

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

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EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

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 in 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**

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EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB μ V	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.

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

Description of Modification for Modification Filing

Not Applicable

Family List Rational

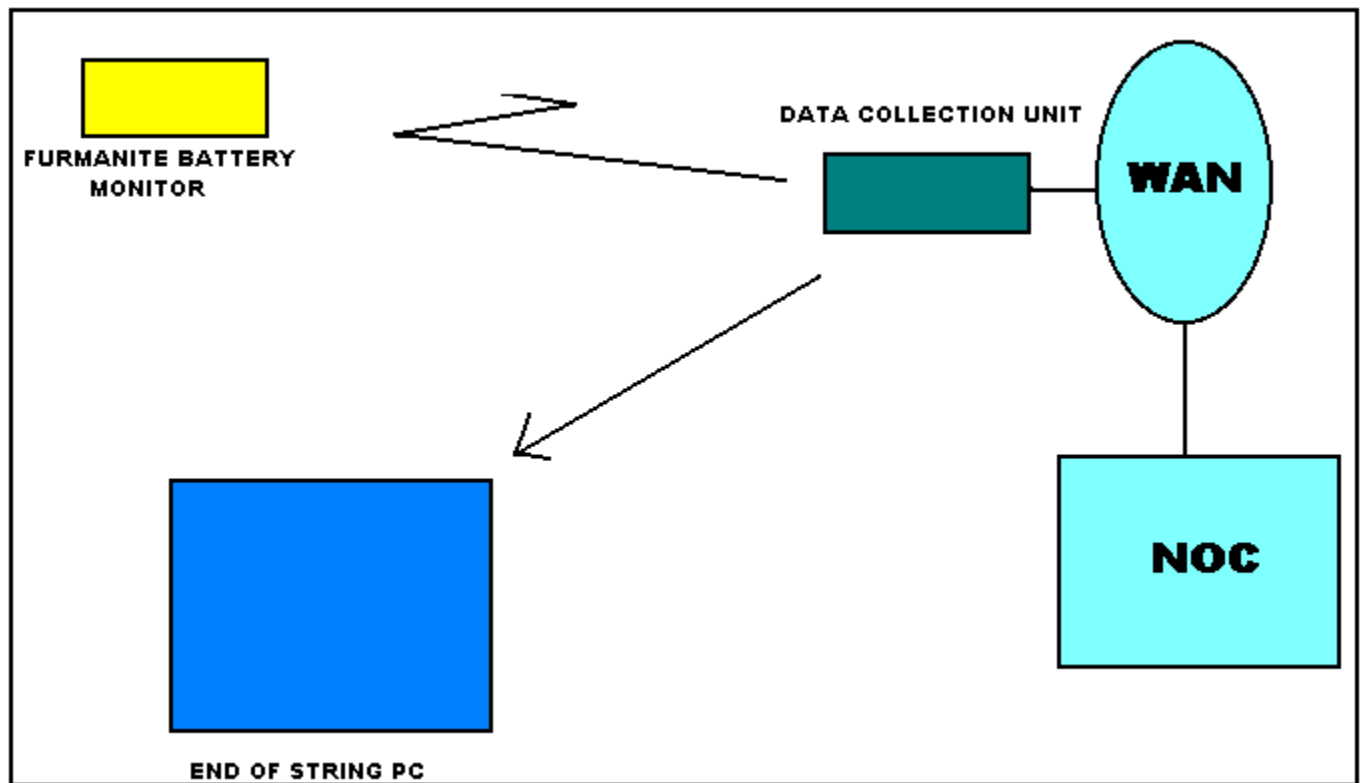
Not Applicable

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

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



EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

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: 1×10^{-7} ppm

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

Test Data – 6 dB Bandwidth



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Data Plot

Page 1 of 3

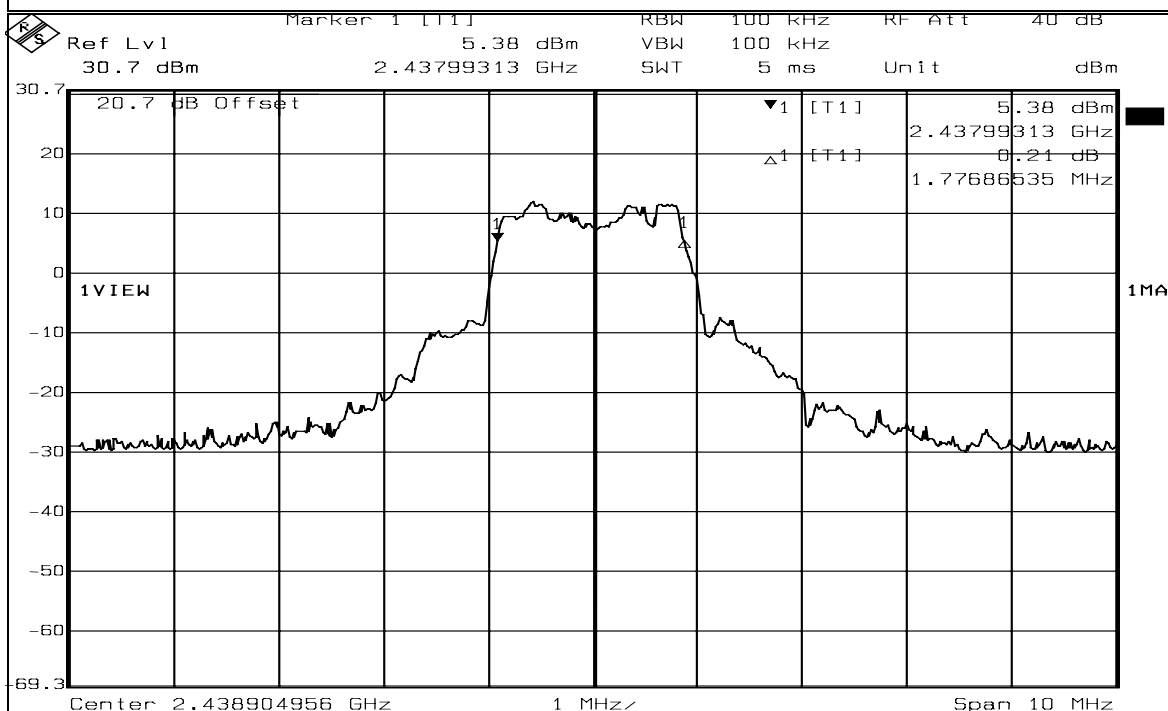
Job No.: 210103r Date: 3/12/2002 Complete x
Preliminary: _____

