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APPLICATION FOR PART 90
TYPE CERTIFICATION
TRANSMITTER VHF (MANCHESTER FSK)

System Innovations, Inc.
1551 Forbes Street
Fredericksburg, VA 22405

MODEL: WeatherScene RF Modem Link
FCC ID: NVQWTHRSCN01

November 30, 1998

This report concerns (check one): **Equipment Type**: **Transmitter**	**Original Grant:** X	**Class II Change:**
Deferred grant requested per 47 CFR 0.457 (d) (1) (ii)? **If yes, defer until:**	**Yes:** ________ ***Date***	**No**: X
Company name agrees to notify the Commission by: ______________________(date) of the intended date of announcement of the product so that the grant can be issued on that date.		

REPORT PREPARED BY:

EMI Technician: K. Franck Schuppius
Administrative Writer: Dixie L. Shetter

Rhein Tech Laboratories, Inc.

Document Number: 980628

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1.0 GENERAL INFORMATION

The following application for Certification of an FCC Part 90 Type Certification Transmitter VHF Manchester FSK, is prepared on behalf of System Innovations, Inc. in accordance with Part 2, and Part 90, of the Federal Communications Commissions rules and regulations. The Equipment Under Test (EUT) was the WeatherScene RF Modem Link. 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.

1.6 RELATED SUBMITTAL(S)/GRANT(S)

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

1.7 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

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	FCC ID	CABLE DESCRIPTIONS	RTL BAR CODE
SYSTEM	GATEWAY 2000, INC.	LP MINI TOWER	N/A	DoC	N/A	9135
MONITOR	MAG TECHNOLOGIES, INC.	E5005 (EV500)	SAM588000020	DoC	SHIELDED I/O, FERRITE BOTH ENDS, SHIELDED POWER	9752
KEYBOARD	MAXISWITCH	2196003-XX-XXX	50432723	D7J2196003-XX	SHIELDED I/O	8441
MOUSE	PRIMAX	MUS9J	N/A	EMJMUSJP	SHIELDED I/O	8581
CAMERA (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**CX-NV36**	**301312**	**N/A**	**UNSHIELDED I/O**	**9942**
PROBE (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**WEATHER POD**	**1210-1015**	**N/A**	**UNSHIELDED I/O, UNSHIELDED POWER**	**9943**
RPU (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**WEATHER SCENE**	**CONTROL DISPLAY UNIT**	**NVQWTHRSCN01**	**SHIELDED I/O, UNSHIELDED POWER**	**9944**
POWER SUPPLY (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**WEATHER SCENE**	**N/A**	**N/A**	**UNSHIELDED POWER**	**9940**
RFCIU (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**RPU**	**N/A**	**N/A**	**UNSHIELDED I/O, UNSHIELDED POWER**	**9941**
POWER SUPPLY (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**WEATHER SCENE**	**N/A**	**N/A**	**UNSHIELDED POWER**	**9939**
CAMERA (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**CX-NV36**	**301327**	**N/A**	**UNSHIELDED I/O**	**9947**
CAMERA (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**CX-NV36**	**301305**	**SAMPLE**	**UNSHIELDED I/O**	**9945**
CAMERA (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**CX-NV36**	**301343**	**N/A**	**UNSHIELDED I/O**	**9946**
ANTENNA (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**LARSEN ANTENNA**	**N/A**	**N/A**	**SHIELDED I/O**	**9949**
ANTENNA (EUT)	**SYSTEM INNOVATIONS, INC., INC.**	**LARSEN ANTENNA**	**N/A**	**N/A**	**SHIELDED I/O**	**9948**

1.9 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.

1.10 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).

3.0 SYSTEM TEST CONFIGURATION

3.1 JUSTIFICATION

The EUT was tested in all three orthogonal planes in order to determine worst case emission. The EUT was investigated and tested from 30 MHz to 2 GHz.

3.2 EUT EXERCISE SOFTWARE

Conducted Emissions, Radiated Emissions (Unintended):
The RPU was commanded to perform real-time video, which exercises all of the hardware in the RPU and PFCIU boxes. In the RPU, all of the electronics are powered (including the cameras and the weather pod) and all of the clocks in the system are active. During real-time video, the video processor board DSP runs at 35 MHz, collecting video from the compression engine and sending it out serially over the 2.4 GHz ISM band modem. The compression engine and the video decoder run at 27 MHz (with a secondary clock at 13.5 MHz). The command and control processor monitors the status of the video processor and handles the VHF links throughout this process. It is clocked at 18 MHz.

During real-time video, all of the electronics in the RFCIU are also powered. The ISM band modem steadily collects and transmits serial data at 115 kbps. The RFCIU processor runs at 19 MHz, controlling the VHF links and communication with the PC at 115 kbps.

