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Uniden®

EXPLANATION OF TEST REPORT

Please note that the Test Report prepared by Compatible Electronics (dated October 5, 1999) for the Uniden 900 MHz Spread Spectrum Phone, Model EXS2010, is being used as the test data for several different FCC applications for Equipment Authorization.

The reason for this duplication is due to the fact that Uniden is manufacturing the same basic cordless telephone chassis for several different applicants.

Please contact the undersigned if you have any questions.

Regards,

James R. Haynes

James R. Haynes
Vice President, Engineering and Regulatory Affairs

FCC PART 15, SUBPART C
TEST METHOD: ANSI C63.4-1992

for

900 MHz SPREAD SPECTRUM PHONE

Model: EXS2010

Prepared for

UNIDEN AMERICA CORPORATION
ENGINEERING SERVICES OFFICE
216 JOHN STREET, PO BOX 580
LAKE CITY, SOUTH CAROLINA 29560

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DATE: OCTOBER 5, 1999

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GENERAL REPORT SUMMARY

This electromagnetic emission test report is generated by Compatible Electronics Inc., which is an independent testing and consulting firm. The test report is based on testing performed by Compatible Electronics personnel according to the measurement procedures described in the test specifications given below and in the "Test Procedures" section of this report.

The measurement data and conclusions appearing herein relate only to the sample tested and this report may not be reproduced in any form unless done so in full with the written permission of Compatible Electronics.

This report must not be used to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Device Tested:	900 MHz Spread Spectrum Phone Model: EXS2010 S/N: N/A
Modifications:	The EUT was not modified in order to meet the specifications.
Manufacturer:	Uniden America Corporation Engineering Services Office 216 John Street, PO Box 580 Lake City, South Carolina 29560
Test Dates:	October 1, 4, and 5, 1999
Test Specifications:	EMI requirements FCC Title 47, Part 15 Subpart B; and Subpart C, sections 15.205, 15.207, 15.209, and 15.247
Test Procedure:	ANSI C63.4: 1992
Test Deviations:	The test procedure was not deviated from during the testing.

SUMMARY OF TEST RESULTS

TEST	DESCRIPTION	RESULTS
1	Conducted RF Emissions, 450 kHz – 30 MHz	Complies with the **Class B** limits of FCC Title 47, Part 15 Subpart B; and Subpart C, section 15.207
2	Spurious Radiated RF Emissions, 10 kHz – 9300 MHz	Complies with the relevant requirements of FCC Title 47, Part 15, Subpart C, section 15.209(a)
3	Fundamental and Emissions produced by the intentional radiator in non-restricted bands, 10 kHz – 9300 MHz	Complies with the relevant requirements of FCC Title 47, Part 15, Subpart C, section 15.247(c)
4	Emissions produced by the intentional radiator in restricted bands, 10 kHz – 9300 MHz	Complies with the relevant requirements of FCC Title 47, Part 15, Subpart C, section 15.209(a)
5	6 dB Bandwidth	Complies with the relevant requirements of FCC Title 47, Part 15, Subpart C, section 15.247 (a)(2)
6	Maximum Peak Output Power	Complies with the relevant requirements of FCC Title 47, Part 15, Subpart C, section 15.247 (b)(1)
7	RF Antenna Conducted	Complies with the relevant requirements of FCC Title 47, Part 15, Subpart C, section 15.247 (c)
8	Peak Power Spectral Density Conducted from the Intentional Radiator to the Antenna	Complies with the relevant requirements of FCC Title 47, Part 15, Subpart C, section 15.247 (d)
9	Processing Gain	Complies with the relevant requirements of FCC Title 47, Part 15, Subpart C, section 15.247 (e)

1. PURPOSE

This document is a qualification test report based on the Electromagnetic Interference (EMI) tests performed on the 900 MHz Spread Spectrum Phone Model: EXS2010. The EMI measurements were performed according to the measurement procedure described in ANSI C63.4: 1992. The tests were performed in order to determine whether the electromagnetic emissions from the 900 MHz Spread Spectrum Phone, referred to as EUT hereafter, are within the specification limits defined by FCC Title 47, Part 15, Subpart C, sections 15.205, 15.207, 15.209, and 15.247.

