TYPE CERTFICATION ACCORDING TO

FCC PART 2, SUBPART J, 1998
FCC PART 95, SUBPART B, 1998
FCC PART 15, SUBPART B, CLASS B, 1997

OF THE

21st CENTURY INNOVATIVE PRODUCTS/HANYANG ELECTRONICS, Ltd.
FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO

PREPARED FOR

21st CENTURY INNOVATIVE PRODUCTS
905 ARMSTRONG STREET
ALGONQUIN, ILLINOIS 60102

PREPARED BY

GLOBAL CERTIFICATION LABORATORIES, LTD.
4 MATTHEWS DRIVE
EAST HADDAM CT 06423

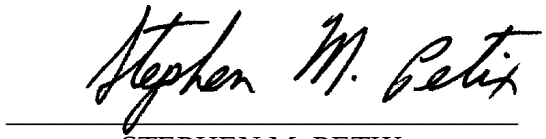
DATE RELEASED

5/4/00

FILE REF: HAN9901

SIGNATURE PAGE

THIS REPORT WAS PREPARED BY:



STEPHEN M. PETIX

TESTING WAS PERFORMED BY:

STEPHEN M. PETIX

THIS REPORT WAS REVIEWED BY:

JAMES COSTELLO

TABLE OF CONTENTS

Due to their file size, the Plot & Photographic sections are in separate exhibits.

INTRODUCTION

This report describes the results of electromagnetic emissions testing for type certification on the:

21st CENTURY INNOVATIVE PRODUCTS/HANYANG ELECTRONICS, Ltd.
FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO,

the Equipment Under Test. The EUT was subjected to the following tests:

FCC Part 15, Subpart B, Class B when it is in the receive mode, and
FCC Part 95, Subpart B, and FCC Part 2 when it is transmitting.

Because the EUT is powered by batteries and does not have a connection to recharge the batteries with AC power, only radiated emission phenomena were examined. Any radiated emissions produced when the FRS-4000 radio is in receive mode are to meet FCC Part 15, Class B requirements. Emissions that appear when the FRS-4000 is transmitting are to meet the requirements of Parts 2 and 95.

The Parts 2 and 95 testing also includes measurements of effective radiated power, spurious emissions, occupied bandwidth, and frequency stability under temperature and power voltage variations and audio system characteristics.

The FCC ID of the FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO is OVCFRS-4000.

The results reported in this document relate only to the unit(s) tested.

All testing was performed at the facilities of

Global Certification Laboratories, Ltd.
East Haddam CT.

All test equipment calibration is N.I.S.T. traceable.

This report contains detailed descriptions of the test procedures, test data, and a written summary of the results. The report may not be reproduced, except in its entirety, without the permission of Global Certification Laboratories.

This report contains 23 numbered pages, plus Title, Signature, and Table of Contents Pages.

PRODUCT IDENTIFICATION

EQUIPMENT UNDER TEST (EUT): 21st CENTURY
INNOVATIVE/PRODUCTS/HANYANG
ELECTRONICS, Ltd.

MODEL:
FRS-4000 "WALK & TALK"
UHF TWO-WAY RADIO

SERIAL: NONE

DEVIATIONS FROM SPECIFICATIONS: NONE

EUT SUPPORT EQUIPMENT: NONE

TECHNICAL DESCRIPTION
21st CENTURY INNOVATIVE PRODUCTS/HANYANG ELECTRONICS, Ltd.
FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO

The FRS-4000 "WALK & TALK" is a frequency-modulated, UHF two-way radio that uses all fourteen frequencies allocated in the FCC part 95, Subpart B, the Family Radio Service (FRS). It is of the "F3E" emission type, the only one allowed for the Family Radio Service.

These fundamental or carrier frequencies in MHz are:

1: 462.5625 *	8: 467.5625 *
2: 462.5875	9: 467.5875
3: 462.6125	10: 467.6125
4: 462.6375	11: 467.6375
5: 462.6625	12: 467.6625
6: 462.6875	13: 467.6875
7: 462.7125*	14: 467.7125 *

The frequencies marked with an * are examined in detail in this report; they represent the highest, middle and lowest frequencies of the entire tuning range.

The FRS-4000 uses an integral antenna and has no user access for increasing its radiated power or modifying its basic functions. There is no enclosure shielding. The enclosure that will be used in production will have a different appearance from what is submitted in this report. This change will not alter the basic operation of the radio.

The FCC identifier label will be placed on the battery cover of the new enclosure. Once a new enclosure is available, a photograph of the label will be sent.

The FRS-4000 is powered by 4.5 vdc, supplied by 3 "AAA" alkaline batteries.
All measurements in this report used fresh batteries. There is no provision for battery charging using AC mains power.

The authorized bandwidth of the FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO is 12 .5 kHz according to Part 95, section 95.6330.

