Science Applications International Corporation
Bell South Fleet Manager

RIM/SAT COM
Spurious Emissions Measurements
IAW CFR 47, Parts 2, 15 & 90

Date of Test
02 October 2002

Conducted For: Science Applications International Corporation
10260 Campus Point Drive
San Diego, CA 92121

Conducted By: Aegis Labs, Inc.
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CERTIFICATION OF TEST DATA

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The data, data evaluation and equipment configuration represented herein are a true and accurate representation of the Equipment Under Test (EUT). The entity and/or person(s) for which this report has been prepared acknowledge that such the report - in its entirety - is for verification of the EUT to the requirements cited below.

The test results provided within this report are based upon the following global standards:

REFERENCE STANDARD	COMMENT
CFR 47, Part 2, 2.1046(a) RF Power Output – Radiated	(ERP)
ANSI TIA/EIA 603-1992 RF Power Output – Signal Substitution	(EIRP)
CFR 47, Part 2, 2.1053(a) RF Spurious Emissions – Radiated	(ERP)
ANSI TIA/EIA 603-1992 RF Spurious Emissions – Signal Substitution	(EIRP)
CFR 47, Part 15, Class A Emissions – Radiated	(Unintentional Radiated)

When measured in accordance with the above-referenced documents, the RIM / SAT MODEM spurious emissions are compliant.

Prepared By:

10/02/02

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Report Approved By:

10/02/02

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Chief Operating Officer
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1.0 TEST REFERENCES:

Federal Communications Commission - CFR 47, Part 2
Federal Communications Commission - CFR 47, Part 15
ANSI TIA/EIA 603-1992

2.0 EQUIPMENT SETUP REFERENCES:

Federal Communications Commission - CFR 47, Part 2, 2.1046(a) & 2.1053(a)
Federal Communications Commission - CFR 47, Part 15, 15.209
ANSI TIA/EIA 603-1992, 2.2.12

The RIM / SAT COM were configured in a typical-use configuration for testing. The EUT consisted of an ICU which receives power from an external DC source, a SAT COM antenna assembly and a Tri Mode antenna assembly. The ICU is controlled with the lap-top PC running Hyperterminal software. Figure 1 shows the equipment setup.

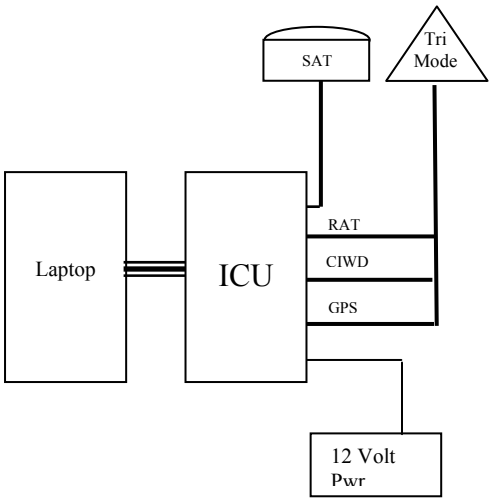

Figure 1. RIM / SAT COM Test Setup

2.1 Test Setup

The RIM / SAT were placed on an 80cm dielectric stand. The units were powered on and operational during testing. The satellite signal was acquired and the test data stream was generated on a laptop in HyperTerminal (19.2k baud, 8 bits, no parity) and was routed out Com1 to the RIM/SAT ICU. For testing, the ICU sent a continuous data stream to the appropriate antenna for transmission. The equipment setup information is given in Table 1.

