

KTL Test Report: 8L0241EUS2

Applicant: NAVIGATION CORPORATION
527 SPIRIT OF ST. LOUIS
CHESTERFIELD, MO 63005

Equipment Under Test: BB-2400 WIRELESS ROUTER
(E.U.T.)

FCC ID: N9I-B2400LEO

In Accordance With: **FCC Part 15, Subpart C**
Direct Sequence Spread Spectrum Transmitters

Tested By: KTL Dallas, Inc.
802 North Kealy
Lewisville, Texas 75057-3136

Authorized By:

Tom Tidwell, RF Group Manager

Date: AUGUST 1999

Total Number of Pages: 37

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Table Of Contents

Section 1.	Summary Of Test Results.....	3
Section 2.	General Equipment Specification	5
Section 3.	Powerline Conducted Emissions.....	8
Section 4.	Occupied Bandwidth	11
Section 5.	Peak Power Output.....	13
Section 6.	Spurious Emissions (Antenna Conducted)	14
Section 7.	Spurious Emissions (Radiated)	18
Section 8.	Transmitter Power Density.....	23
Section 9.	Processing Gain	25
Section 10.	Test Equipment List	26
ANNEX A - TEST METHODOLOGIES		27
ANNEX B BLOCK DIAGRAMS		35

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Section 1. Summary Of Test Results

Manufacturer: Navigation Corporation

Model No.: BB-2400 Wireless Router

Serial No.: 9808468

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 FCC Part 15, Subpart C, Paragraph 15.247 for Direct Sequence Spread Spectrum devices.



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: NONE.

See " Summary of Test Data".

**NVLAP LAB CODE: 100426-0**

TESTED BY: Ron Gaytan

KTL Dallas Inc. authorizes the above named company to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. KTL Dallas Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report applies only to the items tested.

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
Powerline Conducted Emissions	15.207 (a)	48 dB μ V	44 dBuV	Complies
Occupied Bandwidth	15.247 (a)(2)	\geq 500 kHz	9.6 MHz	Complies
Peak Power Output	15.247 (b)	1 watt	500 watts	Complies
Spurious Emissions (Antenna Conducted)	15.247 (c)	-20 dBc	-36.4 dBm	Complies
Spurious Emissions (Radiated)	15.247 (c)	Table 15.209 (a)		Complies
Transmitter Power Density	15.247 (d)	\leq +8 dBm	-7.8 dBm	Complies
Processing Gain	15.247 (e)	\geq 10 dB	11 dB	Complies

Footnotes:**Test Conditions:**Temperature 28°C
Humidity: 48%

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Section 2. General Equipment Specification

Transmitter

Power Input:	Supplied through PC bus.
Frequency Range:	2.45 GHz
Tunable Bands:	1
Type of Modulation	BPSK
Emissions Designator:	4M8F7W
Output Impedance:	50 ohms
Duty Cycle:	N/A
Channel Spacing:	Fixed Frequency
Operator Selection of Operating Frequency:	Fixed frequency
Power Output Adjustment Capability:	Not adjustable by user

Receiver

Frequency Range: 2.45 GHz

LO: 560 MHz

1st IF: 280 MHz

KTL Dallas

FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 8L0241EUS2

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Description of Modification for Modification Filing

Family List Rational

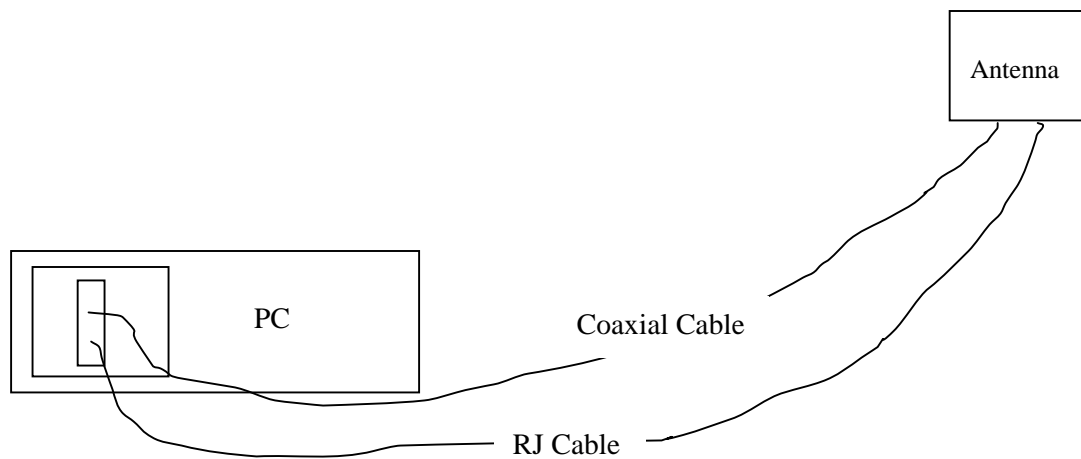
Not Applicable

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID: N9I-B2400LEO

Description of Operation

The device under test is a wireless data modem operating in the 2.4 – 2.4835 GHz band. The system consists of two physical devices. The controller/IF card is a data modem and spread spectrum transceiver. This card performs the modulation/demodulation and generation of the carrier. The modulated carrier emission is passed to the active antenna unit via coaxial cable in IF form. The antenna unit upconverts the carrier signal to the 2.4 GHz band and transmits from a panel radiator. The system is intended to be used in a non-residential environment and will be professionally installed. The antenna unit is to be mounted on a rooftop.

System Diagram



EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Section 3. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
TESTED BY: Ron Gaytan	DATE: 6/10/99

Test Results: Complies.

Measurement Data: See attached data.

