UltraTech
Group of Labs

31040/SIT

C-1376

Canada
46390-2049

200093-0

00-034

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June 28, 2002

FEDERAL COMMUNICATIONS COMMISSION
7435 Oakland Mills Road
Columbia, MD 21046
USA

Subject: **FCC Certification Authorization Application under FCC Docket No.: 99-231:2002 (Amendment of Part 15), Part 15, Subpart C, Sec. 15.247 - Digital Modulation Transmitters operating in the frequency band 2400 - 2483.5 MHz.**

Product: **NETPAD + TRX7431 (DSSS Modular Transceiver)**
Model No.: **NETPAD RLAN**
FCC ID: **GM3WLPC24HN**

Dear Sir/Madam

As appointed agent for Psion Teklogix Inc., we would like to submit the application to the Federal Communications Commission for certification of the above product. Please review all necessary files uploaded to FCC OET site for detailed information.

The Psion Teklogix Model NETPAD RLAN employs an Agere 2.4 GHz DSSS 11 Mb PMCIA Card, FCC ID Number: IMRWLPCE24H and Psion Teklogix Model TRX7431 DSSS Module, FCC ID: GM3WLPC24H. Since our peak power measurements was found higher than that is listed in FCC Grant, FCC ID: IMRWLPCE24H, and the EUT is a portable device, the new FCC Grant is required for compliance with FCC 15.247 and RF Exposure Requirements.

- Compliance with RF Exposure Requirements: The transmitter complies with FCC 2.1093 and FCCOET Bulletin 65 (August 1997) with maximum 0.2869 W/Kg (at 19% duty cycle) with body tissue. Please refer to attached SAR test report.

If you have any queries, please do not hesitate to contact us.

Yours truly,

Tri Minh Luu, P. Eng.,
V.P., Engineering

Encl

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00-034

June 28, 2002

Psion Teklogix Inc.
2100 Meadowvale Blvd.
Mississauga, Ontario
Canada, L5N 7J9

Attn.: **Mr. Sada Dhawarkar**

Subject: **FCC Certification Application Testing under FCC Docket No.: 99-231:2002 (Amendment of Part 15), Part 15, Subpart C, Sec. 15.247 - Digital Modulation Transmitters operating in the frequency band 2400 - 2483.5 MHz.**

Product: **NETPAD + TRX7431 (DSSS Modular Transceiver)**
Model No.: **NETPAD RLAN**
FCC ID: **GM3WLPC24HN**

Dear Mr. Dhawarkar,

The product sample, as provided by you, has been tested and found to comply with **FCC Docket No.: 99-231:2002 (Amendment of Part 15), Part 15, Subpart C, Sec. 15.247 - Digital Modulation Transmitters operating in the frequency band 2400 - 2483.5 MHz.**

The Psion Teklogix Model NETPAD RLAN employs an Agere 2.4 GHz DSSS 11 Mb PMCIA Card, FCC ID Number: IMRWLPCE24H and Psion Teklogix Model TRX7431 DSSS Module, FCC ID: GM3WLPC24H. Since our peak power measurements was found higher than that is listed in FCC Grant, FCC ID: IMRWLPCE24H, and the EUT is a portable device, the new FCC Grant is required for compliance with FCC 15.247 and RF Exposure Requirements.

- Compliance with RF Exposure Requirements: The transmitter complies with FCC 2.1093 and FCCOET Bulletin 65 (August 1997) with maximum 0.2869 W/Kg (at 25% maximum duty cycle) with body tissue. Please refer to attached SAR test report.

Enclosed you will find copies of the engineering report. If you have any queries, please do not hesitate to contact us.

Yours truly,

Tri Minh Luu, P. Eng.,V.P., Engineering

Encl.

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ENGINEERING TEST REPORT

NETPAD + TRX7431 (DSSS Modular Transceiver)
Model No.: NETPAD RLAN

FCC ID: GM3WLPC24HN

Applicant: **Psion Teklogix Inc.**
2100 Meadowvale Blvd.
Mississauga, Ontario
Canada, L5N 7J9

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C, SEC. 15.247
Digital Modulation Transmitters operating in the frequency band 2400 - 2483.5 MHz

UltraTech's File No.: TEK-369FCCTX

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: June 28, 2002	
Report Prepared by: Tri M. Luu, P.Eng. Issued Date: June 28, 2002	Tested by: Hung Trinh, RFI Technician Test Dates: June 18-28, 2002

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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FC	VCCI	Canada	NVLAP	IT	UL	entela
31040/SIT	C-1376	46390-2049	200093-0	00-034		

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
	Test Report	• Exhibit 1: Submittal check lists • Exhibit 2: Introduction • Exhibit 3: Performance Assessment • Exhibit 4: EUT Operation and Configuration during Tests • Exhibit 5: Summary of test Results • Exhibit 6: Measurement Data • Exhibit 7: Measurement Uncertainty • Exhibit 8: Measurement Methods	OK
1	Test Report - Plots of Measurement Data	Plots # 1 to 34	OK
2	Test Setup Photos	Photos # 1 to 3	OK
3	External Photos of EUT	Photos # 1 to 2	OK
4	Internal Photos of EUT	Photos of 1 to 15	OK
5	Cover Letters	• Letter from Ultratech for Certification Request	OK
6	Attestation Statements	• Letter from the Applicant to appoint Ultratech to act as an agent • Letter from the Applicant to request for Confidentiality Filing	OK OK
7	ID Label/Location Info	• ID Label • Location of ID Label	OK OK
8	Block Diagrams	• Block diagrams	OK
9	Schematic Diagrams	• Schematic diagrams	Will be uploaded to FCC OET site by sent by Agere Systems
10	Parts List/Tune Up Info	• Parts List/Tune Up Info	Will be uploaded to FCC OET site by sent by Agere Systems
11	Operational Description	Operational Description	OK
12	RF Exposure Info	SAR Test Report	OK
13	Users Manual	Users Manual	OK

EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Docket No.: 99-231:2002 (Amendment to FCC Part 15 of the Commission's Rules Regarding to Spread Spectrum Devices), Part 15, Subpart C, Section 15.247
Title	Telecommunication - Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Digital Modulation Transmitters operating in the Frequency Band 2400 - 2483.5 MHz .
Test Procedures	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	• Light-industry, Commercial • Industry

1.2. RELATED SUBMITAL(S)/GRANT(S)

The Psion Teklogix Model NETPAD RLAN employs an Agere 2.4 GHz DSSS 11 Mb PMCIA Card, FCC ID Number: IMRWLPCE24H and Psion Teklogix Model TRX7431 DSSS Module, FCC ID: GM3WLPC24H. Since our peak power measurements was found higher than that is listed in FCC Grant, FCC ID: IMRWLPCE24H, and the EUT is a portable device, the new FCC Grant is required for compliance with FCC 15.247 and RF Exposure Requirements.

