Nemko Test Report:	2L0103RUS3
Applicant:	Graviton 9820 Towne Centre Drive San Diego, CA 92121
Equipment Under Test: **(E.U.T.)**	BattGuard™ Telesensor transmitter Model: 0920
In Accordance With:	**FCC Part 15, Subpart C, 15.247** Direct Sequence Spread Spectrum Transmitters
Tested By:	Nemko Dallas Inc. 802 N. Kealy Lewisville, Texas 75057-3136
Authorized By:	 Tom Tidwell, Wireless Group Manager
Date:	3/19/02
Total Number of Pages:	44

Table of Contents

Section 1. Summary of Test Results

Manufacturer: Graviton

Tradename: BattGuard™ Telesensor

Model No.: 0920

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Direct Sequence Spread Spectrum devices. Radiated tests were conducted is accordance with ANSI C63.4-1992. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.

☒ New Submission ☐ Production Unit

☐ Class II Permissive Change ☒ Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.
See " Summary of Test Data".

NVLAP LAB CODE: 100426-0

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dBµV	N/A
Minimum 6 dB Bandwidth	15.247(a)(2)	>500 kHz	Complies
Maximum Peak Power Output	15.247(b)(1)	<1 Watt	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc/100kHz	Complies
Spurious Emissions (Restricted Bands)	15.247(c)	< 74 dBuV/m Peak < 54 dBuV/m Avg	Complies
Peak Power Spectral Density	15.247(d)	+8 dBm/3kHz	Complies
Processing Gain	15.247(e)	>10 dB	Complies

Footnotes:

The device is battery powered.
Processing gain is addressed in a separate report.

Section 2. Equipment Under Test (E.U.T.)

General Equipment Information

Frequency Band:	☐ 902 – 928 MHz ☒ 2400 – 2483.5 MHz ☐ 5725 – 5850 MHz
Operating Frequency of Sample	2401.4 to 2479.4 MHz
Channel Spacing:	1.5 MHz
Emissions Designator:	2M00F9W
User Frequency Adjustment:	Software controlled

Description of Modification for Modification Filing

Not Applicable

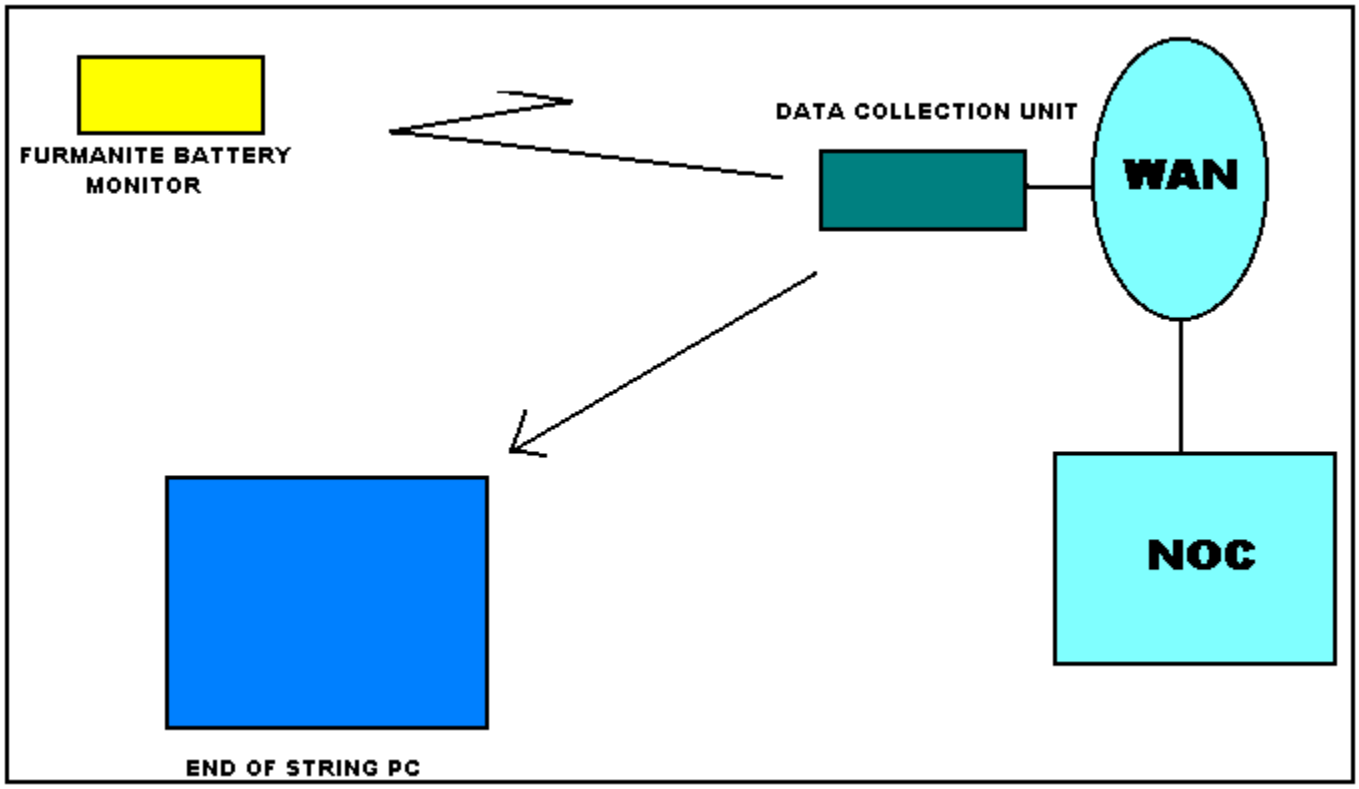
Family List Rational

Not Applicable

System Description

Telesensors are connected to each cell of the battery backup system. Using a wireless radio transmitter, each telesensor precisely measures battery current voltage, calculated impedance and temperature and reports the results at 15 minute intervals to a Graviton DCU data collection device mounted near your battery backup system. The operator can read the results locally or opt to transmit the results to Graviton's Network Operation Center where results are collected, analyzed, stored and presented on a secure website so authorized personnel can view from a browser enabled computer. The transmitter is powered by the battery backup system.

System Diagram



Section 3. Minimum 6 dB Bandwidth

NAME OF TEST: Minimum 6 dB Bandwidth	PARA. NO.: 15.247(a)(2)
TESTED BY: David Light	DATE: 3/12/2002

Test Results: Complies.

Measurement Data: See 6 dB BW plot

Measured 6 dB bandwidth: 2 MHz

Channel Separation: 1.5 MHz

Measurement Uncertainty: $1x10^{-7}$ ppm

Test Data – 6 dB Bandwidth

Dallas Headquarters:
802 N. Kealy
Lewisville, TX 75057
Tel: (972) 436-9600
Fax: (972) 436-2667

Nemko Dallas, Inc.

Data Plot

Page 1 of 3

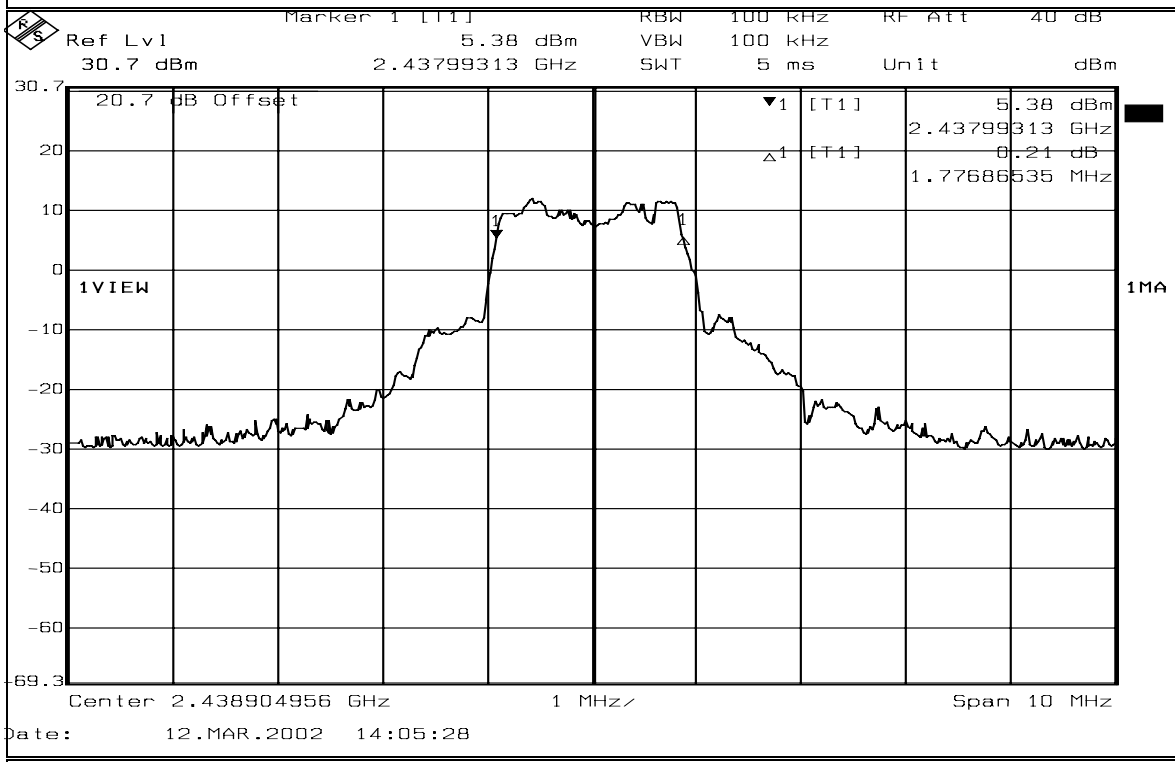
Job No.:	2l0103r	Date:	3/12/2002	Complete	x
Specification:	15.247	Temperature(°C):	22	Preliminary:	
Tested By:	David Light	Relative Humidity(%)	40		
E.U.T.:	802.11b device				
Configuration:	TX				
Sample Number:	1				
Location:	Lab 1	RBW:	Refer to plots	Measurement	
Detector Type:	Peak	VBW:	Refer to plots	Distance:	NA m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1629
Filter:		Cable #2:	
Receiver:	1464	Cable #3:	
Attenuator #1	1477	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: +/-1.7 dB