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

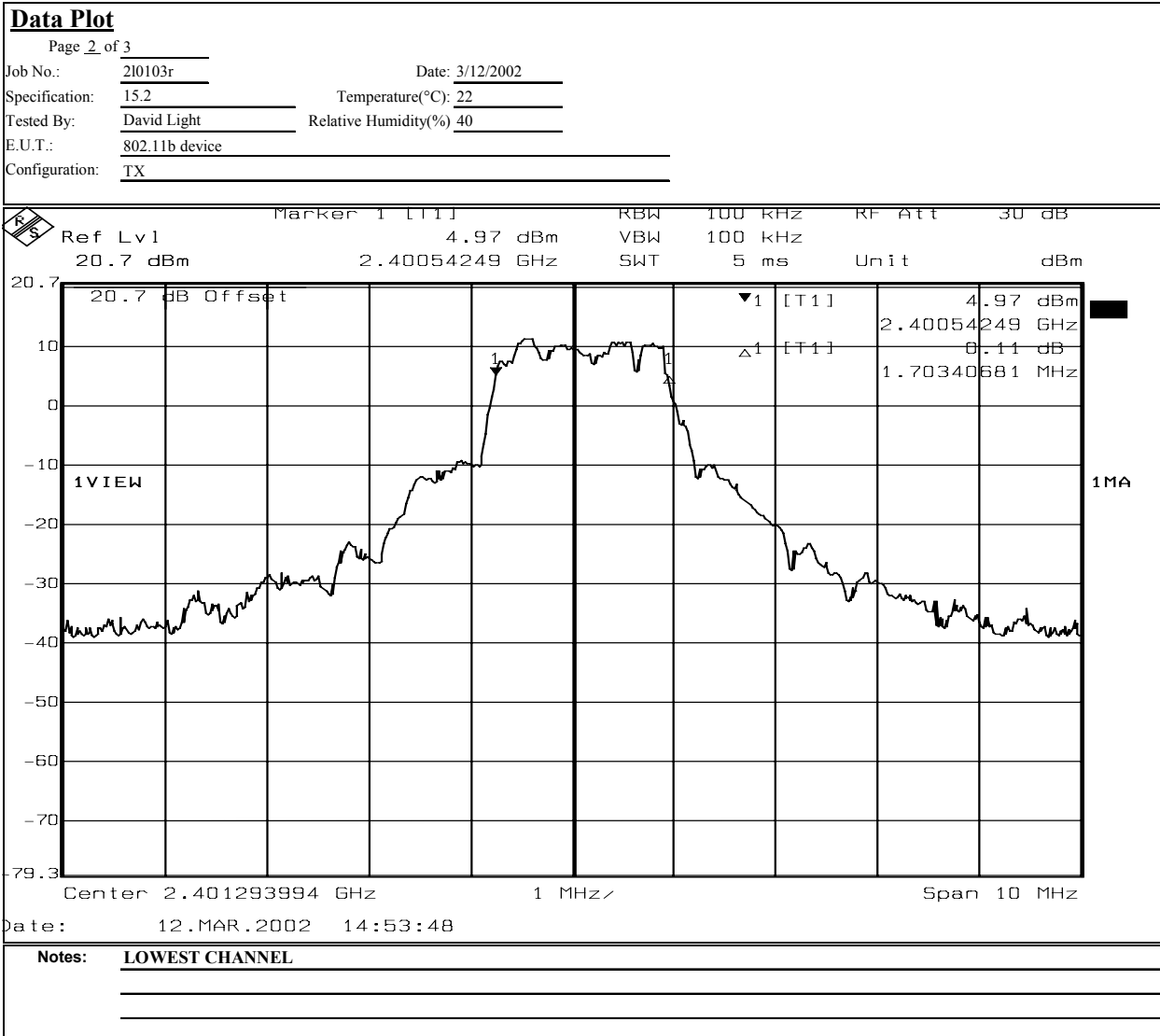


Date: 12.MAR.2002 14:05:28

Notes: MID CHANNEL

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**Test Data – 6 dB Bandwidth****Dallas Headquarters:**

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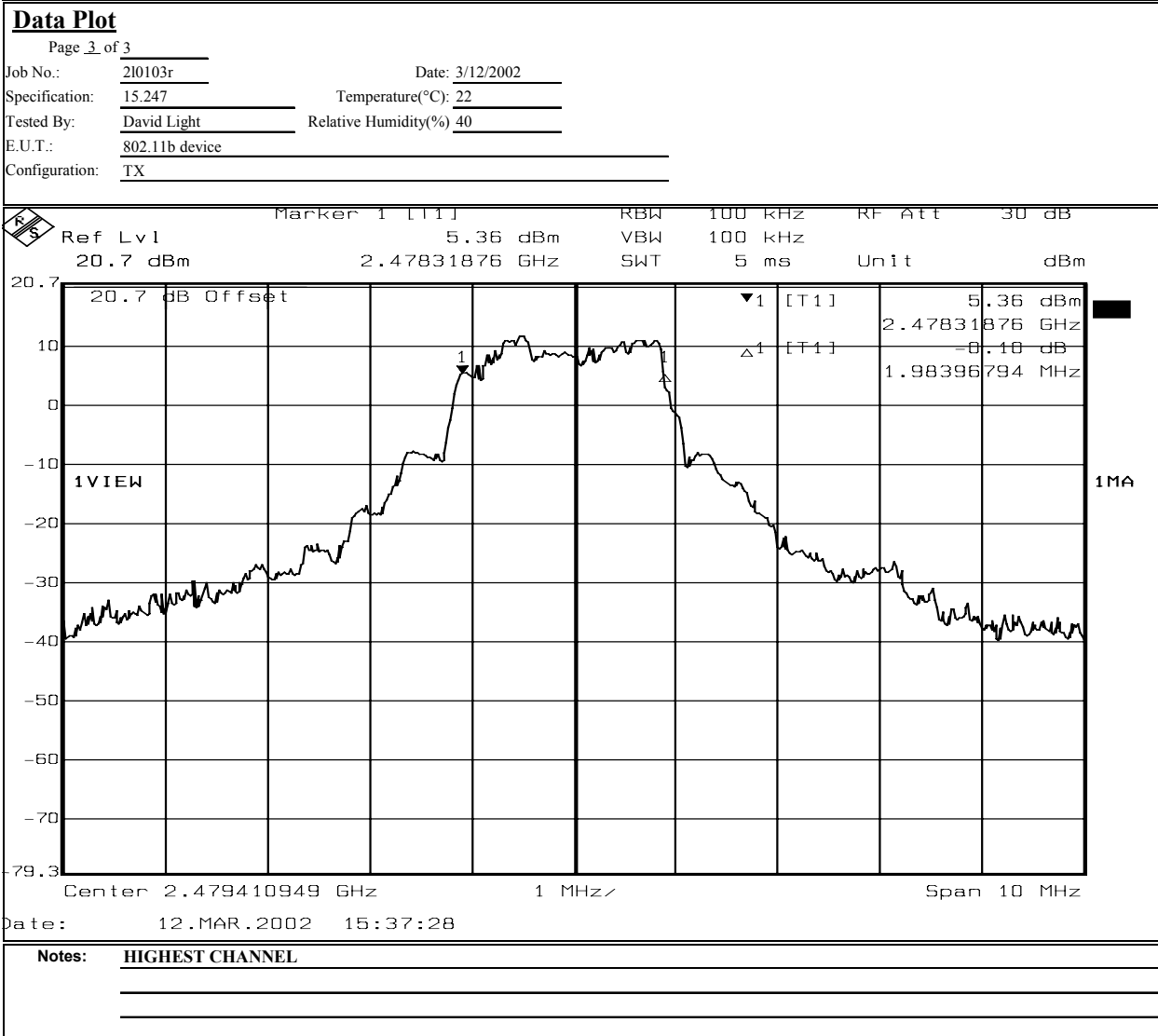
EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