2. ADMINISTRATIVE DATA

2.1 Location of Testing

The EMI tests described herein were performed at the test facility of Compatible Electronics, 114 Olinda Drive, Brea, California 92823.

2.2 Traceability Statement

The calibration certificates of all test equipment used during the test are on file at the location of the test. The calibration is traceable to the National Institute of Standards and Technology (NIST).

2.3 Cognizant Personnel

Uniden America Corporation

James R. Haynes	Vice President

Compatible Electronics Inc.

Kyle Fujimoto	Test Engineer
Scott McCutchan	Lab Manager

2.4 Date Test Sample was Received

The test sample was received on September 29, 1999

2.5 Disposition of the Test Sample

The test sample was returned to Uniden Corporation on October 6, 1999.

2.6 Abbreviations and Acronyms

The following abbreviations and acronyms may be used in this document.

RF	Radio Frequency
EMI	Electromagnetic Interference
EUT	Equipment Under Test
P/N	Part Number
S/N	Serial Number
HP	Hewlett Packard
ITE	Information Technology Equipment
CML	Corrected Meter Limit
LISN	Line Impedance Stabilization Network
NCR	No Calibration Required

3. APPLICABLE DOCUMENTS

The following documents are referenced or used in the preparation of this EMI Test Report.

SPEC	TITLE
FCC Title 47, Part 15 Subpart C	FCC Rules - Radio frequency devices (including digital devices) – Intentional Radiators.
ANSI C63.4 1992	Methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz.
FCC Title 47, Part 15 Subpart B	FCC Rules - Radio frequency devices (including digital devices) – Unintentional Radiators.

4. DESCRIPTION OF TEST CONFIGURATION

4.1 Description of Test Configuration - EMI

Specifics of the EUT and Peripherals Tested

Handset being tested: The 900 MHz Spread Spectrum Phone - Handset Model: EXS2010 (EUT) was placed on the wooden table and tested in three orthogonal axis. The low (channel 1), medium (channel 10), and high (channel 20) channels were tested. The handset was transmitting to and receiving from the base unit. The EUT was investigated for emissions while off hook. The radiated data was taken in this mode of operation. All initial investigations were performed with the EMI receiver in manual mode scanning the frequency range continuously. The cables were bundled and routed as shown in the photographs in Appendix C. **The final radiated data was taken in the Y axis, which was the orthogonal axis that produced the highest emissions during the initial investigation.**

Base being tested: The 900 MHz Spread Spectrum Phone - Base Model: EXS2010 (EUT) was placed on the wooden table. The low (channel 1), medium (channel 10), and high (channel 20) channels were tested. The base was connected to a line simulator and AC adapter via its RJ-11 and power ports, respectively. The line simulator was connected to the Northern Telecom telephone. The base was transmitting and receiving from the handset. The handset was also used to dial out a number on the simulator that caused the Northern Telecom telephone to ring. The Northern Telecom telephone was then taken off hook to allow for normal communications between the base unit and handset. The conducted as well as radiated data was taken in this mode of operation. All initial investigations were performed with the EMI receiver in manual mode scanning the frequency range continuously. The cables were bundled and routed as shown in the photographs in Appendix C. **The final radiated as well as conducted data was taken in the X axis, which was the orthogonal axis that produced the highest emissions during the initial investigation.**

4.1.1 Cable Construction and Termination

Cable 1

This is a 6 foot unshielded cable connecting the base to the line simulator. It has an RJ-11 connector at each end. The cable was bundled to a length of 1 meter.

Cable 2

This is a 6 foot unshielded cable connecting the telephone to the line simulator. It has an RJ-11 connector at each end. The cable was bundled to a length of 1 meter.

Cable 3

This is a 6 foot unshielded round cable connecting the base to the class 2 transformer. It has a 1/8" power jack at the base end and is hard wired into the class 2 transformer.