COMPLIANCE STATEMENT
21st CENTURY INNOVATIVE PRODUCTS/HANYANG ELECTRONICS, Ltd.
FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO

The FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO complies with the requirements of FCC PART 95, Subpart B, the Family Radio Service and FCC PART 15 Subpart B, Class B for radiated emissions, when configured as received by Global Certification Laboratories. The EUT is to meet Part 15, Class B limits because it may be used in domestic environments.

The measurements in this report represent the maximum levels of emissions from the FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO. The measurements and limits are discussed later in the report. Calibration of all instrumentation used in this test program is N.I.S.T. traceable.

The results reported in this document relate only to the unit(s) tested.

ANSI C63.4; FCC Parts 2, 90, 95 and 15 of the Code of Federal Regulations, Title 47 were consulted to insure the measurements are accurate and the test site correctly configured.

EMISSIONS TEST INSTRUMENTATION

The following instrumentation is used in emissions measurements. All test equipment calibration is N.I.S.T. traceable.

	Model	Serial	Last Cal.	Cal. Due
ADVANTEST Spectrum Analyzer	R3361A	91730394	3/14/99	3/14/00
ADVANTEST Preamplifier	R14601	93120019	1/20/00	1/20/01
AILTECH Log Periodic Antenna	90005/3146	1095	11/11/99	11/11/00
EMCO Reference Dipole	3120 B-3	0043	N/A	N/A
EMCO Horn Antenna	3115	2498	N/A	N/A
FLUKE Digital Multimeter	76	6540398	4/11/99	4/11/00
FLUKE Thermocouple Module	80TK	6698122	7/21/99	7/21/00
GLOBAL Laboratories 3, 10 & 30 meter O.A.T.S.	N/A	N/A	11/6/99	11/6/00
HEWLETT PACKARD Spectrum Analyzer	8569B	2607A03112	8/25/99	8/25/00
KROHN-HITE Oscillator	4300a	3357	2/5/98	2/5/01
MARCONI Signal Generator	2022C	52022-930X	4/26/99	4/26/00
OAKTON Thermal-hygrometer	35612-00	none	4/13/99	4/13/00
Power Designs Inc. 0 to 60 V DC, 5 to 1 Amp Power Supply	6050A	201005	N/A	N/A
SCHWARZBECK Biconical Antenna	VHA-9103	"A"	11/11/99	11/11/00
SCHWARZBECK RF Receiver 30 to 1000 MHz	VUME 1520	1520346	2/11/99	2/11/00

EMI TEST PROCEDURES
FCC PART 15, SUBPART B
UNINTENTIONAL RADIATED E-FIELD EMISSIONS

FCC Part 15 radiated measurements are performed on an open field test site with a metal ground plane which conforms to specifications in CISPR 16. At Global Laboratories, our 3 & 10m test site is sheltered with a pegged post-and-beam wooden building. The EUT is positioned on a remotely controlled turntable to permit emission measurements from all sides of the EUT. The EUT is configured per FCC Part 15 to maximize emissions.

A Radio Frequency test receiver, in accordance with CISPR 16 is used to measure radiated emissions. Antenna height is variable between 1 and 4 meters for maximum signal reception. An antenna-to-EUT separation of 3 (Class B), or 10 (Class A) meters is established. Broadband antennas are used in both horizontal and vertical attitudes for maximum signal reception.

Emissions are first examined with a spectrum analyzer in Peak mode and EUT-generated signals are isolated from ambients. Signals are then measured with a Quasi-Peak receiver conforming to CISPR 16 and compared to limits. Antenna factors and cable loss are calculated in a computer spreadsheet.

Limits for radiated emissions are:

	Freq. (MHz)	dB(μV/m) Quasi-Peak
Class A	30-88	39
(@ 10m)	88-216	43.5
	216-960	46.4
	960-1000	49.5
Class B	30-88	40
(@3m)	88-216	43.5
	216-960	46
	960-1000	54

For this project, the class B limits were used to measure any emissions that were present while the FRS-4000 was in the receive mode.

EMI TEST PROCEDURES
FCC PART 95
EFFECTIVE RADIATED POWER & SPURIOUS EMISSION MEASUREMENTS

The effective radiated power (ERP) emission measurements use a substitution method. The ERP measurements are used to determine the radiated power of the carrier, as well as the limit for any spurious emissions produced by the EUT when it is transmitting.

Measurements are performed in the open area test site (OATS) normally used to measure unintentional emissions. The OATS uses a metal ground plane that conforms to specifications in CISPR 16 and ANS C63. In this project, the 3 meter test site was used. A frequency range of 9 kHz to the 10^{th} harmonic of the fundamental carrier frequency is evaluated.

