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July 27, 2000

American Telecommunications
Certification Body, Inc
6731 Whittier Avenue
McLean, VA. 22101

Gentlemen:

The enclosed documents constitute a formal submittal and application for a Grant of Equipment Authorization pursuant to Subpart C of Part 15 of FCC Rules (CFR 47) regarding intentional radiators. Data within this report demonstrates that the equipment tested complies with the FCC limits for intentional radiators.

Elliott Laboratories, as duly authorized agent prepared this submittal. A copy of the letter of our appointment as agent is enclosed.
If there are any questions or if further information is needed, please contact Elliott Laboratories for assistance.

Sincerely,

Mark R. Briggs
Manager, EMC Consulting Services

MRB/dmg
Enclosures: *Agent Authorization Letter*
Emissions Test Report with Exhibits
Confidentiality Request
Manufacturer's Letter
FCC Labeling Requirements Letter

File: R38142

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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C Specifications for an Intentional Radiator on the Nokia Networks Model: Presidio

FCC ID:	NPD-R242-V01
GRANTEE:	Nokia Networks Nokia Networks Mountain View, CA. 94043
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	July 27, 2000
FINAL TEST DATE:	June 15, June 19, June 22 and July 20, 2000
AUTHORIZED SIGNATORY:	Mark R. Briggs Manager, EMC Consulting Services

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SCOPE

An electromagnetic emissions test has been performed on the Nokia Networks model Presidio pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Nokia Networks model Presidio and therefore apply only to the tested sample. The sample was selected and prepared by Darren Lancaster of Nokia Networks.

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units which are subsequently manufactured.

STATEMENT OF COMPLIANCE

The tested sample of Nokia Networks model Presidio complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Nokia Networks model Presidio. The actual test results are contained in an exhibit of this report.

LIMITS OF CONDUCTED INTERFERENCE VOLTAGE

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.207.

The following measurement was extracted from the data recorded during the conducted emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

0.45 – 30.00 MHz, 120V/ 60Hz, with modification, Main Radio Unit

Frequency MHz	Level dBuV	Power Lead	FCC 15.207(a) Limit	Margin	Detector QP/Ave	Comments
28.227	42.4	Line1	48.0	-5.6	QP	

0.45 – 30.00 MHz, 120V/ 60Hz, AC-DC adapter of DC Injector

Frequency MHz	Level dBuV	Power Lead	FCC 15.207(a) Limit	Margin	Detector QP/Ave	Comments
0.5219	35.7	Line	48.0	-12.3	QP	Note 1

Note 1: Signal is broadband, QP reading corrected by -13dB

LIMITS OF ANTENNA CONDUCTED SPURIOUS EMISSIONS – Presidio without amplifier

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247. All out-of-band emissions recorded in any 100 kHz band were more than 20 dB below the highest in-band level. The actual test data and any correction factors are contained an exhibit of this report.

LIMITS OF ANTENNA CONDUCTED SPURIOUS EMISSIONS – Presidio with amplifier

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247. All out-of-band emissions recorded in any 100 kHz band were more than 20 dB below the highest in-band level. The actual test data and any correction factors are contained an exhibit of this report.

LIMITS OF POWER AND BANDWIDTH – Presidio without amplifier

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

The maximum power output was 24.4 dBm on the center channel. The actual test data and any correction factors are contained in an exhibit of this report. Refer to the following section for the 20 dB bandwidth measurement data.

LIMITS OF POWER AND BANDWIDTH – Presidio with amplifier

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

The maximum power output was 29.2 dBm on the low channel. The 20 dB bandwidth was 995kHz. The actual test data and any correction factors are contained in an exhibit of this report.

CHANNEL OCCUPANCY TESTS

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247.

There were a total of 79 channels between 2.401 and 2.479 MHz, with channel spacing of 1000 kHz. The time of occupancy of 130mS seconds every 10 seconds (390mS every 30 seconds).

LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.247 and 15.209 in the case of emissions falling within the frequency bands specified in Section 15.205.

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit for all of the configurations of Presidio Radio without the optional amplifier. The actual test data and any correction factors are contained in an exhibit of this report.

Radiated Emissions In Restricted Bands, 30 – 24000 MHz
Low Channel @2401 MHz, Base Unit without Amplifier, 12dBi Sector Antenna

Frequency MHz	Level dBuV/m	Pol v/h	FCC 15.207(a) Limit	Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
7202.910	40.7	H	54.0	-13.3	Avg	186	1.8	

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit for all of the configurations of Presidio Radio with the optional amplifier. The actual test data and any correction factors are contained in an exhibit of this report.