Notes: **MID CHANNEL**

Test Data – 6 dB Bandwidth

Dallas Headquarters:
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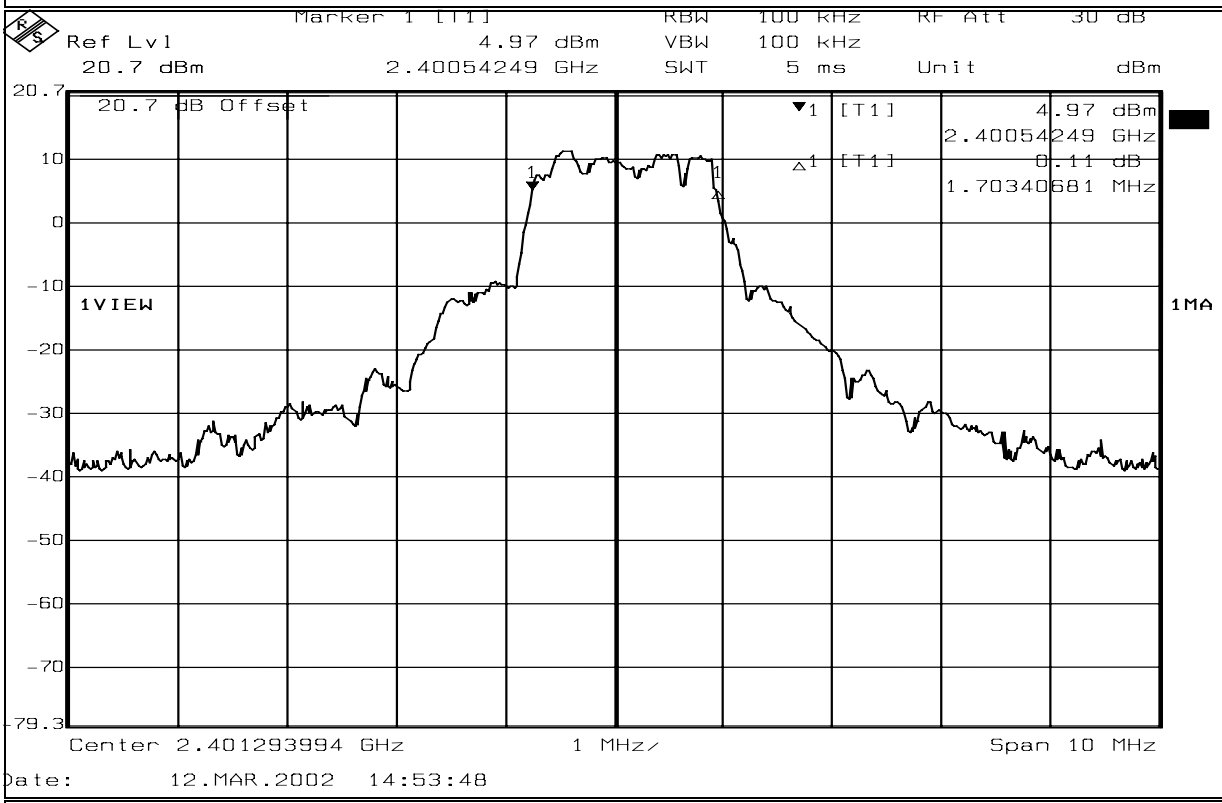
Lewisville, TX 75057
Tel: (972) 436-9600
Fax: (972) 436-2667

Nemko Dallas, Inc.

Data Plot

Page 2 of 3

Job No.:	2l0103r	Date:	3/12/2002
Specification:	15.2	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11b device		
Configuration:	TX		



Notes: **LOWEST CHANNEL**

Test Data – 6 dB Bandwidth

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Tel: (972) 436-9600
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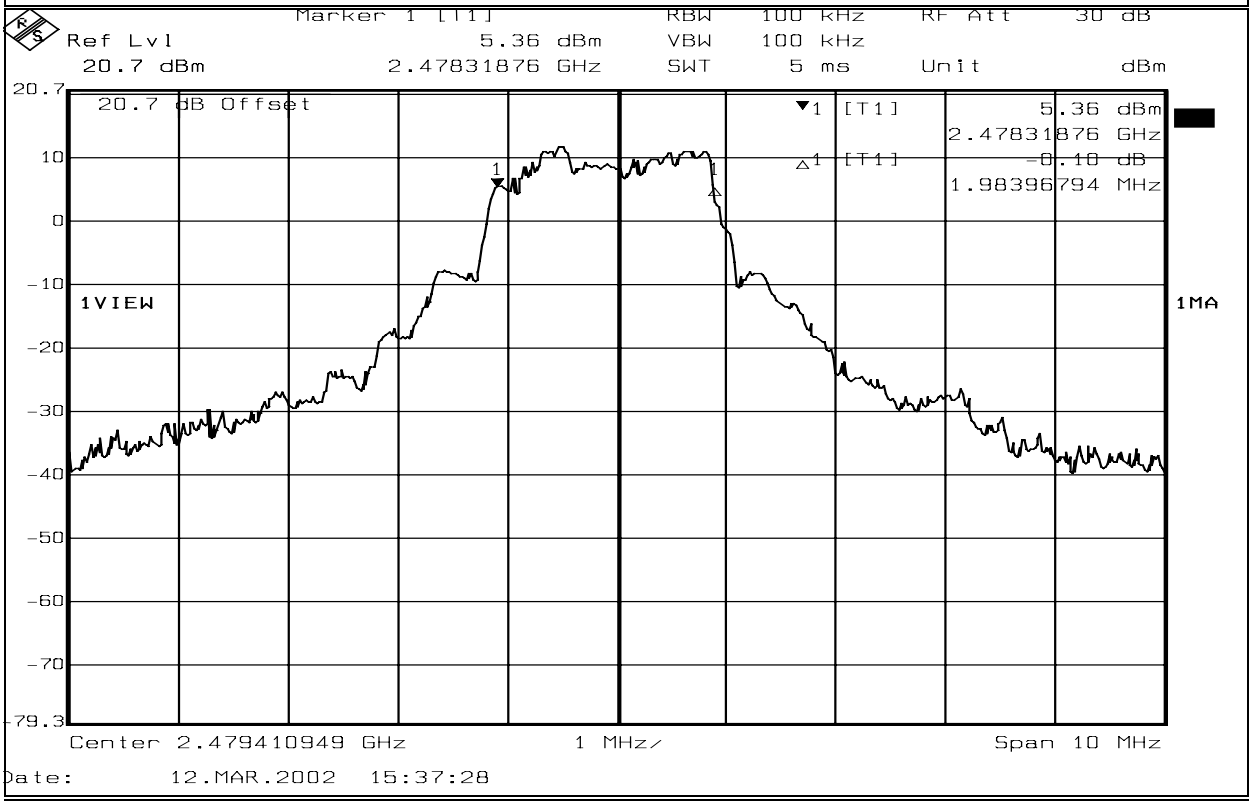
Nemko Dallas, Inc.

Data Plot

Page 3 of 3

Job No.:	2l0103r	Date:	3/12/2002
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11b device		
Configuration:	TX		



Notes: HIGHEST CHANNEL

Section 4. Maximum Peak Output Power

NAME OF TEST: Maximum Peak Output power	PARA. NO.: 15.247(b)(1)
TESTED BY: David Light	DATE: 3/12/02

Test Results: Complies.

Measurement Data:

E.I.R.P. measurement was made using the substitution antenna method.

