844-3826

Report No. RAFN0007

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1.0 General Information

1.1 Product Description

Manufactured By ..... RadioFrame Networks™, Inc..

Address ..... 18211 NE 68th St. Suite E-120, Redmond, WA 98052

Test Requested By: ..... Jason Gardner

Model ..... iDEN RadioBlade

FCC ID PURRFU7

Applicable FCC Rule Part(s) 90.691

Serial Number(s) 170, 148, 101, 108, 110, 111, 114, 118, 121

Date of Test ..... July 27, 2001 through August 22, 2001

Job Number RAFN0007

Prepared By:

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Vicki Albertson, Technical Report and Documentation Manager

Technical Review By:

Greg Kiemel, Director of Engineering

Approved By:

Donald Facteau, IS Manager

1.1 Product Description con't

The Equipment Under Test (EUT) is the RadioFrame Networks™, Inc. iDEN RadioBlade. The transmitter is part of the RadioFrame System. The following is a description of the major components of that system:

RadioFrame System (RFS)

The RFS is an indoor wireless system intended to operate as a collection of 100-foot radius cells. Each cell covers roughly 32,000 sq. ft. The cells each may offer either iDEN or WLAN interfaces, or both. A single RFS supports up to a collection of 64 cells or approximately 2 million sq.ft. All features are supported seamlessly within the RFS, i.e. handoff, call delivery, etc.

RadioFrame Unit (RFU)

Users communicate via their wireless devices to a RFU. Although more than one RFU may be available to a user, a particular RFU will be designated based on signal strength or other parameters. The user can move while communicating in which case the communication link will be handed over to the new best serving RFU or macro cell. The RFU provides the RF front ends for each of the air interface implementations in operation. The RFU also provides the means to effectively communicate baseband digital information to and from the network. The RFU down converts, samples, formats and forwards baseband information through a high speed Ethernet link to a central airlink processing unit called the Airlink Chassis Unit (CU). The RFU provides a B interface to the ACU. Physically, the RFU is a small, ceiling mounted box that houses Printed Circuit Board (PCB) modules, called RadioBlades (RBs), connected together through a backplane PCB. The RFU is remotely powered from the ACU for ease in deployment.

Airlink Chassis Unit (ACU)

The Airlink Chassis Unit (ACU) is the central airlink baseband processing unit for the RFS. The ACU receives airlink traffic from and sends airlink traffic to as many as 8 RFUs simultaneously.

iDEN RadioBlade (Equipment Under Test)

iDEN is a digital communication standard created and maintained by Motorola. RadioFrame Networks has a license to iDEN technology in order to build iDEN products..

The iDEN RadioBlade provides a single RF channel in the SMR band. The iDEN RadioBlade provides frequency conversion for a single, 25 kHz, FDMA channel in the uplink from 806 to 824 MHz and in the downlink from 851 to 869 MHz. The particulars of the airlink can be found in supporting Motorola documentation.

In the uplink, the iDEN RB will perform quadrature demodulation of the FDMA waveform from the mobile to produce baseband in-phase (I) and quadrature (Q) components for digitization. The signal will then be sampled to produce a digital data stream for transfer to the Airlink Chassis Unit. The samples will be packaged as Ethernet packets for deliver to the ACU. In the downlink, the RB will receive Ethernet packets containing sample data from the ACU and reconstruct the analog baseband FDMA waveform for frequency upconversion and transmission over the air to the mobile handset. The RB will also distribute the appropriate power, clock and framing signals from the ACU

Please see Exhibit "H", file name**: **Operational Description.pdf

Hardware Description:

- Frequency Range: 851.0125 MHz to 869.9875 MHz
- Output Power: Tune-able: Max = 13.8 mW, Min = 3.5uW
- Modulation: 16 QAM
- Channel Bandwidth: 25 kHz
- Necessary Bandwidth: 18 kHz
- Emission Designator: D7W
- Frequency Stability: 0.02 PPM
- Antenna: Astron Antenna Co., AXQ8SM-32S, 1/4 wave whip antenna.