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Conducted Emissions – TX Mode

Freq.	Meter	Attn.	Cable	Probe	Corrected		Pol.	Comments:				
(MHz)	Reading	(dB)	Loss	Factor	Reading	Spec.limit		TX Mode				
(dBuV)	(dB)	(dB)	(dB)	(dB)	(dBuV)	(dBuV)						
0.45	14	20	0	0	34	60	L0					
0.538	13	20	0	0	33	60	L0					
0.716	17	20	0	0	37	60	L0					
0.981	17	20	0	0	37	60	L0					
1.25	18	20	0	0	38	60	L0					
1.788	19	20	0	0	39	69.5	L0					
2.863	19	20	0	0	39	69.5	L0					
3.758	10	30	0	0	40	69.5	L0					
4.561	14	30	0	0	44	69.5	L0					
6.71	13	30	0	0	43	69.5	L0					
0.45	16	20	0	0	36	60	L1					
0.627	17	20	0	0	37	60	L1					
0.715	19	20	0	0	39	60	L1					
0.893	17	20	0	0	37	60	L1					
0.983	10	30	0	0	40	60	L1					
1.252	20	20	0	0	40	60	L1					
1.789	20	20	0	0	40	69.5	L1					
2.594	11	30	0	0	41	69.5	L1					
4.028	13	30	0	0	43	69.5	L1					
								Scanned 0.45MHz to 30MHz				

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID: N91-B2400LEO



Photo 1



Photo 2

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Section 4. Occupied Bandwidth

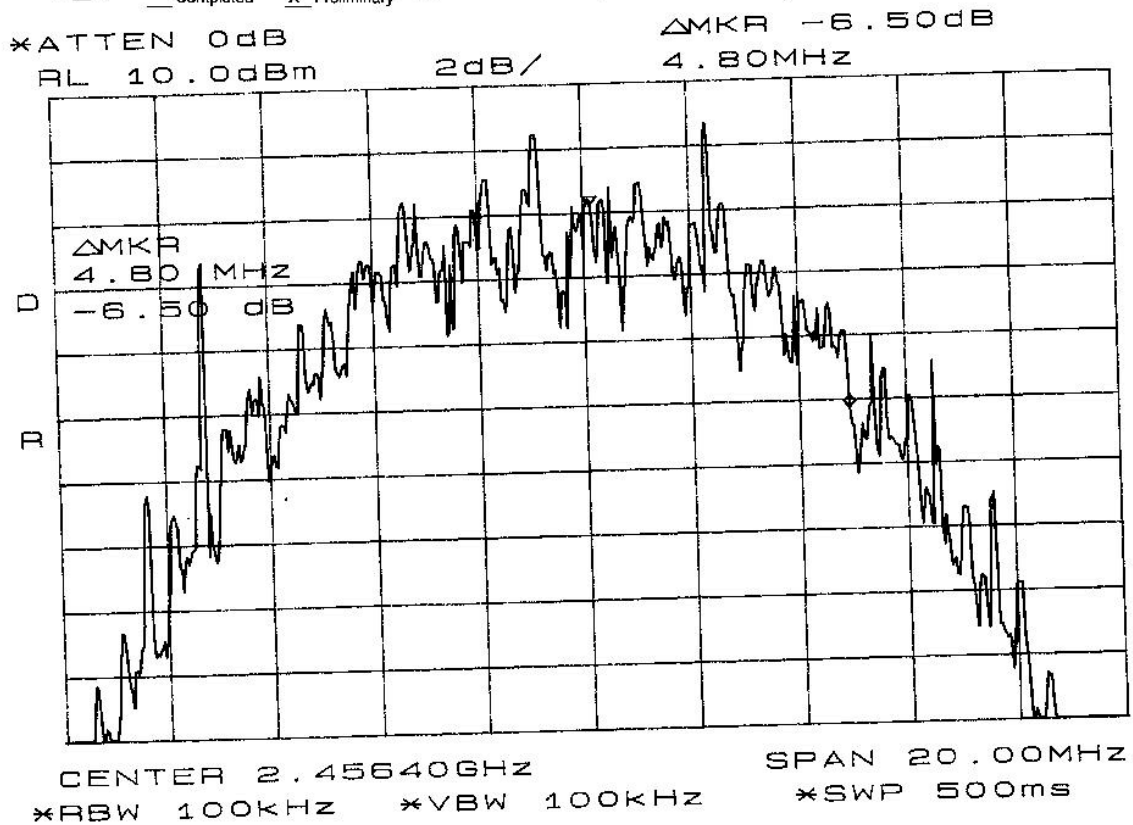
NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(2)
TESTED BY: Ron Gaytan	DATE: 6/10/99

Test Results: Complies. The 6 dB bandwidth is **4.8** MHz.

Measurement Data: See attached graph.

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID: N91-B2400LEO

Client Name:	Navigation Corporation	Work Order #:	810241
Model Number:	BB2000	Plot Number:	With no external atten.
Test Date:	6/10/99	Polarization:	Occupied Bandwidth
Completed	X Preliminary		



Plot 1

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Section 5. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Ron Gaytan	DATE: 6/10/99

Test Results: Complies. The maximum peak power output of the transmitter is 2.5 watts

Measurement Data: Detachable antenna? ☐ Yes ☒ No
A unit was modified for testing with a 50 ohm connection to the antenna port.

Measured peak power output: +18 dBm.
Directional Gain of Antenna: 16 dBi.
Peak Power Output(EIRP): 2.51 watts.