Antennas:

	Type			E.I.R.P. (dBm)
	Integral			18.5
	Integral			20.9
	Integral			21.0
Peak power output at antenna port(dBm): 16.8 MID, 16.2 HIGH, 15.9 LOW				

The device was tested at 4.6 Vdc and 46 Vdc. Variation in rf output power was less than 0.2 dB.

Equipment Used: 1029-1030

Measurement Uncertainty: +/- 0.7 dB (Conducted)
+/- 3.6 dB (Radiated)

Temperature: 22 °C

Relative Humidity: 50 %

Radiated Power

EIRP

Page 1 of 1 Complete X

Job No.: 2L0103R Date: 3/12/2002 Preliminary

Specification: 15.247 Temperature(°C): 22

Tested By: David Light Relative Humidity(%) 50

E.U.T.: 802.11b DEVICE

Configuration: TX FULL POWER

Sample No: 2

Location: AC 3 RBW: 2 MHz Measurement

Detector Type: Peak VBW: 2 MHz Distance: 3 m

Test Equipment Used

Antenna: Directional Coupler:

Pre-Amp: Cable #1: 1484

Filter: Cable #2: 1485

Receiver: 1464 Cable #3:

Attenuator #1 Cable #4:

Attenuator #2: Mixer:

Additional equipment used:

Measurement Uncertainty: +/-3.6 dB

Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)		EIRP (dBm)	EIRP (mW)	Polarity	Comments
2479.5	-27.2	36.2		0	9.5		18.5	70.7946	H	Lowest channel
2479.5	-28.5	34.9		0	9.5		15.9	38.9045	V	
2438.5	-24.8	36.2		0	9.5		20.9	123.0269	H	Mid channel
2438.5	-25.7	34.9		0	9.5		18.7	74.1310	V	
2401.5	-24.7	36.2		0	9.5		21.0	125.8925	H	highest channel
2401.5	-25.3	34.9		0	9.5		19.1	81.2831	V	

Notes:

Section 5. RF Exposure

NAME OF TEST: RF Exposure	PARA. NO.: 15.247(b)(4)
TESTED BY: David Light	DATE: 3/12/2002

Test Results: Complies.

Measurement Data:

MPE Prediction

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	20.00	(dBm)
Maximum peak output power at antenna input terminal:	100	(mW)
Antenna gain(typical):	0	(dBi)
Maximum antenna gain:	1	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2400	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm^2)
Power density at prediction frequency:	0.019894	(mW/cm^2)
Maximum allowable antenna gain:	17.0127	(dBi)

Section 6. Spurious Emissions (conducted)

NAME OF TEST: Spurious Emissions (conducted)	PARA. NO.: 15.247(c)
TESTED BY: David Light	DATE: 3/12/2002

Test Results: Complies.

Measurement Data: See attached plots.

Measurement Uncertainty: +/- 1.7 dB

Test Data – Spurious Emissions at Antenna Terminals

Dallas Headquarters:
802 N. Kealy
Lewisville, TX 75057
Tel: (972) 436-9600
Fax: (972) 436-2667

Nemko Dallas, Inc.

Data Plot **SPURIOUS EMISSIONS AT ANTENNA TERMINAL**

Page 1 of 6 Complete X

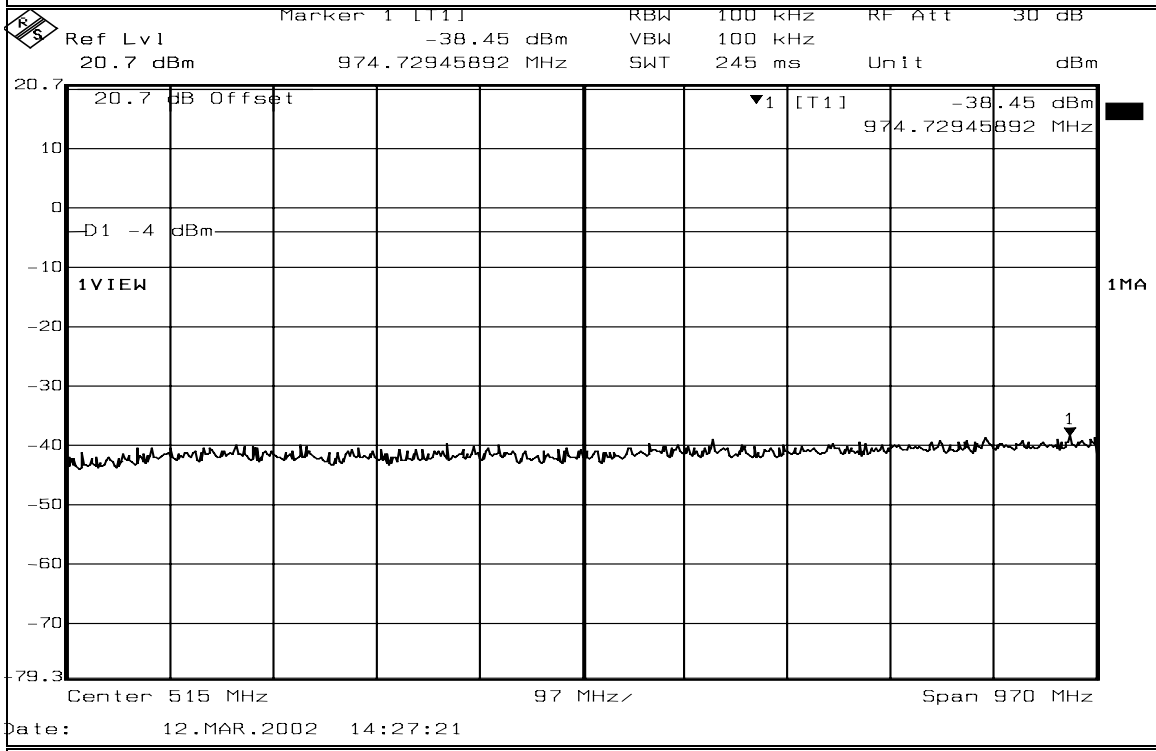
Job No.:	2L0103R	Date:	3/12/2002	Preliminary:	
Specification:	15.247	Temperature(°C):	22		
Tested By:	David Light	Relative Humidity(%)	40		
E.U.T.:	802.11B DEVICE				
Configuration:	TX				
Sample Number:	1				
Location:	Lab 1	RBW:	Refer to plots	Measurement	
Detector Type:	Peak	VBW:	Refer to plots	Distance:	NA m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1629
Filter:		Cable #2:	
Receiver:	1464	Cable #3:	
Attenuator #1	1477	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: +/-1.7 dB



Notes: **DISPLAY LINE IS -20 dBc**
MID CHANNEL

Test Data – Spurious Emissions at Antenna Terminals

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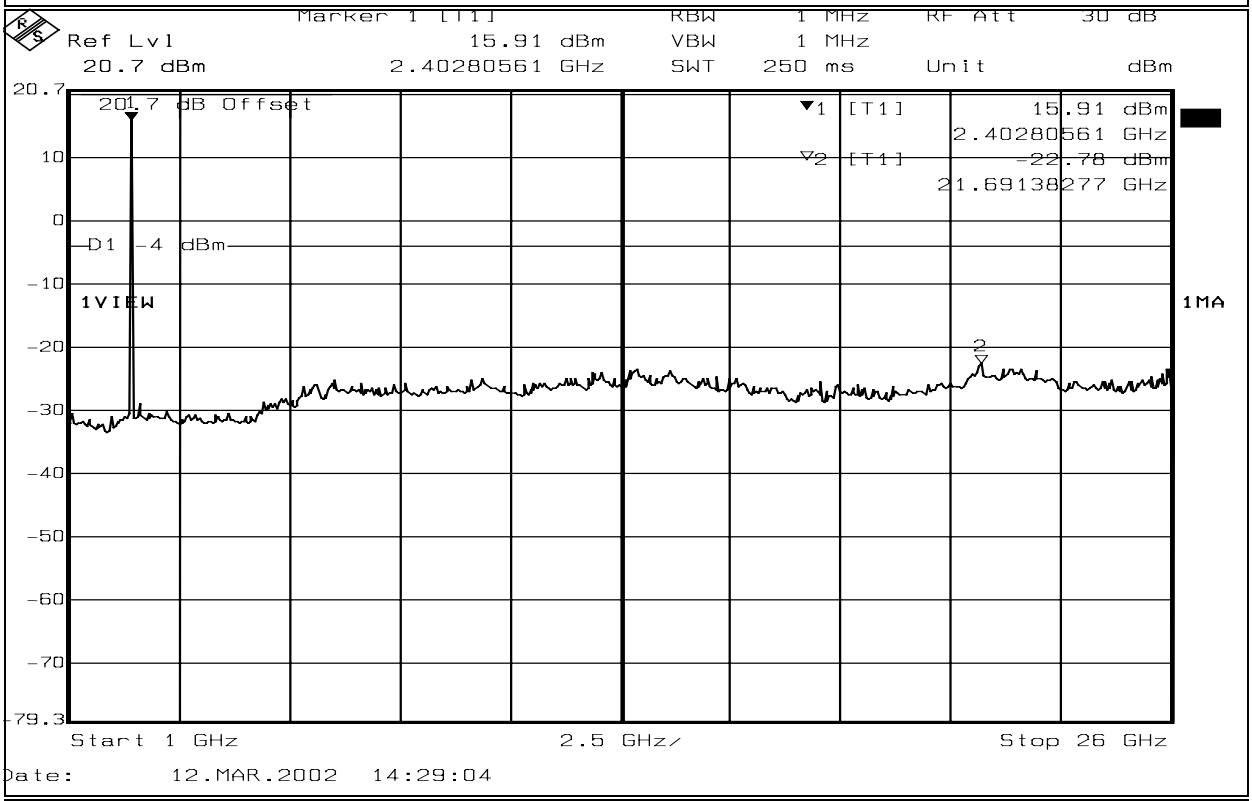
Data Plot **SPURIOUS EMISSIONS AT ANTENNA TERMINAL**