The EUT is positioned with the radiating element oriented normally and 1.5 meters above a metal ground plane. The radiating element can be an integral or external antenna, used to project the transmission signal. The test antenna is oriented to receive the maximum level of the fundamental carrier signal. Horizontal and vertical antenna polarities are used. The maximum carrier signal level is stored in a spectrum analyzer channel.

After this is done, the EUT is removed from the measurement site and replaced with a reference dipole antenna. The reference antenna element lengths are adjusted for ½ wave resonance at the carrier frequency. Then it is located in the EUT position.

A signal generator and amplifier/preamplifier (if necessary) are used to inject a signal into the dipole. Using the second channel of the spectrum analyzer, the signal generator output is adjusted until the same emission level is produced from the dipole as produced from the EUT.

The effective radiated power (ERP) produced by the EUT is calculated from the power generated by the signal generator/amplifier/pre-amplifier, subtracting the cable losses and adding the dipole antenna gain factors.

The limits for spurious emissions are calculated from formulas stated in the standard. The formulas depend on the type of emission (i.e. F3E), the carrier frequency and the authorized bandwidth for the carrier. The limits are in terms of decibels below the ERP of the carrier frequency. The limit formulae are called "emission masks."

For example, emission mask "C" of Part 90 uses a limit formula of $43 + 10 \log P$, where P is the effective radiated power of the EUT in watts. Any frequency more than 250% removed from the authorized bandwidth is to be reduced in dB calculated with this formula.

EMI TEST PROCEDURES
FCC PART 95
EFFECTIVE RADIATED POWER & SPURIOUS EMISSION MEASUREMENTS

The limits spurious emissions must meet are calculated from formulas stated in the standards. The formulas depend on the type of emission (i.e. F3E), the carrier frequency and the authorized bandwidth for the carrier. The limits are in terms of decibels below the Effective Radiated Power (ERP) of the carrier frequency. The limit formulae are called "emission masks", which are discussed in part 90.

For example, emission mask "C" of Part 90 uses a limit formula of 43 + 10 log P, where P is the effective radiated power of the EUT in watts. Any frequency more than 250% removed from the authorized bandwidth is to be reduced in dB calculated with this formula. For this project, emission mask "B" from part 90 is used.

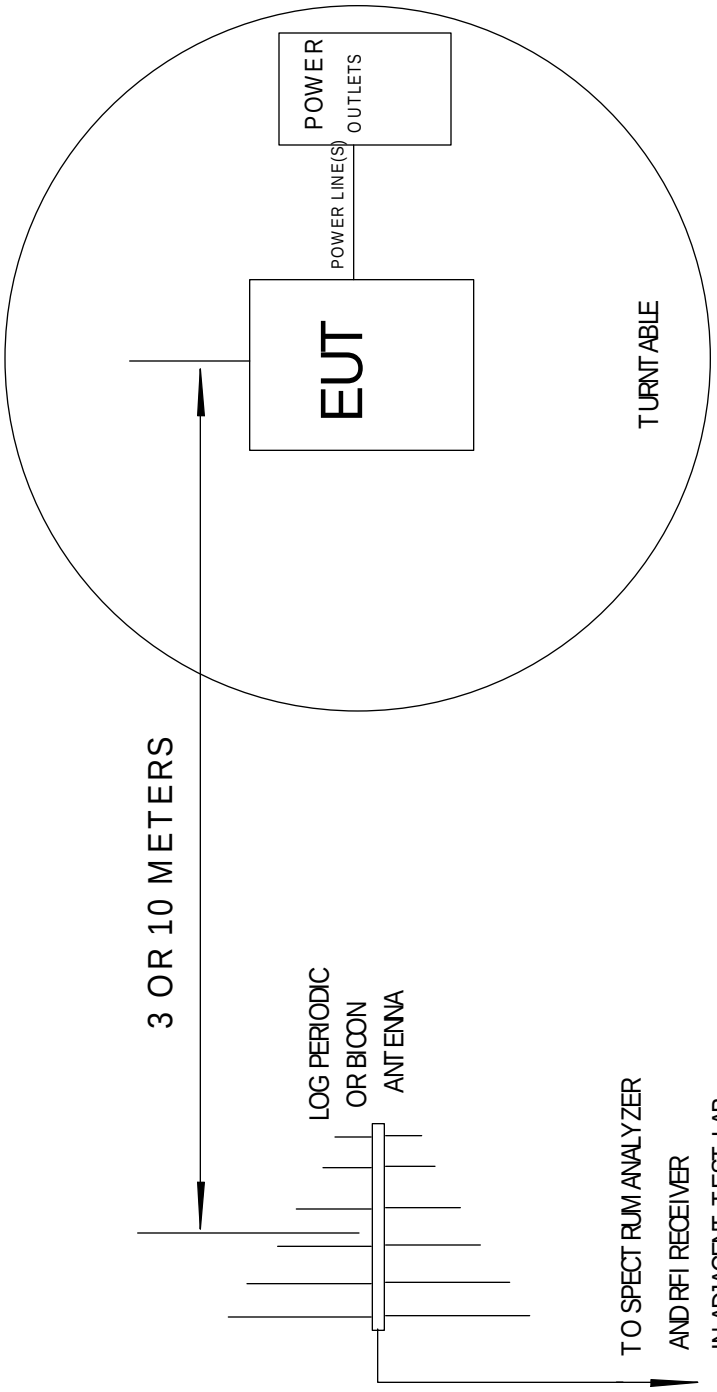
For convenience, the maximum allowable level of the spurious emissions calculated by the emission mask formula is replicated with the same signal source/reference dipole antenna combination that was used to measure the ERP. The receiver reading obtained is then converted to an absolute field strength value as in conventional EMC measurements. The ERP calculation is based on measurements performed with an unmodulated carrier signal.