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

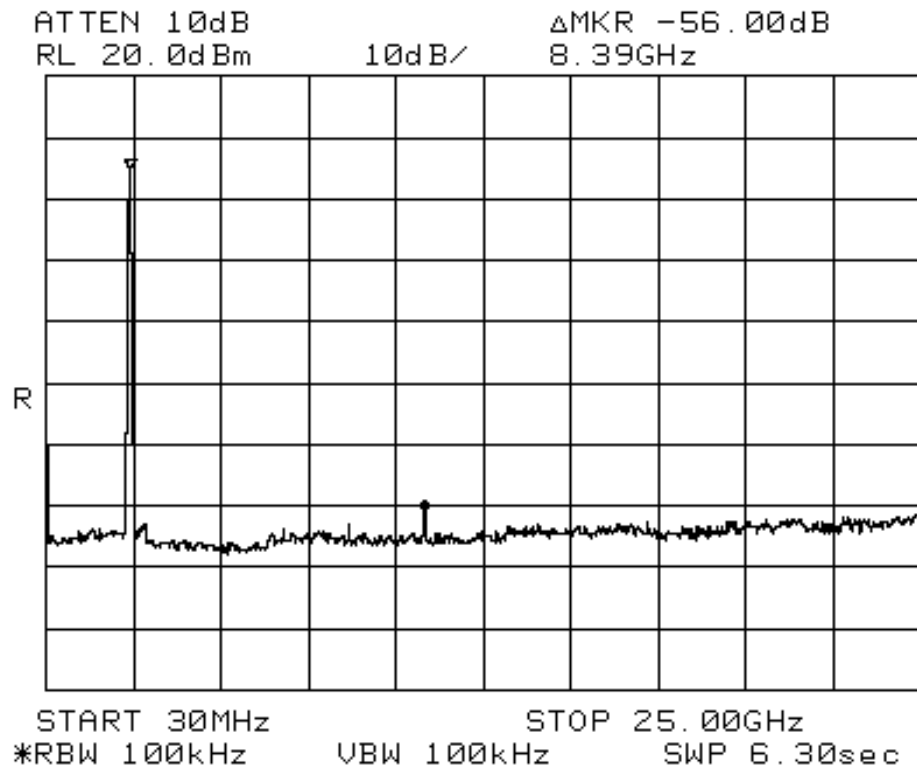
Section 6. Spurious Emissions (Antenna Conducted)

NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY: Ron Gaytan	DATE: 6/10/99

Test Results: Complies. The worst-case emission level is -56 dBc.

Measurement Data: See attached graphs.

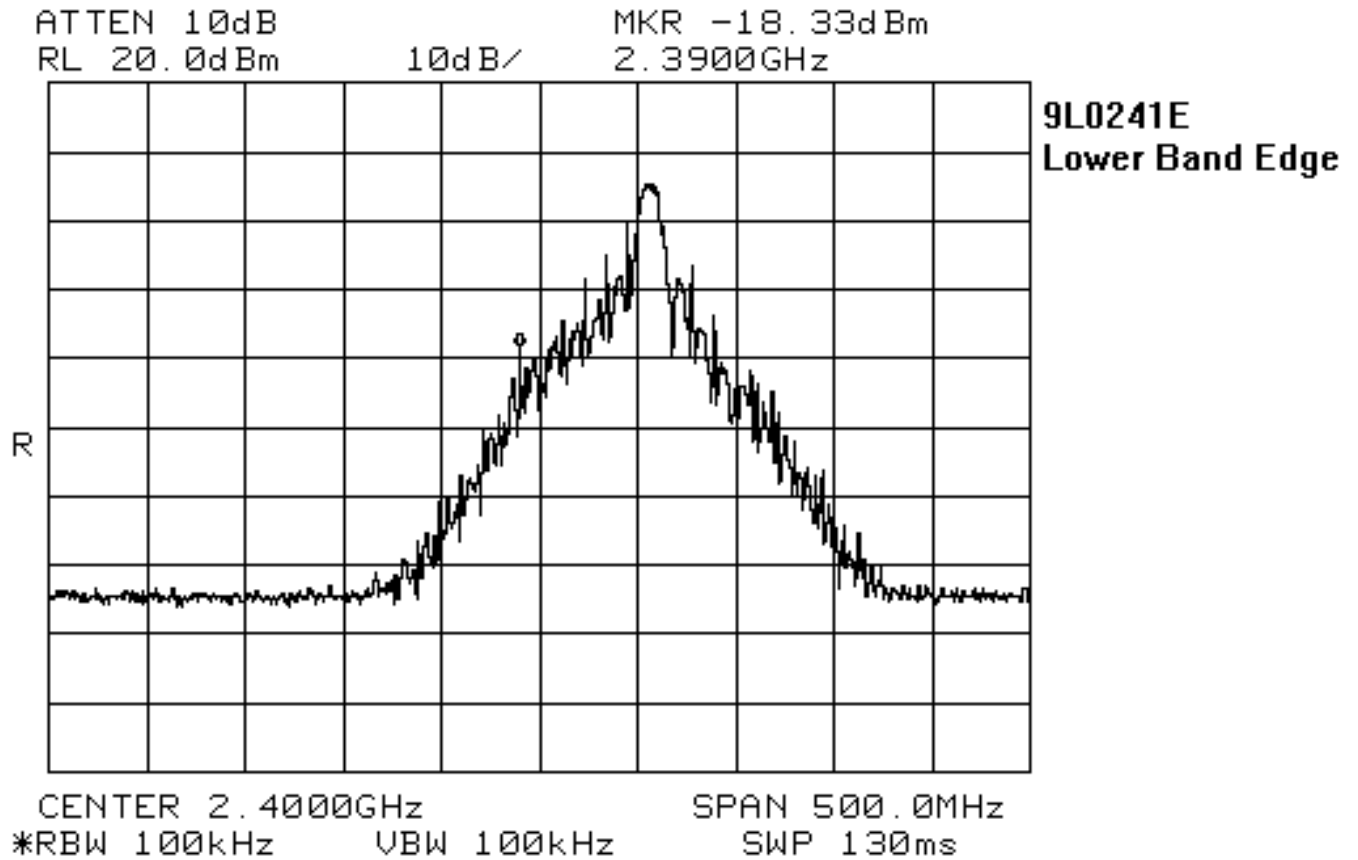
EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID: N9I-B2400LEO



