RUBICOM SYSTEMS, INC.

FCC INTENTIONAL RADIATOR

TEST REPORT

FOR THE

ORION ENGINEERING, INC.

DUAL BEAM RADAR SENSOR

MODEL 1006812

JULY 2003
REVISED MARCH 2004

Rubicom Systems, Inc.
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Melbourne, Florida 32904

FCC INTENTIONAL RADIATOR

TEST REPORT

FOR THE

ORION ENGINEERING, INC.

MODEL 1006812

DUAL BASE RADAR SENSOR

S/N: 002

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ABSTRACT

This report presents test results of the emanations found emitting from the Orion Engineering, Inc. Model 1006812, Dual Beam Radar Sensor and the comparison of these emissions to the requirements of FCC, Title 47, Part 15.245 Subpart C for Intentional Radiators as required for a field disturbance sensor operating within this 24.075-24.175MHz band. In accordance with Part 15.33(a)(2), radiated measurements were performed to 100GHz.

This testing was performed at Rubicom Systems, Inc. (RSI). The testing was performed for Orion Engineering, Inc. under a purchase order no. 3183. The results of this test effort demonstrate compliance of the Dual Beam Radar Sensor to FCC, Title 47, Part 15.245 Subpart C for Intentional Radiators. The transmitter module was tested and found to be compliant.

1.0 INTRODUCTION

1.1 Purpose

The purpose of this report is to show compliance of the Dual Beam Radar Sensor to the requirements of Part 15.245 of the FCC rules and Regulations (47 CFR, Part 15, Subpart C) for Intentional Radiators and extended testing to 100GHz. The band of operation is 24.075 to 24.175MHz. The tests were performed on RSI's 3 meter site and in a semi-anechoic chamber at a distance of 1 meter and .33 meters. Distances are noted on the data plots.

1.2 Requirements

The test requirements for this intentional radiator are as follows:

Radiated (15.245)

Frequency (GHz)	Field Strength	Measurement Distance (m)
24.075 - 24.175	2500 MV/m 127.9dB>µV/m 138.4dBµV/m	 3 1
Harmonics	25 MV/m (88dBµV/m) (98dBµV/m) (108dBµV/m)	3 1 .3

Signals outside the intended band must be attenuated by 40dB below the fundamental or 15.209, whichever is less attenuation (54dBµV/m average, 74dBµV/m Peak).

Signals appearing in the restricted bands must meet the requirements of 15.209.

1.3 Unit Under Test Description

The Dual Beam Radar Sensor is a microwave Doppler unit operating at 24.125GHz for the purpose of measuring true ground speed. There are two parts to the system: a sensor/transmitter and a display unit. The unit is powered by 12 VDC input. The output is a square wave that varies with the speed. The indicator output lead was

terminated across a 10K-ohm resistor during this test. A fan was placed in front of the sensor to give a moving motion, which creates the output signal.

1.4 Summary of Results

Paragraph 6.0 of this document presents the measured results of the tabulated levels detected during testing of the units. There were no signals that exceeded the levels of 15.209 except the transmit frequency itself.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this report to the extent expressed herein:

FCC Code of Federal Regulations title 47, Part 15

ANSI C63.4-2000

FCC Characteristics of Open Field Test Sites, Bulletin OET 55, October 1989

2.1 Procedures

Specific procedures that apply to this report can be found in ANSI C63.4-2000 Paragraphs 8.3.1.1 and 8.3.1.2.

3.0 TEST SITE DESCRIPTION

This testing was performed at Rubicom Systems, Inc. 3 meter test site. The description of the measurement facility was found to be compliant with the requirements of Section 2.948 of the FCC Rules. A copy of the compliance letter is included as Attachment I.

3.1 Environmental Conditions

This test effort was performed between June 20, 2003 and June 26, 2003. Typical conditions in the laboratory during this testing were:

Temperature: 78º
Barometer: 29.75 inches
Humidity: 50%

Conditions on the outside test site during the test were:

Temperature: 88º
Barometer: 29.90 inches
Humidity: 80%

4.0 TEST INSTRUMENTATION

Table 4.0-1 lists the test equipment used during this testing.