1.2 Related Submittals/Grants

None

1.3 Tested System Details

EUT and Peripherals

Item	Description and Serial No.
EUT	RadioFrame Networks™, Inc., iDEN RadioBlade, FCC ID PURRFU7, S/Ns 170, 148, 101, 108, 110, 111, 114, 118, 121
RFU	RadioFrame Networks™, Inc., RadioFrame Unit, 7 Slot, Frame, S/N none

Cables:

Cat5 Network cable	10.0 meters in length, shielded, no ferrites, connected from RFU Input to remote chassis unit.
AC Power	1.8 meters in length, unshielded, no ferrites, connected from AC input of RFU to 120 V mains.

1.4 Test Methodology

TIA/EIA-603 (1993)

1.5 Test Facility

Northwest EMC, Inc.
14128 339th Avenue SE
Sultan, WA 98294
Ph. (360) 793-8675
FAX (360) 793-2536

The Open Area Test Site, and conducted measurement facility used to collect this data is located at the address shown above. This site has been fully described in a report filed with the FCC, dated August 13, 1999, and accepted by the FCC in a letter dated August 30, 1999 (95296).

Northwest EMC, Inc. is recognized under the United States Department of Commerce, National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. NVLAP Lab Code: 200059-0.

2.0 Technical Description

2.1 Type of Emission

The device has D7W emission.

2.2 Frequency Range

The device has a frequency range of 851.0125 to 869.9875 MHz.

2.3 Operating Power Level

The power output for the iDEN RadioBlade device is Tune-able: Max = 13.8 mW, Min = 3.5uW Maximum conducted output power is limited to 13.8 mW.

2.4 DC Voltage and Current Applied

The power amplifier operates directly off the VCC_3.3 line from the RFU back plane, filtered through C126, an EMI filter. The PA draws approximately 450mA at +8dBm antenna connector output.

2.5 Schematics and Bill of Materials

Schematic diagrams of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power are provided as separate attachments.

Schematics may be referenced in Exhibit "J", file name: Schematics.PDF
The Bill of Materials may be referenced in Exhibit "K", file name: Bill of Materials.PDF

2.6 Block Diagram

A Block Diagram of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power are provided as separate attachments..

Block Diagrams may be referenced in Exhibit "F", file name: Frequency Block Diagram.PDF.

2.7 Circuit Description

A circuit description (relating to the block diagram) of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power is provided as a separate attachment.

A circuit description may be referenced in Exhibit "H", file name: Operational Description.pdf

2.8 Tune-up Procedure

A description of the Tune-up procedure is provided as a separate attachment.

A Tune-up procedure may be reference in Exhibit "Q", file name: Tune-up Procedure.pdf

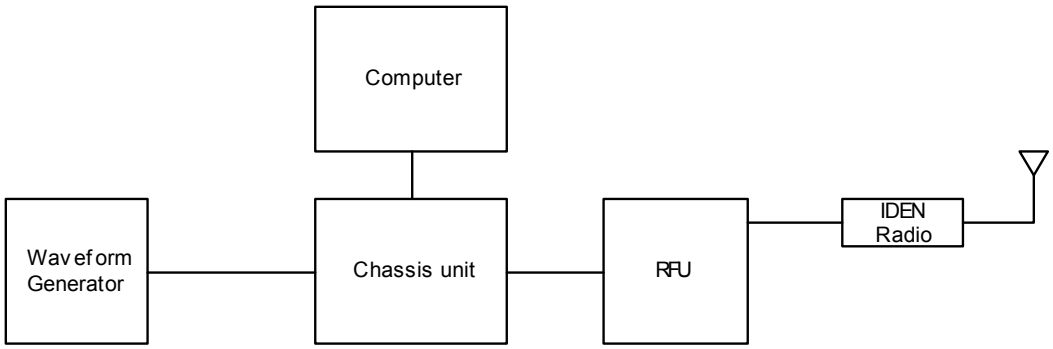
2.9 Description of Modulation System

The following is a general description of the modulation system to be used:

Ethernet data is sent to the iDEN RadioBlade from the RFU backplane and within the RadioBlade is forwarded to two, digital-to-analog converters. The data is converted to analog baseband I & Q signals using a 54kHz clock, filtered to remove sampling energy with a 16kHz low-pass filter and sent to an IQ-modulator for upconversion to RF.