The ERP and spurious emission measurements are described in the Excel spreadsheets that follow the next two pages.

GLOBAL CERTIFICATION LABORATORIES, LTD.

RADIATED EMISSIONS TEST SET-UP

TURNTABLE AND ANTENNA ARE LOCATED
IN A POST-AND-BEAM WOODEN "BARN"



DATA TABLE EXPLANATION
ALL RADIATED ELECTRIC FIELD EMISSIONS TESTS

The DATA TABLE PAGES contain the following information:

TITLE: indicating the test performed
EUT
PERSON WHO PERFORMED THE TEST
TEST STANDARD(S)
DATE OF TEST
TEST SITE
TEST INSTRUMENTATION
NOTES

The DATA TABLE headings are as follows:

FREQ. MHz	The FREQUENCY, in megahertz, at which a signal is detected.
AMPL QUASI-P dB(µV)	The QUASI-PEAK AMPLITUDE, in decibels microvolt, of the signal.
AMPL PEAK dBm	The PEAK AMPLITUDE, in decibels milliwatt, of the signal.
AZIMUTH DEGREES	Approximate turntable position with respect to the antenna (mostly for diagnostics).
CABLE LOSS	Insertion loss due to the transmission line between the antenna and the measuring set. Measured in dB.
ANTENNA FACTORS dB/m	Convert measured antenna voltage to units of field strength, also account for antenna's loss receiving the radiated signal.
TOTAL FIELD dB(µV/m)	the sum of the received signal at the measuring set, plus cable and antenna losses.
EFFECTIVE RADIATED POWER dBm or mW	the power supplied to an antenna multiplied by the gain of the antenna in linear units. The gain is added if dB units are used.
LIMIT QUASI-P dB(µV/m)	the LIMIT, in decibel microvolt per meter, for the above signal
PASS?	Is the signal acceptable under the standards? ("YES" or "NO")
MARGIN	the MARGIN, in decibels, by which the EUT passes or fails.

RADIATED EMISSIONS TEST DATA

RADIATED EMISSIONS DATA USING THE FCC PART 95 METHODS REGARDING INTENTIONAL EMISSIONS AND FCC PART 15, SUBPART "B" REGARDING UNINTENTIONAL EMISSIONS.

FILE NAME: HAN0001
EUT NAME: FRS-4000 "WALK & TALK" TWO-WAY RADIO TRANSCEIVERS

THE EUT IS A 14 CHANNEL TWO WAY RADIO.
THE EUT IS POWERED BY 3 "AAA" BATTERIES WITH NO PROVISION FOR A CHARGER.
CUSTOMER REPRESENTATIVE: JOHN GARNETT (not present)

MEASURED BY STEVE PETIX ON 4/16/00 TO FCC PART 95 USING THE 3 & 1 METER OPEN AREA TEST SITE, (i.e. OATS).

THE EUT MEASURING ANTENNAS ARE:
A SCHWARZBECK MODEL VHA9103 BICONICAL ANTENNA, (s/n: A) IS USED FOR 30 TO 300 MHz.
AN AILTECH MODEL 96005, (s/n 1095), LOG PERIODIC ANTENNA IS USED FOR 300 TO 1000 MHz.
AN EMCO MODEL 3115 s/n 2498 GUIDED RIDGE HORN ANTENNA IS USED FOR 1 TO 18 GHz.

THE SUBSTITUTION ANTENNAS ARE:
EMCO DIPOLES ARE USED FOR 30 TO 1000 MHz.

THE ANTENNAS ARE FACING THE LED DISPLAY SIDE OF THE EUT IN ORDER TO OBTAIN FREQUENCIES OF INTEREST. THE EUT IS STANDING VERTICAL. ONCE THE FREQUENCIES OF INTEREST ARE FOUND, THEY WILL BE MAXIMIZED BY TURNTABLE ROTATIONS AND ANTENNA HEIGHT SCANS.

THE EUT IS 1.5 METERS ABOVE THE SHEET STEEL GROUND PLANE.