Qty.	Description	Manufacturer	Model No.	Cal. Date
1	Coax Attenuator	Hewlett Packard	8494B	01/30/04
1	Bilog Antenna	Chase	CLB6111B	07/16/03
1	Standard Gain Horn	Millitech	SGH-22-RP00	NCR
1	Ridge Guide Horn	Electro Metrics	RGA-180	04/12/04
1	Standard Gain Horn	NARDA	Model 638	NCR
1	Standard Gain Horn	NARDA	B637	NCR
1	Standard Gain Horn	Flann Microwave	25240-20	NCR
1	Standard Gain Horn	Flann Microwave	27240-20	NCR
1	Spectrum Analyzer	Advantest	R3271	08/02/03
1	Harmonic Mixer	OML	M28HWD	10/10/03
1	Harmonic Mixer	OML	M22HWD	10/10/03
1	Harmonic Mixer	OML	M15HWD	10/10/03
1	Harmonic Mixer	OML	M10HWD	10/10/03
1	Waveguide Adapter	OMNI	WR28-SMA	NCR
1	Pre-Amplifier 1-26GHz	Hewlett Packard	8449B	05/08/04

TABLE 4.0-1

5.0 TEST SAMPLE SETUP AND CONFIGURATIONS

The unit was placed on a nonconductive table on the 3 meter Open Area Test Site (OATS). The unit was powered by an external battery. Measurements from 30MHz-26.5GHz were formed on the 3 meter site at distances noted on the data sheets.

During radiated emissions, over the frequency range of 26.5-100GHz, the unit was placed on the table inside the test chamber (semi-anechoic) and rotated for maximum level at .3 meters distance.

Photo 1 shows the typical radiated test setup on the OATS. Photo 2 shows the unit on the test chamber table.