Test Data – 6 dB Bandwidth



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EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

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:** 1029-1030Measurement Uncertainty: +/- 0.7 dB (Conducted)
 +/- 3.6 dB (Radiated)

Temperature: 22 °C

Relative Humidity: 50 %

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**Radiated Power**

<u>EIRP</u>										
Page <u>1</u> of <u>1</u>							Complete <u>X</u>			
Job No.: 2L0103R		Date: 3/12/2002					Preliminary _____			
Specification: 15.247		Temperature(°C): <u>22</u>								
Tested By: David Light		Relative Humidity(%) <u>50</u>								
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			
<u>Test Equipment Used</u>										
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: _____										

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**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/cm²)Power density at prediction frequency: 0.019894 (mW/cm²)

Maximum allowable antenna gain: 17.0127 (dBi)

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

Test Data – Spurious Emissions at Antenna Terminals



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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			
Ref Lvl 20.7 dBm Marker 1 [T1] -38.45 dBm RBW 100 kHz RF Att 30 dB Unit dBm			
20.7 974.72945892 MHz 100 kHz 245 ms			
Center 515 MHz 97 MHz Span 970 MHz			
Date: 12.MAR.2002 14:27:21			
Notes: DISPLAY LINE IS -20 dBc			
MID CHANNEL			

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

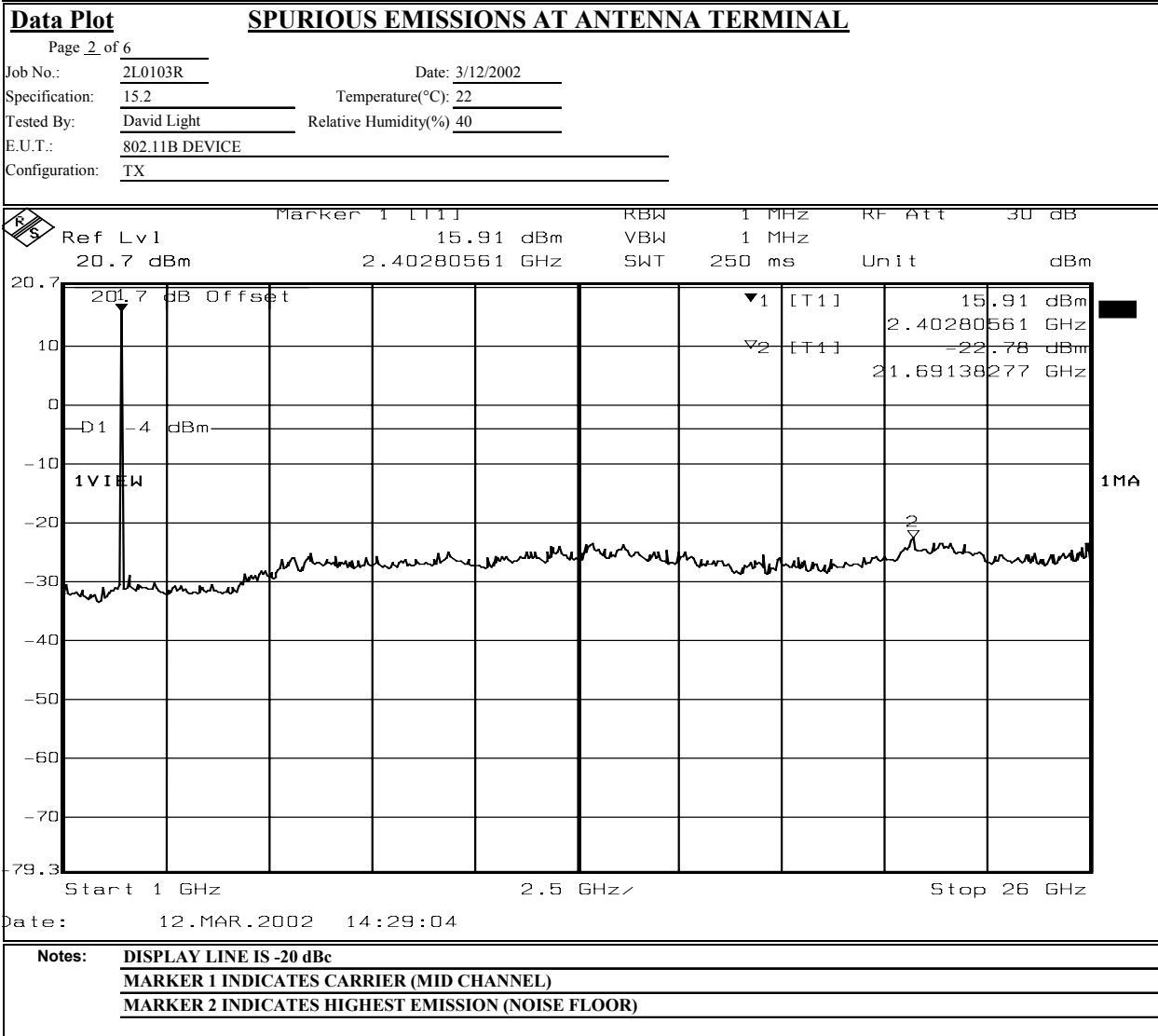
Test Data – Spurious Emissions at Antenna Terminals



Dallas Headquarters:

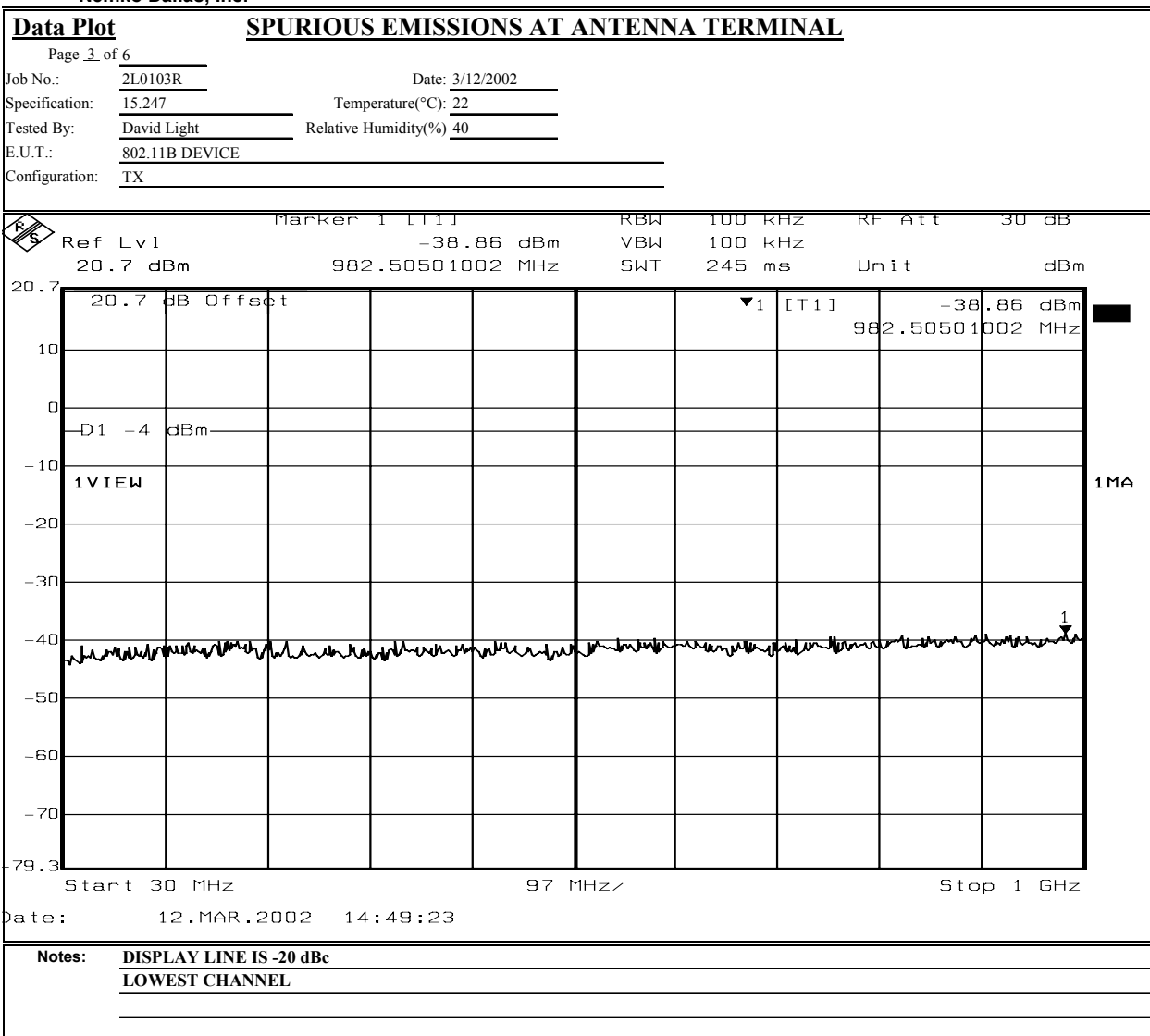
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EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**Test Data – Spurious Emissions at Antenna Terminals**

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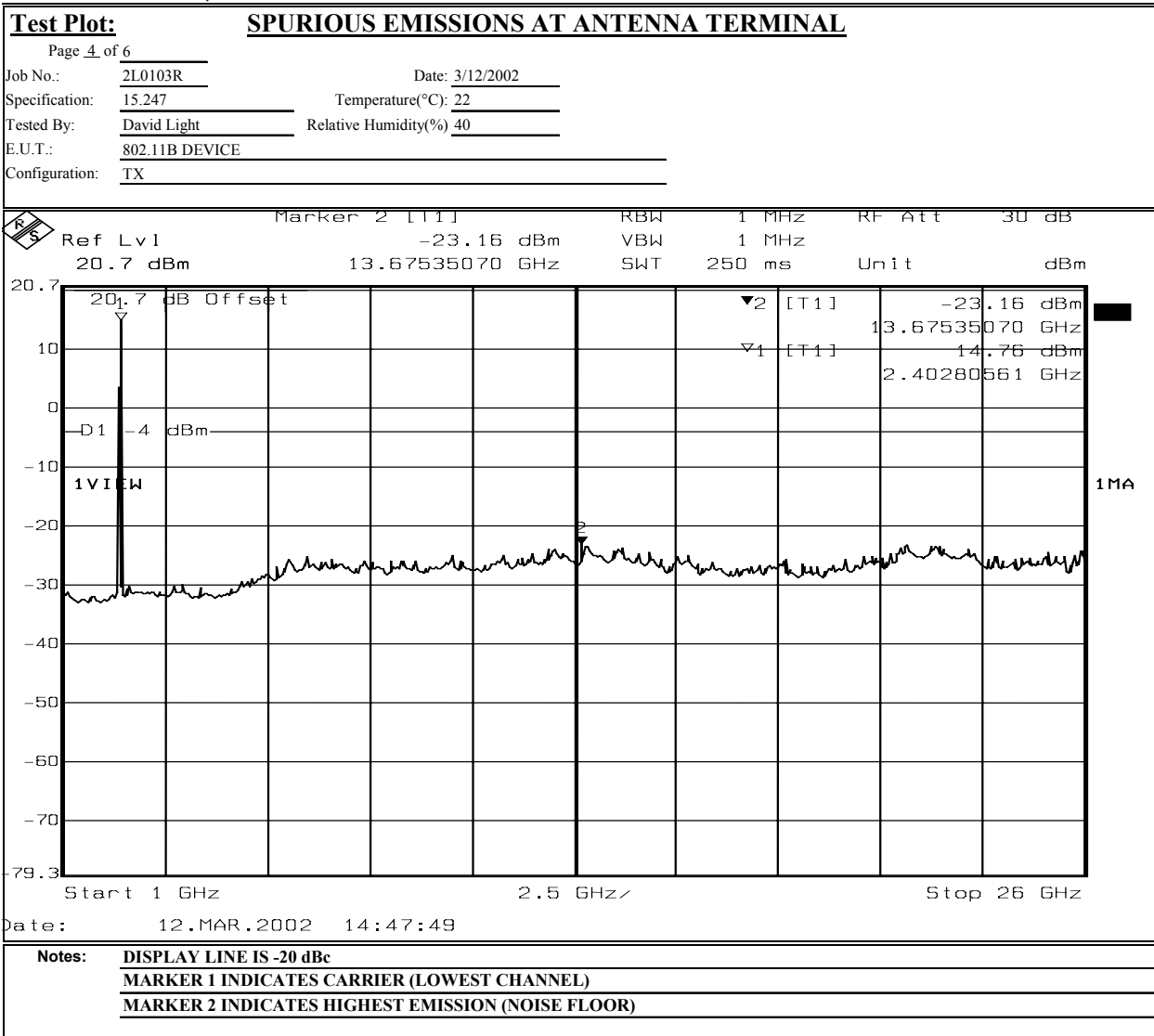
Test Data – Spurious Emissions at Antenna Terminals