A detailed description of the modulation system may be found in Section 5.2.2 of the Operational Description (page 10 of Exhibit "H", file name: Operational Description.pdf)

Figure 2.1: Configuration of Tested System



3.0 RF Conducted Power Output Data

Reference 2.1046 and 90.217, 90.691

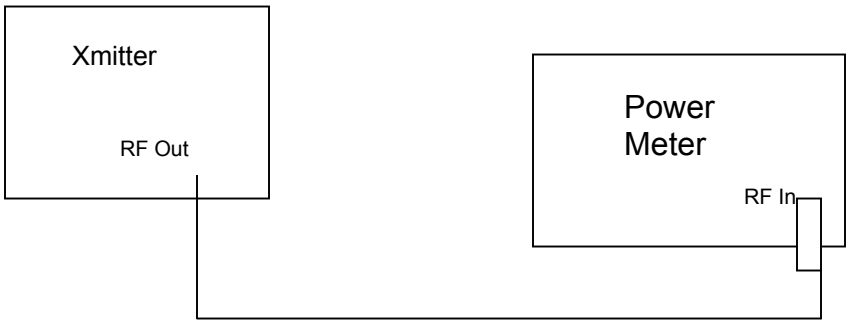
The Conducted Power Output was measured at the RF output terminals after the tune-up procedure. The measured value, the value stated in the manual, and the value on Form 731 must agree.

A spectrum analyzer or power meter may be used to measure the output power of the unmodulated carrier. If using a spectrum analyzer, the resolution bandwidth should be greater than the 6dB bandwidth of Xmit signal.

An external attenuator or directional coupler is usually needed.

The iDEN RadioBlade measurements were made at high, mid, and low transmit frequencies at the lowest and the highest power settings.

Test Setup



3.1 Test Results

Reference Exhibit "N", file name Output Power.PDF for the data.

4.0 Modulation Characteristics Data

Reference 2.1047 (Audio characteristics not required for digital transmitters),

The emission designator “D7W” was selected based upon the guidelines provided by Frank Coperich of the FCC for transmitters that use QAM modulation.

The following is a general description of the modulation system to be used:

Ethernet data is sent to the iDEN RadioBlade from the RFU backplane and within the RadioBlade is forwarded to two, digital-to-analog converters. The data is converted to analog baseband I & Q signals using a 54kHz clock, filtered to remove sampling energy with a 16kHz low-pass filter and sent to an IQ-modulator for upconversion to RF.

A detailed description of the modulation system may be found in Section 5.2.2 of the Operational Description (page 10 of Exhibit “H”, file name: Operational Description.pdf)

5.0 Necessary Bandwidth

Reference 2.202(b)

The necessary bandwidth for the iDEN RadioBlade is as follows:

Subcarrier bandwidth factor = 1.2

Symbol rate = 4.0

Subcarrier BW = 1.2 * 4.0 = 4.8 kHz

The spacing between the two outer identical QAM sub-carriers centered on –6750 Hz and +6750 Hz is 13.5 kHz. Adding each half-BW of the two outer sub-carriers gives:

Necessary Bandwidth = 13.5 kHz + (2 * 2.4 kHz) = 18.3 kHz

6.0 Occupied Bandwidth Data

Reference 47 CFR 90.691 and 2.1049

The Occupied Bandwidth was measured at the RF output terminals.

An external attenuator or directional coupler usually needed (iDEN testing performed with 20dB external attenuator. This is compensated in analyzer).