1.3. NORMATIVE REFERENCES

Publication	YEAR	Title
FCC CFR Parts 0-19	2001	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CISPR 22 & EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1		Specification for Radio Disturbance and Immunity measuring apparatus and methods
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval
FCC ET Docket No. 99-231	2002	Amendment to FCC Part 15 of the Commission's Rules Regarding to Spread Spectrum Devices

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT:	
Name:	Psion Teklogix Inc.
Address:	2100 Meadowvale Blvd. Mississauga, Ontario Canada, L5N 7J9
Contact Person:	Mr. Sada Dhawarkar Phone #: 905-812-6200 Fax #: 905-812-6301 Email Address: sdharwar@teklogix.com

MANUFACTURER:	
Name:	Psion Teklogix Inc.
Address:	2100 Meadowvale Blvd. Mississauga, Ontario Canada, L5N 7J9
Contact Person:	Mr. Sada Dhawarkar Phone #: 905-812-6200 Fax #: 905-812-6301 Email Address: sdharwar@teklogix.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name	Psion Teklogix Inc.
Product Name	NETPAD + TRX7431 (DSSS Modular Transceiver)
Model Name or Number	NETPAD RLAN
Serial Number	Eng 001
Type of Equipment	Digital Modulation Transmitters
Input Power Supply Type	Internal rechargeable Lithium Ion Battery Pack, P/N: A2202-0001-0000, 7.2 V, 1400 mAh
Primary User Functions of EUT:	Provide data communication link through air

NETPAD'S TRANSMITTER	
Equipment Type:	▪ Portable
Intended Operating Environment:	▪ Commercial, light industry & heavy industry
Power Supply Requirement:	Internal rechargeable Lithium Ion Battery Pack, P/N: A2202-0001-0000, 7.2 V, 1400 mAh
RF Output Power Rating:	58.88 mWatts peak
Operating Frequency Range:	2412 - 24632 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	1 MHz
Duty Cycle:	88% in 10 mS and 19% overall
6 dB Bandwidth:	10 MHz maximum
Modulation Type:	• DBPSK for 1Mb/s Data Rate • DQPSK for 2 Mb/s Data Rate • CCK for 5.5 Mb/s Data Rate • CCK for 11 Mb/s Data Rate
Emission Designation:	Direct Sequence Spread Spectrum
Spectral Density	5.888 mW/MHz (Power output at the antenna / bandwidth of the RF output spectrum)
Antenna Connector Type:	• Non-integral, special coupling (reversed thrust SMA connector without a center pin)
Antenna Description:	Manufacturer: Centurion Model Number: FA1089 Antenna Gain: 2.6 dBi max. Operating frequency: 2400 - 2500 MHz Type of Antenna: Stubby In/Out Impedance: 50 Ohms

Duty Cycle Calculation for PSION Teklogix equipment

"The access point sends out a beacon every 100ms.
A client terminal can only transmit once (if at all) during each of these intervals.
The maximum fragmentation limit of a client terminal is 2312 bytes. This translate to 18496 bits.
There is a 192 bit preample for each packet sent.
Thus a client terminal can transmit a maximum of ~19kbits/100ms. At 1Mbps data rate, this will take 19ms every 100ms, translating to a max duty cycle of 19%. Duty cycle will be reduced when a higher data rate is used or when there are less data being transmitted."

2.3. MANUFACTURER'S EUT'S TECHNICAL SPECIFICATIONS

Title:	Author:	File Name:	Date:
Product Configuration, FCC &IC Test	Sada Dharwarkar	RA Product Configuration.doc	June 21, 2002

TITLE: NETPAD + TRX7431 AGERE SYSTEMS NEDERLAND B.V. 802.11 2.4 GHZ RADIO

PRODUCT UNDER TEST	netpad + TRX7431
DESTINATION COUNTRY	NA
APPLICABLE STANDARD	FCC Part 15.247, FCC Part 15 B Unintentional & RSS-210 & SAR
EQUIPMENT CLASS	Class B
EQUIPMENT TYPE	Radio Equipment
TESTER	Sada Dharwarkar
DATE	June 21, 2002

Revision	Date	Change Description	by	Comments
Draft 1	2002-06-07	Initial Draft	Sada Dharwarkar	

HARDWARE	
MANUFACTURER	Psion Teklogix Inc.
PRODUCT	netpad
MODEL NUMBER	netpad RLAN
SERIAL NUMBER	Eng 001
MLB PART NUMBER	A220100140003
PCMCIA EXPANSION BOARD	A220100430001
MISCELANEOUS HARDWARE	
MANUFACTURER	Symbol Technology
PRODUCT	Scanner Module
MODEL NUMBER	SE923-1000A
SERIAL NUMBER	N/A
TEKLOGIX PART NUMBER	A220200290001
MANUFACTURER	Hitachi
PRODUCT	LCD Display (Transmissive)
SERIAL NUMBER	N/A
TEKLOGIX PART NUMBER	A220400060003

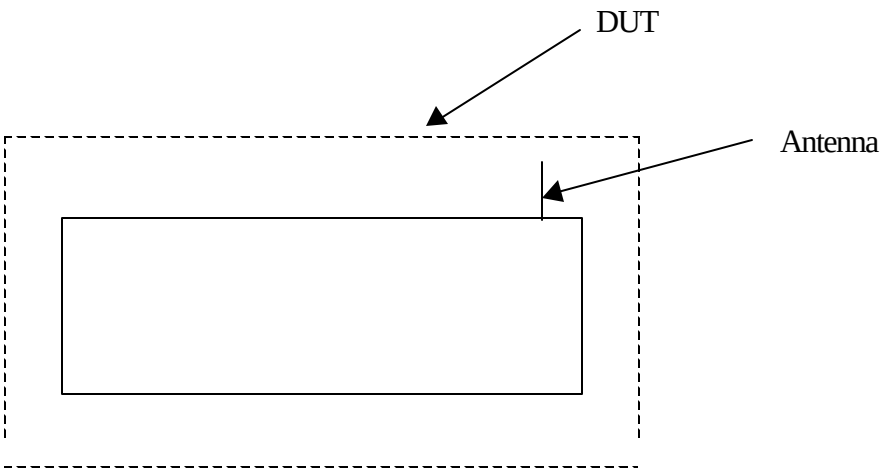
SOFTWARE	
OPERATING SYSTEM	WinCE
SOFTWARE VERSION (netpad)	1000420p1
BOOT CODE VERSION (netpad5)	1000378A
Pic	12c7
CLOCK SPEED (netpad)	206 MHz
OSCILLATOR FREQUENCIES (netpad)	3.686MHz; 1MHz RC Oscillator, 32KHz; 8MHz/40MHz to FPGA;24MHz Coodec; 100MHz SDLK
IP ADDRESS	10.1.0.4
ESSID	N/A

ADD ON CARDS	
LOCATION	MMC port
MANUFACTURER	Hitachi
PRODUCT	Multi-Media Card (MMC)
MODEL NUMBER	16Mb Hitachi HB288016 MMI
TEKLOGIX PART NUMBER	A220100190001

Remarks: The Psion Teklogix Model NETPAD RLAN employs an Agere 2.4 GHz DSSS 11 Mb PMCIA Card, FCC ID Number: IMRWLPCE24H, FCC Certified for mobile and base application without SAR Tests. Since our peak power measurements was found higher than that is listed in FCC Grant, FCC ID: IMRWLPCE24H, and the EUT is a portable device, the new FCC Grant is required to be submitted to FCC.