PHOTO 1

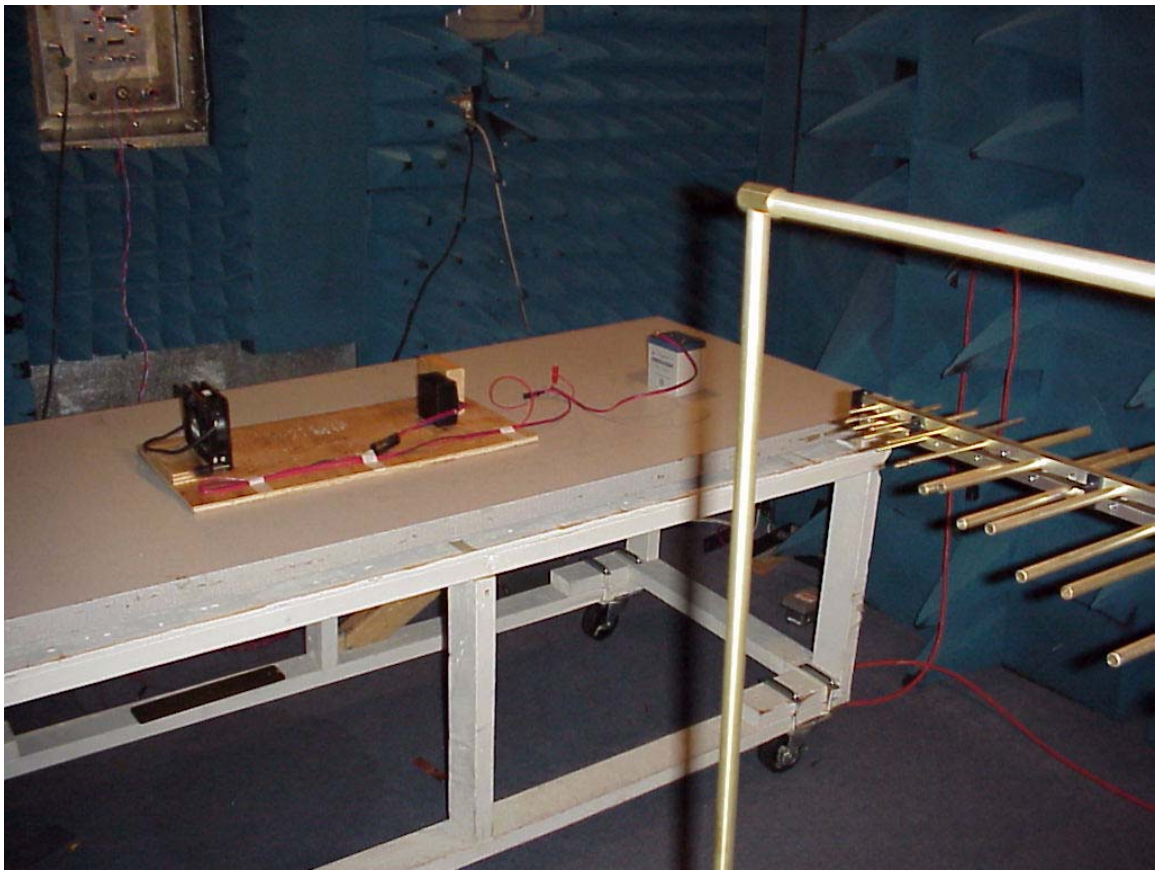


PHOTO 2

6.0 PROCEDURES AND RESULTS

6.1 General

The unit was placed on a nonconductive table with anechoic material on three sides. The requirement for the first harmonic is to be less than 2500μVolts/m = (127.9dBμV/m) at a 3 meter distance. The harmonics are required to be 40dB below the fundamental. The first harmonic was peaked in amplitude and elevation by moving the EUT for maximum pickup in the narrow beam width. Frequency and amplitude was recorded. Figure 6.1-1 presents the test equipment configuration for each frequency band from 18GHz to 100GHz.

Table 6.1-1 presents the measured levels of significant signals detected during this testing. Only the fundamental (24.125GHz) was found above the measurement noise floor. The harmonics and spurs are not detectable over the range of 25.6GHz to 100GHz. The measurement capabilities are included on Table 6.1-1. Plots of the peak and average bands above 26.5GHz are on file at RSI under JA-1974.

Appendix A presents the preliminary data taken in the semi-anechoic chamber at 1 meter. This effort is for detecting frequencies of emissions prior to moving to the 3 meter range.

Appendix B presents the data plots for 30MHz-1GHz quasi-peak, 1-26.5GHz peak and 1-26.5GHz average measurements. Only the 24.125GHz TX frequency was found to emit from the unit above the measurement capabilities.

Appendix C presents the 3 meter ambient data up to 1.0GHz for the quasi-peak detector, 1-26.5GHz for the peak mode and 1-26.5GHz for average mode. Above 4GHz the ambient does not cause measurement problems in the average mode.

In areas where the harmonic levels could not be achieved, the resolution bandwidth was reduced as well as decreasing the distance of measurement. The horn and detector were removed from the tripod and moved around the unit for signal searching. Since the transmit signal is not modulated the decrease in bandwidths do not degrade the amplitude measurement.

As a result of this investigation, the signal listed in Table 6.1-1 is the only signal of any significance emitting from the unit under test.

Frequency GHz	Polarization	Measured Level (dBµV/m)	Limit
24.125	H	107	127.9
24.125	V	86	127.9
48.25	H & V	98.7 nf	88.9
72.375	H & V	109 nf	88.9
96.50	H & V	126.9 nf	88.9

nf = Noise floor of receiver system.

TABULATED DATA

TABLE 6.1-1

Measurements were made as close as .3 meters in probing for the harmonics. This would increase the level of the harmonic by approximately 20dB.

No signals were detected above the noise floor of the receiver.

Calculations

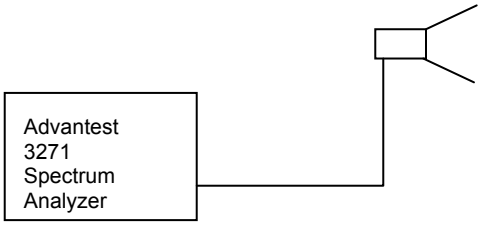
Measured level in dBµV + antenna factor + cable loss – amplifier gain + attenuator loss = dBµV/meter.

Above 30MHz measurement distance is calculated using 20 log of the difference ratio.

The factors are compiled on memory cards for use in the Advantest analyzer. The resultant level plotted on the graphs can be compared directly against the specification limit.