EUT & Mode:	*Model*	RIM with TriMode Antenna, SAT with Sat Antenna
	ERP	RIM +3.44dBm, SAT COM +15.5dBm
	Frequency MHz	RIM 896-902MHz, SAT 1606-1681MHz
	Operating Mode: *Signals Acquired & Transmitting*	RIM with TriMode Antenna, & SAT with Sat Antenna
Test Instruments:	*Spec Analyzer*	HP 8564EC 100kHz-40GHz
	Pre Amplifier	HP 8449B 1-18GHz
	Antennas	Biconical 20MHz-200MHz Log Periodic 200MHz – 1000MHz Double Ridge Guide 1-18GHz
Limit Line:	-31dBc	RIM -27.5dBm, SAT COM -15.5 dBm
Measurement Distance:	*10m*	

Table 1. Test Information

2.2 Test Detection System

The test data collection system for ERP measurements was comprised of a spectrum analyzer, a preamplifier and a high pass filter – when required (see Figure 2). This same system was also used in the EIRP / signal substitution measurements; additionally, a synthesizer and radiating horn were required to complete EIRP measurements (see Figure 3).

The RIM / SAT COM emissions testing was accomplished on a certified 3/10 m Open Area Test Site at Aegis Labs, Inc. A 1 to 4 meter mast and a turntable were used on the OATS to maximize the signals selected for measurement. All test equipment are in current calibration (see Table 2).