RADIO	
MANUFACTURER:	Agere Systems Nederland B.V.
PRODUCT	2.4 GHz DSSS 11MB PCMCIA Card
MODEL NUMBER	PC24-H-FC
PSION TEKLOGIX MODEL NUMBER	TRX7431
PSION TEKLOGIX PART NUMBER	30589-211
FCC ID	IMRWLPCE24H
POWER	32 mW
FREQUENCY RANGE	2.412 to 2.462 GHz
Duty Cycle	88% in 100 ms interval as measured 19% overall
DATA RATES	11 MBps
CHANNELS	11 (FCC)
L.O. FREQUENCIES	352 MHz
REF. OSC. FREQUENCIES	22 MHz
INTERNAL/EXTRENAL ANTENNA	INTERNAL TO NETPAD
RF CABLE TYPE	N/A
TEKLOGIX PART NUMBER	N/A
ANTENNA TYPE + GAIN	CENTURION STUBBY + 1.9dBi
PSION TEKLOGIX PART NUMBER	

2.4. BLOCK DIAGRAM OF TEST SETUP



2.5. ANCILLARY EQUIPMENT

None

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	7.2 V, 1400 mAh Rechargeable Lithium Ion Battery

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements.
Special Test Software:	▪ None
Special Hardware Used:	▪ None
Transmitter Test Antenna:	As intended to be used

Transmitter Test Signals:	
Frequencies: ▪ 2400 - 2483.5 MHz band:	Lowest, middle and highest channel frequencies tested: 2412, 2437 and 2462 MHz
Transmitter Wanted Output Test Signals: ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation ▪ Modulating signal source:	 ▪ 8.88 m Watts peak (conducted) ▪ DBPSK (1Mbps), DQPSK (2Mbps), CCK (5.5 Mbps), CCK (11 Mbps) ▪ Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 16'(L) by 12'(W) by 12'(H).

- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

  The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: Aug. 08, 2001.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
15.107(a) & 207	AC Power Conducted Emissions	N/A for battery operated device
15.247(a)(2)	6dB Bandwidth of a Digital Modulation System	Yes
15.247(b) & 1.1310	Maximum Peak Power (Conducted)	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
15.247(c)	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d)	Transmitted Power Density of a Digital Modulation System	Yes
15.247(c), 15.209 & 15.205	Transmitter Radiated Emissions	Yes
FCC Part 15, Sub. B, Sec. 15.109	Class B Radiated Emissions	Yes. Note 1

Note 1: A separate engineering test report for compliance with FCC Part 15, Subpart B - Class B Unintentional Radiators will be provided upon request.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report and ANSI C63-4:1992

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C64-3:1992, FCC 15.247 and CISPR 16-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER:

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

5.5. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: • The application (or intended use) of the EUT • The installation requirements of the EUT • The method by which the EUT will be marketed	Special coupling antenna is used. Reverse thrust SMA connector without a center pin. N/A
15.204	Provided the information for every antenna proposed for use with the EUT: (a) type (e.g. Yagi, patch, grid, dish, etc…), (b) manufacturer and model number (c) gain with reference to an isotropic radiator	Manufacturer: Centurion Model Number: FA1089 Antenna Gain: 2.6 dBi max. Operating frequency: 2400 - 2500 MHz Type of Antenna: Stubby In/Out Impedance: 50 Ohms

5.6. 6 DB BANDWIDTH @ FCC 15.247(A)(2)

5.6.1. Limits

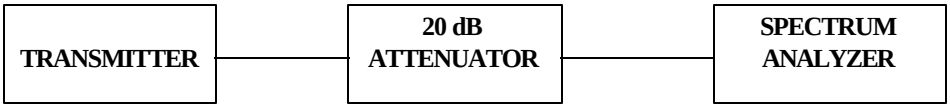
For a Digital Modulation System, the minimum 6 dB bandwidth shall be at least 500 KHz.

5.6.2. Method of Measurements

Refer to ANSI C63-4:1992

The transmitter output was connected to the spectrum analyzer through an attenuator. the bandwidth of the fundamental frequency was measured with the spectrum analyzer using 30 KHz RBW, VBW = 100 KHz,. The 6 dB bandwidth was measured and recorded.

5.6.3. Test Arrangement



5.6.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz

5.6.5. Test Data

CHANNEL FREQUENCY (MHz)	Modulation & Data Rate	6 dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS/FAIL
2412	CCK, 11 Mbps	9.83	0.5	PASS
2437	CCK, 11 Mbps	9.09	0.5	PASS
2462	CCK, 11 Mbps	9.06	0.5	PASS
2437	DBPSK, 1 Mbps	10.0	0.5	PASS
2437	DQPSK, 2 Mbps	9.89	0.5	PASS
2437	CCK, 5.5 Mbps	8.71	0.5	PASS

5.6.6. Plots

Please refer to Plots # 1 & 6 in Annex 1 for Measurements data

5.7. PEAK OUTPUT POWER (CONDUCTED) @ FCC 15.247(B)

5.7.1. Limits

- **FCC 15.247(b)(3):** Maximum peak output power of the transmitter shall not exceed 1 Watt.
- **FCC 15.247(b)(4)(i):** If the device is not for fixed point to point radio, the antenna 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.

5.7.2. Method of Measurements & Test Arrangement

Refer to Exhibit 8, Sec. 8.3 of this test report, FCC 15.247(b)(1)&(3), ANSI C63-4:1992 & ETSI 300 328

Note: The conducted peak power measurement method was performed in accordance with ETSI 300 328 since it was proven to be independent with the peak power meter characteristics.

5.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz
67297 RF Detector (Diode Detector)	Herotex	DZ122-553	63400	..
Storage Oscilloscope	Philips	PM3320A	ST9907959	--

5.7.4. Test Data

Transmitter Channel	Modulation & Data Rate	Frequency (MHz)	(full bandwidth) Peak Power at Antenna Terminals (dBm)	Limit (dBm)
Lowest	DBPSK (1 Mbps)	2412	17.7	30.0
Middle	DBPSK (1 Mbps)	2437	17.7	30.0
Highest	DBPSK (1 Mbps)	2462	17.7	30.0
Lowest	DQPSK (2 Mbps)	2412	17.7	30.0
Middle	DQPSK (2 Mbps)	2437	17.7	30.0
Highest	DQPSK (2 Mbps)	2462	17.7	30.0
Lowest	CCK (5.5 Mbps)	2412	17.7	30.0
Middle	CCK (5.5 Mbps)	2437	17.7	30.0
Highest	CCK (5.5 Mbps)	2462	17.7	30.0
Lowest	CCK (11 Mbps)	2412	17.7	30.0
Middle	CCK (11 Mbps)	2437	17.7	30.0
Highest	CCK (11 Mbps)	2462	17.7	30.0

5.8. RF EXPOSURE REQUIRMENTS @ FCC 15.247(B)(4), 1.1310 & 2.1091

Please refer to the SAR Test report for Psion Teklogix Model NETPAD RLAN.

- Compliance with RF Exposure Requirements: The transmitter complies with FCC 2.1093 and FCCOET Bulletin 65 (August 1997) with maximum 0.2869 W/Kg (at 19% duty cycle) with body tissue. Please refer to attached SAR test report.

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
SAR Tests for Portable Transmitters • Body Tissue	• Comply with SAR limits with body tissue, please refer to SAR test report with maximum SAR level of 0.2869 W/Kg at maximum duty cycle of 19%. (Peak SAR is 1.51 W/Kg measured with the EUT transmit continuously, the EUT and its antenna touch the flat phantom)

5.9. TRANSMITTER BAND-EDGE & SPURIOUS EMISSIONS (CONDUCTED), FCC CFR 47, PARA. 15.247(C)

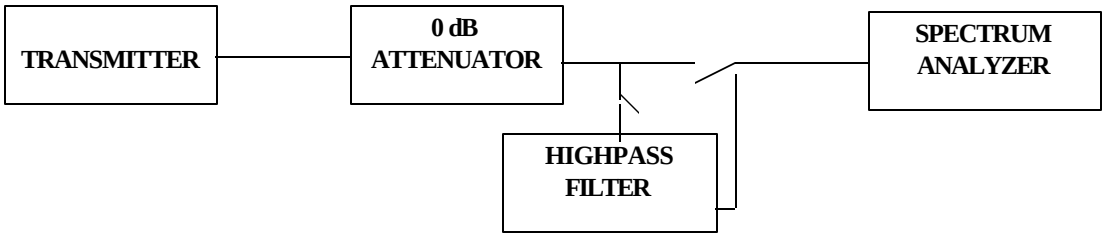
5.9.1. Limits

In any 100 KHz bandwidth outside the operating frequency band, the radio frequency power that is produced by modulation products of the spreading sequence, the information sequence and the carrier frequency shall be at least 20 dB below that in any 100 KHz bandwidth within the band that contains the highest level of the desired power.