Cable 4

This is a 6 foot unshielded round cable connecting the handset to the headset. It has a special headset connector at the EUT end and is hard wired into the headset.

5. LISTS OF EUT, ACCESSORIES AND TEST EQUIPMENT

5.1 EUT and Accessory List

EQUIPMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID
900 MHz Spread Spectrum Phone - Base (EUT)	UNIDEN AMERICA CORPORATION	EXS2010	N/A	AMWUC668
900 MHz Spread Spectrum Phone - Handset (EUT)	UNIDEN AMERICA CORPORATION	EXS2010	N/A	AMWUC668
AC ADAPTOR	UNIDEN AMERICA CORPORATION	AD-310	N/A	N/A
REGULAR TELEPHONE	NORTHERN TELECOM	N/A	N/A	N/A
HEADSET	N/A	N/A	N/A	N/A
TEST LINE SIMULATOR	TELTONE	TLS-3	N/A	N/A

5.2 EMI Test Equipment

EQUIPMENT TYPE	MANU-FACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. DUE DATE
Spectrum Analyzer	Hewlett Packard	8566B	3638A08784	Nov. 16, 1998	May 16, 1999
Preamplifier	Com Power	PA-102	1017	Jan. 16, 1999	Jan. 16, 2000
Quasi-Peak Adapter	Hewlett Packard	85650A	2430A00424	July 14, 1999	July 14, 2000
RF Attenuator	Com-Power	412-10	N/A	Nov. 20, 1998	Nov. 20, 1999
LISN	Com Power	LI-200	1764	Jan. 3, 1999	Jan. 3, 2000
LISN	Com Power	LI-200	1771	Jan. 3, 1999	Jan. 3, 2000
LISN	Com Power	LI-200	1775	Jan. 3, 1999	Jan. 3, 2000
LISN	Com Power	LI-200	1780	Jan. 3, 1999	Jan. 3, 2000
Biconical Antenna	Com Power	AB-100	1548	Oct. 15, 1998	Oct. 15, 1999
Log Periodic Antenna	Com Power	AL-100	1117	Oct. 15, 1998	Oct. 15, 1999
Antenna Mast	Com Power	AM-100	N/A	N/A	N/A
Turntable	Com Power	TT-100	N/A	N/A	N/A
Computer	Hewlett Packard	D5251A 888	US74458128	N/A	N/A
Printer	Hewlett Packard	C5886A	SG7CM1P090	N/A	N/A
Monitor	Hewlett Packard	D5258A	DK74889705	N/A	N/A
Loop Antenna	Com-Power	AL-130	25309	Feb. 5, 1999	Feb. 5, 2000
Horn Antenna	Antenna Research	DRG-118/A	1053	Dec. 8, 1995	N/A
Microwave Preamplifier	Hewlett Packard	8449B	3008A008766	Jan. 30, 1999	Jan. 30, 2000

5.3 Processing Gain Test Equipment

EQUIPMENT TYPE	MANU-FACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. DATE	CAL. DUE DATE
Variable Attenuator	Hewlett Packard	HP8496A/002	3308A14623	Oct. 12.1998	Oct. 31.1999
Variable Attenuator	Hewlett Packard	HP8494A/002	3308A32418	Oct. 16, 1998	Oct. 31, 1999
BER Counter	JRC	NJZ-940	ED24250	Oct. 20, 1998	Oct. 31, 1999
Signal Generator	Hewlett Packard	ESG-D3000A	US37231038	Aug. 17, 1999	Aug. 17, 2000
Combiner	Anritsu	MA1612A	M08562	N/A	N/A

6. TEST SITE DESCRIPTION

6.1 Test Facility Description

Please refer to section 2.1 and 8.1.2 of this report for EMI test location.

6.2 EUT Mounting, Bonding and Grounding

The EUT was mounted on a 1.0 by 1.5 meter non-conductive table 0.8 meters above the ground plane.

The EUT was not grounded.

7. CHARACTERISTICS OF THE TRANSMITTER

7.1 Transmitter Power

Transmit power is herein defined as the power delivered to a 50 Ohm load at the antenna port of the T/R switch.