WHEN THE SUBSTITUTION ANTENNA IS USED, IT IS PLACED AT THE INTEGRAL ANTENNA HEIGHT AND LOCATION. IT IS VERTICALLY POLARIZED.

ALL MEASUREMENTS BELOW 1000 MHz USE QUASI-PEAK DETECTION.
MEASUREMENTS ABOVE 1000 MHz USE PEAK DETECTION.

A QUASI-PEAK RFI RECEIVER IS USED TO PRODUCE THE MEASUREMENTS BELOW 1000 MHz. A MICROWAVE SPECTRUM ANALYZER IS USED TO PRODUCE THE MEASUREMENTS ABOVE 1000 MHz.

The spurious emissions are performed with the FRS-4000 continuously transmitting.

continued on next page

RADIATED EMISSIONS TEST DATA

The following measurements are performed with the FRS-4000 in the receive only mode. These are the Part 15, Class B measurements.

THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB(µV)	ANTENNA FACTORS dB	TOTAL FIELD dB(µV/m)	LIMIT QUASI-P dB(µV)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB(µV)	ANTENNA FACTORS dB	TOTAL FIELD dB(µV/m)	LIMIT QUASI-P dB(µV)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB(µV)	ANTENNA FACTORS dB	TOTAL FIELD dB(µV/m)	LIMIT QUASI-P dB(µV)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL & AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB(µV)	ANTENNA FACTORS dB	TOTAL FIELD dB(µV/m)	LIMIT QUASI-P dB(µV)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

THE 1 TO 18 GHz HORN IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB(µV)	ANTENNA FACTORS dB	TOTAL FIELD dB(µV/m)	LIMIT QUASI-P dB(µV)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

THE 1 TO 18 GHz HORN IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB(µV)	ANTENNA FACTORS dB	TOTAL FIELD dB(µV/m)	LIMIT QUASI-P dB(µV)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

The Effective Isotropic Radiated Power (EIRP) for low, medium and high channels is calculated below:
Because of the limited power of the signal generator, a preamplifier was needed at the spectrum analyzer input to boost the signal strength for all EIRP measurements.
The preamp gain was measured with the R33361A tracking generator for the frequencies measured.

The EIRP of the lowest frequency, Channel 1 (462.5625 MHz) is calculated.

THE 400 TO 1000 MHz SUBSTITUTION DIPOLE IS VERTICAL.								
FREQ. (MHz)	LENGTH OF EACH DIPOLE AERIAL (mm)	MATCH SIG GEN OUTPUT (dBuV)	MATCH SIG GEN OUTPUT (dBm)	LAB to OATS REF ANT CABLE LOSS (dB)	R14601 PRE-AMP GAIN (dB)	DIPOLE ANTENNA. GAIN (dBi)	EFFECTIVE RADIATED POWER (dBm)	EFFECTIVE RADIATED POWER (mw)
462.5625	160.00	103	-4.00	4.7	32.00	2.20	25.50	354.81

The EIRP of the middle frequency, Channel 8 (467.5625 MHz) is calculated.

THE 400 TO 1000 MHz SUBSTITUTION DIPOLE IS VERTICAL.								
FREQ. (MHz)	LENGTH OF EACH DIPOLE AERIAL (mm)	MATCH SIG GEN OUTPUT (dBuV)	MATCH SIG GEN OUTPUT (dBm)	LAB to OATS REF ANT CABLE LOSS (dB)	R14601 PRE-AMP GAIN (dB)	DIPOLE ANTENNA. GAIN (dBi)	EFFECTIVE RADIATED POWER (dBm)	EFFECTIVE RADIATED POWER (mw)
467.5625	160.00	103	-4.00	4.7	32.00	2.20	25.50	354.81

The EIRP for the highest frequency, Channel 14 (467.7125 MHz) is calculated.

THE 400 TO 1000 MHz SUBSTITUTION DIPOLE IS VERTICAL.								
FREQ. (MHz)	LENGTH OF EACH DIPOLE AERIAL (mm)	MATCH SIG GEN OUTPUT (dBuV)	MATCH SIG GEN OUTPUT (dBm)	LAB to OATS REF ANT CABLE LOSS (dB)	R14601 PRE-AMP GAIN (dB)	DIPOLE ANTENNA. GAIN (dBi)	EFFECTIVE RADIATED POWER (dBm)	EFFECTIVE RADIATED POWER (mw)
467.7125	160.00	104	-3.00	4.7	32.00	2.20	26.50	446.68

Because it has slightly more power, Channel 14 (467.7125 MHz) is used to determine the limit of spurious emissions during transmissions.

The formula 43 + 10log P (In this case, P = 0.4467) yields 39.5, which is the number of dB below the carrier strength the spurious signals must fall. The matching signal generator output of 64.5 dB (104-39.5) produces a level which is the maximum level spurious emissions are allowed.