5.9.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.4 of this test report, FCC 15.247(c) & ANSI C63-4:1992

5.9.3. Test Arrangement



5.9.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz

5.9.5. Test Data

5.9.5.1. CONDUCTED EMISSIONS AT THE BAND-EDGES OF THE FCC PERMITTED BAND

- Plots # 8 to 12 show the Conducted Band-edge Emissions at LOWEST channel frequency with different modulation & data rate such as DBPSK (1 Mbps), DQPSK (2 Mbps), CCK (5.5 Mbps) and CCK (11 Mbps). The results conform.
- Plots # 13 to 16 show the Conducted Band-edge Emissions at HIGHEST channel frequency with different modulation & data rate such as DBPSK (1 Mbps), DQPSK (2 Mbps), CCK (5.5 Mbps) and CCK (11 Mbps). The results conform.

Since the emissions at lowest and the highest channel frequencies are well within the permitted band 2.4-2.4835 GHz, test for the center channel frequency is un-necessary.

5.9.5.2. TRANSMITTER RF CONDUCTED EMISISONS

Remarks: The Peak Power, 6 dB BW and Band-edge Emissions at different modulation/data rate show no difference in the rf output spectrum characteristics with different modulation and data rate. Therefore, tests will be performed only highest data rate (11 Mbps CCK) and represent for all different modulations.

5.9.5.2.1. Tx Conducted Emissions at Lowest Frequency (2412 MHz Modulation: CCK @ 11 Mbps)

FREQUENCY (MHz)	RF LEVEL (dBm)/100kHz	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2412.00	3.72	PEAK	--	--	--
14.00	-50.8	PEAK	-16.3	-34.5	PASS
263.00	-50.0	PEAK	-16.3	-33.7	PASS
874.00	-48.7	PEAK	-16.3	-32.4	PASS
1326.00	-48.0	PEAK	-16.3	-31.7	PASS
1717.00	-57.0	PEAK	-16.3	-40.7	PASS
4824.00	-48.7	PEAK	-16.3	-32.4	PASS
7236.00	-48.0	PEAK	-16.3	-31.7	PASS
8207.00	-57.0	PEAK	-16.3	-40.7	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 30 dB below the limits were recorded.
- Refer to Plots # 11 & 17-18 for detailed measurement information

5.9.5.2.2. Tx Conducted Emissions at Middle Frequency (2437 MHz, Modulation: CCK @ 11 Mbps)

FREQUENCY (MHz)	RF LEVEL (dBm)/100kHz	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2437	4.22	PEAK	--	--	--
14.00	-51.4	PEAK	-15.8	-35.6	PASS
263.00	-50.7	PEAK	-15.8	-34.9	PASS
874.00	-49.3	PEAK	-15.8	-33.5	PASS
1308.00	-48.0	PEAK	-15.8	-32.2	PASS
1717.00	-57.1	PEAK	-15.8	-41.3	PASS
4874.00	-54.8	PEAK	-15.8	-39.0	PASS
7311.00	-75.5	PEAK	-15.8	-59.7	PASS
8308.00	-74.1	PEAK	-15.8	-58.3	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 30 dB below the limits were recorded.
- Refer to Plots # 12 & 19-20 for detailed measurement information

5.9.5.2.3. Tx Conducted Emissions at Highest Frequency (2462 MHz, Modulation: CCK @ 11 Mbps)

FREQUENCY (MHz)	RF LEVEL (dBm)/100kHz	DETECTOR USED (PEAK/QP)	LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
2462	3.25	PEAK	--	--	--
14.00	-50.8	PEAK	-16.3	-34.5	PASS
263.00	-49.4	PEAK	-16.3	-33.1	PASS
885.00	-48.8	PEAK	-16.3	-32.5	PASS
1308.00	-48.3	PEAK	-16.3	-32.0	PASS
1717.00	-57.1	PEAK	-16.3	-40.8	PASS
2970.00	-64.6	PEAK	-16.3	-48.3	PASS
3876.00	-60.6	PEAK	-16.3	-44.3	PASS
4924.00	-53.2	PEAK	-16.3	-36.9	PASS
7386.00	-70.3	PEAK	-16.3	-54.0	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 30 dB below the limits were recorded.
- Refer to Plots # 13 & 21-22 for detailed measurement information

5.10. TRANSMITTED POWER DENSITY OF A DIGITAL MODULATION SYSTEM, FCC CFR 47, PARA. 15.247(D)

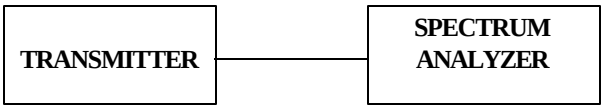
5.10.1. Limits

For a direct sequence system, the transmitted power density average over any 1 second interval shall not be greater than 8 dBm in any 3 KHz bandwidth within this band.

5.10.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.5 of this test report for detailed measurement procedures

5.10.3. Test Arrangement



5.10.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz

5.10.5. Plots

- Refer to Plots # 23 to 26 in Annex 1 for Transmitted Power Density Measurements with different Modulation at the center frequency (2437 MHz).
- Plots # 27 & 28 show the Power Density Measurements at worst case CCK Modulation (11 Mbps) at lowest (2412 MHz) and highest (2462 MHz) frequencies.

5.10.6. Test Data

CHANNEL FREQUENCY (MHz)	MODULATION DATA RATE	RF POWER LEVEL IN 3 KHz BW (dBm)	LIMIT (dBm)	MARGIN (dB)	COMMENTS (PASS/FAIL)
2437	DBPSK 1 Mbps	-8.5	8.0	-16.5	PASS
2437	DQPSK 1 Mbps	-8.6	8.0	-16.6	PASS
2437	CCK 5.5 Mbps	-8.2	8.0	-16.2	PASS
2437	CCK 11 Mbps	-9.3	8.0	-17.3	PASS
2412	CCK 5.5 Mbps	-10.1	8.0	-18.1	PASS
2462	CCK 11 Mbps	-9.0	8.0	-17.0	PASS

5.11. SPURIOUS EMISSIONS (RADIATED @ 3 METERS), FCC CFR 47, PARA. 15.247(C), 15.209 & 15.205

5.11.1. Limits

In any 100 KHz bandwidth outside the operating frequency band, the radio frequency power that is produced by modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 KHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in @ 15.209(a), which lesser attenuation.

All other emissions inside restricted bands specified in @ 15.205(a) shall not exceed the general radiated emission limits specified in @ 15.209(a)

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- **@ FCC CFR 47, Para. 15.237(c)** - The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in **@15.35** for limiting peak emissions apply.