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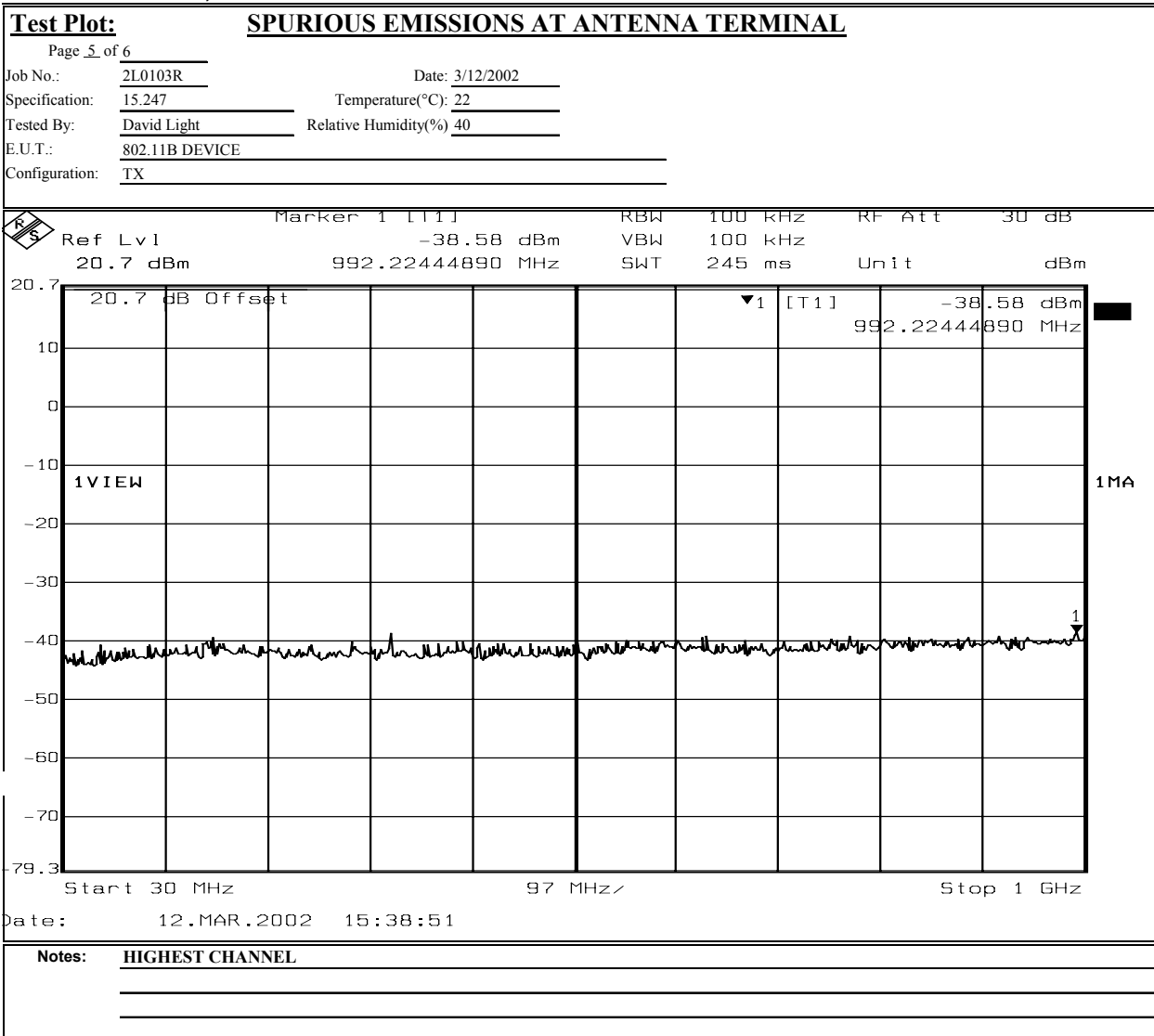
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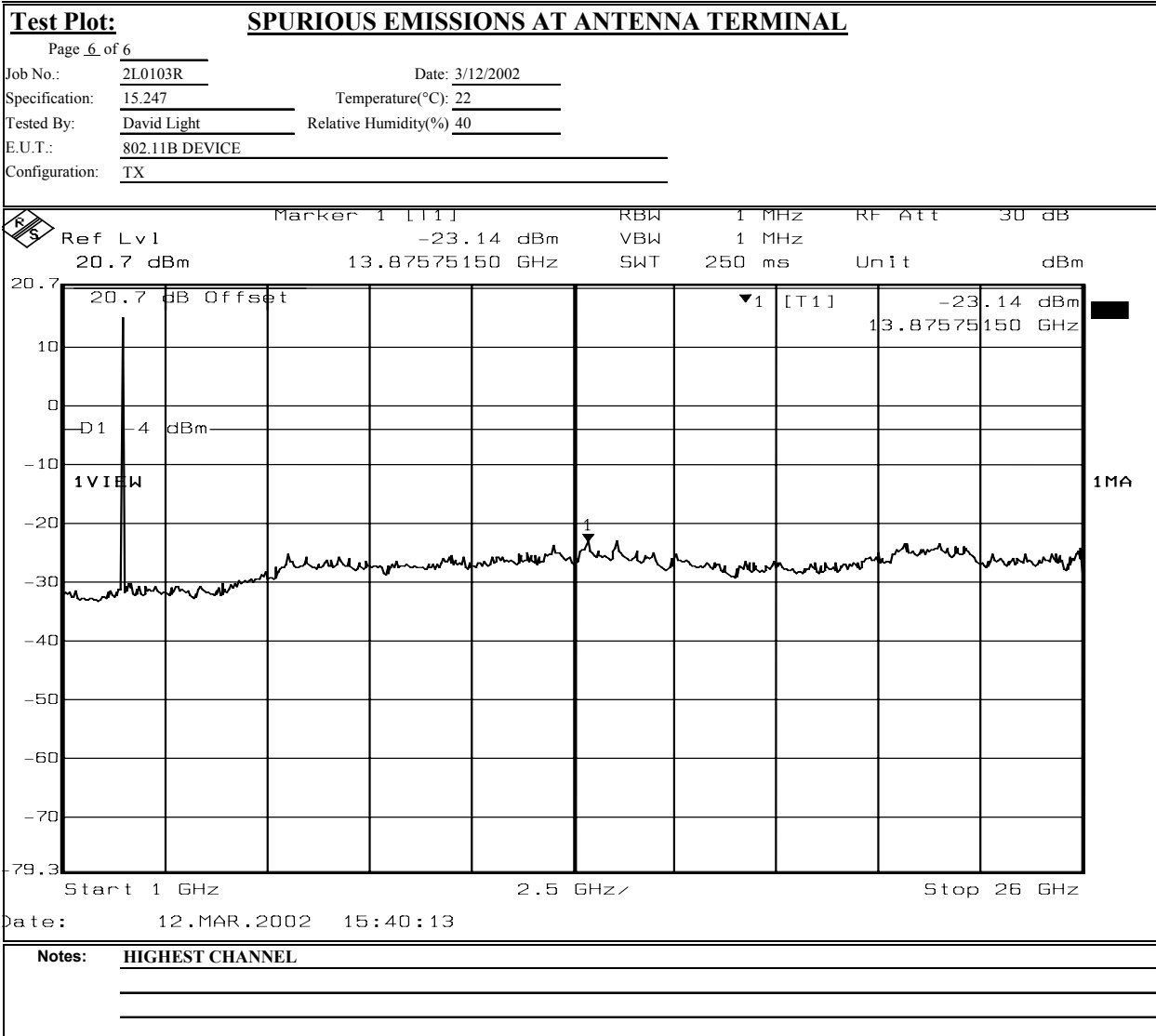
EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**Test Data – Spurious Emissions at Antenna Terminals**