Radiated Emissions In Restricted Bands, 30 – 24000 MHz
Low Channel @2401 MHz, Base Unit with Amplifier, 10 dBi Omni Antenna

Frequency MHz	Level dBuV/m	Pol v/h	FCC 15.207(a) Limit	Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
4802.000	52.7	V	54.0	-1.3	Avg	200	1.0	

MEASUREMENT UNCERTAINTIES

ISO Guide 25 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Nokia Networks model Presidio is a 2.4 – 2.4835 GHz frequency-hopping spread spectrum (FHSS) transceiver that is designed for multipoint operation. The device incorporates a Symbol Spread Spectrum Radio PCMCIA card and can be configured with different antennas and an optional amplifier as shown in the table below:

Antenna Type and Manufacturer	Antenna Model Number	Gain dBi	Minimum Feeder Cable Length (ft)[1]	Cable Loss (dB) [2]	Amp (Y/N)	Max. EIRP (dBm)
8 dBi omni Maxrad	MFB24008	8	0	0.62	N	33.88
8 dBi omni with 7 degree downtilt Maxrad	MFB24008	8	0	0.62	N	33.88
10 dBi omni Maxrad	MFB24010	10	50	2.52	N	33.98
8 dBi panel Maxrad	MP24008PT	7.7	0	0.62	N	33.58
10 dBi sector Til-Tek Maxrad	TA-2404-2-90	10	50	2.52	N	33.98
12 dBi sector Til-Tek Maxrad	TA-2304	12	50	2.52	N	35.98
8 dBi omni with amplifier Maxrad	MFB24008	8	0	0.62	Y	36
15 dBi panel[3] Maxrad	MP24015PT	15	0	0.62	N	40.88
17 dBi panel[3] Til-Tek	TA-2408	17	0	0.62	N	42.88

[1] Feeder cable loss is 0.038 dB/ft.
[2] Default cable loss for all deployments includes 6 ft. jumper cable (0.095 dB/ft attenuation) plus 0.05 dB connector losses.
[3] These configurations are only legal on systems that are 1 hop from the AirHead and not amplified (i.e. point-to-point operation)

The actual configurations tested for radiated spurious emissions were:

1. Un-amplified system with Omni 10dBi
2. Un-amplified system with Panel to 17dBi
3. Un-amplified system with Sector to 12dBi
4. Amplified system with Omni 8dBi antenna

The configurations chosen were selected since they represent the highest gain antennas of each antenna type for the amplified and un-amplified configurations.

The antenna connector is a standard N-type connector. This is considered acceptable since the maneer in which the system is marketed and the location of the antennae is such that professional installation is always required.

The sample was received on June 15, 2000 and tested on June 15, June 19, June 22 and July 20, 2000. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number
Nokia	-	PCB	792924
Nokia	-	Radio	0G3UH3
Young Design	2441-E1	2.4 GHz bi-directional antenna amplifier with dc injector	None
Maxrad	MFB24010	10 dBi Omni Antenna	N/A
Til-Tek	TA-2408	17dBi Panel Antenna	N/A
Til-Tek	TA-2304	12 dBi Sector Antenna	N/A
Maxrad	MFB24008	8 dBi Omni Antenna	N/A

ENCLOSURE

It measures approximately 13.7 cm wide by 11.4 cm deep by 3.4 cm high. It is primarily constructed of plastic with an internal conductive coating.

MODIFICATIONS

The EUT required the following modifications in order to comply with the conducted emission specifications:

Added copper foil tape to edge of radio module inside EUT during conducted emissions testing.

SUPPORT EQUIPMENT

The following equipment was used as remote support equipment for emissions testing:

Manufacturer	Model	Description	Serial Number
IBM	-	Laptop	78-LZ070
IBM	-	AC Adapter	J15JR533PB4

The laptop was located on the table during conducted emissions measurements to facilitate changing the operating frequency quickly.