FCC CFR 47, Part 15, Subpart C, Para. 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 – 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 – 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 – 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 – 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 – 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 – 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 – 156.9	2200 - 2300	9000 - 9200	

FCC CFR 47, Part 15, Subpart C, Para. 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	DISTANCE (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.11.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.4 of this test report and **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

The following measurement procedures were also applied:

- Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.
- For measurement below 1 GHz, set RBW = 100 KHz, VBW $\geq$ 100 KHz, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz (Peak) & VBW = 10 Hz (Average), SWEEP=AUTO.
- If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

5.11.3. Test Arrangement

Please refer to Test Arrangement in Sec. 5.5.3 for details of test setup for emission measurements.

5.11.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Highpass Filter	K&L	11SH10-1500-T8000	--	Cut-off at 1500 MHz used for 902-928 MHz Radio
Highpass Filter	Michael Lab	XD40N	--	Cut-off at 4 GHz used for 2.4-2.4835 GHz

5.11.5. Photographs of Test Setup

Refer to the Photographs #1, 2 & 3 in Annex 2 for setup and arrangement of equipment under tests and its ancillary equipment.

5.11.6. Test Data

Note: Duty Cycle in 100 mS: X = 10*log(duty cycle) = 10*log (0.88) = -.0.56 dB.
Please refer Plot # 7 in Annex 1 of this test report.

5.11.6.1. RADIATED EMISSIONS AT THE BAND-EDGES OF THE FCC PERMITTED BAND

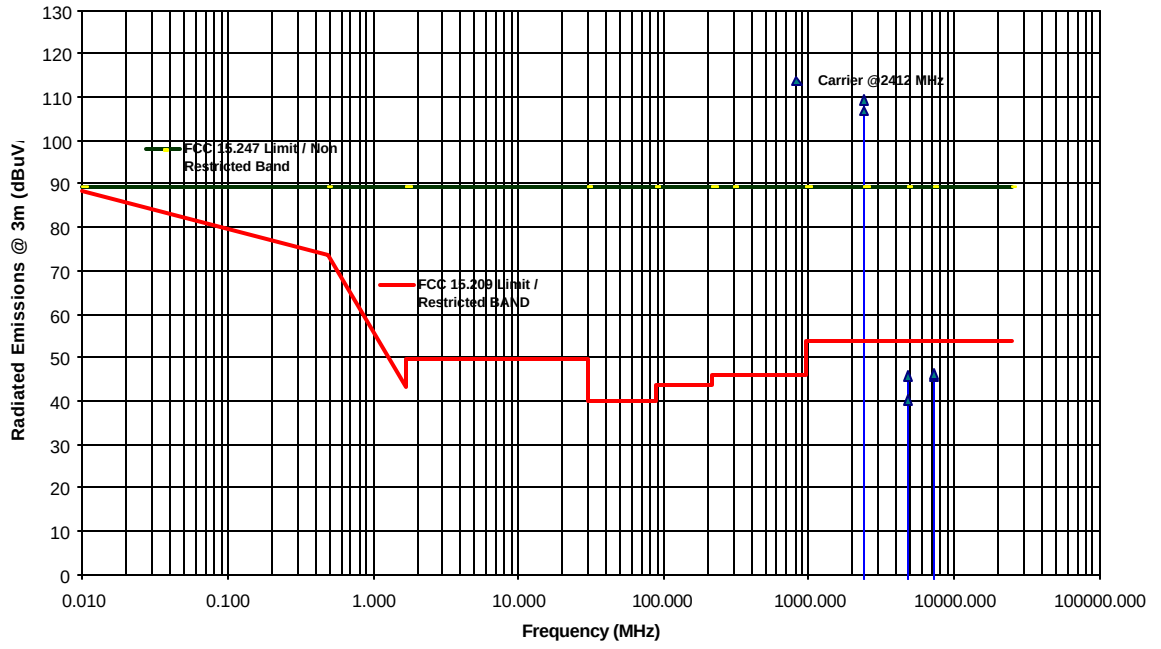
- Plots # 29 to 34 show the Radiated Emissions at the Band-edges of the FCC Permitted Band 2.4-2.4835 GHz of LOWEST, MIDDLE and HIGHEST channel frequencies with modulation & data of CCK & 11 Mbps. These results shall also represent other modulations and data rate since the rf output characteristics are identical according to the transmitter conducted tests in the previous sections of this test report..

5.11.6.1.1. Tx Radiated Emissions at Lowest Frequency (2412 MHz Modulation: CCK @ 11 Mbps)

FREQUENCY (MHz)	RF PEAK LEVEL @3m (dBuV/m)/MHz	RF AVG LEVEL @3m (dBuV/m)/MHz	ANTENNA PLANE (H/V)	LIMIT @3m 15.209 (dBuV/m)	LIMIT @3m 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2412.00	107.2	106.6	V	--	--	--	--
2412.00	109.8	109.2	H	--	--	--	--
4824.00	65.6	45.7	V	54.0	89.2	-8.3	* PASS
4824.00	67.3	40.2	H	54.0	89.2	-13.8	* PASS
7236.00	59.0	45.4	H	54.0	89.2	-43.8	PASS
7236.00	62.2	46.1	H	54.0	89.2	-43.1	PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 50 dB below the limits were recorded.
- * frequency falls in the restricted band.
- The EUT was placed in 3 different orthogonal positions and full maximization (rotating turn-table and moving measuring antenna up & down from 1 to 4 meters) was performed to find the maximum RF level at 3 meters.

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
NETPAD + TRX7431 (DSSS Modular Transceiver), Model NETPAD RLAN
TRANSMIT Freq.: 2412 MHz, Modulation CCK @ 11 Mbps