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EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**Test Data – Spurious Emissions at Antenna Terminals**

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EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

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: $20 \times \log(50\text{ms}/100\text{ms}) = -6.0 \text{ dB}$

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

Measurement Uncertainty: +/- 3.7 dB

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

Test Data – Radiated Spurious Emissions (Restricted Bands)

#	Freq	Rdng	Cable	Cable	Horn	Pre-A	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	-6 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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

Radiated Photographs (Worst Case Configuration)



EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

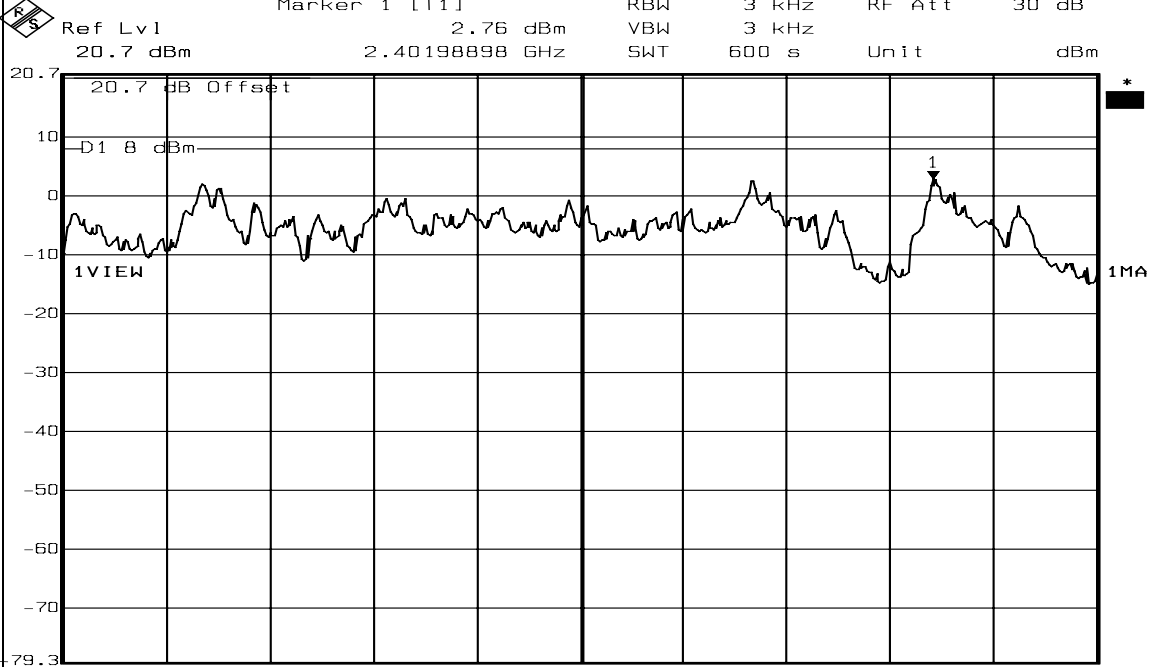
Test Data – Peak Power Spectral Density

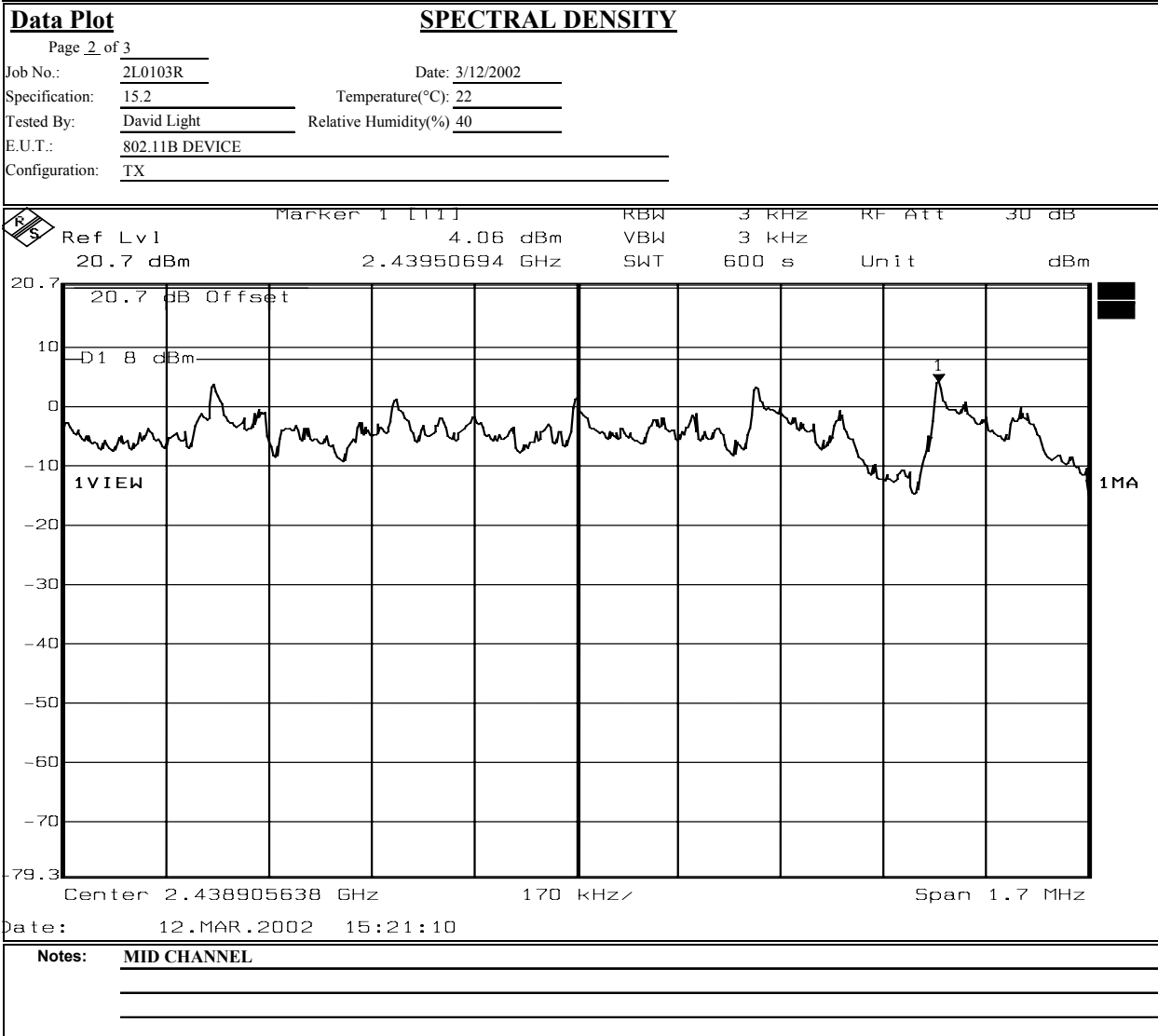


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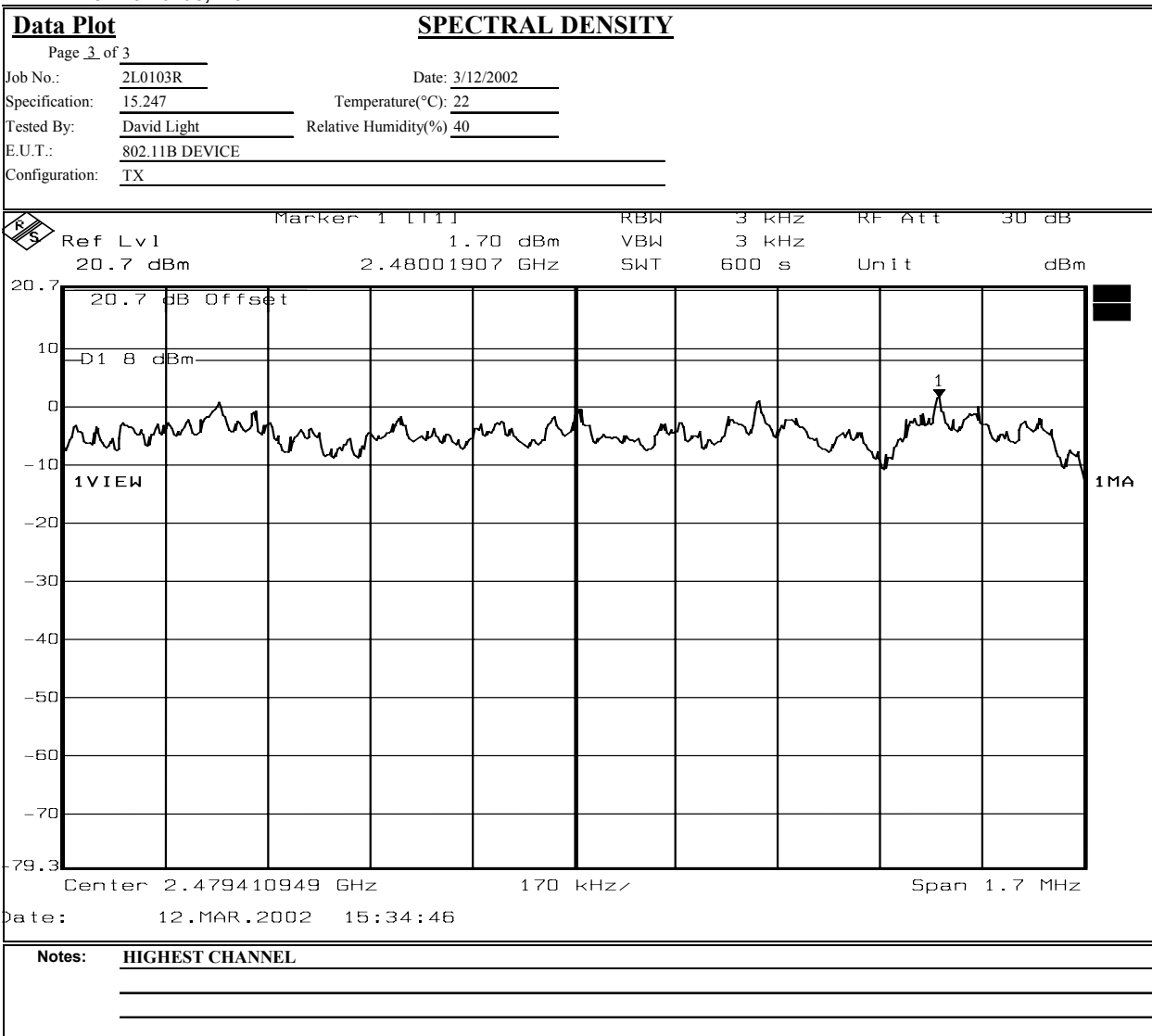
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Data Plot		SPECTRAL DENSITY	
Page 1 of 3		Complete <u>X</u>	
Job No.: 2L0103R	Date: 3/12/2002	Preliminary: _____	
Specification: 15.247	Temperature(°C): 22		
Tested By: David Light	Relative Humidity(%): 40		
E.U.T.: 802.11B DEVICE			
Configuration: 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			
			
Ref Lvl 20.7 dBm Marker 1 1111 2.76 dBm RBW 3 kHz RF Att 30 dB Unit dBm			
20.7 2.40198898 GHz VBW 3 kHz 600 s Span 1.7 MHz			
Center 2.401408122 GHz 170 kHz			
Date: 12.MAR.2002 15:07:44			
Notes: LOWEST CHANNEL			

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**Test Data – Peak Power Spectral Density****Dallas Headquarters:**802 N. Kealy
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EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**Test Data – Peak Power Spectral Density**

Nemko Dallas, Inc.

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Section 9. Minimum Processing Gain

This testing is addressed in a separate report.

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3**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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
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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 250 μ V (48 dB μ V) across 50 ohms.