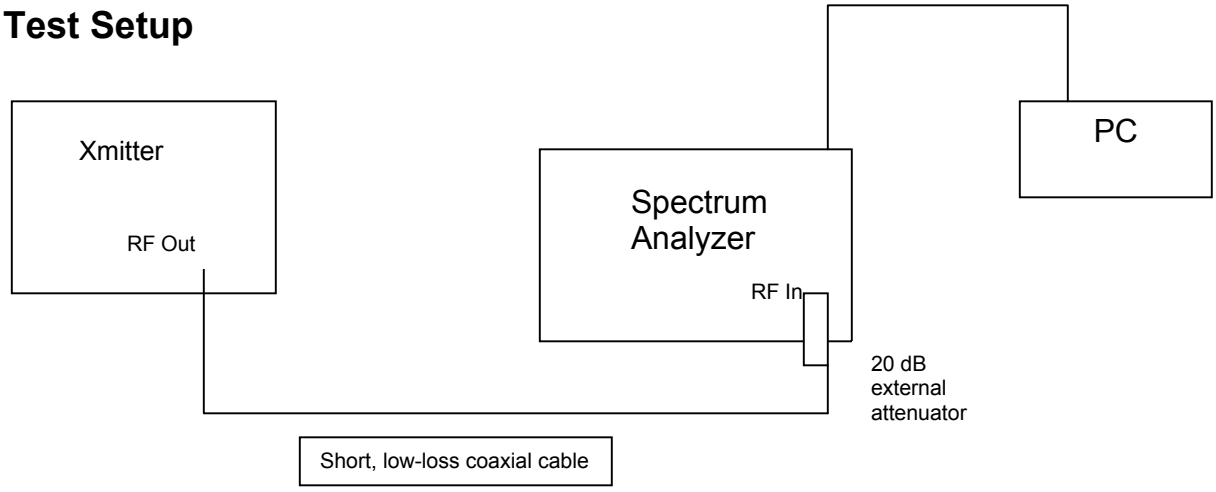
A 300Hz resolution bandwidth with no video filtering and a peak detector were used. Some transmitters may require a larger RBW (10kHz < 1 GHz, 100kHz > 1GHz) if they are broadband such as CDMA. It is important to use a RBW that is sufficiently narrow to plot the actually bandwidth of the signal and not the filter response curve of the spectrum analyzer.

The emission mask is shown on each plot. The 0dB reference for the mask is the measured output power.

The span was varied across 2 plots to clearly show compliance with the emission mask.

The iDEN RadioBlade measurements were made at high, mid, and low transmit frequencies at the lowest and the highest power settings.

Test Setup



6.1 Test Results

Reference Exhibit "S", file name: Occupied Bandwidth.PDF for the data plots.

7.0 Spurious Emissions at Antenna Terminals Data

Reference 2.1051 and 90.217, 90.691

The Spurious Emissions at the antenna terminals were measured at the RF output.

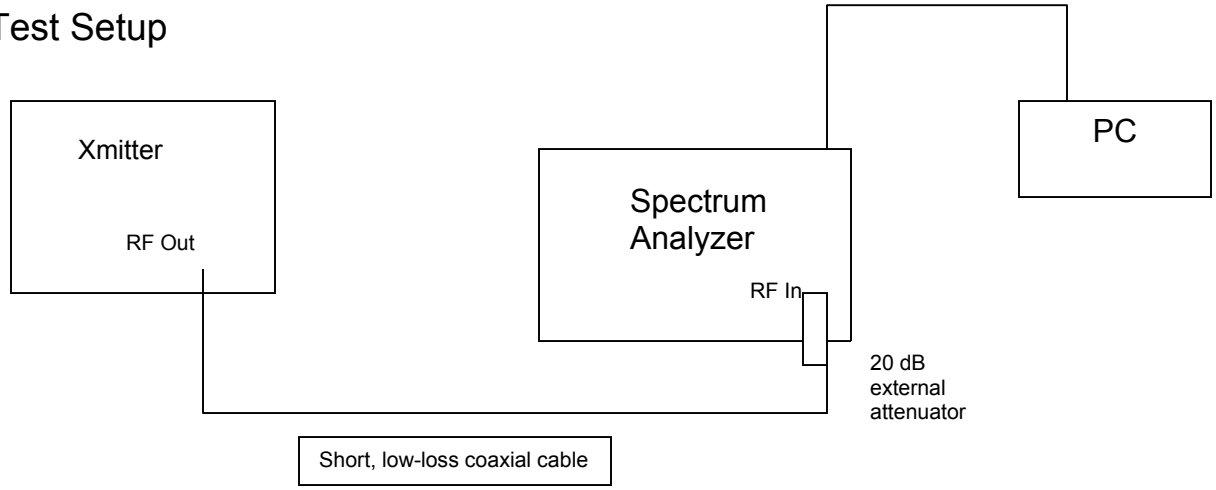
A spectrum analyzer was used to scan from 0 to 10 GHz. A 10kHz resolution bandwidth was used below 1GHz and 100kHz above 1GHz. No video filtering was employed.