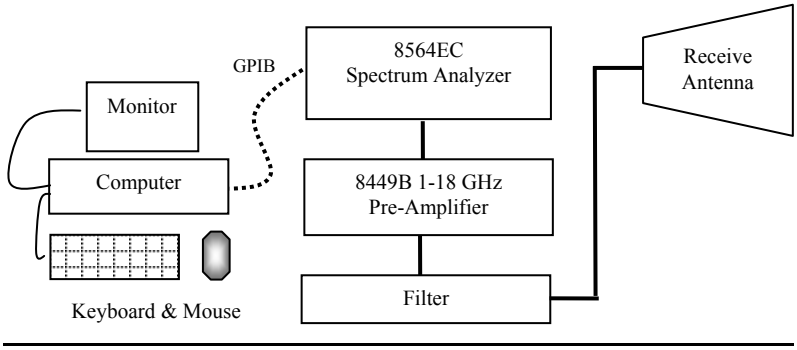

Figure 2. ERP Test Setup

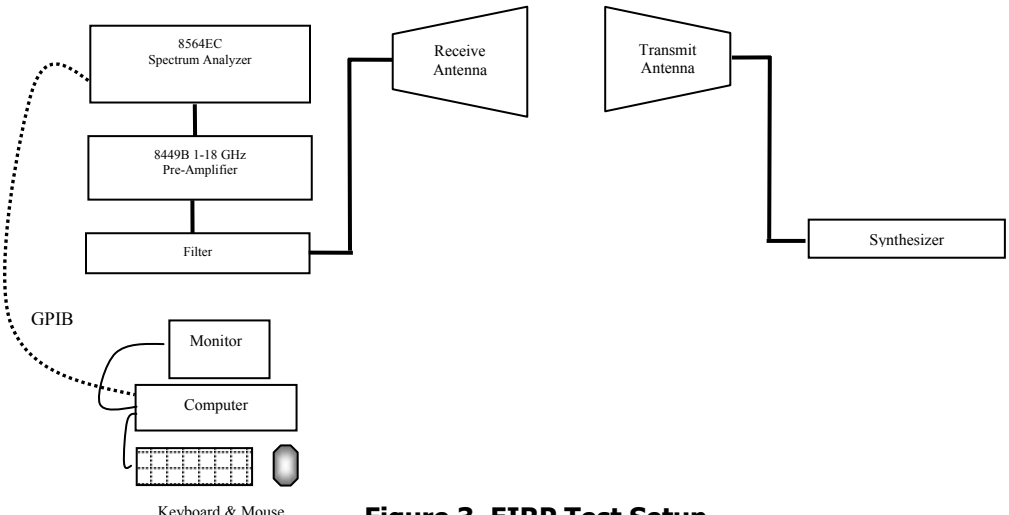

Figure 3. EIRP Test Setup

Equipment Name	Manufacturer	Model Number	Serial Number	Cal. Due Date	Cal Cycle
Site #2 NSA	Aegis Labs, Inc.	N/A	N/A	10/24/02	1 Year
Spectrum Analyzer	Agilent	8564EC	4046A00387	02/28/04	2 Years
Preamplifier	Agilent	8449B	3008A01573	04/29/03	1 Year
Antenna-Bicon	EMCO	9018-1421	3110	10/12/02	1 Year
Antenna – Log Periodic	EMCO	3148	1947	10/12/02	1 Year
Antenna - Horn	EMCO	3115	2230	09/14/03	1 Year
Temperature/Humidity Monitor	Dickson	TH550	7255185	01/08/03	1 Year

Table 2. Test Equipment Calibration

2.3 Derivation of Limit Line

The limit cited in the tables is the level at which the measured spurious emission is -31dBc from the transmitter fundamental. The limit line calculation is given in Table 3.

RIM				
Freq. (MHz)	Meter (dBuV)	Corrected (dBuV/m)	ERP dBm	Limit at 31dBc
897.96	81.20	110.44	3.44	-27.56
SAT MODEM				
Freq. (MHz)	Meter (dBuV)	Corrected (dBuV/m)	ERP dBm	Limit at 31dBc
1657.94	129.33	122.53	15.53	-15.47

Table 3. Limit Line Calculation

3.0 ERP Test Data

The ERP test data collection for RIM and SAT COM was accomplished on the OATS at a distance of 10m from the perimeter of the EUT. The equipment was operated in a typical mode; satellite locked and tracking and data transmitting.

3.1 RIM ERP Test Data

The RIM data reported below were the highest readings received in each receive antenna polarization. The ERP data were collected, corrected for the cable loss or amplification factor and are presented as corrected data in Table 4.

RIM Harmonic ERP Measurements
Horizontal Open Field Maximized Data

Freq. (MHz)	Meter (dBuV)	Ant Ht. (cm)	Azimuth (degrees)	Corrected (dBuV/m)	ERP (dBm)	Limits dBm	Diff (dB) +=FAIL
1795.5	75.5	100	0	69.66	-37.34	-27.56	-9.77
2693.37	56.67	100	0	53.55	-53.45	-27.56	-25.89
3591.04	52.33	100	0	52.41	-54.59	-27.56	-27.02
4488.74	42.67	100	0	44.54	-62.46	-27.56	-34.90
5386.12	42.5	100	0	46.12	-60.88	-27.56	-33.32
6284.38	44.67	100	0	48.77	-58.23	-27.56	-30.67

No signals found for the remaining harmonics

RIM Harmonic ERP Measurements
Vertical Open Field Maximized Data

Freq. (MHz)	Meter (dBuV)	Ant Ht. (cm)	Azimuth (degrees)	Corrected (dBuV/m)	ERP (dBm)	Limits dBm	Diff (dB) +=FAIL
1795.48	85.17	100	0	79.33	-27.67	-27.56	-0.10
2693.25	66.17	100	0	63.05	-43.95	-27.56	-16.39
3591.01	59	100	0	59.08	-47.92	-27.56	-20.36
4488.78	45.5	100	0	47.37	-59.63	-27.56	-32.07
5386.88	43.32	100	0	46.94	-60.06	-27.56	-32.50
6284.27	44.17	100	0	48.27	-58.73	-27.56	-31.17

No signals found for the remaining harmonics

Table 4. RIM Spurious Emissions - ERP

3.2 SAT MODEM ERP Test Data

The SAT MODEM data reported below were the highest readings received in each receive antenna polarization. The ERP data were collected, corrected for the cable loss or amplification factor and are presented as corrected data in Table 5.