Page 2 of 6

Job No.:	2L0103R	Date:	3/12/2002
Specification:	15.2	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11B DEVICE		
Configuration:	TX		



Notes:
DISPLAY LINE IS -20 dBc
MARKER 1 INDICATES CARRIER (MID CHANNEL)
MARKER 2 INDICATES HIGHEST EMISSION (NOISE FLOOR)

Test Data – Spurious Emissions at Antenna Terminals

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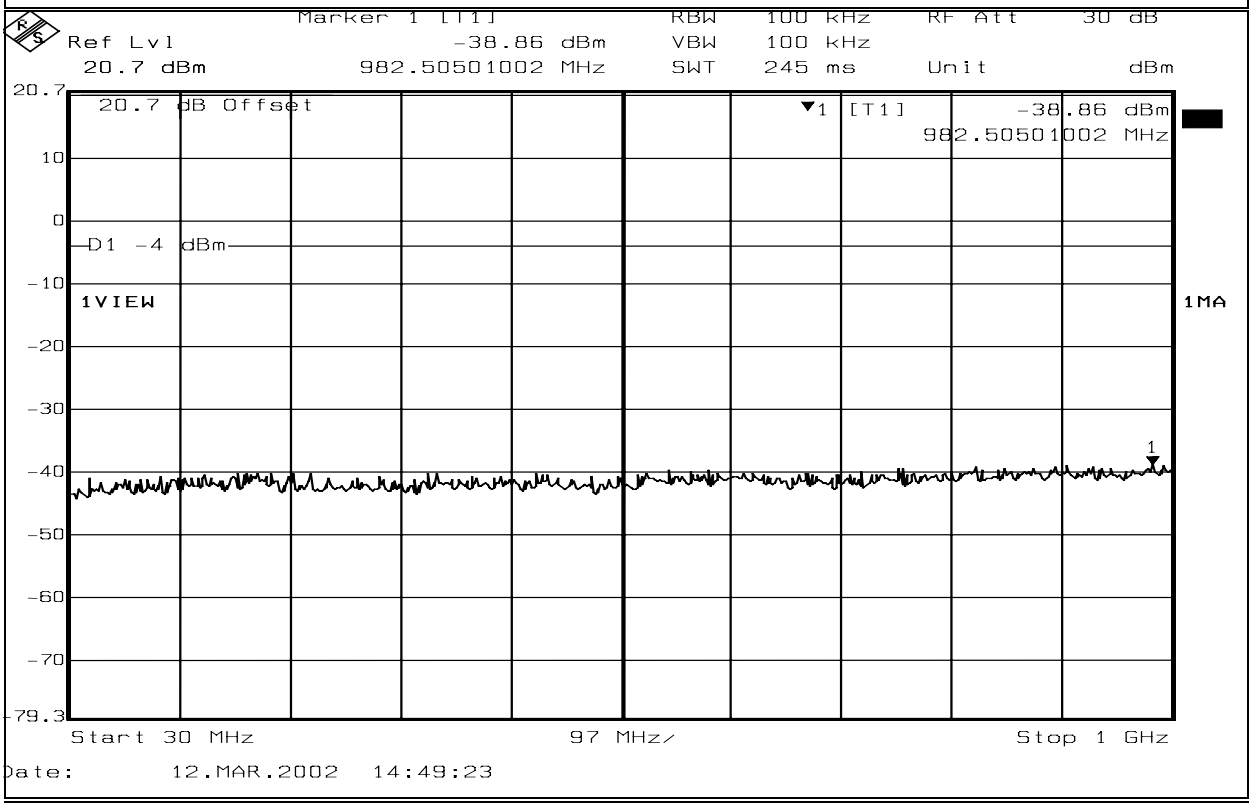
Data Plot **SPURIOUS EMISSIONS AT ANTENNA TERMINAL**

Page 3 of 6

Job No.:	2L0103R	Date:	3/12/2002
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11B DEVICE		
Configuration:	TX		



Notes: DISPLAY LINE IS -20 dBc
LOWEST CHANNEL

Test Data – Spurious Emissions at Antenna Terminals

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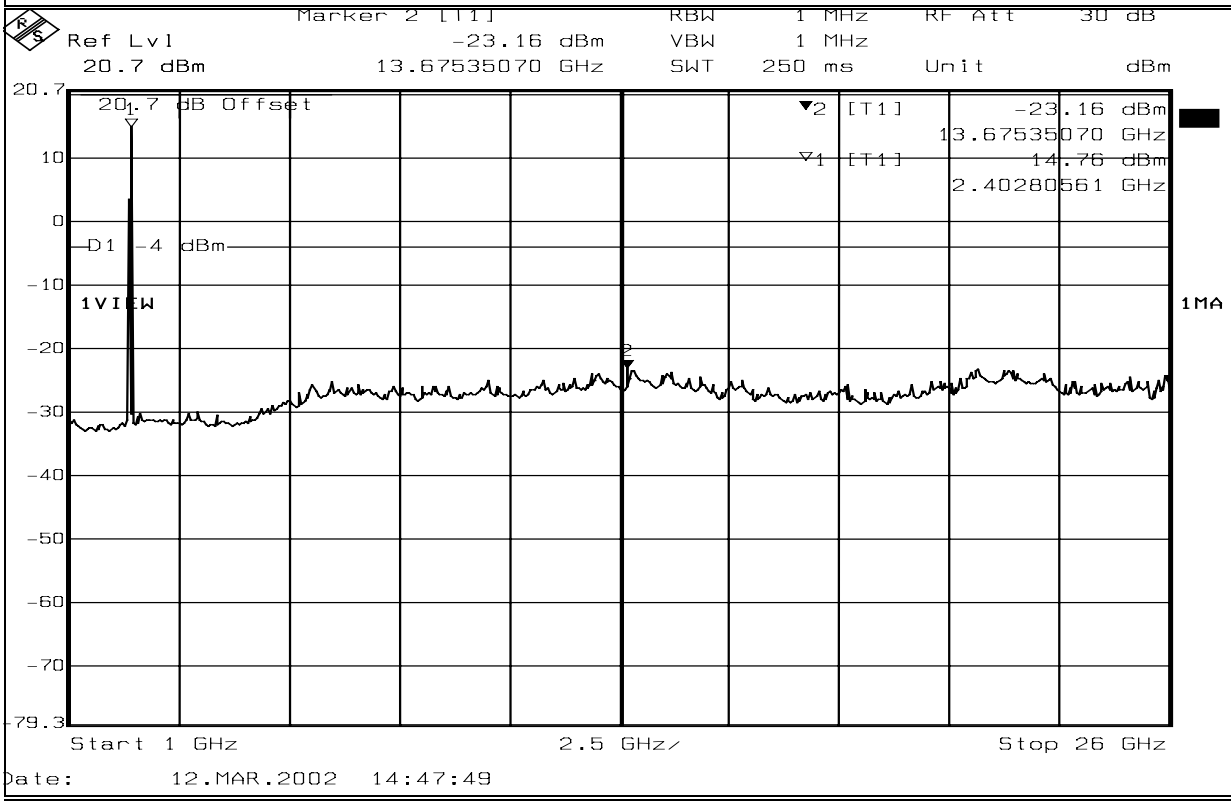
Test Plot: **SPURIOUS EMISSIONS AT ANTENNA TERMINAL**

Page 4 of 6

Job No.:	2L0103R	Date:	3/12/2002
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11B DEVICE		
Configuration:	TX		



Notes:
DISPLAY LINE IS -20 dBc
MARKER 1 INDICATES CARRIER (LOWEST CHANNEL)
MARKER 2 INDICATES HIGHEST EMISSION (NOISE FLOOR)