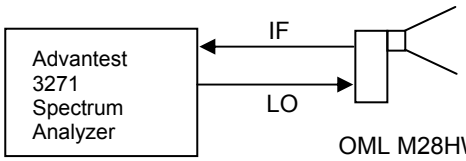
NARDA Model 638 Standard Gain Horn

18-26GHz EQUIPMENT SETUP



NARDA Model V637 Standard Gain Horn

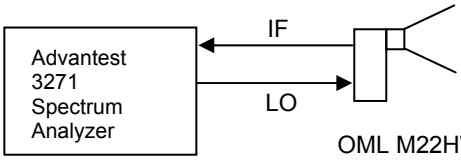
26.5-40GHz EQUIPMENT SETUP



OML M28HWD Mixer

Millitech SGH-22-RP000 Standard Gain Horn

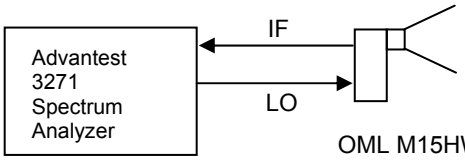
33-50GHz EQUIPMENT SETUP



OML M22HWD Mixer

Flann Microwave Model 25240-20
Standard Gain Horn

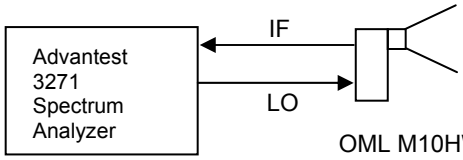
50-75GHz EQUIPMENT SETUP



OML M15HWD Mixer

Flann microwave Model 27240-20
Standard Gain Horn

75-110GHz EQUIPMENT SETUP



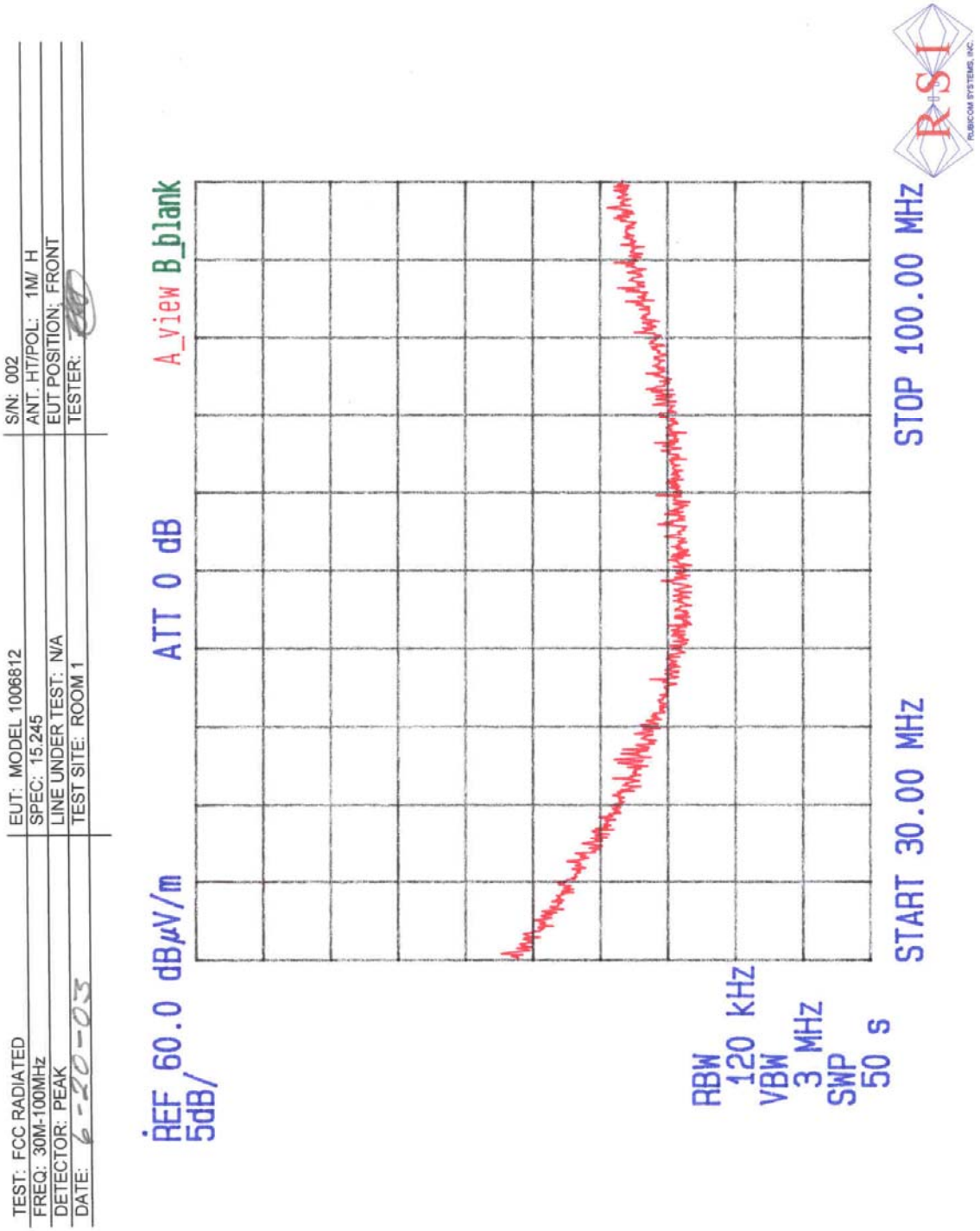
OML M10HWD Mixer

FIGURE 6.1-1

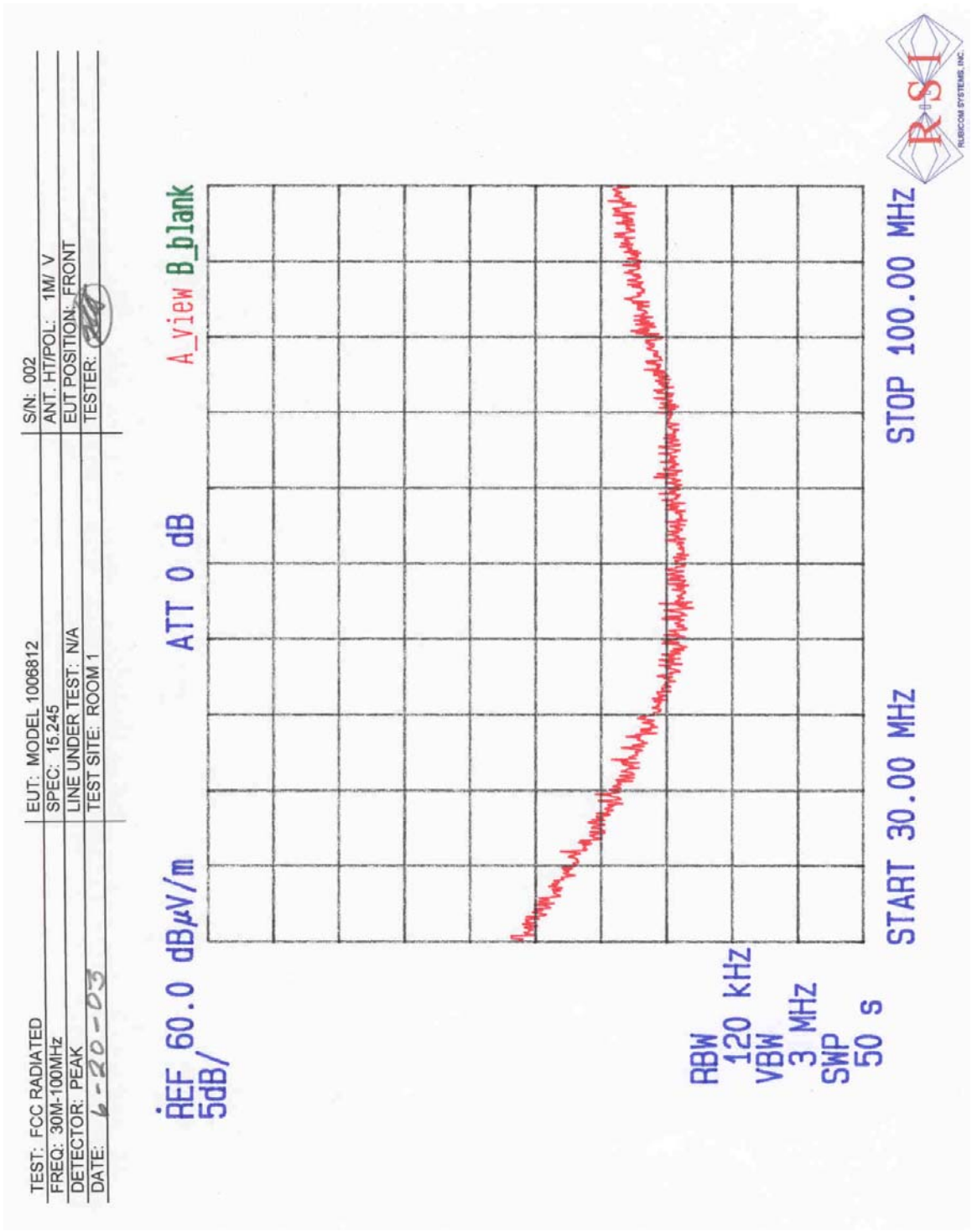
APPENDIX A

PRELIMINARY DATA PLOTS

(30MHz-26.5GHz)



DATA SHEET A-1



DATA SHEET A-2