SAT MODEM
Horizontal Data

Freq. (MHz)	Meter (dBuV)	Ant Ht. (cm)	Azimuth (degrees)	Corrected (dBuV/m)	ERP (dBm)	Limits dBm	Diff (dB) +=FAIL
3315.78	43.67	100.00	0.00	43.07	-63.93	-15.50	-48.43
4973.67	42.83	100.00	0.00	45.79	-61.21	-15.50	-45.71
6631.56	42.33	100.00	0.00	46.67	-60.33	-15.50	-44.83
8289.68	48.17	100.00	0.00	53.15	-53.85	-15.50	-38.35
9947.34	42.17	100.00	0.00	49.29	-57.71	-15.50	-42.21
11605.23	No Signal						
13263.12	No Signal						
14921.01	No Signal						
16578.90	No Signal						

SAT MODEM
Vertical Data

Freq. (MHz)	Meter (dBuV)	Ant Ht. (cm)	Azimuth (degrees)	Corrected (dBuV/m)	ERP (dBm)	Limits dBm	Diff (dB) +=FAIL
3315.88	41.83	100.00	0.00	41.23	-65.77	-15.50	-50.27
4973.77	41.50	100.00	0.00	44.46	-62.54	-15.50	-47.04
6631.61	47.17	100.00	0.00	51.51	-55.49	-15.50	-39.99
8289.48	49.50	100.00	0.00	54.48	-52.52	-15.50	-37.02
9948.04	44.33	100.00	0.00	51.45	-55.55	-15.50	-40.05
11605.23	No Signal						
13263.12	No Signal						
14921.01	No Signal						
16578.90	No Signal						

Table 5. SAT COM Spurious Emissions - ERP

4.0 EIRP Test Data

The EIRP data were derived using a signal substitution method presented in TIA/EIA 603-1992, paragraph 2.2.12. The frequency under evaluation was radiated from the RIM or SAT COM, a synthesizer and radiating horn were placed at the EUT location on the OATS and a signal was radiated which matched the amplitude of the EUT spurious emission. That synthesizer RF level, adjusted for the transmit antenna cable loss and substitute-antenna gain figure, is presented as corrected EIRP data. Again, the limit cited in the tables is the level at which the measured spurious emission is -31dBc from the transmitter fundamental.

4.1 RIM EIRP Test Data

The RIM data reported below were the highest readings received in each receive antenna polarization. The EIRP data were collected, corrected for the cable loss and antenna gain figure and are presented as corrected data in Table 6.

RIM Harmonic EIRP Measurements
Horizontal Measurement using Signal Substitution TIA/EIA 603

Frequency (MHz)	Spec. An. (dBuV)	Sig. Gen. (dBm)	Antenna Gain (Db)	EIRP (dBm)	Limit (dBm)	Differ +=FAIL
1795.5	75.5	-37.7	4.6	-33.1	-27.56	-5.54
2693.37	56.67	-56.3	6.9	-49.4	-27.56	-21.84
3591.04	52.33	-58.2	9.2	-49	-27.56	-21.44
4488.74	42.67	-67.8	8.7	-59.1	-27.56	-31.54
5386.12	42.5	-69.6	8.4	-61.2	-27.56	-33.64
6284.38	44.67	-65.8	8.8	-57	-27.56	-29.44

RIM Harmonic EIRP Measurements
Vertical Measurement using Signal Substitution TIA/EIA 603

Frequency (MHz)	Spec. An. (dBuV)	Sig. Gen. (dBm)	Antenna Gain (Db)	EIRP (dBm)	Limit (dBm)	Differ +=FAIL
1795.48	78.17	-34.8	4.6	-30.2	-27.56	-2.64
2693.25	66.17	-44.7	6.9	-37.8	-27.56	-10.24
3591.01	59	-51.1	9.2	-41.9	-27.56	-14.34
4488.78	45.5	-63	8.7	-54.3	-27.56	-26.74
5386.88	43.32	-65.1	8.4	-56.7	-27.56	-29.14
6284.27	44.17	-63.5	8.8	-54.7	-27.56	-27.14

Table 6. RIM Spurious Emissions - EIRP

4.2 SAT MODEM EIRP Test Data

The SAT MODEM data reported below were the highest readings received in each receive antenna polarization. The ERP data were collected, corrected for the cable loss and antenna gain figure and are presented as corrected data in Table 7.