A 20dB external attenuator was used on the RF input of the spectrum analyzer.

Spurious emissions must be attenuated 43+10log(transmitter power)

The iDEN RadioBlade measurements were made at high, mid, and low transmit frequencies at the lowest, middle, and the highest power settings.

Test Setup



7.1 Test Results

Reference Exhibit "P", file name: Spurious RF Conducted Emissions.PDF for the data plots.

8.0 Spurious Radiation Data

Reference 2.1053 & 90.217, 90.691

The Field Strength of Spurious Radiation was measured in the far-field at an FCC OATS up to 10 GHz.

Spectrum analyzer, signal generator, and linearly polarized antennas were used to measure radiated harmonics and spurious emissions.

The orientation of the EUT and measurement antenna were manipulated to maximize the level of emissions.

The EUT was configured to transmit at the highest output power into a dummy load at mid band.

The substitution method as described in TIA/EIA-603 Section 2.2.12 was used for the highest spurious emissions. Preliminary measurements were made using the alternate limit at 3 meters of 84.3dBuV/m.

Radiated Spurious Emissions
Test Methodology

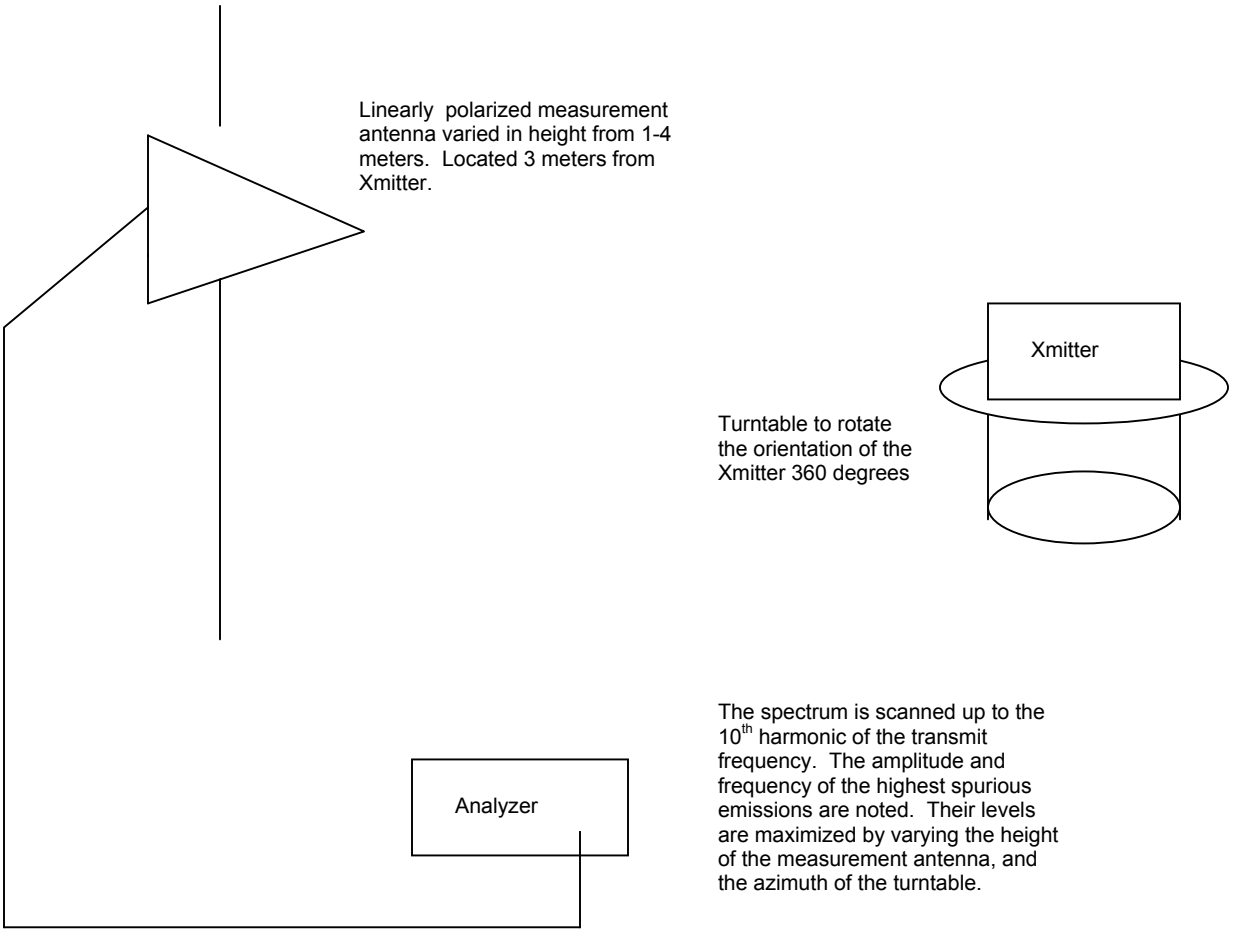
For licensed transmitters, the FCC references TIA/EIA-603 as the measurement procedure standard. TIA/EIA-603 Section 2.2.12 describes a method for measuring radiated spurious emissions that utilizes an antenna substitution method:

At an approved test site, the transmitter is place on a remotely controlled turntable, and the measurement antenna is placed 3 meters from the transmitter. The turntable azimuth is varied to maximize the level of spurious emissions. The height of the measurement antenna is also varied from 1 to 4 meters. The amplitude and frequency of the highest emissions are noted. The transmitter is then replaced with a ½ wave dipole that is successively tuned to each of the highest spurious emissions. A signal generator is connected to the dipole (horn antenna for frequencies above 1 GHz), and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the dipole antenna and its gain; the power (dBm) into an ideal ½ wave dipole antenna is determined for each radiated spurious emission.

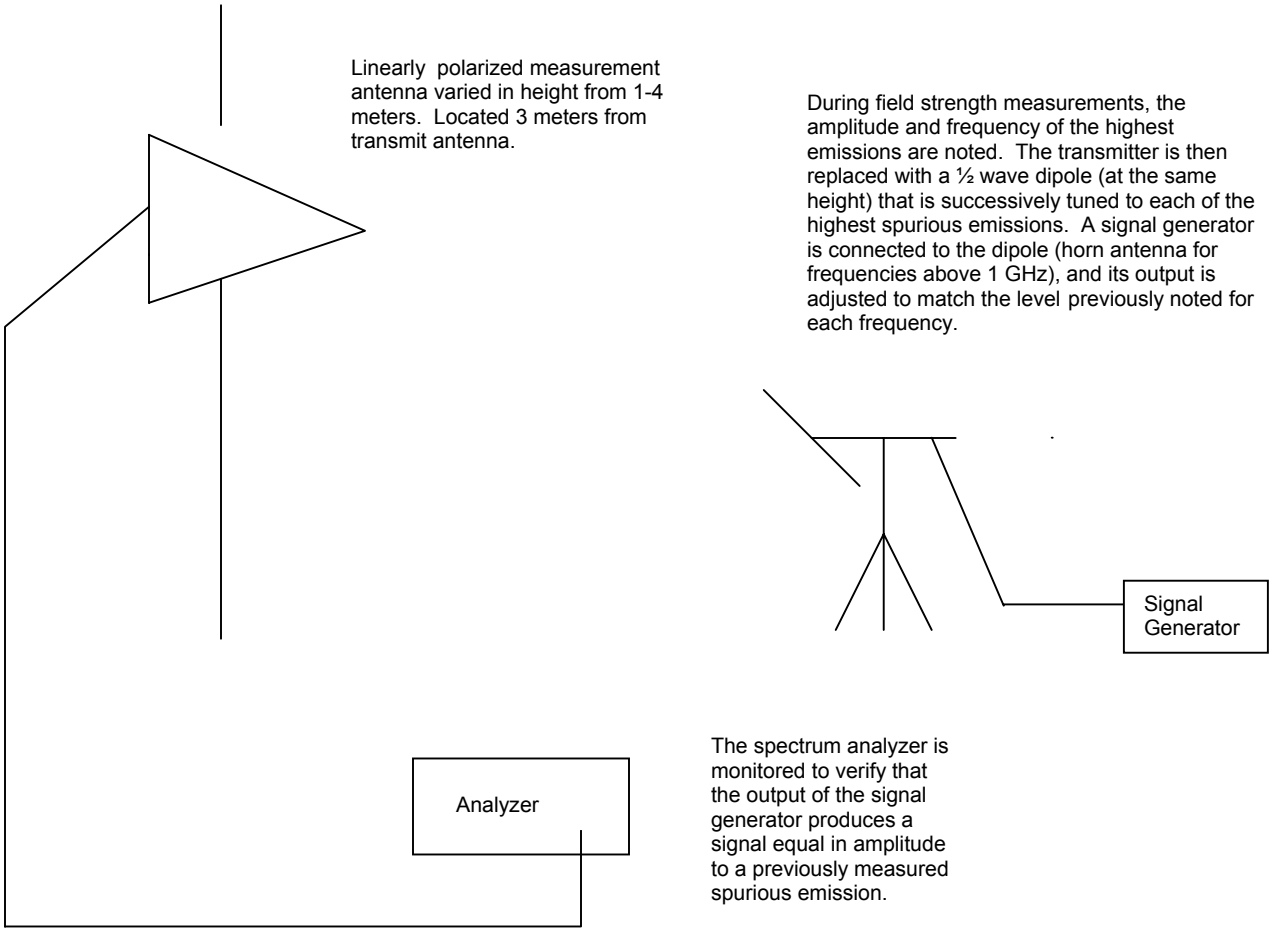
For the purposes of preliminary measurements, the field strength of the spurious emissions can be measured and compared with a 3 meter limit. The final measurements must be made utilizing the substitution method described above. Usually, the 3 meter limit is 84.3 dBuV/m - irrespective of the output power of the device.