EUT INTERFACE PORTS

The I/O cabling configuration during emissions testing was as follows:

-	-	Cable(s)		
EUT Port	Connected To	Description	Shielded or Unshielded	Length(m)
Antenna Output	Antenna	Coax (Andrew)	Shielded	1.5

EUT OPERATION

EUT was set to transmit continuously on a single channel for radiated emissions, power and bandwidth tests. For Channel occupancy measurements the EUT was set to transmit in hopping mode.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on June 15, June 19, June 22 and July 20, 2000 at the Elliott Laboratories Open Area Test Site #1, 2, 3, and CCA1 located at 684 West Maude Avenue, Sunnyvale, California. The test sites contain separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table-mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS, SECTION 15.207

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

RADIATED EMISSIONS SPECIFICATION LIMITS, SECTION 15.209

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1: Test Equipment Calibration Data

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T 38016 **33 Pages**
T 38457 **33 Pages**

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Emissions Spec:	FCC	Class:	B
Immunity Spec:		Environment:	N/A

EMC Test Data

For The

Nokia

Model

2.4GHz FHSS Wireless 10/100

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Emissions Spec:	FCC	Class:	B
Immunity Spec:		Environment:	N/A

TEST SUMMARY

Date	Test Performed	Level	Results	Comments
06/15/2000	Spurious Emissions In Restricted Bands - Omni Antenna	FCC Part 15.209 / 15.247(c)	Pass	-13.3dB @ 7202.91MHz
06/15/2000	Spurious Emissions In Restricted Bands - Panel Antenna	FCC Part 15.209 / 15.247(c)	Pass	-14.8dB @ 7202.91MHz
06/15/2000	Spurious Emissions In Restricted Bands - Sector Antenna	FCC Part 15.209 / 15.247(c)	Pass	-6.9dB @ 7202.91MHz
06/19/2000	Antenna Conducted Spurious Emissions	FCC Part 15.209 /	Pass	> 20dB
06/19/2000	Output Power	15.247(b)	Pass	24.4dBm
06/19/2000	Channel Occupancy / Separation / Number of Channels	15.247(a)	Pass	
06/22/2000	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	Required modification

Abbreviations Used: RE - Radiated Emissions, CE- Conducted Emissions, RI - Radiated Immunity, CI - Conducted Immunity, ESD - Electrostatic Discharge, EFT - Electrical Fast Transients, VDI - Voltage Dips and Interrupts

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Emissions Spec:	FCC	Class:	B
Immunity Spec:		Environment:	N/A

EUT INFORMATION

General Description

The EUT is a 2.4 – 2.4835 GHz frequency-hopping spread spectrum (FHSS) transceiver that is designed for multipoint operation. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, placed in this position during testing to simulate the end user environment.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Nokia		PCB	792924	
Nokia		Radio	0G3UH3	

EUT Enclosure

It measures approximately 13.7 cm wide by 11.4 cm deep by 3.4 cm high. It is primarily constructed of plastic with an internal conductive coating. The amplifier and dc injector are mounted in die-cast metal boxes.

Modification History

Mod. #	Test	Date	Modificaiton
1			
2			
3			

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Emissions Spec:	FCC	Class:	B
Immunity Spec:		Environment:	N/A

Test Configuration Information (1)

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Maxrad	MFB24010	10 dBi Omni Antenna	N/A	
Til-Tek	TA-2408	17dBi Panel Antenna	N/A	
Til-Tek	TA-2304	12 dBi Sector Antenna	N/A	

Note: Antennas used for radiated spurious emissions tests.

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
IBM		Laptop	78-LZ070	
IBM		AC Adapter	J15JR533PB4	

Note: The laptop was only used to configure the EUT prior to testing. It was not connected during testing.

EUT Interface Ports

		Cable(s)		
EUT Port	Connected To	Description	Shielded or Unshielded	Length(m)
Antenna Output	Antenna	Coax (Andrew)	Shielded	1.5

EUT Operation During Emissions

EUT was set to transmit continously on a single channel for radiated emissions, power and bandwidth tests. For Channel occupancy measurements the EUT was set to transmit in hopping mode.

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing the EUT relative to the specification defined above.

