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1.0 GENERAL INFORMATION

The following application for Certification of an FCC Part 90 Transmitter (FSK 421-475 MHz Band), is prepared on behalf of Dominion Wireless Inc. in accordance with Part 2, and Part 90, of the Federal Communications Commissions rules and regulations. The Equipment Under Test (EUT) was the Personal Protection Device (PPD). The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with CFR 47, Part 90, ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Some accessories are used to increase sensitivity and prevent overloading of the measuring instruments. These are explained in the appendix of this report. Calibration checks are performed regularly on the instruments, and all accessories including the high pass filter, preamplifier and cables.

All radiated and conducted emissions measurement were performed manually at Rhein Tech, Incorporated. The radiated emissions measurements required by the rules were performed on the three meter, open field, test range maintained by Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. Complete description and site attenuation measurement data have been placed on file with the Federal Communications Commission. The power line conducted emission measurements were performed in a shielded enclosure also located at the Herndon, Virginia facility. Rhein Tech Laboratories, Inc. is on the FCC accepted lab list as a facility available to do measurement work for others on a contract basis.

1.1 TEST METHODOLOGY

All tests were performed according to the procedures in FCC Part 90 and FCC Part 2. Field strength of spurious radiation testing was performed at an antenna to EUT distance of 3 meters. Additionally, RF power output, spurious emissions at antenna terminal, occupied bandwidth, frequency stability versus temperature and modulated characteristics were measured per FCC Rules and Regulations: CFR 47, part 90, October 1, 1997 and Part 2, October 1, 1997.

1.2 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report dated March 3, 1994, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

1.3 JUSTIFICATION

The EUT was tested in all three orthogonal planes in order to determine worst case emission. The EUT was investigated and tested from 9kHz to 5GHz. The unit was tested for field strength of spurious radiation with its integral patch antenna. This antenna was disconnected and replaced by an SMA connector to measure spurious noise at the antenna terminal port. This unit is also available and manufactured with an optional external wip antenna (0 dBi). The low (421 MHz), middle (458 MHz) and high (470 MHz) channels were investigated and were found to exhibit the same (RF profile 458 MHz out-power, harmonic spurious emission). Therefore, the midband channel was selected for final measurement.

1.4 EUT EXERCISE

The unit is activated in its repeated RF on/off mode by pulling the activation pin; replacing it shuts the unit off.


1.5 SPECIAL ACCESSORIES

The unit is not designed for frequent activation, it has a very small lithium battery with less than 10 min battery life in continuous use. The unit was configured with a “battery illuminator” to allow a connection to a shielded coax DC power cable for extended temperature and time testing. A laboratory power supply was used to power the device. Final testing was performed using standard batteries.

1.6 CONFORMANCE STATEMENT

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. No modifications were made to the equipment during testing in order to achieve compliance with these standards.


Furthermore, there was no deviation from, additions to or exclusions from the FCC Part 2 and FCC Part 90 test methodology.

Signature: 

Date: October 11, 1999

Typed/Printed Name: Bruno Clavier

Position: Quality Manager
(NVLAP Signatory)

 Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 20061-0.

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

2.0 STANDARD REQUIREMENTS

**TYPE CERTIFICATION FCC PART 90: PRIVATE LAND MOBILE RADIO SERVICES
SUBPART I : GENERAL TECHNICAL STANDARDS
AND FCC PART 2 SUBPART J: EQUIPMENT AUTHORIZATION PROCEDURES**

2.1 FCC PART 90.217(b): EXEMPTION FROM TECHNICAL STANDARDS

The Personal Protection Device Transmitter meets the following requirements:

Transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 mW are exempt from the technical requirements set out in this subpart, but must instead comply with the following:

For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

2.2 PART 2.1047(D): MODULATION REQUIREMENTS AND CHARACTERISTICS

The curve provided in this report, shows that the equipment met the modulation requirements of the rules under which the equipment is to be licensed.

2.3 FCC PART 2.1046: RF OUTPUT POWER

2.3.1 Method of Measurement and Test Results

Transmitter antenna port connected to EMI receiver or Power Meter.