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

NAME OF TEST: Minimum 6 dB bandwidth	PARA. NO.: 15.247(a)(2)
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Minimum Standard: The minimum 6 dB bandwidth shall be at least 500 kHz

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

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 ($\mu\text{V/m}$ @ 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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

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 ($\mu\text{V/m @ 3m}$)	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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

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

EQUIPMENT: BattGuard™ Telesensor transmitter 0920 PROJECT NO.: 2L0103RUS3

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

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

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

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

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

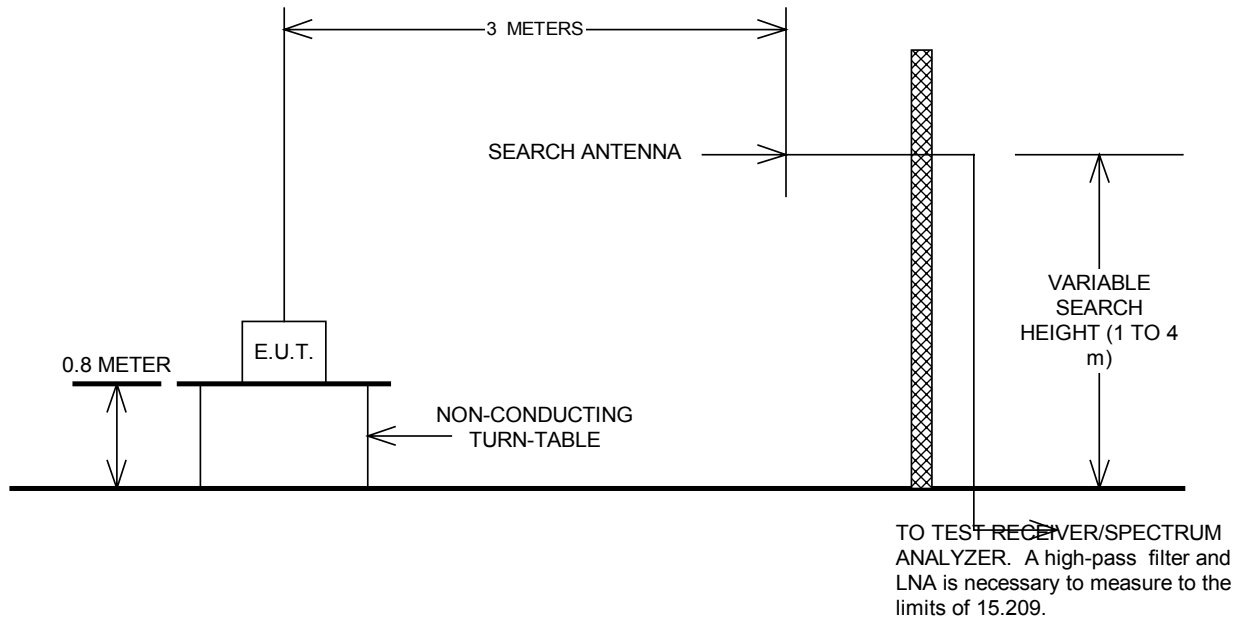
L_{sys} (system losses) is assumed to be 2 dB.

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

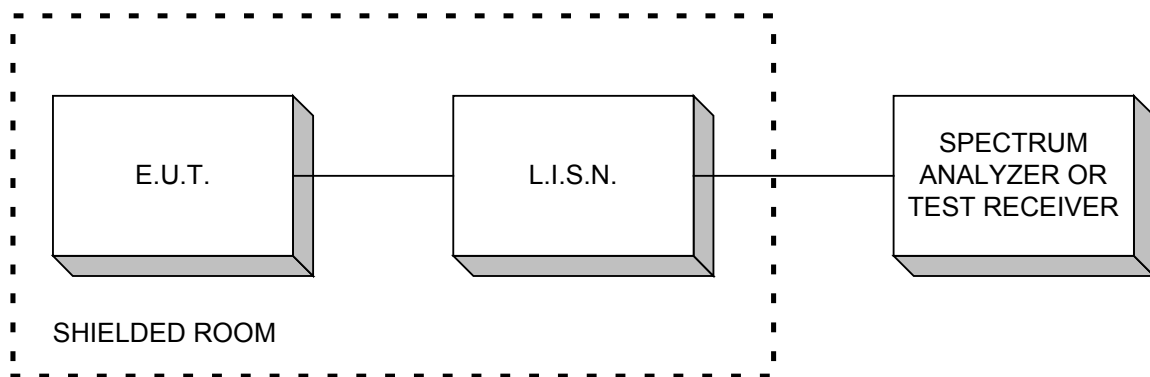
Measurement performed at a channel in the center of the operating band of the EUT.

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions

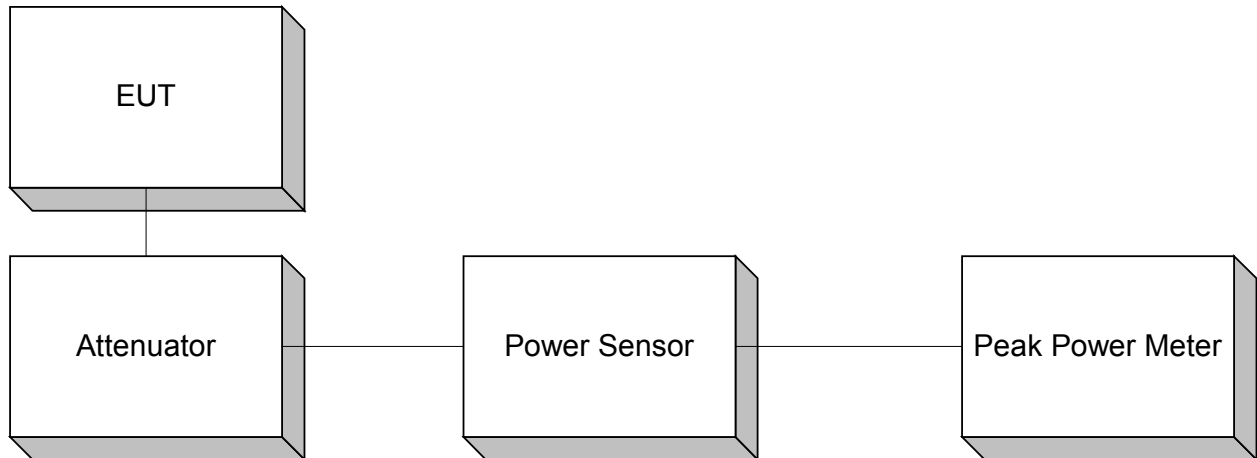


Conducted Emissions



EQUIPMENT: BattGuard™ Telesensor transmitter 0920 *PROJECT NO.:* 2L0103RUS3

Peak Power At Antenna Terminals



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