Test Data – Spurious Emissions at Antenna Terminals

Dallas Headquarters:
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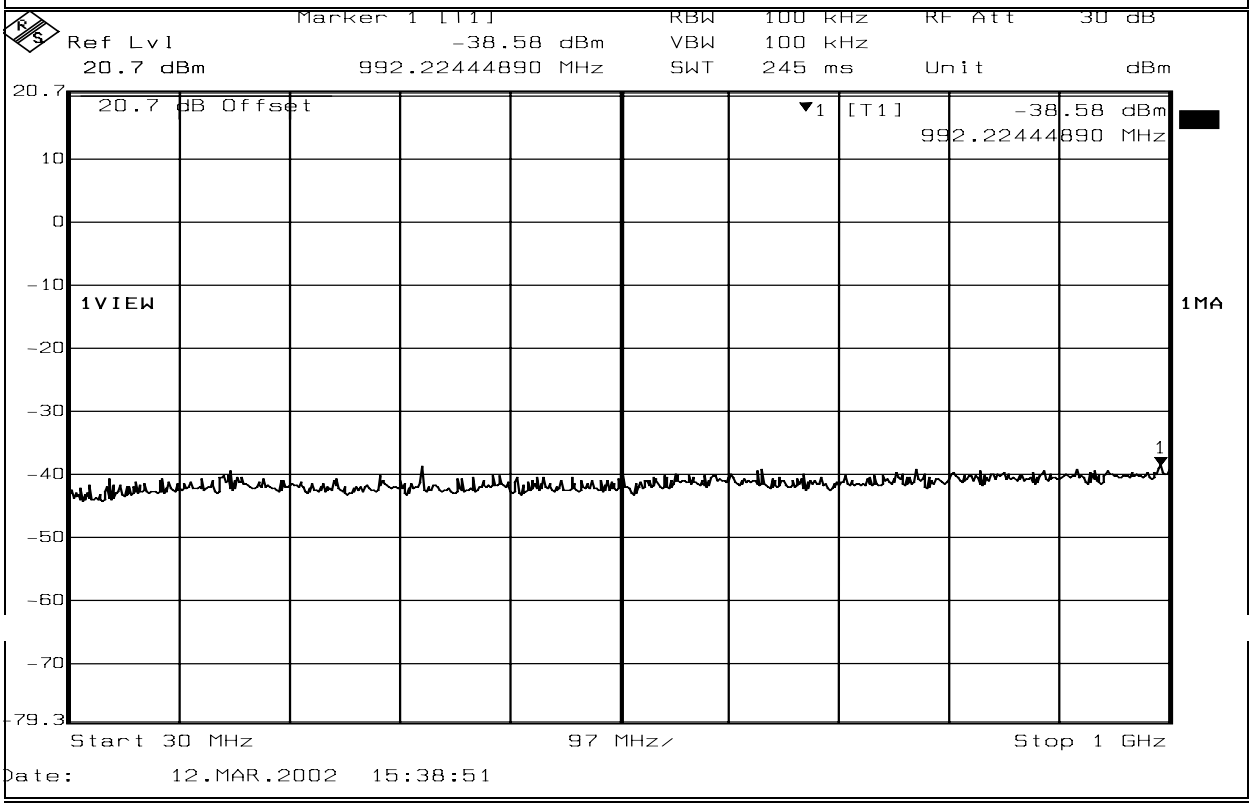
Nemko Dallas, Inc.

Test Plot: **SPURIOUS EMISSIONS AT ANTENNA TERMINAL**

Page 5 of 6

Job No.:	2L0103R	Date:	3/12/2002
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11B DEVICE		
Configuration:	TX		



Notes: HIGHEST CHANNEL

Test Data – Spurious Emissions at Antenna Terminals

Dallas Headquarters:
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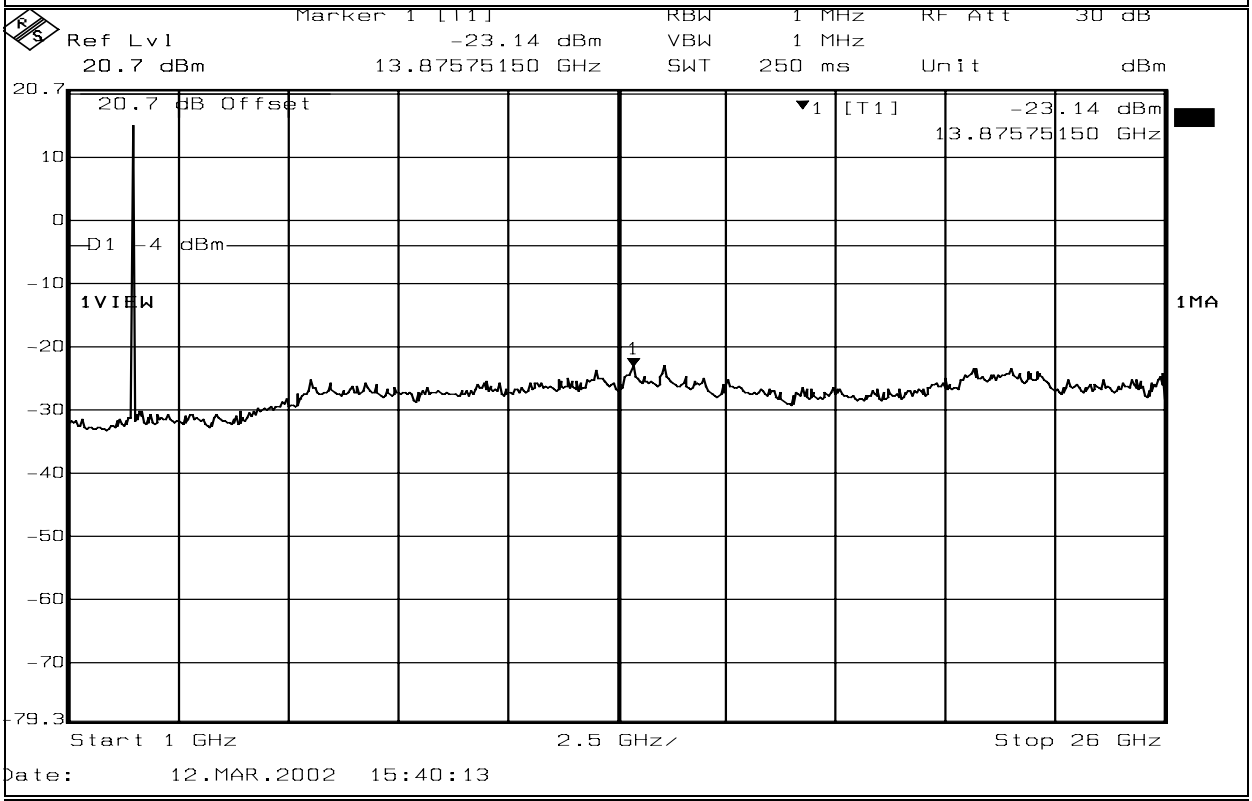
Nemko Dallas, Inc.

Test Plot: **SPURIOUS EMISSIONS AT ANTENNA TERMINAL**

Page 6 of 6

Job No.:	2L0103R	Date:	3/12/2002
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11B DEVICE		
Configuration:	TX		



Notes: **HIGHEST CHANNEL**

Section 7. Spurious Emissions (radiated)

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (c)
TESTED BY: David Light	DATE: 3/11/2002

Test Results: Complies.

Measurement Data: See attached table.

Duty Cycle Calculation: 20 x $_{\mathbf{log}}$(50ms/100ms) = -6.0 dB

Duty Cycle correction factor(dB) = 20 log (rf_{ON} in ms/100ms)

Measurement Uncertainty: +/- 3.7 dB

Test Data – Radiated Spurious Emissions (Restricted Bands)

Test Location: Nemko Dallas, Inc. • 802 N. Kealy • Lewisville, TX 75057-3136 • 972-436-9600

Customer:	**Graviton**		
Specification:	**FCC Radiated B High Freq.**		
Work Order #:	**2L0103R**	Date:	03/11/2002
Test Type:	**Radiated Scan**	Time:	15:54:30
Equipment:	**802.11b Device**	Sequence#:	1
Manufacturer:	Graviton	Tested By:	Light
Model:			
S/N:	0054		

***Test Equipment*:**

Function	Asset #	Temp	20°C
Antenna	1304	RH	45%
Pre-amplifier	1016	Measurement Distance	3 Meters
Cable #1	1484		
Cable #2	1485		

Test Conditions / Notes:

HIGH POWER (power level 3)
Average readings 1 MHz RBW/10 Hz VBW : Peak readings 1MHZ RBW/1 MHz VBW
Average readings were not taken if peak measurements passed the average limit by 3 dB