8L0241E
Spurious Emissions
Antenna Conducted

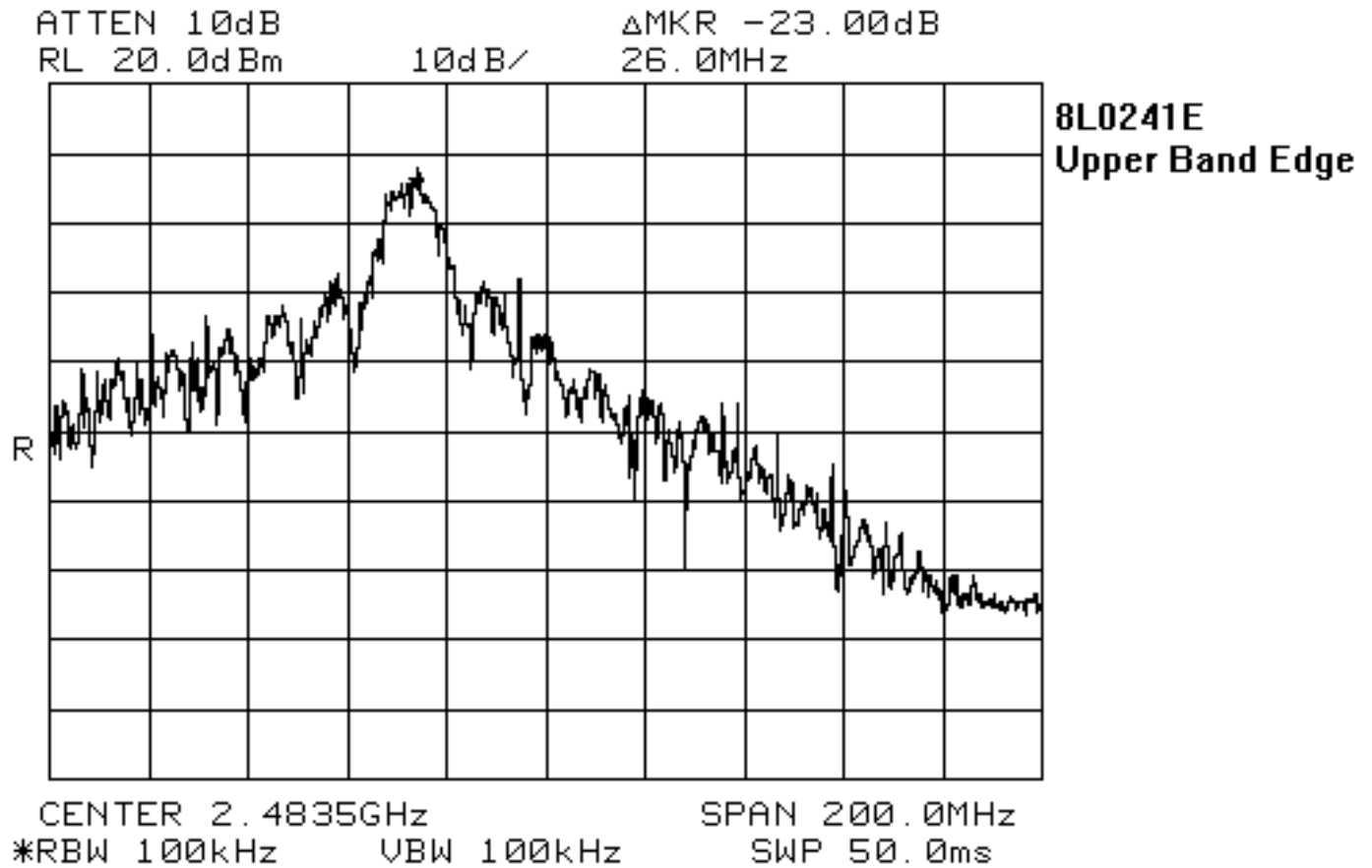
Plot 2

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID: N9I-B2400LEO



Plot 3

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID: N9I-B2400LEO



Plot 4

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Section 7. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Ron Gaytan	DATE: 6/8/99, 6/10/99

Test Results: Complies.

Measurement Data: See attached data.