Date of Test: 06/15/2000
Test Engineer: Mehran Birgani
Test Location: OATS #1

Config. Used: 1
Config Change: None
EUT Voltage: 120V /60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 17°C
Rel. Humidity: 93%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Spurious Emissions In Restricted Bands - Omni Antenna	FCC Part 15.209 / 15.247(c)	Pass	-13.3dB @ 7202.91MHz
2	Spurious Emissions In Restricted Bands - Panel Antenna	FCC Part 15.209 / 15.247(c)	Pass	-14.8dB @ 7202.91MHz
3	Spurious Emissions In Restricted Bands - Sector Antenna	FCC Part 15.209 / 15.247(c)	Pass	-6.9dB @ 7202.91MHz

Modifications Made During Testing: None

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Run #1a: Radiated Spurious Emissions, 2400-24000 MHz. Low Channel @ 2401 MHz
UNIT: 10 dBi OMNI

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
7202.910	40.7	H	54.0	-13.3	Avg	186	1.8	
7202.910	37.5	V	54.0	-16.5	Avg	260	1.2	
4801.910	36.6	H	54.0	-17.4	Avg	28	1.2	
7202.910	52.2	H	74.0	-21.8	Pk	186	1.8	
7202.910	48.0	V	74.0	-26.0	Pk	260	1.2	
4801.910	47.4	H	74.0	-26.6	Pk	28	1.2	

Run #1b: Radiated Spurious Emissions, 2400-24000 MHz. Center Channel @ 2439 MHz
UNIT: 10 dBi OMNI

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7317.000	39.8	V	54.0	-14.2	Avg	164	1.4	
7317.000	38.0	H	54.0	-16.0	Avg	128	1.0	
4878.000	37.9	V	54.0	-16.1	Avg	270	2.0	
7317.000	51.5	V	74.0	-22.5	Pk	164	1.4	
7317.000	50.7	H	74.0	-23.3	Pk	128	1.0	
4878.000	47.3	V	74.0	-26.7	Pk	270	2.0	

Run #1c: Radiated Spurious Emissions, 2400-24000 MHz. High Channel @ 2479 MHz
UNIT: 10 dBi OMNI

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7436.910	38.5	V	54.0	-15.5	Avg	15	2.0	
7436.910	37.0	H	54.0	-17.0	Avg	251	1.0	
4957.940	34.7	V	54.0	-19.3	Avg	209	1.4	
7436.910	52.3	V	74.0	-21.7	Pk	15	2.0	
7436.910	49.3	H	74.0	-24.7	Pk	251	1.0	
4957.940	46.2	V	74.0	-27.8	Pk	209	1.4	

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Run #2a: Radiated Spurious Emissions, 2400-24000 MHz. Low Channel @ 2401 MHz

UNIT: 17 dBi Panel

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
7202.910	39.2	V	54.0	-14.8	Avg	312	1.2	
4801.910	38.6	V	54.0	-15.4	Avg	83	1.0	
7202.910	38.3	H	54.0	-15.7	Avg	320	1.5	
7202.910	51.3	V	74.0	-22.7	Pk	312	1.2	
7202.910	50.6	H	74.0	-23.4	Pk	320	1.5	
4801.910	47.5	V	74.0	-26.5	Pk	83	1.0	

Run #2b: Radiated Spurious Emissions, 2400-24000 MHz. Center Channel @ 2439 MHz

UNIT: 17 dBi Panel

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7317.000	37.7	H	54.0	-16.3	Avg	123	1.0	
7317.000	37.6	V	54.0	-16.4	Avg	8	1.6	
4878.000	35.5	H	54.0	-18.5	Avg	320	2.2	
7317.000	51.0	V	74.0	-23.0	Pk	8	1.6	
7317.000	50.4	H	74.0	-23.6	Pk	123	1.0	
4878.000	46.3	H	74.0	-27.7	Pk	320	2.2	

Run #2c: Radiated Spurious Emissions, 2400-24000 MHz. High Channel @ 2479 MHz

UNIT: 17 dBi Panel

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7436.910	38.1	H	54.0	-15.9	Avg	185	1.5	
7436.910	37.7	V	54.0	-16.3	Avg	163	1.3	
4957.940	33.2	V	54.0	-20.8	Avg	335	1.3	
4957.940	32.7	H	54.0	-21.3	Avg	60	1.4	
7436.910	50.4	H	74.0	-23.6	Pk	185	1.5	
7436.910	50.0	V	74.0	-24.0	Pk	163	1.3	
4957.940	46.0	V	74.0	-28.0	Pk	335	1.3	
4957.940	46.0	H	74.0	-28.0	Pk	60	1.4	

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Run #3a: Radiated Spurious Emissions, 2400-24000 MHz. Low Channel @ 2401 MHz

UNIT: 12 dBi Sector

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
7202.910	47.1	V	54.0	-6.9	Avg	203	1.0	
7202.910	43.1	H	54.0	-10.9	Avg	135	1.2	
4801.910	41.2	V	54.0	-12.8	Avg	120	1.0	
7202.910	54.8	V	74.0	-19.2	Pk	203	1.0	
7202.910	53.1	H	74.0	-20.9	Pk	135	1.2	
4801.910	49.3	V	74.0	-24.7	Pk	120	1.0	