HANDSET UNIT

Power	Channel Number	Accuracy
+6.40 dBm	1	+3/-3 dB
+4.20 dBm	11	+3/-3 dB
+4.40 dBm	20	+3/-3 dB

BASE UNIT

Power	Channel Number	Accuracy
+5.60 dBm	1	+3/-3 dB
+5.10 dBm	11	+3/-3 dB
+5.40 dBm	20	+3/-3 dB

7.2 Channel Number and Frequencies

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	905.280	11	914.880
2	906.240	12	915.840
3	907.200	13	916.800
4	908.160	14	917.760
5	909.120	15	918.720
6	910.080	16	919.680
7	911.040	17	920.640
8	912.000	18	921.600
9	912.960	19	922.560
10	913.920	20	923.520

7.3 Chipping Rate

1.366 M cps

7.4 Spreading Gain

The theoretical spreading gain, is 10.8 dB.

7.5 Antenna Gain

The antenna gain is 3.34 dBi for the base.
The antenna gain is 1.74 dBi for the handset.

Note that antenna gain measurement was conducted based on substitution method using with double ridged antenna.

7.6 Description of Transmitter

The transmitter takes baseband data, high pass filters it to remove any DC contributed by bias networks, then lowpass filters it to provide spectral shaping. After filtering, the resultant signal is modulated to the synthesized RF carrier. The modulated signal is then amplified at the buffer for driving the final stage. The harmonics of the amplified signal are removed with a lowpass filter. Finally, the signal is routed through the T/R switch for transmission by the antenna.

7.7 Processing Gain

The Processing Gain is measured using the CW jamming margin method. Figure 1 shows the test configuration. The test consists of stepping a signal generator in 50 kHz increments across the passband of the system (up to 1 MHz away from the center frequency). At each point, the generator level required to produce the recommended Bit Error Rate (BER) (Set at BER=1.0E-3) is recorded. This level is the jamming level. The output power of the transmitter unit is measured at the same point. The Jammer to Signal (J/S) ratio is then calculated. Discard the worst 20% of the J/S data point. The lowest remaining J/S ratio is used to calculate the processing gain. The maximum implementation loss a system can claim in calculating processing gain is 2 dB. The equation to calculate the processing gain (Gp) is the following:

$$Gp = (S/N)o + Mj + Lsys$$

Where (S/N)o = signal to noise ratio required for a FSK system with BER of 1.0E-3 = 11 dB,
Mj = jamming margin (J/S) in dB,
Lsys = system implementation loss = 2 dB.

8. TEST PROCEDURES

The following sections describe the test methods and the specifications for the tests. Test results are also included in this section.

8.1 RF Emissions

8.1.1 Conducted Emissions Test

The spectrum analyzer was used as a measuring meter along with the quasi-peak adapter. The data was collected with the spectrum analyzer in the peak detect mode with the "Max Hold" feature activated. The quasi-peak detector was used only where indicated in the data sheets. A 10 dB attenuation pad was used for the protection of the spectrum analyzer input stage, and the spectrum analyzer offset was adjusted accordingly to read the actual data measured. The LISN output was read by the spectrum analyzer. The output of the second LISN was terminated by a 50 ohm termination. The effective measurement bandwidth used for the conducted emissions test was 9 kHz.

Please see section 6.2 of this report for mounting, bonding and grounding of the EUT. The EUT was powered through the LISN, which was bonded to the ground plane. The LISN power was filtered and the filter was bonded to the ground plane. The EUT was set up with the minimum distances from any conductive surfaces as specified in ANSI C63.4: 1992. The excess power cord was wrapped in a figure eight pattern to form a bundle not exceeding 0.4 meters in length.

The initial test data was taken in manual mode while scanning the frequency ranges of 0.45 MHz to 1.6 MHz, 1.6 MHz to 5 MHz and 5 MHz to 30 MHz. The conducted emissions from the EUT were maximized for operating mode as well as cable placement. Once a predominant frequency (within 12 dB of the limit) was found, it was more closely examined with the spectrum analyzer span adjusted to 1 MHz.