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEORADIATED EMISSIONS DATA
ELECTRIC FIELD

CLIENT NAME:		Navigation Corporation					W.O.#: 8L0241		DATE:		6/08/99		
EUT MODEL:		BB2000			SERIAL #:			TIME:		9:00 am			
EUT CONFIG.:		Tx Mode					TECH.:		R. Gaytan				
TEST SPECIFICATION:		FCC 15.247 (3m)					TEST NUMBER:		RE-4				
ROD ANT. #:		CABLE #:		1A		DETECT. TYPE:		LOCATION:		B OATS			
BICON ANT. #:		2032		PREAMP. #:		399		RES. BW (kHz):		DISTANCE (m):		3	
LOG ANT. #:		2026		LIMITER#:		1506		VIDEO BW (kHz):		EUT VOLTAGE:		115	
HORN ANT. #:				ATTEN.#:		N/A		TEMP. (deg. C):		EUT FREQ. (Hz):		60	
DIPOLE ANT #:				DETECTOR#:		2624		HUMIDITY (%):		PHOTO ID:		8L0241 RE-4 RAD. EM.	
Emission Frequency (MHz)	Ant. Pol. (H/V)	Det. Atten. (dB)	Meter Reading (dBuV)	Antenna Factor (dB)	Path Loss (dB)	RF Gain (dB)	Corrected Reading (dBuV/m)	Spec. Limit (dBuV/m)	CR/SL Delta (dB)	Pass Fail Marginal	Notes		
35.9	V	0.0	42.0	13.2	1.6	0.0	56.8	91.0	-34.22	Pass	BB		
85.9	V	0.0	51.0	9.2	1.8	0.0	62.0	91.0	-29	Pass			
176.0	V	0.0	38.8	13.2	3.5	0.0	55.6	91.0	-35.45	Pass			
232.2	V	0.0	39.9	14.8	4.6	0.0	59.3	91.0	-31.74	Pass	BB		
240.4	V	0.0	37.5	15.2	4.6	0.0	57.3	46.0	11.26	Fail			
256.4	V	0.0	37.5	15.9	5.1	0.0	58.5	46.0	12.5	Fail			
288.5	V	0.0	40.4	17.9	5.1	0.0	63.4	91.0	-27.6	Pass			
35.3	H	0.0	37.0	13.2	1.6	0.0	51.8	91.0	-39.22	Pass	BB		
62.5	H	0.0	31.0	10.0	2.3	0.0	43.2	91.0	-47.76	Pass			
129.5	H	0.0	31.1	12.0	3.5	0.0	46.7	43.5	3.15	Fail			
143.1	H	0.0	32.1	12.7	3.5	0.0	48.3	91.0	-42.74	Pass			
166.0	H	0.0	36.8	12.4	3.5	0.0	52.7	43.5	9.21	Fail			
184.2	H	0.0	36.8	13.7	3.5	0.0	54.0	91.0	-36.97	Pass			
192.3	H	0.0	35.5	13.9	3.5	0.0	52.9	91.0	-38.07	Pass			
232.3	H	0.0	39.4	14.8	4.6	0.0	58.8	91.0	-32.24	Pass			
240.4	H	0.0	38.2	15.2	4.6	0.0	58.0	46.0	11.96	Fail			
248.4	H	0.0	34.3	15.6	4.6	0.0	54.4	46.0	8.42	Fail			
256.4	H	0.0	38.6	15.9	5.1	0.0	59.6	46.0	13.6	Fail			
264.4	H	0.0	35.3	16.4	5.1	0.0	56.8	46.0	10.78	Fail			
272.4	H	0.0	39.2	17.0	5.1	0.0	61.3	46.0	15.28	Fail			
280.4	H	0.0	32.0	17.6	5.1	0.0	54.7	46.0	8.68	Fail			
288.4	H	0.0	37.0	17.9	5.1	0.0	60.0	91.0	-31	Pass			
304.5	H	0.0	39.2	20.9	5.3	0.0	65.4	91.0	-25.64	Pass			
320.4	H	0.0	38.6	17.6	5.3	0.0	61.5	91.0	-29.54	Pass			
323.4	H	0.0	37.9	17.6	5.3	0.0	60.8	46.0	14.76	Fail			
331.9	H	0.0	35.8	17.2	5.3	0.0	58.3	46.0	12.26	Fail			
365.0	H	0.0	34.4	16.4	5.3	0.0	56.1	91.0	-34.94	Pass			
368.6	H	0.0	35.2	16.4	5.3	0.0	56.9	91.0	-34.14	Pass			
384.6	H	0.0	35.2	16.7	5.3	0.0	57.2	91.0	-33.84	Pass			
398.2	H	0.0	38.6	16.4	5.3	0.0	60.3	91.0	-30.74	Pass			
464.5	H	0.0	38.9	21.9	6.5	0.0	67.3	91.0	-23.73	Pass			
497.8	H	0.0	42.0	18.9	6.5	0.0	67.4	91.0	-23.59	Pass			
531.1	H	0.0	38.5	18.1	6.8	0.0	63.4	91.0	-27.65	Pass			
544.8	H	0.0	27.5	19.2	6.8	0.0	53.5	91.0	-37.49	Pass			
630.4	H	0.0	31.0	20.6	7.6	0.0	59.2	91.0	-31.84	Pass			
304.6	V	0.0	32.6	20.9	5.3	0.0	58.8	91.0	-32.24	Pass			
320.5	V	0.0	33.9	17.6	5.3	0.0	56.8	91.0	-34.24	Pass			
331.9	V	0.0	35.8	17.2	5.3	0.0	58.3	46.0	12.26	Fail			
336.6	V	0.0	29.7	17.0	5.3	0.0	52.0	91.0	-39.04	Pass			
352.6	V	0.0	30.7	16.6	5.3	0.0	52.5	91.0	-38.49	Pass			
365.1	V	0.0	32.0	16.4	5.3	0.0	53.7	91.0	-37.34	Pass			
384.6	V	0.0	30.3	16.7	5.3	0.0	52.3	91.0	-38.74	Pass			
398.2	V	0.0	40.2	16.4	5.3	0.0	61.9	91.0	-29.14	Pass			
400.6	V	0.0	34.9	16.3	6.5	0.0	57.7	46.0	11.71	Fail			
416.6	V	0.0	36.1	17.2	6.5	0.0	59.8	91.0	-31.19	Pass			
431.4	V	0.0	36.1	18.9	6.5	0.0	61.5	91.0	-29.49	Pass			
432.7	V	0.0	36.1	18.9	6.5	0.0	61.5	91.0	-29.49	Pass			
464.5	V	0.0	37.3	21.9	6.5	0.0	65.7	91.0	-25.33	Pass			
497.8	V	0.0	44.8	18.9	6.5	0.0	70.2	91.0	-20.79	Pass			
564.1	V	0.0	35.9	20.8	6.8	0.0	63.5	91.0	-27.53	Pass			
											Scanned 30-1000 MHz		