This spurious emission level produced by the signal generator is now measured by a quasi-peak receiver and expressed in terms of a field strength.

THE 300 TO 1000 MHz ANTENNA IS VERT. & AT 3 m.					
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	R14601 PRE-AMP GAIN (dB)	TOTAL FIELD dB(μV/m)
467.7125	28	6.19	16.88	32.00	83.07

The limit for all spurious emissions greater than 22.5 kHz from the carrier shall be no higher than 83 dBuV/m. The pre-amp will not be used for actual EUT measurements.

continued on next page

RADIATED EMISSIONS TEST DATA

The following measurements are performed with the FRS-4000 continuously transmitting. There were no emissions in the 9kHz to 30 MHz range.

CHANNEL 14 (Fundamental = 467.76125 MHz)

THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.

FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB	ANTENNA FACTORS dB	TOTAL FIELD dB(µV/m)	FCC LIMIT dB(µV/m)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 14 (Fundamental = 467.76125 MHz)

THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.

FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB	ANTENNA FACTORS	TOTAL FIELD dBµV/m	FCC LIMIT dB(µV/m)	PASS?	MARGIN (dBµV)
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 14 (Fundamental = 467.76125 MHz)

THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.

FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB	ANTENNA FACTORS	TOTAL FIELD dBµV/m	FCC LIMIT dB(µV/m)	PASS?	MARGIN (dBµV)
467.7613	94.0	6.19	16.88	117.07	N/A	N/A	N/A
425.0000	27.0	5.31	15.48	47.79	83	YES	35.2
446.5100	31.0	6.19	16.18	53.37	83	YES	29.6
458.3700	24.0	6.19	16.60	46.79	83	YES	36.2
510.0000	32.0	7.31	18.17	57.48	83	YES	25.5
530.0000	25.0	7.31	18.39	50.70	83	YES	32.3
612.0000	55.0	7.78	19.33	82.11	83	YES	0.9
935.5300	44.0	13.08	23.19	80.27	83	YES	2.7
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 14 (Fundamental = 467.76125 MHz)

THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL & AT 3 METERS.

FREQ. (MHz)	AMPL QUASI-P (dBµV)	CABLE LOSS dB	ANTENNA FACTORS	TOTAL FIELD dBµV/m	FCC LIMIT dB(µV/m)	PASS?	MARGIN (dBµV)
467.7613	84.0	6.19	16.88	107.07	N/A	N/A	N/A
458.3700	12.0	6.19	16.60	34.79	83	YES	48.2
612.0000	43.0	7.78	19.33	70.11	83	YES	12.9
935.5300	36.0	13.08	23.19	72.27	83	YES	10.7
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

CHANNEL 8 (Fundamental = 467.5625 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS dB**	**TOTAL FIELD dB(µV/m)**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN dB**
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 8 (Fundamental = 467.5625 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 8 (Fundamental = 467.5625 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
425.0000	24.0	5.31	15.48	44.79	83	YES	38.2
446.3200	27.0	6.19	16.18	49.37	83	YES	33.6
467.5625	96.0	6.19	16.88	119.07	N/A	N/A	N/A
470.0000	17.0	6.19	17.02	40.21	83	YES	42.8
477.3900	20.0	6.19	17.30	43.49	83	YES	39.5
935.1250	32.0	13.08	23.19	68.27	83	YES	14.7
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 8 (Fundamental = 467.5625 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
467.5625	80.0	6.19	16.88	103.07	N/A	N/A	N/A
612.0000	38.0	7.78	19.33	65.11	83	YES	17.9
935.1250	29.0	13.08	23.19	65.27	83	YES	17.7
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

CHANNEL 7 (Fundamental = 462.7125 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS dB**	**TOTAL FIELD dB(µV/m)**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN dB**
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 7 (Fundamental = 462.7125 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 7 (Fundamental = 462.7125 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
420.2500	26.0	5.31	15.34	46.65	83	YES	36.3
437.0000	29.0	5.31	15.90	50.21	83	YES	32.8
462.7125	94.0	6.19	16.74	116.93	N/A	N/A	N/A
615.2400	51.0	7.78	19.33	78.11	83	YES	4.9
925.4250	39.0	11.31	23.44	73.75	83	YES	9.2
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 7 (Fundamental = 462.7125 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
462.7125	80.0	6.19	16.74	102.93	N/A	N/A	N/A
615.2400	38.0	7.78	19.33	65.11	83	YES	17.9
925.4250	36.0	11.31	23.44	70.75	83	YES	12.2
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