Run #3b: Radiated Spurious Emissions, 2400-24000 MHz. Center Channel @ 2439 MHz

UNIT: 12 dBi Sector

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7317.000	45.6	V	54.0	-8.4	Avg	180	1.9	
4878.000	45.0	V	54.0	-9.0	Avg	180	1.3	
7317.000	41.5	H	54.0	-12.5	Avg	140	1.0	
7317.000	54.1	V	74.0	-19.9	Pk	180	1.9	
7317.000	52.0	H	74.0	-22.0	Pk	140	1.0	
4878.000	51.0	V	74.0	-23.0	Pk	180	1.3	

Run #3c: Radiated Spurious Emissions, 2400-24000 MHz. High Channel @ 2479 MHz

UNIT: 12 dBi Sector

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7436.910	39.5	V	54.0	-14.5	Avg	330	1.3	
4957.940	39.1	V	54.0	-14.9	Avg	248	1.3	
4957.940	37.9	H	54.0	-16.1	Avg	225	2.1	
7436.910	51.6	V	74.0	-22.4	Pk	330	1.3	
7436.910	50.1	H	74.0	-23.9	Pk	140	1.5	
4957.940	48.1	H	74.0	-25.9	Pk	225	2.1	

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Antenna Conducted Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing the EUT relative to the specification) defined above.

Date of Test: 06/19/2000
Test Engineer: Vishal Narayan
Test Location: SVOATS 2

Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 25.6°C
Rel. Humidity: 55%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Antenna Conducted Spurious Emissions	FCC Part 15.209 / 15.247(c)	Pass	> 20dB
3	Output Power	15.247(b)	Pass	24.4dBm
4	Channel Occupancy / Separation / Number of Channels	15.247(a)	Pass	

Modifications Made During Testing: None

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Run #1: Radiated Spurious Emissions, 30-2484 MHz. Low Channel @ 2401 MHz

Channel	Graph reference #s	Comments
Low	T38016/101-104	All out-of-band emissions more than 20dB below the highest in-band signal level
Mid	T38016/105-108	
High	T38016/109-113	

Run #2: Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	20dB Signal Bandwidth	Graph reference #
Low	2401	30 kHz	To be measured on the configuration with the amplifier.	
Mid	2439	30 kHz		
High	2479	30 kHz		

Run #3: Output Power

Channel	Frequency (MHz)	Res BW	Output Power	Graph reference #
Low	2401	2 MHz	24.2	T38016/301
Mid	2439	2 MHz	24.4	T38016/302
High	2479	2 MHz	23.4	T38016/303

Run #4: Number of Channels, Channel Occupancy And Spacing

There were 79 channels (refer to graph T38016/401), giving a channel spacing of 1000kHz.
The channel occupancy was measured with the radio transmitting normally (i.e. In hopping mode)

The dwell time on a particular channel was:	130	ms
The period between successive transmissions on a channel was:	10	s
Period of occupancy in 30 seconds was, therefore:	390	ms

Refer to graphs numbered T384016/401 and 402

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	B

Conducted Emissions

Test Specifics

Objective: The objectiveThe objective of this test session is to perform final qualification testing the EUT relative to the specification(s) defined above.

Date of Test: 06/22/2000
Test Engineer: David W. Bare
Test Location: CCA#1

Config. Used: 1
Config Change:
EUT Voltage: 230V/50 Hz or 120V/60Hz or 208V/60 Hz

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane. The LISN was located 80 cm from the EUT.

Ambient Conditions:

Temperature: 21°C
Rel. Humidity: 45%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 120V/60Hz	FCC 15.207(a)	Fail	
2	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	

Modifications Made During Testing:

Added copper foil tape to edge of radio module inside EUT

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.45 - 30 MHz 120 V / 60 Hz

Frequency	Level	Power	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Lead	Limit	Margin	QP/Ave	
19.996	57.1	Line1	48.0	9.1	QP	
19.996	51.6	Line1	48.0	3.6	Avg	Note 1
2.090	43.5	Line1	48.0	-4.5	QP	
21.790	45.5	Line1	48.0	-2.5	QP	
19.996	42.3	Line1	48.0	-5.7	QP	Note 2
19.996	36.8	Line1	48.0	-11.2	QP	Note 3