Spurious Radiation Data con't

Test Setup for Field Strength Measurements



Test Setup for Power Measurements Utilizing the Antenna Substitution Method



8.1 Test Results

Preliminary testing showed the worse-case configuration to be seven iDEN RadioBlades installed in a single RadioFrame Unit. Final measurements on the iDEN RadioBlade were made in this configuration with the radios set to the highest power settings mid band.

Reference Exhibit "R", file name: Spurious Radiated Emissions.PDF for the data plots.

9.0 Frequency Stability Data

Reference 2.1055 & 90.213

The Frequency Stability was measured at the RF output terminals.

A spectrum analyzer or frequency counter can be used to measure the frequency stability. If using a spectrum analyzer, it must have a precision frequency reference that exceeds the stability requirement of the transmitter.

An external attenuator or directional coupler is usually needed.

A temperature / humidity chamber is also required.

Variation of Supply Voltage

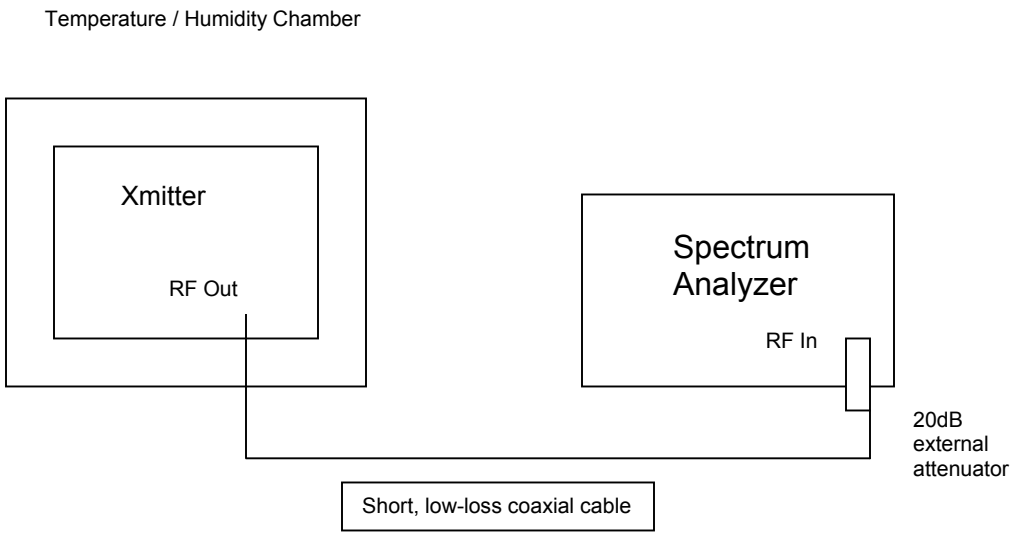
The primary supply voltage was varied from 85% to 115% of nominal. Because the EUT cannot be battery operated, the D.C. voltage was not varied.