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID: N9I-B2400LEO

Test Data - Radiated Emissions

Microwave Radiated Emissions Data

Complete ☐ Preliminary ☐ Page: 1 of 2Client: Navigation Corporation Test #: MW-1A W.O.#: 8L0241eEUT: BB2000 S/N: 1066 / 1019 Photo ID: 8L0241e MW-1aTechnician: Ron Gaytan Specification: CFR47 15.247 Lab: A OATS Date: 6/10/99Equipment Used: 677-G2624-494-CF33-CF34-CF35-G2235-934Configuration: Tx Mode Chip rate (11 mcps)Bandwidth: 1 MHz Video Bandwidth: N/A Antenna Distance 3 m Detector:

Climatic Conditions:	EUT Power: <u>X</u> 115 V.A.C.	<u>X</u> 60 Hz	<u>X</u> Peak
Temperature: <u>28</u> C	<u>208</u> V.A.C.	<u>50</u> Hz	<u> </u> Average
Relative Humidity: <u>48</u> %	<u>230</u> V.A.C.		
Atmospheric Pressure: <u>1002</u> mbar	<u>Other</u> <u> </u>	<u>1</u> Phase	<u>3</u> Phase

Freq. (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	RF Gain (dB)	Conver. Factor	Corrected Reading (dBuV/m)	Spec. Limit (dBuV/m)	Pol.	Comments:
2.456	69.7	29.1	5.4	0	0	104.2	N/A	V	
2.452	67.8	29.1	5.4	0	0	102.3	N/A	V	KTL # 677
4.904	14	33.9	6	0	0	53.9	54	V	Noise Floor
4.904	2	33.9	6	0	0	41.9	54	V	Avg. Det., Noise Floor
7.356	18	37	5.5	0	0	60.5	74	V	Noise Floor, CF34-CF35
9.808	17	37.8	6.4	0	0	61.2	74	V	Noise Floor, CF34-CF35
12.26	14	39.3	7.2	0	0	60.5	54	V	Noise Floor, CF34-CF35
12.26	4	39.3	7.2	0	0	50.5	54	V	Avg. Det., NF CF34-CF35
14.712	18	42.2	8.0	0	0	68.2	74	V	Noise Floor, CF34-CF35
17.164	4	44.5	8.8	0	0	57.3	74	V	Noise Floor, CF34-CF35
2.452	60	29.1	5.4	0	0	94.5	N/A	H	KTL # 677
4.904	14	33.9	6	0	0	53.9	74	H	Noise Floor
4.904	2	33.9	6	0	0	41.9	74	H	Avg. Det., Noise Floor
7.356	18	37	5.5	0	0	60.5	74	H	Noise Floor, CF34-CF35
9.808	17	37.8	6.4	0	0	61.2	74	H	Noise Floor, CF34-CF35
12.26	14	39.3	7.2	0	0	60.5	54	H	Noise Floor, CF34-CF35
12.26	4	39.3	7.2	0	0	50.5	54	H	Avg. Det., NF CF34-CF35
14.712	18	42.2	8.0	0	0	68.2	74	H	Noise Floor, CF34-CF35
17.164	4	44.5	8.8	0	0	57.3	74	H	Noise Floor, CF34-CF35
									Scanned 1-25 GHz

DATA\COMMON\FORMS\TESTDATASHEETS\MICRORE REV 030597

NOTE: The discrepancy in frequency (2.456 to 2.452 GHz) is due to the use of a test receiver (KTL #677). The frequency was taken from the receiver dial. In each case the same emission is being measured.

[illegible]

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID: N9I-B2400LEO

Radiated Photographs (Worst Case Configuration)