The final data was collected under program control by the HP 9000/300 in several overlapping sweeps by running the spectrum analyzer at a minimum scan rate of 10 seconds per octave.

8.1.2 Radiated Emissions (Spurious and Harmonics) Test

The spectrum analyzer was used as a measuring meter along with the quasi-peak adapter. Amplifiers were used to increase the sensitivity of the instrument. The Com Power Preamplifier Model: PA-102 was used for frequencies from 30 MHz to 1 GHz, and the Hewlett Packard Microwave Amplifier Model: 8449B was used for frequencies above 1 GHz. The spectrum analyzer was used in the peak detect mode with the "Max Hold" feature activated. In this mode, the spectrum analyzer records the highest measured reading over all the sweeps. The quasi-peak adapter was used only for those readings which are marked accordingly on the data sheets. The measurement bandwidths and transducers used for the radiated emissions test were:

FREQUENCY RANGE	EFFECTIVE MEASUREMENT BANDWIDTH	TRANSDUCER
10 kHz to 150 kHz	200 Hz	Active Loop Antenna
150 kHz to 30 MHz	9 kHz	Active Loop Antenna
30 MHz to 300 MHz	120 kHz	Biconical Antenna
300 MHz to 1 GHz	120 kHz	Log Periodic Antenna
1 GHz to 9.3 GHz	1 MHz	Horn Antenna

The open field test site of Compatible Electronics, Inc. was used for radiated emission testing. This test site is set up according to ANSI C63.4: 1992. Please see section 6.2 of this report for mounting, bonding and grounding of the EUT. The turntable supporting the EUT is remote controlled using a motor. The turntable permits EUT rotation of 360 degrees in order to maximize emissions. Also, the antenna mast allows height variation of the antenna from 1 meter to 4 meters. Data was collected in the worst case (highest emission) configuration of the EUT. At each reading, the EUT was rotated 360 degrees and the antenna height was varied from 1 to 4 meters (for E field radiated field strength). The gunsight method was used when measuring with the horn antenna in order to ensure accurate results.

Radiated Emissions (Spurious and Harmonics) Test (con't)

The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT. The EUT was tested at a 3 meter test distance to obtain final test data.

8.2 6 dB Bandwidth for Direct Sequence Systems

The 6 dB Bandwidth was taken using the spectrum analyzer. The bandwidth was measured using a direct connection from the RF out on the RF board. The resolution bandwidth was 100 kHz, and the video bandwidth 1 MHz. Both the base and handset were tested.

Test Results:

The EUT complies with the relevant requirements of FCC Title 47, Part 15, Subpart C section 15.209 (a)(2). The bandwidth is at least 500 kHz. Please see the data sheets located in Appendix D.

8.3 Peak Output Power

The peak output power was taken using the spectrum analyzer. The peak output power was measured using a direct connection from the RF out on the RF board. The resolution bandwidth was 3 MHz, and the video bandwidth 1 MHz. Both the base and handset were tested.

Test Results:

The EUT complies with the relevant requirements of FCC Title 47, Part 15, Subpart C section 15.209 (b)(1). The maximum peak output power is less than 1 watt. Please see the data sheets located in Appendix D.

8.4 Spectral Density Output

The spectral density output was using the spectrum analyzer. The spectral density output power was measured using a direct connection from the RF out on the RF board into the input of the analyzer. The resolution bandwidth was 3 kHz, and the video bandwidth 10 kHz. The highest 1.5 MHz of the signal was used as the frequency span with the sweep rate being 1 second for every 3 kHz of span.

Test Results:

The EUT complies with the relevant requirements of FCC Title 47, Part 15, Subpart C section 15.209 (d). The spectral density output does not exceed 8 dBm in any 3 kHz band. Please see the data sheets located in Appendix D.