Note 1:	Average less than 6 dB below the QP, so emission is narrowband
Note 2:	Removed Ethernet cable
Note 3:	Added copper tape to end of radio module

Run #2: AC Power Port Conducted Emissions, 0.45 - 30 MHz 120 V / 60 Hz with modification

Frequency	Level	Power	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Lead	Limit	Margin	QP/Ave	
28.227	42.4	Line1	48.0	-5.6	QP	
1.254	34.0	Line1	48.0	-14.0	QP	Note 1
1.254	37.4	Line1	48.0	-10.6	Avg	Note 1
2.398	33.0	Line1	48.0	-15.0	QP	Note 1
2.398	34.9	Line1	48.0	-13.1	Avg	Note 1
28.226	39.5	Neutral	48.0	-8.5	QP	
2.398	41.6	Neutral	48.0	-6.4	QP	
1.177	42.2	Neutral	48.0	-5.8	QP	

Note 1:	Emisssion considered broadband so 13 dB was subtracted from the Quasi peak amplitude

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	B

Conducted Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing the EUT relative to the specification(s) defined above.

Date of Test: 07/20/2000
Test Engineer: Pamela Galvan
Test Location: SVOATS #3

Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane. The LISN was located 80 cm from the EUT. A second LISN was used for all local support equipment. Remote support equipment was located approximately 30 meters from the EUT with all I/O connections running on top of the groundplane.

Ambient Conditions:

Temperature: ??°C
Rel. Humidity:

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	

Modifications Made During Testing: None

Elliott

EMC Test Data

Client:	Nokia	Job Number:	T36596
Model:	2.4GHz FHSS Wireless 10/100	T-Log Number:	T38016
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.45 - 30 MHz 120 V / 60 Hz

Transmit 75% / Receive 20 %mode

Frequency	Level	Power	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Lead	Limit	Margin	QP/Ave	
0.5219	35.7	Line	48.0	-12.3	QP	Signal is broadband, QP reading corrected by -13dB
0.6714	30.1	Line	48.0	-17.9	QP	Signal is broadband, QP reading corrected by -13dB
0.9266	33.9	Line	48.0	-14.1	QP	
		Neutral	0.0	0.0	QP	
		Neutral	0.0	0.0	QP	
		Neutral	0.0	0.0	QP	

Elliott

EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Emissions Spec:	FCC	Class:	B
Immunity Spec:		Environment:	N/A

EMC Test Data

For The

Nokia

Model

2.4GHz FHSS Wireless 10/100 w/ AMP

Elliott

EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Emissions Spec:	FCC	Class:	B
Immunity Spec:		Environment:	N/A

TEST SUMMARY

Date	Test Performed	Level	Results	Margin
07/20/2000	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	-8.7dB @ .8996MHz
07/20/2000	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	-9.7dB @ .8314MHz
07/20/2000	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	-9.3dB @ .848MHz
7/17/2000 & 7/18/00	Output Power	FCC Part 15.247	Pass	Power was 29.19dBm
7/17/2000 & 7/18/00	Spurious Emissions In Restricted Bands - Omni	FCC Part 15.209 /	Pass	-1.8dB @ 4878MHz
7/17/2000 & 7/18/00	20dB Bandwidth	15.247(a)	Pass	995kHz
7/17/2000 & 7/18/00	Out-Of Band Antenna Spurious	15.247(a)	Pass	All out-of-band emissions more than

Abbreviations Used: RE - Radiated Emissions, CE- Conducted Emissions, RI - Radiated Immunity, CI - Conducted Immunity, ESD - Electrostatic Discharge, EFT - Electrical Fast Transients, VDI - Voltage Dips and Interrupts

Elliott

EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Emissions Spec:	FCC	Class:	B
Immunity Spec:		Environment:	N/A

EUT INFORMATION

General Description

The EUT is a 2.4 – 2.4835 GHz frequency-hopping spread spectrum (FHSS) transceiver that is designed for point-to-multipoint and point-to-point operation. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, placed in this position during testing to simulate the end user environment.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Nokia	R242	Module	PCB #79295d	
Nokia	LA-302C-500-1C	Radio card	UG34H3	
Nokia		Power Supply	00000047FH2410594X	
Nokia	to be provided	Pre-Amp		

Other EUT Details

EUT Enclosure

It measures approximately 13.7 cm wide by 11.4 cm deep by 3.4 cm high. It is primarily constructed of plastic with an internal conductive coating. The amplifier and dc injector are mounted in die-cast metal boxes.