Radiated Emissions (Intended):
The CDU was placed in a mode to repeatedly command the RPU to perform frame grabs. The command rate was approximately 2 commands per second, which provided 2 VHF commands (i.e., RFCIU to RPU) and 2 corresponding VHF responses (i.e., RPU to RFCIU). Both VHF transmitters were transmitting at maximum power.

3.3 SPECIAL ACCESSORIES

N/A.

3.4 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 Type Certification Transmitter VHF Manchester FSK test methodology.

Signature: _____ Date: December 4, 1998

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.

4.0 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

4.1 FCC PART 90.217(A): EXEMPTION FROM TECHNICAL STANDARDS

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 milliwatts 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 25kHz channel bandwidth, the sum of the bandwidth occupied by the signal plus the bandwidth required for frequency stability shall be adjusted so that any mission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30dB below the unmodulated carrier.

4.2 PART 2.987(D): MODULATION REQUIREMENTS AND CHARACTERISTICS

The curve provided in Section 5.1, shows that the equipment met the modulation requirements of the rules under which the equipment is to be licensed.

4.3 FCC PART 2.985: RF OUTPUT POWER

4.3.1 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	151.513	118.8	15.2
	151.645	119.6	18.2

4.4 FCC PART 2.989(B) 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.

Please refer to Section5.2 for data test results.

4.5 FCC PART 2.997(A)(1): FREQUENCY SPECTRUM TO BE INVESTIGATED

(a) In all of the measurements set forth in 2.991 and 2.993, 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.

4.6 FCC Part 2.991 and Part 90.217(a): Spurious Emissions at Antenna Terminals

4.6.1 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 25 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 40 kHz or more removed from the assigned frequency is attenuated at least 30dB below the unmodulated carrier.

Please refer to Section 5.3 for data test results.

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

4.7.1 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. See section 1.5 and section 8 for additional information concerning the radiated emissions test methodology.

Data test results are provided in table 2, section 5.4.

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

4.8.1 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.

4.8.2 Test Results:

Frequency (MHz)	Frequency Stability (ppm)
151.513	10
151.645	10

See table 2, section 5.4 for data test results.

5.4 FCC PART 2.993: 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
Output Power Measured 118.9dBuV=0.015
With 30dB down from the power we have 118.9-30=88.9dBuV=-18.1dBm
Oscillators: 173.040MHz/20.945MHz

Freq. MHz	Polar.	CL Ref. dB	S/G level dBm	TX Gain dBi	Gain Diff.* dB	Ref. Rdg. DBm	DUT Rdg. dBm	Margin dB	TX Antenna #
75.752	V	2.7	-15.4	N/A	N/A	-34.7	-84.8	-50.1	1
75.824	V	2.7	-15.4	N/A	N/A	-34.7	-91.1	-56.4	1
113.634	V	3.3	-14.8	N/A	N/A	-36.6	-91.2	-54.6	1
113.774	V	3.3	-14.8	N/A	N/A	-36.6	-91.9	-55.3	1
138.882	V	3.7	-14.4	N/A	N/A	-34.5	-73.0	-38.5	1
139.008	V	3.7	-14.4	N/A	N/A	-34.5	-70.8	-36.3	1
164.110	V	4.1	-14.0	N/A	N/A	-36.0	-90.1	-54.1	1
164.270	V	4.1	-14.0	N/A	N/A	-36.0	-89.4	-53.4	1
303.020	H	5.7	-12.4	N/A	N/A	-36.5	-83.1	-46.6	1
303.279	H	5.7	-12.4	N/A	N/A	-36.5	-85.3	-48.8	1
454.527	V	7.3	-10.8	N/A	N/A	-42.1	-88.7	-46.6	1
454.922	V	7.3	-10.8	N/A	N/A	-42.2	-89.1	-46.9	1
1515.125	V	14.6	-3.5	N/A	N/A	-55.8	-76.1	-20.3	1
1516.770	V	14.6	-3.5	N/A	N/A	-55.8	-78.4	-22.6	1

Antenna:
1.) Half Wave dipole S/N 274
*Difference in gain between half-wave dipole and antenna used for the reference power level.

Note: It is assumed that all emissions are radiated from half wave dipole antennas.

TEST PERSONNEL:

Signature: _____ **D**ate: December 4, 1998

Typed/Printed Name: K. Franck Schuppius

6.0 SCHEMATICS

Please see following pages.

7.0 Field Strength Calculation, and Radiated Test Methodology

7.1 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:

$$FI(dBuV/m) = SAR(dBuV) + SCF(dB/m)$$

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:

$$SCF(dB/m) = -PG(dB) + AF(dB/m) + CL(dB)$$

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:

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

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:

$$49.3\ dBuV - 11.5\ dB/m = 37.8\ dBuV/m$$

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

7.2 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.

8.0 PHOTOS OF TESTED EUT

Please see following pages.

APPENDIX A: Emissions Equipment List

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 B:

USER'S MANUAL

Please see following pages.