CHANNEL 1 (Fundamental = 462.5625 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS dB**	**TOTAL FIELD dB(µV/m)**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN dB**
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 1 (Fundamental = 462.5625 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 1 (Fundamental = 462.5625 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
420.2500	21.0000	5.31	15.34	41.65	83	YES	41.3
441.3500	24.0000	6.19	16.04	46.23	83	YES	36.8
462.5625	94.0000	6.19	16.74	116.93	N/A	N/A	N/A
615.2400	52.0000	7.78	19.33	79.11	83	YES	3.9
925.4250	36.0000	11.31	23.44	70.75	83	YES	12.2
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

CHANNEL 1 (Fundamental = 462.5625 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL & AT 3 METERS.							
FREQ. (MHz)	**AMPL QUASI-P (dBµV)**	**CABLE LOSS dB**	**ANTENNA FACTORS**	**TOTAL FIELD dBµV/m**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
462.5625	80.0	6.19	16.74	102.93	N/A	N/A	N/A
612.0000	38.0	7.78	19.33	65.11	83	YES	17.9
925.1250	29.0	11.31	23.44	63.75	83	YES	19.2
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

The following measurements above 1000 MHz were done with the spectrum analyzer set to 5dB/Division, 100 kHz resolution bandwidth, no video filtering and 0 dB attenuation.

CHANNEL 1 (Fundamental = 462.5625 MHz)

THE 1 TO 18 GHz HORN IS VERTICAL AND AT 3 METERS.

FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(µV/m)	PASS?	MARGIN (dBµV)
1389.5	-72	35	16.60	25.52	77	83	YES	5.9
NO OTHER SIGNIFICANT EUT SIGNALS FOUND TO 8 GHz.								

CHANNEL 1 (Fundamental = 462.5625 MHz)

THE 1 TO 18 GHz HORN IS HORIZONTAL AND AT 3 METERS.

FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(µV/m)	PASS?	MARGIN (dBµV)
1389.5	-69	38	16.60	25.52	80	83	YES	2.9
NO OTHER SIGNIFICANT EUT SIGNALS FOUND TO 8 GHz.								

CHANNEL 7 (Fundamental = 462.7125 MHz)

THE 1 TO 18 GHz HORN IS VERTICAL AND AT 3 METERS.

FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(µV/m)	PASS?	MARGIN (dBµV)
1389.8	-72	35	16.60	25.52	77	83	YES	5.9
NO OTHER SIGNIFICANT EUT SIGNALS FOUND TO 8 GHz.								

CHANNEL 7 (Fundamental = 462.7125 MHz)

THE 1 TO 18 GHz HORN IS HORIZONTAL AND AT 3 METERS.

FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(µV/m)	PASS?	MARGIN (dBµV)
1389.8	-69	38	16.60	25.52	80	83	YES	2.9
NO OTHER SIGNIFICANT EUT SIGNALS FOUND TO 8 GHz.								

continued on next page

RADIATED EMISSIONS TEST DATA

CHANNEL 8 (Fundamental = 467.5625 MHz)								
THE 1 TO 18 GHz HORN IS VERTICAL AND AT 3 METERS.								
FREQ. (MHz)	**AMPL PEAK dBm**	**AMPL PEAK dBuV**	**CABLE LOSS dB**	**HORN ANTENNA FACTOR**	**TOTAL FIELD (dBuV/m)**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
1404.5	-76	31	16.60	25.76	73	83	YES	9.6
NO OTHER SIGNIFICANT EUT SIGNALS FOUND TO 8 GHz.								

CHANNEL 8 (Fundamental = 467.5625 MHz)								
THE 1 TO 18 GHz HORN IS HORIZONTAL AND AT 3 METERS.								
FREQ. (MHz)	**AMPL PEAK dBm**	**AMPL PEAK dBuV**	**CABLE LOSS dB**	**HORN ANTENNA FACTOR**	**TOTAL FIELD (dBuV/m)**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
1404.5	-69	38	16.60	25.76	80	83	YES	2.6
NO OTHER SIGNIFICANT EUT SIGNALS FOUND TO 8 GHz.								

CHANNEL 14 (Fundamental = 467.7125 MHz)								
THE 1 TO 18 GHz HORN IS VERTICAL AND AT 3 METERS.								
FREQ. (MHz)	**AMPL PEAK dBm**	**AMPL PEAK dBuV**	**CABLE LOSS dB**	**HORN ANTENNA FACTOR**	**TOTAL FIELD (dBuV/m)**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
1404.9	-75	32	16.60	25.76	74	83	YES	8.6
NO OTHER SIGNIFICANT EUT SIGNALS FOUND TO 8 GHz.								

CHANNEL 14 (Fundamental = 467.7125 MHz)								
THE 1 TO 18 GHz HORN IS HORIZONTAL AND AT 3 METERS.								
FREQ. (MHz)	**AMPL PEAK dBm**	**AMPL PEAK dBuV**	**CABLE LOSS dB**	**HORN ANTENNA FACTOR**	**TOTAL FIELD (dBuV/m)**	**FCC LIMIT dB(µV/m)**	**PASS?**	**MARGIN (dBµV)**
1404.9	-69	38	16.60	25.76	80	83.07	YES	2.7
NO OTHER SIGNIFICANT EUT SIGNALS FOUND TO 8 GHz.								