Modification History

Mod. #	Test	Date	Modificaiton
1			
2			
3			

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EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Emissions Spec:	FCC	Class:	B
Immunity Spec:		Environment:	N/A

Test Configuration Information (1)

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Maxrad	MFB24008	8 dBi Omni Antenna	N/A	

Note: Antennas used for radiated spurious emissions tests.

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
IBM		Laptop	78-LZ070	
IBM		AC Adapter	J15JR533PB4	
Young	2441-E1	DC injector and 2.4GHz amplifier		

Note: The laptop was only used to configure the EUT prior to testing. It was not connected during testing.

EUT Interface Ports

		Cable(s)		
EUT Port	Connected To	Description	Shielded or Unshielded	Length(m)
Antenna Output	Antenna	Coax (Andrew)	Shielded	1.5
Antenna Output	Amplifier	Coax (Andrew)	Shielded	1.8

EUT Operation During Emissions

EUT was set to transmit continously on a single channel for radiated emissions, power and bandwidth tests.

Elliott

EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	B

Conducted Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing the EUT relative to the specification(s) defined above.

Date of Test: 07/20/2000
Test Engineer: Pamela Galvan
Test Location: SVOATS #3

Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane. The LISN was located 80 cm from the EUT. The laptop was located on the test table during conducted emissions testing to facilitate changing the channels.

Ambient Conditions:

Temperature: 16 °C
Rel. Humidity: 75%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1 (Low channel)	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	-8.7dB @ .8996MHz
2 (center channel)	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	-9.7dB @ .8314MHz
3 (high channel)	CE, AC Power 120V/60Hz	FCC 15.207(a)	Pass	-9.3dB @ .848MHz

Modifications Made During Testing: None

Elliott

EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.45 - 30 MHz 120 V / 60 Hz

DC power injector. Low Channel. Transmit 75% / Receive 20 %

Frequency	Level	Power	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Lead	Limit	Margin	QP/Ave	
0.8996	39.4	Neutral	48.0	-8.6	QP	
0.5219	35.7	Line	48.0	-12.3	QP	Signal is broadband, QP reading corrected by -13dB
0.9266	33.9	Line	48.0	-14.1	QP	
0.5081	32.6	Neutral	48.0	-15.4	QP	Signal is broadband, QP reading corrected by -13dB
0.6714	30.1	Line	48.0	-17.9	QP	Signal is broadband, QP reading corrected by -13dB
0.6701	28.9	Neutral	48.0	-19.1	QP	Signal is broadband, QP reading corrected by -13dB

Run #2: AC Power Port Conducted Emissions, 0.45 - 30 MHz 120 V / 60 Hz

DC power injector. Center Channel. Transmit 75% / Receive 20 %

Frequency	Level	Power	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Lead	Limit	Margin	QP/Ave	
0.8314	38.4	Line	48.0	-9.6	QP	
0.8322	38.3	Neutral	48.0	-9.7	QP	
0.4742	35.1	Line	48.0	-12.9	QP	Signal is broadband, QP reading corrected by -13dB
0.6564	29.1	Line	48.0	-18.9	QP	Signal is broadband, QP reading corrected by -13dB
0.4767	28.7	Neutral	48.0	-19.3	QP	Signal is broadband, QP reading corrected by -13dB
0.6583	28.7	Neutral	48.0	-19.3	QP	Signal is broadband, QP reading corrected by -13dB

Run #3: AC Power Port Conducted Emissions, 0.45 - 30 MHz 120 V / 60 Hz

DC power injector. High Channel. Transmit 75% / Receive 20 %

Frequency	Level	Power	FCC 15.207(a)		Detector	Comments
MHz	dBµV	Lead	Limit	Margin	QP/Ave	
0.8480	38.8	Neutral	48.0	-9.2	QP	
0.8480	37.4	Line	48.0	-10.6	QP	
0.4836	35.6	Line	48.0	-12.4	QP	Signal is broadband, QP reading corrected by -13dB
0.4836	30.4	Neutral	48.0	-17.6	QP	Signal is broadband, QP reading corrected by -13dB
0.6589	28.9	Neutral	48.0	-19.1	QP	Signal is broadband, QP reading corrected by -13dB
0.6565	28.6	Line	48.0	-19.4	QP	Signal is broadband, QP reading corrected by -13dB

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EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing the EUT relative to the specification defined above.