Termination	Frequency (MHz)	Level (dBuV)	Output Power (mW)
50 ohm	458.9375		92.7

Modulation Characteristics

RBW = 3kHz VBW = 3kHz Sweep = 375ms Atten = 40 dB Ext. Atten = 0 dB

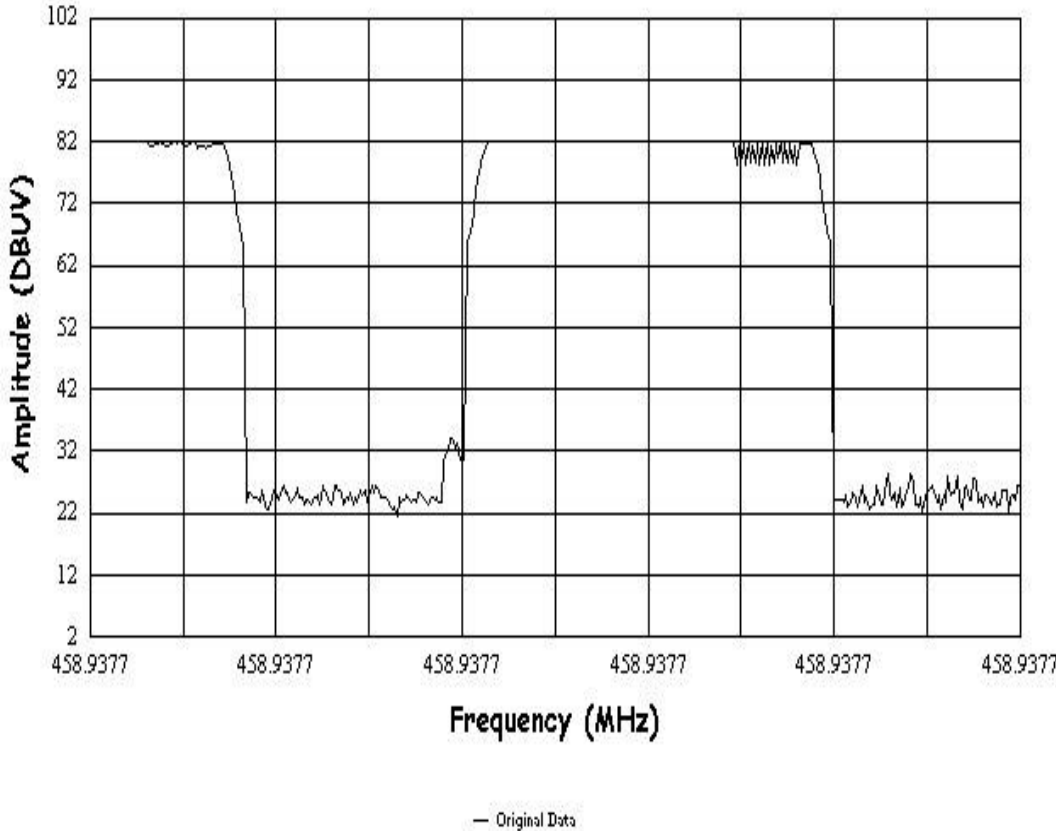


FIGURE 1: MODULATION CHARACTERISTICS PLOT

2.4 FCC PART 2.1049 AND ANSI C63.4, SECTION 13.1.7: OCCUPIED BANDWIDTH

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

Other keyed transmitters—when keyed at the maximum machine speed.

2.5 FCC PART 2.1057(A)(1): FREQUENCY SPECTRUM TO BE INVESTIGATED

(a) In all of the measurements set forth in 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10GHz: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

The transmitter was tested up to 5 GHz

2.6 FCC Part 2.1051 and Part 90.217(a): Spurious Emissions at Antenna Terminals

2.6.1 Method of measurement:

The transmitter was properly loaded with a 50 Ohm termination and operated under normal condition in its intended use. That is the maximum rated conditions under which the equipment will be operated.

For measuring emissions up to and including 50kHz from the edge of the authorized bandwidth, the resolution bandwidth was adjusted to 100Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps was measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must no be less than the instrument resolution bandwidth. For frequencies more that 50kHz removed from the edge of the authorized bandwidth a resolution of at least 10 kHz was used for frequencies below 1000 MHz. Above 1000 MHz the resolution bandwidth of the instrumentation was at least 1 MHz.

For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30dB below the unmodulated carrier.

Note: operation using equipment designed to operate wit a 25 kHz channel bandwidth will be authorized an 11.25 kHz bandwidth. Therefore, 50 kHz from the edge of the authorized bandwidth corresponds to 61.25 kHz frequency. The test data provided in this report were used to compare the 3 channels investigated as previously stated. The level of the spectrum lines identified on the plots is without any loss compensation.

2.7 FCC PART 2.993 AND PART 90.217(a): FIELD STRENGTH OF SPURIOUS RADIATION

2.7.1 Method of measurement:

A 50 Ohm dummy load is used to terminate the transmitter antenna output port. A second antenna is placed adjacent to the device under test and is connected to a signal generator providing a reference power level. The requirement assumes that all emissions are radiated from half-wave dipole antennas.