SAT MODEM Harmonic EIRP Measurments
Horizontal Measurement using Signal Substitution TIA/EIA 603

Frequency (MHz)	Spec. An. (dBuV)	Sig. Gen. (dBm)	Antenna Gain (Db)	EIRP (dBm)	Limit (dBm)	Differ +=FAIL
3315.78	43.67	-70.6	8.9	-61.7	-15.50	-46.2
4973.67	42.83	-69.9	8.6	-61.3	-15.50	-45.8
6631.56	42.33	-67.7	8.6	-59.1	-15.50	-43.6
8289.68	48.17	-52.6	8.8	-43.8	-15.50	-28.3
9947.34	42.17	-68.8	9.9	-58.9	-15.50	-43.4

SAT MODEM Harmonic EIRP Measurments
Vertical Measurement using Signal Substitution TIA/EIA 603

Frequency (MHz)	Spec. An. (dBuV)	Sig. Gen. (dBm)	Antenna Gain (Db)	EIRP (dBm)	Limit (dBm)	Differ +=FAIL
3315.88	41.83	-72.4	8.9	-63.5	-15.50	-48
4973.77	41.5	-72.7	8.6	-64.1	-15.50	-48.6
6631.61	47.17	-60.8	8.6	-52.2	-15.50	-36.7
8289.48	49.5	-50.9	8.8	-42.1	-15.50	-26.6
9948.04	44.33	-65.8	9.9	-55.9	-15.50	-40.4

Table 7. SAT COM Spurious Emissions - EIRP

5.0 Radiated Emissions Test Data

The radiated emissions were measured on the OATS from 30MHz to 1000MHz and compared to the CFR 47, Part 15, Class A limits. The test data collection for RIM and SAT COM was accomplished at a distance of 10m from the perimeter of the EUT. The equipment was operated in a typical mode; satellite locked and tracking and data transmitting.

5.1 RIM Radiated Emissions Test Data

The RIM data reported below were the highest readings received in each receive antenna polarization. The data were collected, corrected for the cable loss or amplification factor and are presented as corrected data in Table 8.

RIM Radiated Emissions 30M-1000MHz
Horizontal Open Field Maximized Data

Freq. (MHz)	Meter (dBuV)	Ant Hgt (cm)	Azimuth (degrees)	QP or AV (dBuV)		Corrected (dBuV/m)	Limits (dBuV/m)	Delta Limit (dB)
34.11	43.60	350.00	180.00			27.74	39.00	-11.26
65.18	44.00	400.00	0.00			18.62	39.00	-20.38
128.90	48.60	400.00	135.00			30.38	43.50	-13.12
199.90	47.30	400.00	270.00			32.29	43.50	-11.21
288.06	35.70	400.00	270.00			23.96	46.50	-22.54
298.58	44.50	400.00	45.00			33.37	46.50	-13.13
331.79	47.10	250.00	225.00			31.09	46.50	-15.41
344.09	39.20	300.00	225.00			23.27	46.50	-23.23
347.67	39.50	300.00	270.00			23.59	46.50	-22.91
400.34	44.40	200.00	270.00			29.78	46.50	-16.72