FRONT VIEW



REAR VIEW



EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

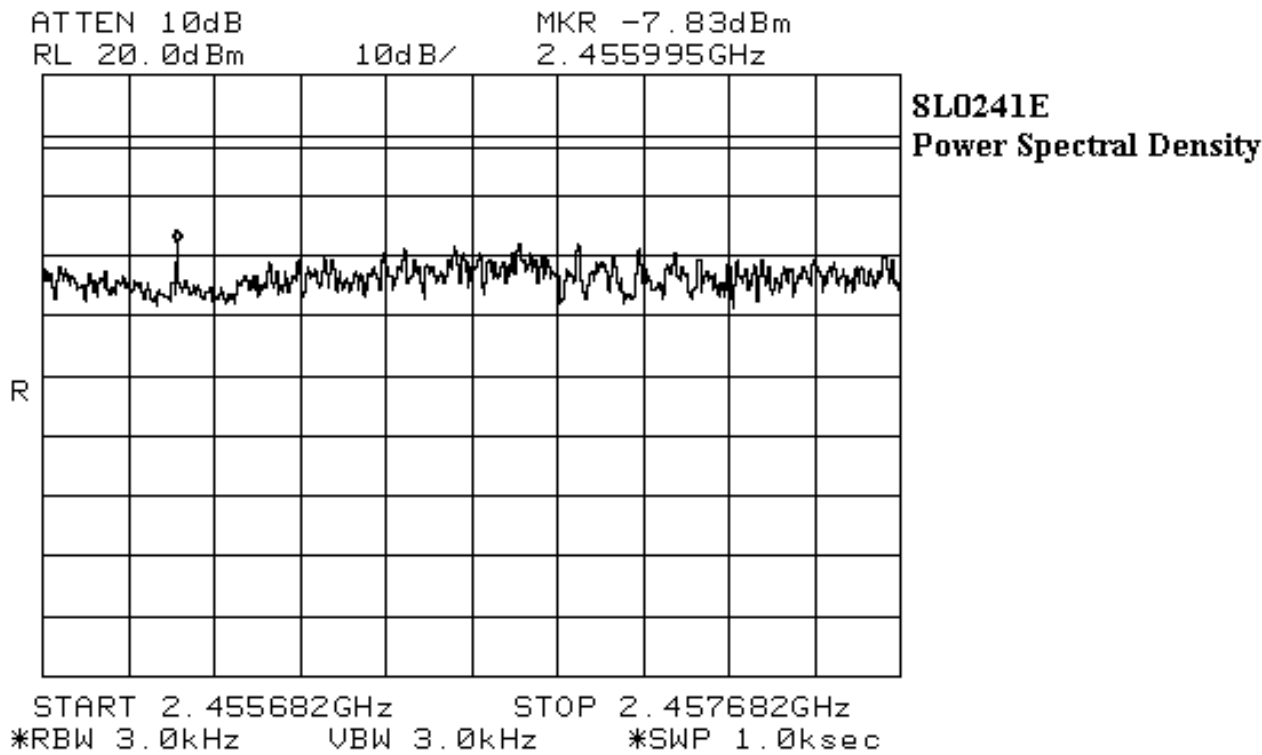
Section 8. Transmitter Power Density

NAME OF TEST: Transmitter Power Density	PARA. NO.: 15.247(d)
TESTED BY: Ron Gaytan	DATE: 10/6/99

Test Results: Complies.

Measurement Data: See attached graph.

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO



Plot 5

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Section 9. Processing Gain

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

Test Results: Complies. The processing gain of the system is 11 dB.

Measurement Data: See data in separate attachment provided in submission package.

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO**Section 10. Test Equipment List**

KTL ID	Description	Manufacturer Model Number	Serial Number	Calibration Date
677	RECEIVER, 1-18 GHz	ELECTRO METRICS EMC 50	185	08/31/99
G2624	SPECTRUM ANALYZER	HP 8563E	3551A04428	11/03/99
494	ANTENNA, HORN	A.H. SYSTEMS SAS-200/571	162	CBU
CF33	CABLE, 4.6m	KTL Semi-Flex	N/A	09/22/98
CF34	CABLE, 12'	KTL Armored, Storm CABLE	N/A	04/01/99
CF35	CABLE, 12'	KTL Armored, Storm CABLE	N/A	04/01/99
G2235	PRE-AMP, 18-40 GHz	KTL BB1	1	01/13/99
934	HORN ANTENNA (18-26.5GHZ)	EMCO 3160-09	9705-1079	08/13/97
G2032	ANTENNA-BICONICAL	ICC BCON-30300	N/A	01/21/99
G2026	ANTENNA,LP	A.H. SYSTEMS SAS-200/510	121	01/25/99
399	PREAMP, 25dB	ICC LNA25	399	03/04/99
G1506	LIMITER	FISCHER FCC-450-1.25-N	447	10/22/98
1A	CABLE	KTL Site A OATS	N/A	04/01/99
		Site A OATS (OPEN AREA TEST SITE)		

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

ANNEX A - TEST METHODOLOGIES

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

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 250 μ V (48 dB μ V) across 50 ohms.

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)

Minimum Standard: The minimum bandwidth shall be at least 500 kHz.**Method Of Measurement:**

The spectrum analyzer is set as follows:

RBW: 100 kHz

VBW: 100 kHz

Span: >RBW

LOG dB/div.: 2 dB

Sweep: Auto

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: BB-2400 WIRELESS ROUTER
FCC ID: N91-B2400LEO

NAME OF TEST: Peak Power Output

PARA. NO.: 15.247(b)

Minimum Standard:

The maximum peak power output 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.

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.

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

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

NAME OF TEST: Spurious Emissions at Antenna Terminal	PARA. NO.: 15.247(c)
--	----------------------

Minimum Standard:

In any 100kHz bandwidth outside the 2.4 – 2.4835 GHz bands 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.

Method Of Measurement:

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: 2483.5 MHz
Marker: Peak of fundamental emission
Marker Δ: Peak of highest spurious level above 2.4835GHz

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: 2400 MHz
Marker: Peak of fundamental emission
Marker Δ: Peak of highest spurious level below 2.4 GHz

30 MHz - 10th Harmonic Plot

RBW: 100 kHz
VBW: 300 kHz
Sweep: Auto
Display line: -20 dBc

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: BB-2400 WIRELESS ROUTER
FCC ID: N91-B2400LEO

NAME OF TEST: Radiated Spurious Emissions

PARA. NO.: 15.247(c)

Minimum Standard:

In any 100kHz bandwidth outside the 2.400 – 2.4835 GHz bands 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

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

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: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

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:

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

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 $(S/N)_{\text{out}}$

if, 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.