2.8 FCC PART 90.213 AND PART 2.995(A): FREQUENCY STABILITY FUNCTION OF TEMPERATURE

2.8.1 Method of Measurement:

The transmitter is set in operation with the maximum rated output power specified by the manufacturer. A Thermotron temperature chamber is used to perform the test. The transmitter is exercised with a transmission mode providing a continuous stream of data.

The ambient temperature is varied from -30° to +50°C. The device under test is operated for 15 minutes prior to testing. A sufficient period of time (about 30 minutes) before any measurements was observed to stabilize all the transmitter components for each temperature level.

2.8.2 Test Results:

458.938023 (low temperature)
-458.937353 (room temperature)
 0.000670

670 Hz

458.937353 (room temperature)
-458.937013 (high temperature)
 0.000340

340 Hz Total deviation: 1.01 kHz

Temperature (°C)	Frequency (MHz)	Voltage End Point (V)
-30	458.938023	2.62
-20	458.937993	2.62
-10	458.937873	2.54
0	458.937753	2.52
10	458.937628	2.63
20	458.937463	2.72
23.3	458.937353	2.73
30	458.937288	2.73
40	458.937123	2.81
50	458.937013	2.86

3.0 SYSTEM TEST CONFIGURATION

3.1 RELATED SUBMITTAL(S)/GRANT(S)

N/A. This is an original submission for Certification.

3.2 TEST SYSTEM DETAILS

The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system (including inserted cards, which have grants) are:

TABLE 1: TEST SYSTEM DETAILS

PART	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID	CABLE DESCRIPTION	RTL BAR CODE
PERSONAL PROTECTION DEVICE (EUT)	INNOVATEK, INC.	PPD	N/A	N/A		011001
PATCH ANTENNA	LINX	ANTSP-458-TWC-A REV 1	N/A	N/A		
WIP ANTENNA	GENTURION	EXD-420-SM	N/A	N/A		

4.0 TEST RESULTS

4.1 FCC PART 2.1053: FIELD STRENGTH OF SPURIOUS RADIATION

The following data lists the significant emission frequencies, measured levels, correction factor (includes cable and antenna corrections), the corrected reading, plus the limit. Explanation of the Correction Factor is given in paragraph 6.0.

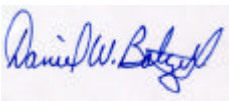
TABLE 2: RADIATED EMISSIONS: FCC PART 2.993

Transmitter Section
Distance: 3 Meters

Frequency (MHz)	Polarity	S/A Emission Level (dBuV)	S/G level applied for S/A Emission level (dBm)	Cable Loss (dB)	Corrected Antenna Gain to ½ wave dipole	Corrected S/G level (dBm)	Limit (dBm)	Margin (dB)
917.875	H	82.8	-9.2	-11.5	N/A	-20.7	-10.33	-10.37
1376.812	H	85.7	-3.1	-14.0	4.75	-12.35	-10.33	-2.02
1835.749	H	69.9	-13.3	-16.6	4.3	-25.6	-10.33	-15.27
2294.678	H	47.5	-25.6	-18.6	5.5	-38.7	-10.33	-28.37
2753.61	H	45.7	-16.4	-21.6	6.64	-31.36	-10.33	-21.03
3212.553	V	53.0	-5.1	-23.7	6.95	-21.9	-10.33	-11.57
3671.48	V	49.0	-4.3	-25.7	7.1	-22.9	-10.33	-12.57
4130.429	V	44.0	-6.7	-26.4	7.3	-25.8	-10.33	-15.47
4589.376	V	44.6	-4.6	-28.9	8.25	-25.25	-10.33	-14.92

Transmitter output power at 458 MHz is $P=92.7 \text{ mW}=19.67 \text{ dBm}$, Limit is at -30dBc from 19.67 dBm that is -10.33dBm

TEST PERSONNEL:

Signature: 

Date: September 8, 1999

Typed/Printed Name: Daniel Baltzell

5.0 Field Strength Calculation, and Radiated Test Methodology

5.1 Field Strength Calculation

The field strength is calculated by adding the 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:

$$FI(\text{dBuV/m}) = SAR(\text{dBuV}) + SCF(\text{dB/m})$$

FI = Field Intensity

SAR = Spectrum Analyzer Reading

SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

$$SCF(\text{dB/m}) = -PG(\text{dB}) + AF(\text{dB/m}) + CL(\text{dB})$$

SCF = Site Correction Factor

PG = Pre-amplifier Gain

AF = Antenna Factor

CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(\text{uV/m}) = 10^{FI(\text{dBuV/m})/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

$$49.3 \text{ dBuV} - 11.5 \text{ dB/m} = 37.8 \text{ dBuV/m}$$

$$10^{37.8/20} = 10^{1.89} = 77.6 \text{ uV/m}$$

5.2 Radiated measurement

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one meter and three meter distances if necessary in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three-meter, open-field test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane. The spectrum was examined from 30 MHz to 1000 MHz using a Hewlett Packard 8566B spectrum analyzer, a Hewlett Packard 85650A quasi-peak adapter, and an Antenna Research bilog antenna. In order to gain sensitivity, an RTL PR-1040 preamplifier was connected in series between the antenna and the input of the spectrum analyzer.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations.