Measurement Data: Reading listed by order taken. Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	Cable -6 dB dB	Cable dB	Horn dB	Pre-A dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2483.500	39.2	+0.8 +6.0	+2.3	+28.2	+0.0	+0.0	64.5	74.0 Ch 54	-9.5	Vert
2	2483.500 Ave	26.7	+0.8 +6.0	+2.3	+28.2	+0.0	+0.0	52.0	54.0 Ch 54	-2.0	Vert
3	4958.600	43.3	+1.0 +6.0	+3.3	+33.8	+29.6	+0.0	45.8	54.0 Ch 54	-8.2	Vert
4	7437.900	43.0	+1.2 +6.0	+4.1	+36.2	+34.1	+0.0	44.4	54.0 Ch 54	-9.6	Vert
5	12396.50	42.7	+1.8 +6.0	+5.5	+39.9	+32.7	+0.0	51.2	74.0 Ch 54	-22.8	Vert
6	12396.50 Ave	31.2	+1.8 +6.0	+5.5	+39.9	+32.7	+0.0	39.7	54.0 Ch 54	-14.3	Vert
7	2483.500	37.8	+0.8 +6.0	+2.3	+28.2	+0.0	+0.0	63.1	74.0 Ch 54	-10.9	Horiz
8	2483.500 Ave	25.7	+0.8 +6.0	+2.3	+28.2	+0.0	+0.0	51.0	54.0 Ch 54	-3.0	Horiz
9	4958.600	42.7	+1.0 +6.0	+3.3	+33.8	+29.6	+0.0	45.2	54.0 Ch 54	-8.8	Horiz
10	7437.900	42.5	+1.2 +6.0	+4.1	+36.2	+34.1	+0.0	43.9	54.0 Ch 54	-10.1	Horiz

Test Data – Radiated Spurious Emissions (Restricted Bands)

#	Freq	Rdng	Cable -6 dB	Cable	Horn	Pre-A	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
11	12396.50	42.7	+1.8 +6.0	+5.5	+39.9	+32.7	+0.0	51.2	74.0 Ch 54	-22.8	Horiz
12	12396.50 Ave	30.8	+1.8 +6.0	+5.5	+39.9	+32.7	+0.0	39.3	54.0 Ch 54	-14.7	Horiz
13	4877.637	42.0	+1.0 +6.0	+3.3	+33.5	+29.9	+0.0	43.9	54.0 Ch 27	-10.1	Horiz
14	7316.457	41.0	+1.2 +6.0	+4.0	+36.1	+34.2	+0.0	42.1	54.0 Ch 27	-11.9	Horiz
15	12194.10	41.7	+1.8 +6.0	+5.5	+40.0	+33.0	+0.0	50.0	54.0 Ch 27	-4.0	Horiz
16	4877.637	42.3	+1.0 +6.0	+3.3	+33.5	+29.9	+0.0	44.2	54.0 Ch 27	-9.8	Vert
17	7316.457	41.5	+1.2 +6.0	+4.0	+36.1	+34.2	+0.0	42.6	54.0 Ch 27	-11.4	Vert
18	12194.10	42.2	+1.8 +6.0	+5.5	+40.0	+33.0	+0.0	50.5	54.0 Ch 27	-3.5	Vert
19	4802.684	43.5	+1.0 +6.0	+3.2	+33.3	+30.1	+0.0	44.9	54.0 Ch 02	-9.1	Vert
20	12006.66	43.0	+1.8 +6.0	+5.5	+40.0	+33.5	+0.0	50.8	54.0 Ch 02	-3.2	Vert
21	4802.684	43.5	+1.0 +6.0	+3.2	+33.3	+30.1	+0.0	44.9	54.0 Ch 02	-9.1	Horiz
22	12006.66	41.5	+1.8 +6.0	+5.5	+40.0	+33.5	+0.0	49.3	54.0 Ch 02	-4.7	Horiz

Radiated Photographs (Worst Case Configuration)

Section 8. Peak Power Spectral Density

NAME OF TEST: Peak Power Spectral Density	PARA. NO.: 15.247(d)
TESTED BY: David Light	DATE: 3/13/2002

Test Results: Complies.

Measurement Data: See attached plots.

Measurement Uncertainty: +/- 0.7 dB

Test Data – Peak Power Spectral Density

Dallas Headquarters:
802 N. Kealy
Lewisville, TX 75057
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Fax: (972) 436-2667

Nemko Dallas, Inc.

Data Plot **SPECTRAL DENSITY**

Page 1 of 3 Complete X

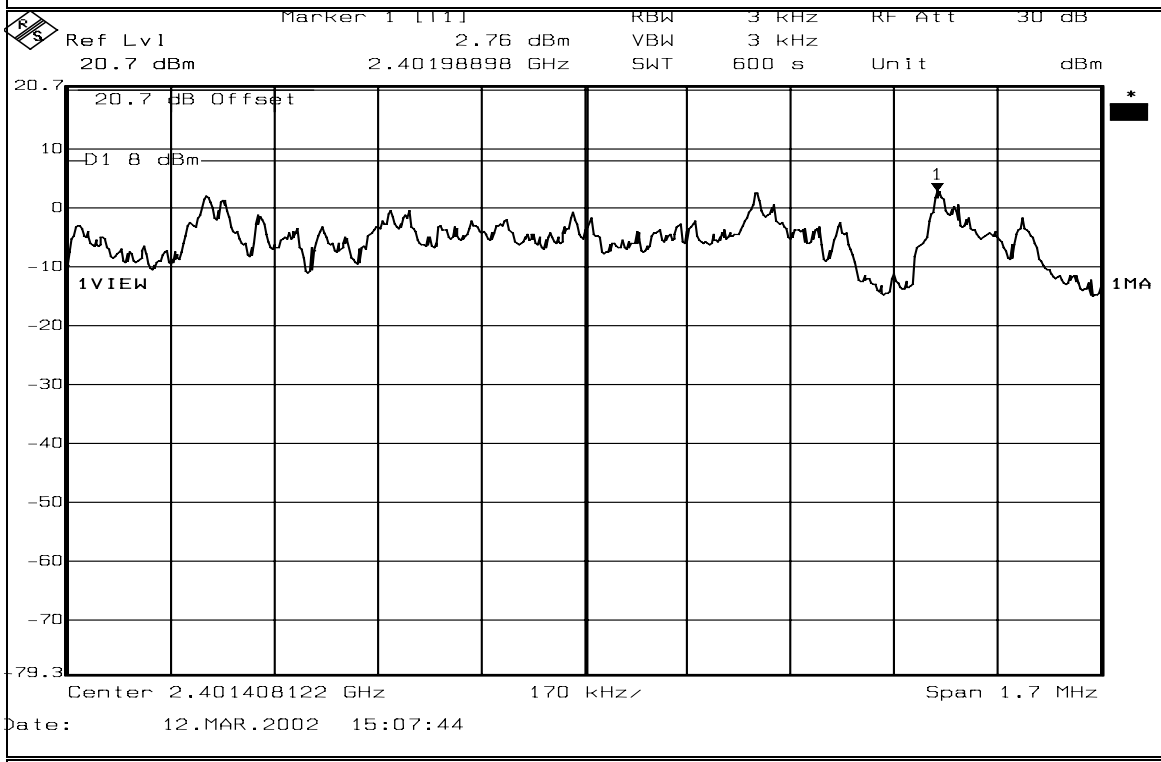
Job No.:	2L0103R	Date:	3/12/2002	Preliminary:	
Specification:	15.247	Temperature(°C):	22		
Tested By:	David Light	Relative Humidity(%)	40		
E.U.T.:	802.11B DEVICE				
Configuration:	TX				
Sample Number:	1				
Location:	Lab 1	RBW:	3 kHz	Measurement	
Detector Type:	Peak	VBW:	3 kHz	Distance:	NA m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1629
Filter:		Cable #2:	
Receiver:	1464	Cable #3:	
Attenuator #1	1477	Cable #4:	
Attenuator #2:		Mixer:	

Additional equipment used:

Measurement Uncertainty: +/-1.7 dB



Notes: **LOWEST CHANNEL**

Test Data – Peak Power Spectral Density

Dallas Headquarters:
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Lewisville, TX 75057
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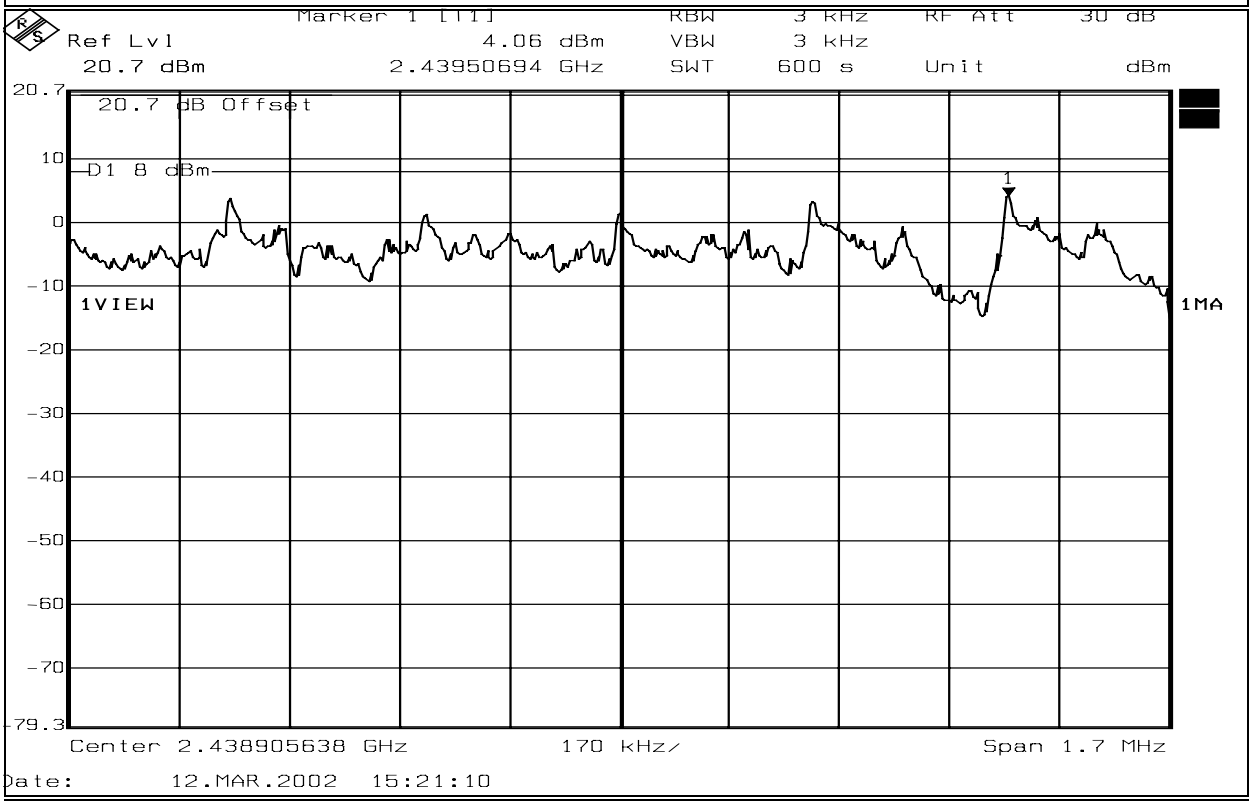
Fax: (972) 436-2667

Nemko Dallas, Inc.

Data Plot **SPECTRAL DENSITY**

Page 2 of 3

Job No.:	2L0103R	Date:	3/12/2002
Specification:	15.2	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11B DEVICE		
Configuration:	TX		



Notes: **MID CHANNEL**

Test Data – Peak Power Spectral Density

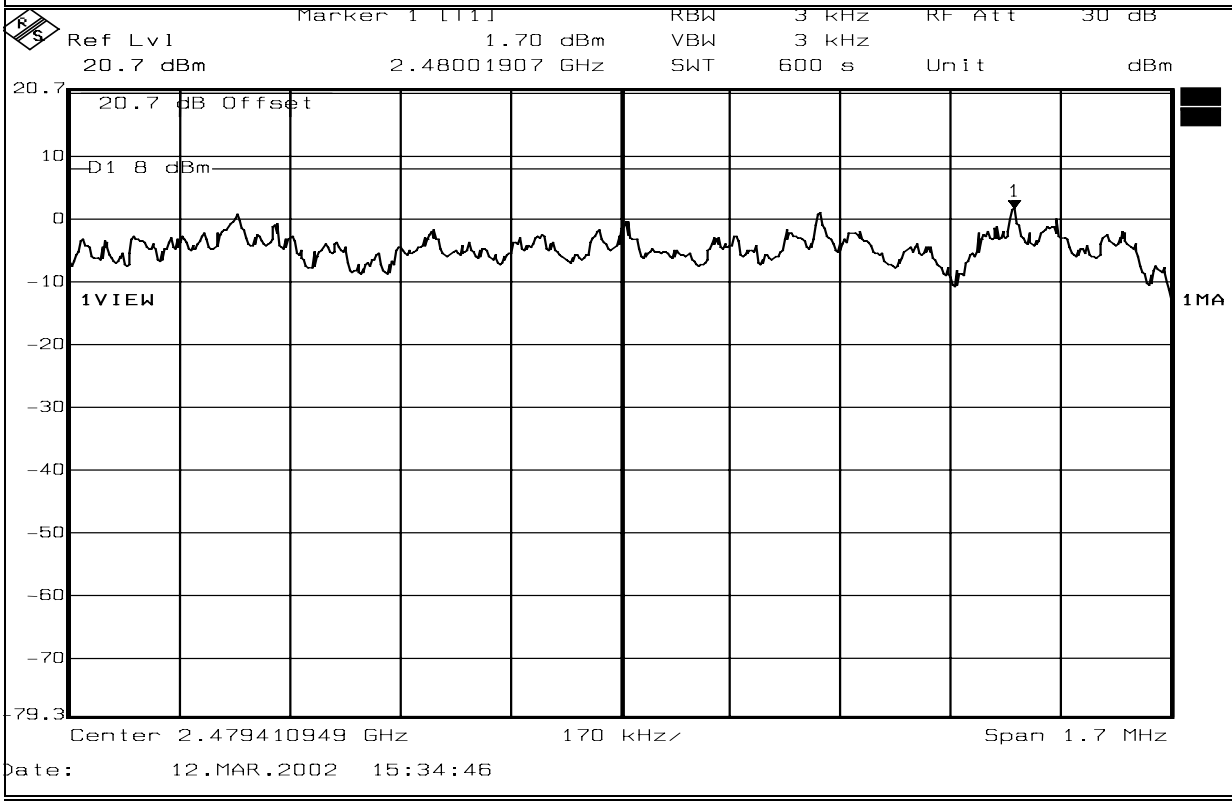
Dallas Headquarters:
802 N. Kealy
Lewisville, TX 75057
Tel: (972) 436-9600
Fax: (972) 436-2667

Nemko Dallas, Inc.

Data Plot **SPECTRAL DENSITY**

Page 3 of 3

Job No.:	2L0103R	Date:	3/12/2002
Specification:	15.247	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	802.11B DEVICE		
Configuration:	TX		



Notes: **HIGHEST CHANNEL**

Section 9. Minimum Processing Gain

This testing is addressed in a separate report.

Section 10. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date
1629	CABLE, 6 ft	MEGAPHASE 10311 1GVT4	N/A	CBU
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	12/18/01
1477	20db Attenuator DC 18 Ghz	MCL Inc. BW-S20W5	NONE	CBU
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	07/30/01
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/30/01
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	06/01/01
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	06/01/01
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01
1029	PEAK POWER METER	HP 8900D	3303U0012	03/12/01
1030	PEAK POWER SENSOR	HP 84811A	2539A03573	03/12/01

ANNEX A - TEST DETAILS

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)

Minimum Standard: The R.F. that is conducted back onto the AC power line on any frequency within the band 0.45 to 30 MHz shall not exceed 250µV (48 dBµV) across 50 ohms.

NAME OF TEST: Minimum 6 dB bandwidth	PARA. NO.: 15.247(a)(2)

Minimum Standard: The minimum 6 dB bandwidth shall be at least 500 kHz

NAME OF TEST: Maximum Peak Output Power	PARA. NO.: 15.247(b)(1)

Minimum Standard: The maximum peak output power shall not exceed 1 watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point to point operation may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operation may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Direct Measurement Method For Detachable Antennas:
If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load. The dBi gain of the antenna(s) employed shall be reported.

Calculation Of EIRP For Integral Antenna:
If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts
E = the maximum measured field strength in V/m
R = the measurement range (3 meters)
G = the numeric gain of the transmit antenna in relation to an isotropic radiator

The RBW of the spectrum analyzer shall be set to a value greater than the measured 6 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: RF Exposure	PARA. NO.: 15.247(b)(4)

Minimum Standard: Systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines stipulated in 1.1307(b)(1) of CFR 47.

NAME OF TEST: Spurious Emissions(conducted)	PARA. NO.: 15.247(c)

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (µV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM IS SEARCHED TO THE 10th HARMONIC OF THE HIGHEST FREQUENCY GENERATED IN THE EUT.

Method Of Measurement:

30 MHz - 10th harmonic plot
RBW: 100 kHz
VBW: 300 kHz
Sweep: Auto
Display line: -20 dBc

Lower Band Edge
RBW: At least 1% of span/div.
VBW: >RBW
Span: As necessary to display any spurious at band edge.
Sweep: Auto
Center Frequency: 902 MHz, 2400 MHz, or 5725 MHz
Marker: Peak of fundamental emission
Marker Δ: Peak of highest spurious level below center frequency.