8.5 RF Antenna Conducted Test

The RF antenna conducted test was taken using the spectrum analyzer. The RF antenna conducted test was measured using a direct connection from the RF out on the RF board into the input of the analyzer. The resolution bandwidth was 100 kHz, and the video bandwidth 1 MHz. The spans were wide enough to include all the harmonics and emissions that were produced by the intentional radiator. Both the base and handset were tested.

Test Results:

The EUT complies with the relevant requirements of FCC Title 47, Part 15, Subpart C section 15.247 (c). The RF power that is produced by the intentional radiator is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. Please see the data sheets located in Appendix D.

8.6 RF Band Edges

The RF band edges were taken at the edges of the ISM spectrum (902 MHz when the EUT was on channel 1 and 928 MHz when the EUT was on channel 20) using the spectrum analyzer. The RF band edges were measured using a direct connection from the RF out on the RF board into the input of the analyzer. Both the handset and base were tested.

Test Results:

The EUT complies with the relevant requirements of FCC Title 47, Part 15, Subpart C section 15.247(c). The RF power at the band edges at 902 MHz and 928 MHz are at least 20 dB below the fundamental. Please see the data sheets located in Appendix D.

8.7 Processing Gain

1. B/S output to H/S input

(1)The B/S is connected by its RF test connector to the fixed attenuator which is 50 dB. The output of the fixed attenuator is combined with the output of the signal generator through a combiner. The output of the combiner is connected by the H/S RF test connector. The H/S is connected by the BB-ASIC(UC2484)'s test pins to the BER counter (RX data is pin 32 and RX clock is pin 41).

(2)The PULSE/TONE SW of the B/S is set at PULSE. The B/S is powered by the adapter while pushing the PAGE-KEY. The PAGE-KEY shall be held at least for 3 seconds. Then the PAGE-KEY is released and pushed 11 times. The H/S is powered by the battery while pushing the *-KEY and #-Key. Those keys are held at least for 2 seconds. Then those keys are released and the #-KEY is pushed once.

(3)BER counter is JRC NJZ-940 (Continuous mode, PN15, and the receive clock uses an external clock with its leading edge.).

(4)The signal generator is stepped in 50 kHz increments. The required BER is 1.0e-3. When this error rate is achieved (displayed on the BER counter), the reading of signal generator is taken. This reading is then subtracted from the signal level of the B/S (while adding in the combiner loss and signal generator calibration factor) to obtain the J/S ratio. The J/S ratio is then combined with the system loss (2 dB) and signal to noise ratio (11 dB) of the unit to obtain the processing gain.

2. H/S output to B/S input

(1)The H/S is connected by its RF test connector to the fixed attenuator which is 50 dB. The output of the fixed attenuator is combined with the output of the signal generator through a combiner. The output of the combiner is connected by the B/S RF test connector. The B/S is connected by the BB-ASIC(UC2484)'s test pins to the BER counter (RX data is pin 32 and RX clock is pin 41).

(2)The PULSE/TONE SW of the B/S is set at PULSE. The B/S is powered by the adapter while pushing the PAGE-KEY. The PAGE-KEY shall be held at least for 3 seconds. Then the PAGE-KEY is released and pushed 11 times. The H/S is powered by the battery while pushing the *-KEY and #-Key. Those keys are held at least for 2 seconds. Then those keys are released and the #-KEY is pushed once.

(3)BER counter is JRC NJZ-940 (Continuous mode, PN15, and the receive clock uses an external clock with its leading edge.).

(4)The signal generator is stepped in 50 kHz increments. The required BER is 1.0e-3. When this error rate is achieved (displayed on the BER counter), the reading of signal generator is taken. This reading is then subtracted from the signal level of the H/S (while adding in the combiner loss and signal generator calibration factor) to obtain the J/S ratio. The J/S ratio is then combined with the system loss (2 dB) and signal to noise ratio (11 dB) of the unit to obtain the processing gain.

9. CONCLUSIONS

The 900 MHz Spread Spectrum Phone Model: EXS2010 meets all of the specification limits defined in FCC Title 47, Part 15, Subpart B; and Subpart C, sections 15.205, 15.207, 15.209, and 15.247.