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

APPENDIX A:

EQUIPMENT LIST

Please see following pages.

DESCRIPTION	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. LAB
PRE-AMPLIFIER	HEWLETT PACKARD	11975A	2304A00348	TEST EQUITY
PRE-AMPLIFIER	HEWLETT PACKARD			TEST EQUITY
PRE-AMPLIFIER (S/A 1)	RHEIN TECH	PR-1040	00001	RTL
PRE-AMPLIFIER (S/A 2)	RHEIN TECH	RTL2	900723	RTL
PRE-AMPLIFIER (S/A 3)	RHEIN TECH	8447F	2944A03783	RTL
PRE-AMPLIFIER (S/A 4)	RHEIN TECH	8447D	2727A05397	RTL
BICONICAL/LOG ANTENNA 1	ANTENNA RESEARCH	LPB-2520	1037	LIBERTY LABS
BICONICAL/LOG ANTENNA 2	ANTENNA RESEARCH	LPB-2520	1036	LIBERTY LABS
FIELD SITE SOURCE	EMCO	4610	9604-1313	RTL
FILTER (ROOM 1)	SOLAR	8130	947305	RTL
FILTER (ROOM 2)	SOLAR	8130	947306	RTL
HARMONIC MIXER 1	HEWLETT PACKARD	11970K	2332A00563	TELOGY
HARMONIC MIXER 2	HEWLETT PACKARD	11970A	2332A01199	TELOGY
HORN ANTENNA 1	EMCO	3160-10	9606-1033	EMCO
HORN ANTENNA 2	EMCO	3160-9	9605-1051	EMCO
HORN ANTENNA 3	EMCO	3160-7	9605-1054	EMCO
HORN ANTENNA 4	EMCO	3160-8	9605-1044	EMCO
HORN ANTENNA 5	EMCO	3160-03	9508-1024	EMCO
LISN (ROOM 1/L1)	SOLAR	7225-1	900727	ACUCAL
LISN (ROOM 1/L2)	SOLAR	7225-1	900726	ACUCAL
LISN (ROOM 2/L1)	SOLAR	7225-1	900078	ACUCAL
LISN (ROOM 2/L2)	SOLAR	7225-1	900077	ACUCAL
PRE-AMPLIFIER	HEWLETT PACKARD	8449B OPT	3008A00505	TELOGY
QUASI-PEAK ADAPTER (S/A 1)	HEWLETT PACKARD	85650A	3145A01599	ACUCAL
QUASI-PEAK ADAPTER (S/A 2)	HEWLETT PACKARD	85650A	2811A01276	ACUCAL
QUASI-PEAK ADAPTER (S/A 3)	HEWLETT PACKARD	85650A	2521A00473	ACUCAL
QUASI-PEAK ADAPTER (S/A 4)	HEWLETT PACKARD	85650A	2521A01032	ACUCAL
RF PRESELECTOR (S/A 1)	HEWLETT PACKARD	85685A	3146A01309	ACUCAL
SIGNAL GENERATOR (HP)	HEWLETT PACKARD	8660C	1947A02956	ACUCAL
SIGNAL GENERATOR (WAVETEK)	WAVETEK	3510B	4952044	ACUCAL
SPECTRUM ANALYZER 1	HEWLETT PACKARD	8566B	3138A07771	ACUCAL
EMI RECEIVER	HEWLETT PACKARD	8546A	3325A00159	ACUCAL
SPECTRUM ANALYZER 2	HEWLETT PACKARD	8567A	2841A00614	ACUCAL
SPECTRUM ANALYZER 4	HEWLETT PACKARD	8567A	2727A00535	ACUCAL
TUNABLE DIPOLE	EMCO	3121	274	LIBERTY LABS
HARMONIC MIXER	HEWLETT PACKARD	11970A	2332A01199	ACUCAL
HARMONIC MIXER	HEWLETT PACKARD	11970K	2332A00563	ACUCAL

APPENDIX H:

Personal Alarm Transmitter Design Specification

Please see following pages.

APPENDIX H:

USER'S MANUAL

Please see following pages.