Upper Band Edge
RBW: At least 1% of span/div.
VBW: >RBW
Span: As necessary to display any spurious at band edge.
Sweep: Auto
Center Frequency: 928 MHz, 2483.5 MHz, or 5850 MHz
Marker: Peak of fundamental emission
Marker Δ: Peak of highest spurious level above center frequency.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Radiated Spurious Emissions PARA. NO.: 15.247(c)

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (µV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	1718		

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Transmitter Power Density	PARA. NO.: 15.247(d)

Minimum Standard: The transmitted power density averaged over any 1 second interval shall not be greater than +8 dBm in any 3 kHz bandwidth.

Method Of Measurement: The spectrum analyzer is set as follows:

RBW: 3 kHz
VBW: >3 kHz
Span: => measured 6 dB bandwidth
Sweep: Span(kHz)/3 (i.e. for a span of 1.5 MHz the sweep rate is 1500/3 = 500 sec.
LOG dB/div.: 2 dB

Note: For devices with spectrum line spacing =< 3 kHz, the RBW of the analyzer is reduced until the spectral lines are resolved. The measurement data is normalized to 3 kHz by summing the power of all the individual spectral lines within a 3 kHz band in linear power units.

For Devices With Integral Antenna:

For devices with non-detachable antennas, the received field strength is peaked and the spectrum analyzer is set as above. The peak emission level is then measured and converted to a field strength by adding the appropriate antenna factor and cable loss. This field strength is then converted to an equivalent isotropic radiated power using the same method as described for Peak Power output.

Number of channels tested:

Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

NAME OF TEST: Processing Gain	PARA. NO.: 15.247(e)

Minimum Standard: The processing gain shall be at least 10 dB.

Method Of Measurement: The CW jamming margin method was used to determine the processing gain. A CW signal generator is stepped across the passband of the receiver in 50 kHz increments. At each point the signal generator level required to obtain the recommended bit error rate is recorded. The jammer to signal ratio (J/S) is then calculated. The worst 20% of the J/S points is discarded. The lowest remaining J/S ratio is used to calculate the processing gain.

Calculation Of Processing Gain:

The processing gain was determined by measuring the jamming margin of the E.U.T. and using the following formula:

Jamming Margin = G_p - $(S/N)_{out}$ - L_{sys}

For a receiver using non-coherent detection the value $(S/N)_{out}$ is calculated using the formula:

$P_e = (1/2)EXP\{-E/2N_o\}$ where P_e is the probability of error (minimum Bit Error Rate required for proper operation).

E/N_o is $(S/N)_{out}$
for example, for a bit error rate of 10^{-4} a S/N ratio of 12.3 dB is required.

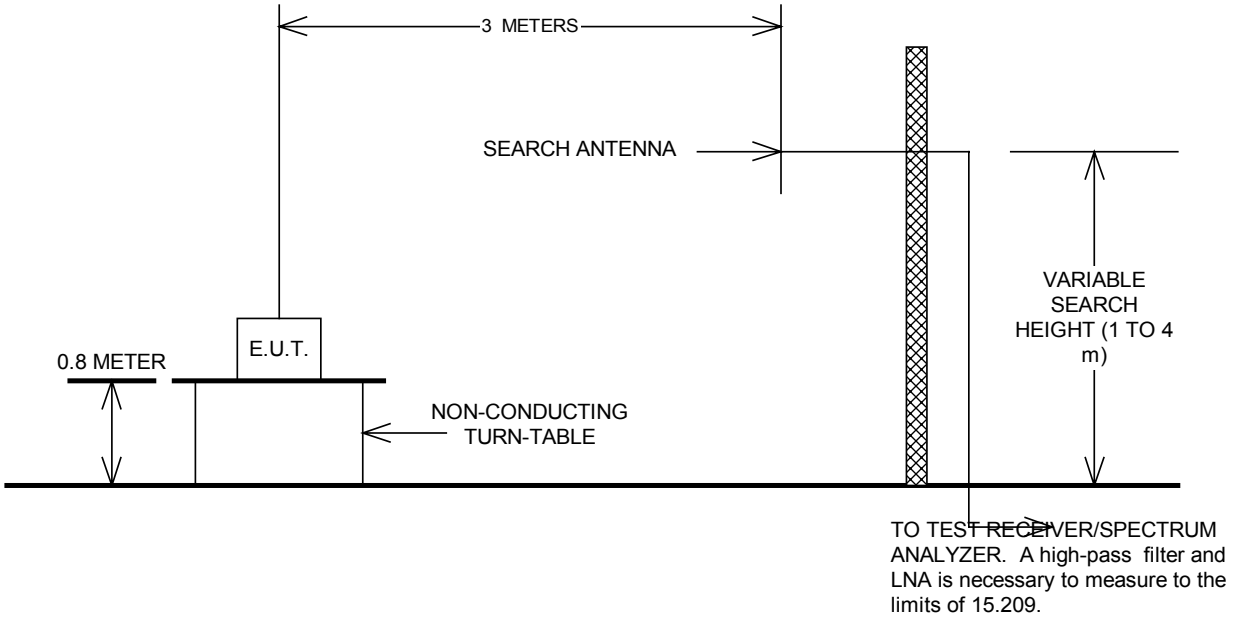
$L_{sys\ (system\ losses)}$ is assumed to be 2 dB.

Therefore $G_p = Mj + (S/N)_{out} + L_{sys}$

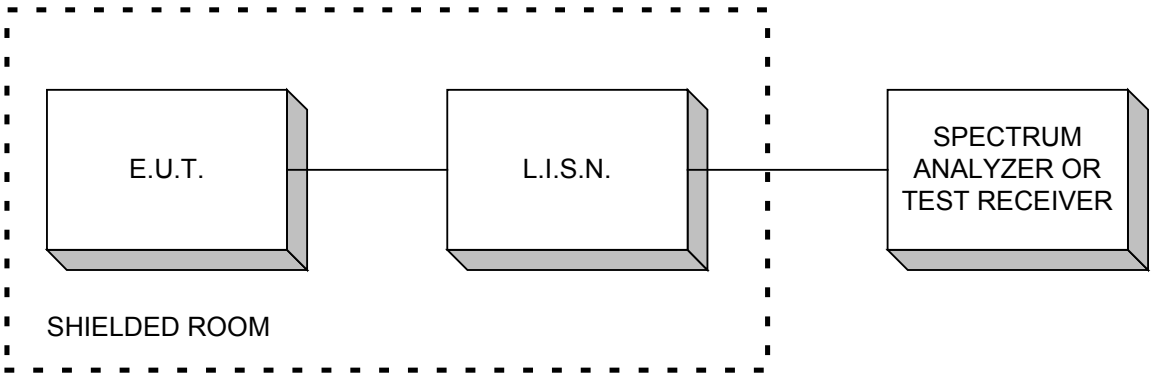
Measurement performed at a channel in the center of the operating band of the EUT.

ANNEX B - TEST DIAGRAMS

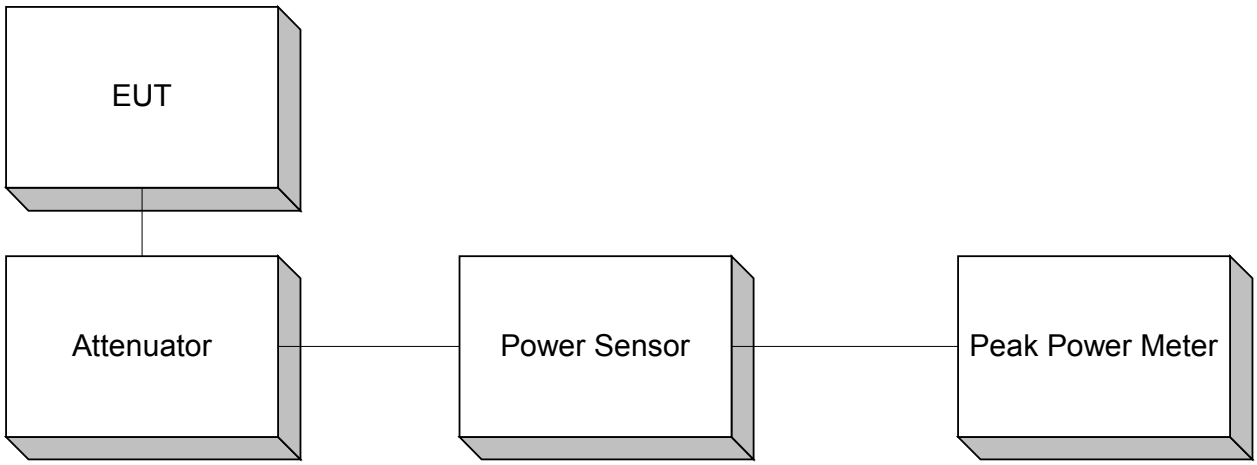
Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals



Minimum 6 dB Bandwidth
Peak Power Spectral Density
Spurious Emissions (conducted)