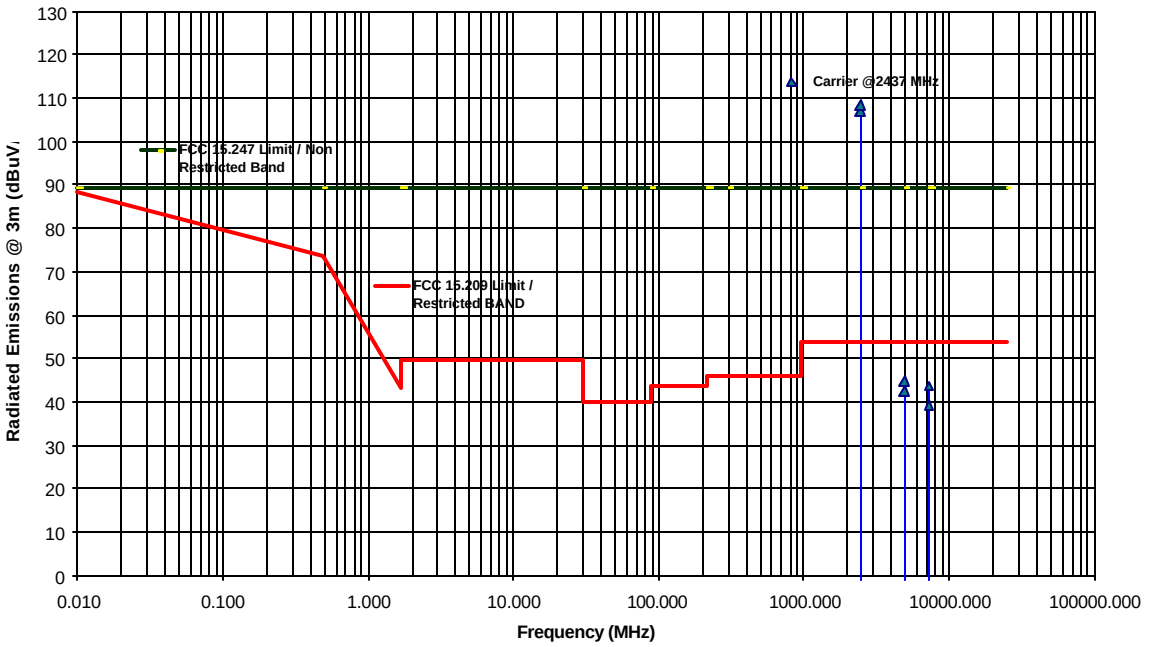


5.11.6.1.2. Tx Radiated Emissions at Middle Frequency (2437 MHz, Modulation: CCK @ 11 Mbps)

FREQUENCY (MHz)	RF PEAK LEVEL @3m (dBuV/m)/MHz	RF AVG LEVEL @3m (dBuV/m)/MHz	ANTENNA PLANE (H/V)	LIMIT @3m 15.209 (dBuV/m)	LIMIT @3m 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2437.00	107.6	107.0	V	--	--	--	--
2437.00	109.0	108.4	H	--	--	--	--
4874.00	60.1	42.5	V	54.0	89.0	-11.5	* PASS
4874.00	59.5	44.7	H	54.0	89.0	-9.3	* PASS
7311.00	61.3	39.3	H	54.0	89.0	-14.7	* PASS
7311.00	61.4	43.6	H	54.0	89.0	-10.4	* PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 50 dB below the limits were recorded.
- * frequency falls in the restricted band.
- The EUT was placed in 3 different orthogonal positions and full maximization (rotating turn-table and moving measuring antenna up & down from 1 to 4 meters) was performed to find the maximum RF level at 3 meters.

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
NETPAD + TRX7431 (DSSS Modular Transceiver), Model NETPAD RLAN
TRANSMIT Freq.: 2437 MHz, Modulation CCK @ 11 Mbps



5.11.6.1.3. Tx Radiated Emissions at Highest Frequency (2462 MHz, Modulation: CCK @ 11 Mbps)

FREQUENCY (MHz)	RF PEAK LEVEL @3m (dBuV/m)/MHz	RF AVG LEVEL @3m (dBuV/m)/MHz	ANTENNA PLANE (H/V)	LIMIT @3m 15.209 (dBuV/m)	LIMIT @3m 15.247 (dBuV/m)	MARGIN (dB)	PASS/ FAIL
2462.00	106.9	106.3	V	--	--	--	--
2462.00	108.0	107.4	H	--	--	--	--
4924.00	57.5	39.5	V	54.0	88.0	-14.5	* PASS
4924.00	61.4	46.2	H	54.0	88.0	-7.8	* PASS
7386.00	55.0	41.8	H	54.0	88.0	-12.2	* PASS
7386.00	56.4	41.7	H	54.0	88.0	-12.3	* PASS

- The emissions were scanned from 10 MHz to 25 GHz and all emissions less 30 dB below the limits were recorded.
- * frequency falls in the restricted band.
- The EUT was placed in 3 different orthogonal positions and full maximization (rotating turn-table and moving measuring antenna up & down from 1 to 4 meters) was performed to find the maximum RF level at 3 meters.

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
NETPAD + TRX7431 (DSSS Modular Transceiver), Model NETPAD RLAN
TRANSMIT Freq.: 2462 MHz, Modulation CCK @ 11 Mbps

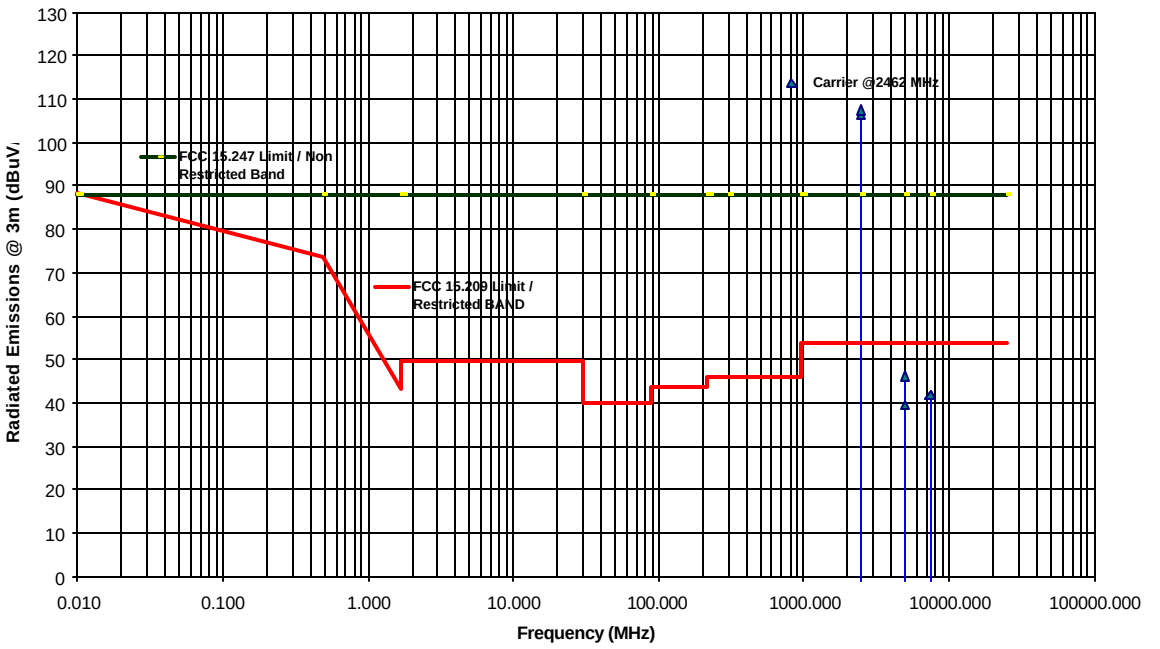


EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

6.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	±1.5	±1.5
LISN coupling specification	Rectangular	±1.5	±1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	±0.3	±0.5
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8$(9 kHz) 0.2 (30 MHz) Uncertainty limits $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	U-Shaped	±0.2	±0.3
System repeatability	Std. deviation	±0.2	±0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	±1.25	±1.30
Expanded uncertainty U	Normal (k=2)	±2.50	±2.60

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 7. MEASUREMENT METHODS

7.1. GENERAL TEST CONDITIONS

The following test conditions shall be applied throughout the tests covered in this report.

7.1.1. Normal temperature and humidity

- Normal temperature: +15°C to +35°C
- Relative Humidity: +20% to 75%

The actual values during tests shall be recorded in the test report.

7.1.2. Normal power source

7.1.2.1. MAINS VOLTAGE

The nominal test voltage of the equipment to be connected to mains shall be the nominal mains voltage which is the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of test power source corresponding to the AC mains shall be between 59 Hz and 61 Hz.

7.1.2.2. BATTERY POWER SOURCE.

For operation from battery power sources, the nominal test voltage shall be as declared by the equipment manufacturer. This shall be recorded in the test report.