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

KTL Dallas

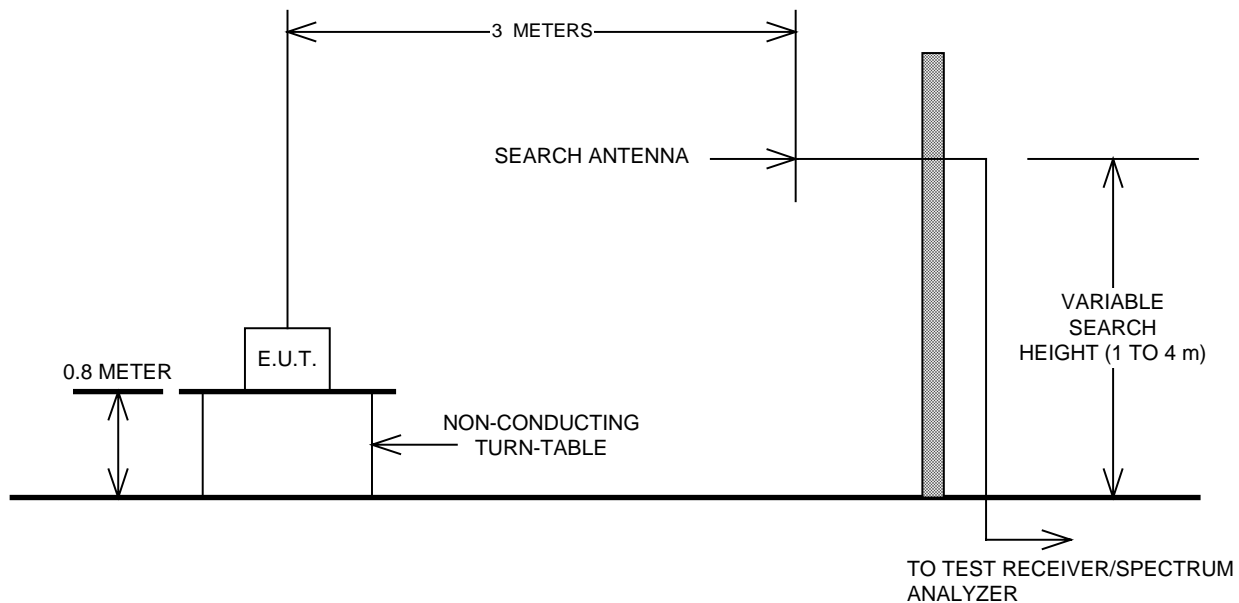
FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 8L0241EUS2

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

ANNEX B - BLOCK DIAGRAMS

EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Test Site For Radiated Emissions



Below 1 GHz

Peak detector.
RBW = 100 kHz

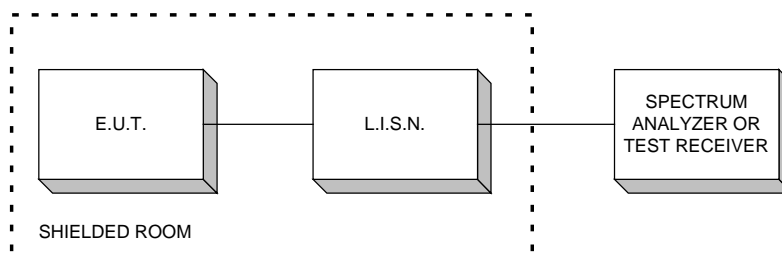
Above 1 GHz For Peak Emission Levels

Peak detector
RBW = 1 MHz
VBW = >RBW

Above 1 GHz For Average Emission Levels

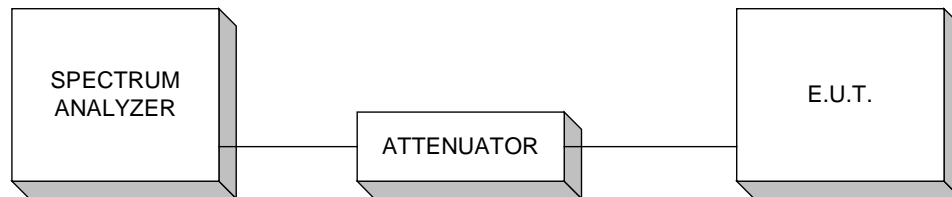
Peak detector
RBW = 1 MHz
VBW = 10 Hz

Conducted Emissions



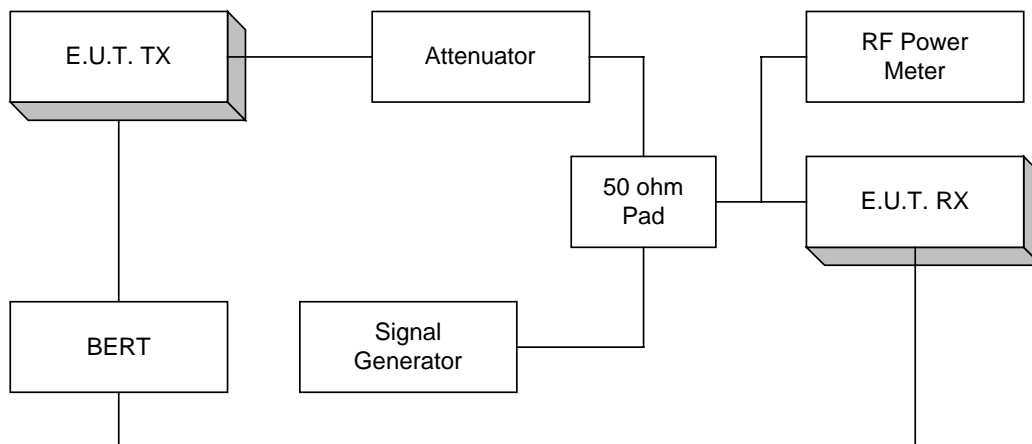
EQUIPMENT: BB-2400 WIRELESS ROUTER
FCC ID:N9I-B2400LEO

Transmitter Power Density & Peak Power At Antenna Terminals



If the E.U.T. has an integral (non-detachable) antenna, the above test is performed as a radiated measurement and the result is reported as EIRP.

Processing Gain



NOTE: This is a typical setup. The setup may vary slightly since many devices have BER test functions built into the device.