RIM Radiated Emissions 30M-1000MHz
Vertical Open Field Maximized Data

Freq. (MHz)	Meter (dBuV)	Ant Hgt (cm)	Azimuth (degrees)	QP or AV (dBuV)		Corrected (dBuV/m)	Limits (dBuV/m)	Delta Limit (dB)
34.65	46.40	100.00	0.00			30.35	39.00	-8.65
65.18	54.30	100.00	315.00			28.92	39.00	-10.08
127.81	54.00	100.00	135.00	53.59	Q	35.26	43.50	-8.24
200.08	43.70	100.00	270.00			28.69	43.50	-14.81
288.04	33.40	100.00	0.00			21.66	46.50	-24.84
299.72	47.90	100.00	270.00	46.45	Q	35.39	46.50	-11.11
306.62	38.50	100.00	90.00			21.64	46.50	-24.86
320.66	38.70	100.00	0.00			22.45	46.50	-24.05
333.10	43.30	100.00	270.00			27.29	46.50	-19.21
344.11	36.10	100.00	315.00			20.17	46.50	-26.33
368.65	36.30	100.00	315.00			20.74	46.50	-25.76
414.46	46.20	100.00	45.00			31.78	46.50	-14.72

Table 8. RIM Radiated Emissions – Class A Limit

5.2 SAT MODEM Radiated Emissions Test Data

The SAT MODEM data reported below were the highest readings received in each receive antenna polarization. The data were collected, corrected for the cable loss or amplification factor and are presented as corrected data in Table 9.

SAT COM Radiated Emissions 30M-1000MHz
Horizontal

Freq. (MHz)	Meter (dBuV)	Ant Hgt (cm)	Azimuth (degrees)	QP or AV (dBuV)		Corrected (dBuV/m)	Limits (dBuV/m)	Delta Limit (dB)
65.16	44.80	300.00	315.00			19.42	39.00	-19.58
128.56	49.00	350.00	135.00			30.74	43.50	-12.76
165.95	39.50	400.00	315.00			23.33	43.50	-20.17
199.69	47.20	400.00	270.00			32.19	43.50	-11.31
233.39	39.60	400.00	270.00			25.46	46.50	-21.04
266.53	42.10	400.00	270.00			29.19	46.50	-17.31
288.06	34.50	400.00	270.00			22.76	46.50	-23.74
298.59	45.00	250.00	0.00			33.87	46.50	-12.63
306.62	43.30	300.00	270.00			26.44	46.50	-20.06
319.52	43.20	300.00	270.00			26.90	46.50	-19.60
331.80	47.10	250.00	225.00			31.09	46.50	-15.41
344.11	38.10	250.00	225.00			22.17	46.50	-24.33
368.67	36.30	200.00	225.00			20.74	46.50	-25.76
400.37	44.60	200.00	270.00			29.98	46.50	-16.52
497.58	44.80	200.00	90.00			33.45	46.50	-13.05

SAT COM Radiated Emissions 30M-1000MHz
Vertical Open Field Maximized Data

Freq. (MHz)	Meter (dBuV)	Ant Hgt (cm)	Azimuth (degrees)	QP or AV (dBuV)		Corrected (dBuV/m)	Limits (dBuV/m)	Delta Limit (dB)
65.20	38.60	100.00	135.00			13.22	39.00	-25.78
128.22	54.30	100.00	90.00			36.01	43.50	-7.49
166.54	39.40	100.00	315.00			23.26	43.50	-20.24
199.83	42.60	100.00	315.00			27.59	43.50	-15.91
233.50	34.50	100.00	315.00			20.37	46.50	-26.13
288.05	33.00	100.00	90.00			21.26	46.50	-25.24
298.62	47.40	100.00	225.00			36.28	46.50	-10.22
306.60	40.20	100.00	225.00			23.34	46.50	-23.16
325.75	39.70	100.00	0.00			23.64	46.50	-22.86
331.80	44.20	100.00	315.00			28.19	46.50	-18.31
344.10	37.40	100.00	315.00			21.47	46.50	-25.03
368.64	36.80	100.00	315.00			21.24	46.50	-25.26
414.21	47.00	100.00	270.00			32.58	46.50	-13.92
497.61	42.50	100.00	270.00			31.15	46.50	-15.35

Table 9. SAT COM Radiated Emissions – Class A Limit