7.1.3. Operating Condition of Equipment under Test

- All tests were carried out while the equipment operated at the following frequencies:
  - The lowest operating frequency,
  - The middle operating frequency and
  - The highest operating frequency

- Modulation were applied using the Test Data sequence
- The transmitter was operated at the highest output power, or in the case the equipment able to operate at more than one power level, at the lowest and highest output powers

7.2. METHOD OF MEASUREMENTS - AC MAINS CONDUCTED EMISSIONS

- AC Mains conducted emissions measurements were performed in accordance with the standard against appropriate limits for each detector function.
- The test was performed in the shielded room, 16'(L) by 16'(W) by 12'(H).
- The test was performed were made over the frequency range from 450 kHz to 30 MHz to determine the line-to-ground radio noise voltage which was conducted from the EUT power-input terminals that were directly connected to a public power network.
- The EUT normally received power from another device that connects to the public utility ac power lines, measurements would be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power.
- If the EUT operates only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines, AC Mains conducted measurements are not required.
- Table-top devices were placed on a platform of nominal size 1 m by 1.5m raised 80 cm above the conducting ground plane.
- The EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the power source. All unused 50-Ohm connectors of the LISN was terminated in 50-ohm when not connected to the measuring instruments.
- The line cord of the EUT connected to one LISN which was connected to the measuring instrument. Those power cords for the units of devices not under measurement were connected to a separate multiple ac outlet. Drawings and photographs of typically conducted emission test setups were shown in the Test Report. Each current-carrying conductor of the EUT shall be individually tested.
- The EUT was normally operated with a ground (safety) connection, the EUT was connected to the ground at the LISN through a conductor provided in the lead from the ac power mains to the LISN.
- The excess length of the power cord was folded back and forth in an 8-shape on a wooden strip with a vertical prong located on the top of the LISN case.
- The EUT was set-up in its typical configuration and operated in its various modes as described in 3.2 of the test report.
- A preliminary scan was made by using spectrum analyzer system with the detector function set to PEAK mode (9 KHz RBW, VBW > RBW), frequency span 450 kHz to 30 MHz.

- The maximum conducted emission for a given mode of operation was found by using the following step-by-step procedure:

  Step1. Monitor the frequency range of interest at a fixed EUT azimuth.

  Step2. Manipulate the system cables and peripheral devices to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

  Step3. The effects of various modes of operation is examined. This is done by varying equipment operation modes as step 2 is being performed.

  Step4. After completing step 1 through 3, record EUT and peripheral device configuration, mode of operation, cable configuration, signal levels and frequencies for final test.

- Each highest signal level at the maximized test configuration was zoomed in a small frequency span on the spectrum analyzer's display (the manipulation of cables and peripheral devices and EUT operation modes might have to be repeated to obtain the highest signal level with the spectrum analyzer set to PEAK detector mode 10 KHz RBW and VBW > RBW). The spectrum analyzer was then set to CISPR QUASI-PEAK detector mode (9 KHz RBW, 1 MHz VBW) and AVERAGE detector mode (10 kHz RBW, 1 Hz VBW). The final highest RF signal levels and frequencies were record.

- ***Broad-band ac Powerline conducted emissions***:- If the EUT exhibits ac Powerline conducted emissions that exceed the limit with the instrument set to the quasi-peak mode, then measurements should be made in the average mode. If

the amplitude measured in the quasi-peak mode is at least 6 dB higher than the amplitude measured in the average mode, the level measured in quasi peak mode may be reduced by 13 dB before comparing it to the limit.

7.3. PEAK CONDUCTED POWER & PEAK EIRP

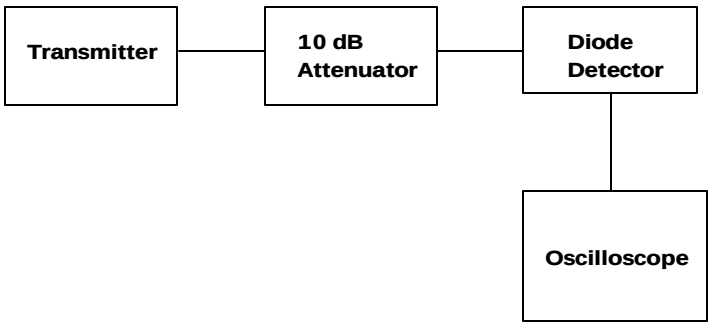
7.3.1. Measurements of Transmitter Parameters (Duty Cycle & Peak Power)

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

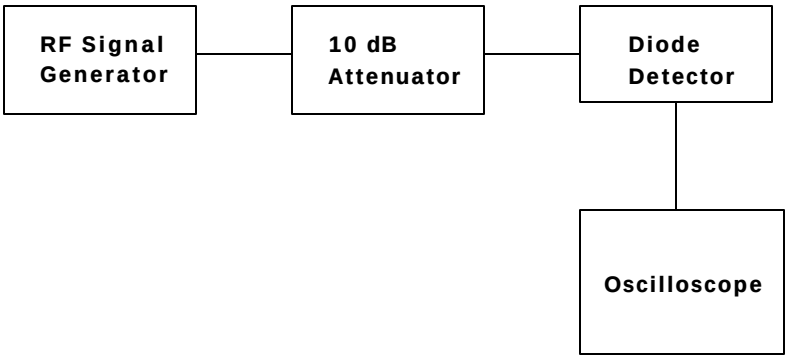
Step 1: Duty Cycle (x) and Peak Power (y) parameters measurements

- Connect the transmitter output to a diode detector through an attenuator
- Connect the diode detector to the vertical channel of an oscilloscope.
- The observed duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with $0<x<1$, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.
- Observe and record the y parameter of the DC level on the oscilloscope.



Step 2: Peak Power Measurements

- Replace the transmitter by a RF signal generator
- Set the signal generator frequency be the same as the transmitter frequency
- Adjust the rf output level of the RF signal generator until the DC level on the oscilloscope is same as that (y) recorded in step 1.
- Measure the RF signal generator output level using a power meter
- Calculate the total peak power (Pp) by adding the signal generator level with the attenuator value and the cable loss.



Step 3: Total Peak EIRP Substitution Method. See Figure 2

(a) The setting of the spectrum analyzer shall be:

Center Frequency:	equal to the signal source
Resolution BW:	100 kHz for FSS, 1 MHz for DIGITAL MODULATION
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Connect the transmitter output to the spectrum analyzer and measure the peak power in 1 MHz bandwidth for reference.
(c) Calculate the difference (Kp) between the total peak power and 1 MHz BW peak power. This value will be used to add onto the 1MHz BW peak EIRP to obtain the TOTAL peak EIRP.
(d) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(e) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(f) The horn test antenna was used and tuned to the transmitter carrier frequency.
(g) The spectrum analyzer was tuned to transmitter carrier frequency. The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The substitution horn antenna and the signal generator replaced the transmitter and antenna under test in the same position, and the substitution horn antenna was placed in vertical polarization. The test horn antenna was lowered or raised as necessary to ensure that the maximum signal is stilled received.
(k) The input signal to the substitution antenna was adjusted in level until an equal or a known related level to that detected from the transmitter was obtained in the test receiver. The maximum carrier radiated power is equal to the power supply by the generator.
(l) The substitution antenna gain and cable loss were added to the signal generator level for the corrected 1MHz BW peak EIRP level. The total peak EIRP can be calculated by adding its value with the Kp

(m) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization. Measured in step (c).