Variation of Ambient Temperature

Using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature range (-30° to +50° C) and at 10°C intervals.

The iDEN RadioBlade measurements were made at high, mid, and low transmit frequencies at the highest power setting. EUT was configured for CW operation. Temperature testing was performed at nominal AC line voltage. Variation of supply voltage measurements were performed at ambient temperature.

Test Setup



9.1 Test Results

Reference Exhibit "O", file name: Frequency Stability.PDF for the data plots.

10.0 RF Exposure Compliance Requirements

The EUT meets the requirement that it be operated in a manner that ensures the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines (ref . 47 CFR 1.1307, 1.1310, 2.1091, and 2.1093. Also OET Bulletin 65, Supplement C).

The EUT will be professionally installed at fixed locations. The installation instructions specify that the radio should never be used closer than 20cm from a person's head or body. Therefore it should be considered a fixed location per 47 CFR 2.1091. The EUT supports the connection of only one antenna at a time. Up to seven radios can be installed in a RadioFrame Unit. Only two radios are approved by the manufacturer for use in the RadioFrame: a) the EUT, and b) a WLAN card, FCC ID: M4Y-XI-300. Since the EUT has the higher EIRP and a more stringent MPE level, a worse-case estimate can be derived by assuming a configuration of seven iDEN RadioBlades.

The MPE estimates are as follows:

Table 1 in 47 CFR 1.1310 defines the maximum permissible exposure (MPE) for the general population as 0.567 mW/cm^2 . The distance from seven RadioBlade transmitting antennas where the exposure level reaches the maximum permitted level is calculated using the general equation:

$$S = 7(PG)/4\pi R^2$$

where: S = power density (0.567 mW/cm^2 maximum permitted level)
P = power input to the antenna (13.8 mW)
G = linear power gain relative to an isotropic radiator (0 dBi = numeric gain of 1)
R = distance to the center of the radiation of the antenna
7 = maximum number of RadioBlades installed in one RFU

Solving for R, the 0.567 mW/cm^2 limit is reached 3.68 cm or closer to the transmitting antennas.

On page 6 of the **RadioFrame System Installation Guide** (see Exhibit L, page 15), it states the following warning:

> "Warning: To comply with FCC RF exposure requirements, iDEN antennas must be installed to provide at least 20cm separation from all persons"

11.0 Measurement Equipment

Instrument	Model	Serial No.	Calibration Due
Spectrum Analyzer	Hewlett-Packard 8566B	2747A05213	3/23/02
Pre-Amplifier	Amplifier Research LN1000A	25660	12/4/01
Antenna, Biconilog	EMCO 3141	9906-1146	12/14/01
Antenna, Horn	EMCO 3115	9710-5305	10/8/01
Pre-Amplifier	Miteq AMF-4D-005180-24-10P	456374	12/4/01
Spectrum Analyzer	Tektronix 2784	B010105	03/8/02
Quasi-Peak Adapter	HP 85650A	2811A01353	03/23/02
Horn Antenna	EMCO 3115	9605-4826	11/06/01
Dipole Antenna	EMCO DB-4	1452	07/08/02
Signal Generator	HP 8648A	3426A00956	04/30/02
Oscilloscope	Tektronix TDS3052	B011236	06/15/02
Temp. / Humidity Chamber	Cincinnati Sub Zero ZH-32-2-2-H/AC	ZN9722620	10/31/01