Date of Test: 7/17/2000 & 7/18/00
Test Engineer: Tuan Banh
Test Location: OATS #2

Config. Used: 1
Config Change: None
EUT Voltage: 120V /60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 13.9°C
Rel. Humidity: 83%

Summary of Results

Run #	Test Performed	Limit	Result	Comment
1	Output Power	FCC Part 15.247	Pass	Power was 29.19dBm
2,3,4	Spurious Emissions In Restricted Bands - Omni Antenna	FCC Part 15.209 / 15.247(c)	Pass	-1.8dB @ 4878MHz
5	20dB Bandwidth	15.247(a)	Pass	995kHz
6	Out-Of Band Antenna Spurious	15.247(a)	Pass	All out-of-band emissions more than 20dB below fundamental signal level.

Modifications Made During Testing: None

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EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Run #1: Output Power

Channel	Frequency (MHz)	Res BW	Output Power	Graph reference #
Low	2.401	3MHz	29.19dBm	T38457/101
Mid	2.439	3MHz	28.65dBm	T38457/102
High	2.4789	3MHz	28.16dBm	T38457/103

Run #2: Radiated Spurious Emissions, 2400-24000 MHz. Low Channel @ 2401 MHz

Config: EUT is now tested with Amplifier and is running Slow frame in the software.

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
4802.000	52.7	V	54.0	-1.3	Avg	200	1.0	
7202.910	49.6	V	54.0	-4.4	Avg	320	1.0	
7202.910	47.8	H	54.0	-6.2	Avg	330	1.0	
4802.000	43.9	H	54.0	-10.1	Avg	90	1.0	
4802.000	60.4	V	74.0	-13.6	Pk	200	1.0	
7202.910	59.6	V	74.0	-14.4	Pk	320	1.0	
7202.910	57.7	H	74.0	-16.3	Pk	330	1.0	
4802.000	54.1	H	74.0	-19.9	Pk	90	1.0	

Run #3: Radiated Spurious Emissions, 2400-24000 MHz. Center Channel @ 2439 MHz

Config: EUT is now tested with Amplifier and is running Slow frame in the software.

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4878.000	52.2	V	54.0	-1.8	Avg	90	1.0	
7317.000	50.8	V	54.0	-3.2	Avg	180	1.0	
4878.000	46.7	H	54.0	-7.3	Avg	120	1.1	
7317.000	44.4	H	54.0	-9.6	Avg	190	1.0	
7317.000	61.2	V	74.0	-12.8	Pk	180	1.0	
4878.000	60.0	V	74.0	-14.0	Pk	90	1.0	
7317.000	55.3	H	74.0	-18.7	Pk	190	1.1	
4878.000	55.2	H	76.0	-20.8	Pk	120	1.1	

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EMC Test Data

Client:	Nokia	Job Number:	J36596
Model:	2.4GHz FHSS Wireless 10/100 w/ AMP	T-Log Number:	T38457
		Proj Eng:	Mark Briggs
Contact:	Ivar Sanders		
Spec:	FCC	Class:	N/A

Run #4: Radiated Spurious Emissions, 2400-24000 MHz. High Channel @ 2479 MHz

Config: EUT is now tested with Amplifier and is running Slow frame in the software.

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4957.940	44.5	V	54.0	-9.5	Avg	270	1.0	
7436.910	43.4	V	54.0	-10.6	Avg	300	1.0	
7436.910	42.0	H	54.0	-12.0	Avg	330	1.0	
4957.940	39.2	H	54.0	-14.8	Avg	200	1.5	
7436.910	56.2	V	74.0	-17.8	Pk	300	1.0	
4957.940	55.3	V	74.0	-18.7	Pk	270	1.0	
7436.910	54.0	H	74.0	-20.0	Pk	330	1.0	
4957.940	50.9	H	75.0	-24.1	Pk	200	1.0	

Run #5: Signal Bandwidth

Channel	Frequency (MHz)	Resolution Bandwidth	20dB Signal Bandwidth	Graph reference #
Low	2.401	30kHz	995kHz	T38457/501
Mid	2.439	30kHz	990kHz	T38457/502
High	2.4789	30kHz	955kHz	T38457/503

Run #6: Antenna Conducted Spurious Emissions

Channel	Graph reference #s	Comments
Low	T38457/601-604	All out-of-band emissions more than 20dB below the highest in-band signal level
Mid	T38457/605-608	
High	T38457/609-612	