(n) Actual gain of the EUT's antenna is the difference of the measured ERP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

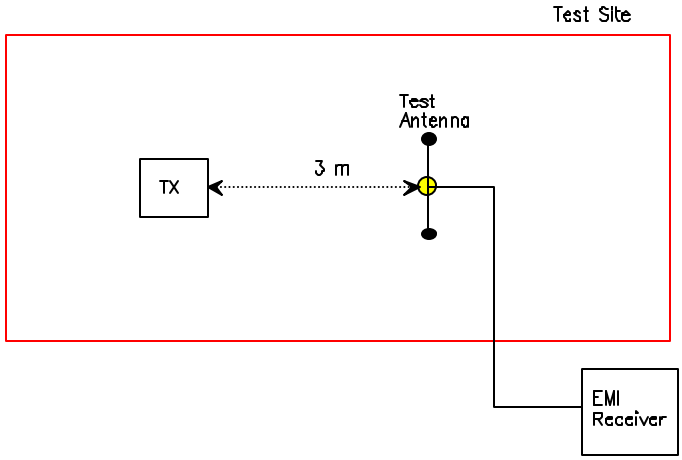
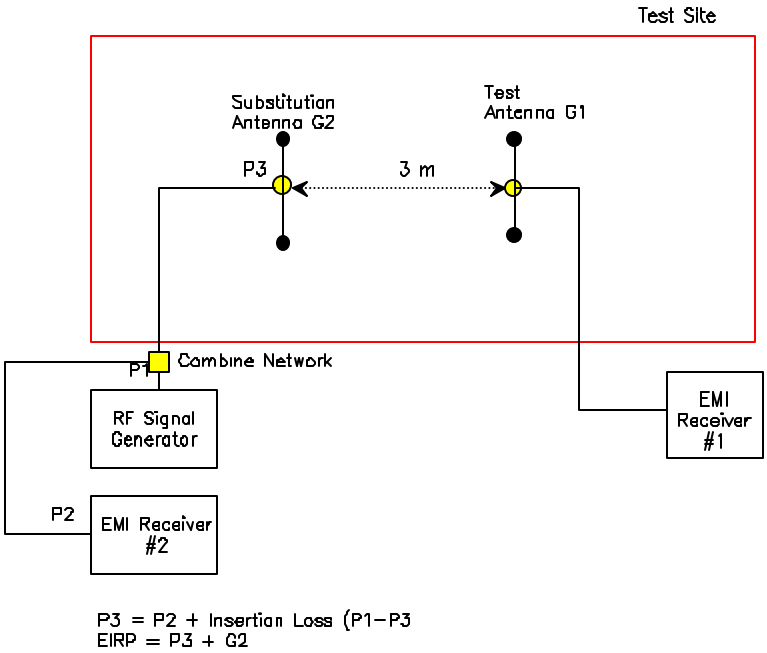


Figure 3



7.4. SPURIOUS EMISSIONS (CONDUCTED & RADIATED)

For both conducted and radiated measurements, the spurious emissions were scanned from the lowest frequency generated by the EUT or 10 MHz whichever is lower to 10th harmonic of the highest frequency generated by the EUT.

7.4.1. Band-edge and Spurious Emissions (Conducted)

Band-edge Compliance of RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW = 1 % of the span
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge
- Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- The marker-delta value now displayed must comply with the limit specified
- Submit this plot

Spurious RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the in-band-emission and all spurious emissions (e.g. harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, sevral plots are required to cover this entire span.
- RBW = 100 kHz
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the any spurious emission recorded. The level displayed must comply with the limit specified in this Section.
- Submit this plot

7.4.2. Spurious Emissions (Radiated)

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.
- Radiated emissions measurements were made using the following test instruments:

1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).

3. The test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

- RBW = 100 kHz for f < 1GHz and RBW = 1 MHz for f ≥ 1 GHz
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Follows the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc.. A pre-amp and highpass filter are required for this test, in order to provide the measuring system with sufficient sensitivity.
- Allow the trace to stabilize.
- The peak reading of the emission, after being corrected by the antenna correction factor, cable loss, pre-amp gain, etc…. is the peak field strength which comply with the limit specified in Section 15.35(b)

Calculation of Field Strength:

The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength
RA = Receiver/Analyzer Reading
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Example: If a receiver reading of 60.0 dBuV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:
Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBuV/m.
Field Level = $10^{(38/20)}$ = 79.43 uV/m.

- Submit this test data
- Now set the VBW to 10Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time of the each channel is less than 100ms, then the reading obtained may be further adjusted by a "duty cycle correction factor", derived from 10log(dwell time/100mS) in an effort to demonstrate compliance with the 15.209.
- Submit test data

Maximizing The Radiated Emissions:

- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

Step4: Move the antenna over its full allowable range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

7.5. ALTERNATIVE TEST PROCEDURES

If the antenna conducted tests cannot be performed on this device, radiated tests show compliance with the peak output power limit specified in Section 15.247(b) and the spurious RF conducted emission limit specified in Section 15.247(c) are acceptable. As stated previously, a pre-amp, and, in the later case, a high pass filter, are required for the following measurements:

7.5.1. Peak Power Measurements

Calculate the transmitter's peak power using the following equation:

$E = 30PG/d$
$P = (Ed)^2/30G$

Where:

- E: measured maximum fundamental field strength in V/m. Utilizing a RBW, the 20 dB bandwidth of the emission VBW >RBW, peak detector function. Follow the procedures in C63.4-1992 with respect to maximizing the emission
- G is numeric gain of the transmitting antenna with reference to an isotropic radiator
- D is the distance in meters from which the field strength was measured
- P is the distance in meters from which the field strength was measured

7.5.2. Spurious RF conducted emissions

The demonstrate compliance with the spurious RF conducted emission requirement of Section 15.247©, use the following spectrum analyzer settings:

- Span = wide enough to fully capture the emission being measured
- RBW = 100 kHz
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Measure the field strength of both the fundamental and all spurious emissions with these settings.
- Follow the procedures C62-4:1994 with respect to maximizing the emissions. The measured field strength of all spurious emissions must be below the measured field strength of the fundamental emission by the amount specified in Section 15.247©. Note that if the emission falls in a Restricted Band, as defined in Section 15.205, the procedure for measuring spurious radiated emissions listed above must be followed

7.6. TRANSMITTED POWER DENSITY OF A DIGITAL MODULATION SYSTEM

- The radio was connected to the measuring equipment via a suitable attenuator.
- Locate and zoom in on emission peak(s) within the passband
- The spectrum analyzer were used and set as follows:

  - Resolution BW: 3 kHz
  - Video BW: same or greater
  - Detector Mode: Normal
  - Averaging: Off
  - Span: 3 MHz
  - Amplitude: Adjust for middle of the instrument's range
  - Sweep Time: 1000 seconds

- Locate and zoom in on emission peak(s) within the passband. Set RBW = 3 KHz, VBW $\geq$ RBW, Sweep = SPAN/3 KHz. For example, a span of 1.5 MHz, the sweep should be $1.6x10^6/3.0x10^3$= 500 seconds. The measured peak level must be no greater than +8 dBm.
- For devices with spectrum line spacing greater than 3 KHz no change is required.
- For devices with spectrum line spacing equal to or less than 3 KHz, the resolution bandwidth must be reduced below 3 KHz until the individual lines in the spectrum are resolved. The measurement data must then be normalized to 3 KHz by summing the power of all the individual spectral lines within 3 KHz band (in linear power units) to determine compliance.
- If the spectrum line spacing cannot be resolved on the available spectrum analyzer, the noise density function on most modern conventional spectrum analyzer will directly measure the noise power density normalized to 1 Hz noise power bandwidth. Add 30 dB for correction to 3 KHz.
- Should all the above fail or any controversy develop regarding accuracy of measurement, the Laboratory will use HP 89440A Vector Signal Analyzer for final measurement unless a clear showing can be made for a further alternate.