THE 21st CENTURY/HANYANG ELECTRONICS, Ltd. MODEL FRS-4000 MEETS THE RADIATED EMISSIONS REQUIREMENT OF FCC PART 95, SUBPART "B" FOR THE FAMILY RADIO SERVICE AND FCC PART 15, SUBPART B WITHOUT MODIFICATIONS.

EMI TEST PROCEDURES
MODULATION CHARACTERISTICS

Part 2, section 2.1047 of the FCC title 47 rules requires a description of the modulation characteristics of the EUT. For equipment that is voice modulated, it is necessary to state the frequency response of the audio modulating circuit while using a modulation signal of 100 to 5000 Hz in discrete steps. For equipment that employs audio modulation limiting circuitry, it is necessary to state the percentage of modulation versus the modulation signal voltage.

The manufacturer of the FRS-4000, HanYang Electronics Co., Ltd. has performed the audio frequency response with a 1 kHz deviation signal. They have supplied the data in a table format.

Audio Frequency, (Hz)	Relative Response, (dB)
100	-25.0
300	-11.5
500	-4.4
900	-1.0
1200	1.6
1500	3.4
1800	4.8
2100	5.7
2400	6.6
2700	6.3
3000	5.6
3300	5.3
3600	4.0
4000	1.5
5000	-10

EMI TEST PROCEDURES
MODULATION CHARACTERISTICS, Continued

The modulation limiting characteristic measurements are stated as maximum deviations in kHz found for each of 11 test frequencies. They have also supplied this data in a table format.

Audio Frequency, (Hz)	Maximum Deviation, (kHz)
300	1.98
600	1.90
900	1.92
1200	1.93
1500	1.93
1800	1.95
2100	1.94
2400	1.86
2700	1.75
3000	1.80
3300	1.61

Schematics of the audio limiting circuitry and band pass filter are included in the separate schematic exhibits.

EMI TEST PROCEDURES
FCC PART 95
OCCUPIED BANDWIDTH MEASUREMENTS

It is necessary to measure and submit the occupied bandwidth of the fundamental or carrier transmitter signals according to Part 2, section 2.1049 of title 47 of the FCC rules. The occupied bandwidth is the frequency span centered on the fundamental frequency where 99% of the radiated power exists. The FCC specifies the occupied bandwidth i.e. "authorized bandwidth" for all relevant product families.

The occupied bandwidths for the transmitter frequencies of this EUT are documented in the spectrum analyzer plots uploaded in the exhibits. All plots show the occupied bandwidth with and without a 2500 Hz modulation signal.

The plots of the occupied bandwidth for the three test frequencies were obtained by connecting the center conductor of a BNC coax cable to the antenna mounting stud and leaving the shield floating. The cable was then attached to the input of the R3361A spectrum analyzer. The antenna impedance was stated to be 50 ohms according to HanYang. A 27 dB test signal was used from the signal generator to produce a maximum FM effect on the spectrum analyzer display.

To inject the modulation signal, a signal generator was soldered to the microphone terminals with a BNC to two-wire adapter. The signal generator was set to 2500 Hz. The microphone was disconnected from the FRS-4000 for this work and battery power was brought to the FRS-4000 with jumper wires.

The spectrum produced by the modulated and unmodulated cases were plotted and the emission mask drawn on them. They are found in the plot and photo section. Emission mask "B" of section 90.210 of the rules was used. It has the following characteristics:
1) On any frequency removed from the assigned frequency by more than 50 %, but not more than 100% of the authorized bandwidth, the frequency must be below the unmodulated carrier by at least 25 dB.
2) On any frequency removed from the assigned frequency by more than 100 %, but not more than 250% of the authorized bandwidth, the frequency must be below the unmodulated carrier by at least 35 dB.
3) On any frequency removed from the assigned frequency by more than 250 %, the frequency must be below the unmodulated carrier according to $43 + 10 \log P$ (dB).
In this case, P = 0.446 watts when channel 14 is used, yielding 39.5 dB.

The carrier of all test frequencies was within the 12.5 kHz bandwidth authorized in 905.633, paragraph "c." This bandwidth does not increase when normal speech is transmitted from the FRS-4000 radios.

EMI TEST PROCEDURES
SPURIOUS EMISSIONS AND RF POWER OUTPUT
AT THE ANTENNA TERMINALS

Part 2; section 2.1051 of the FCC title 47 rules requires a relative measurement of spurious emissions at the antenna terminals of the EUT. Because the FRS-4000 can only employ it's integral antenna for lawful use, these measurements were performed with the Open Area Test Site (OATS) used for Effective Radiated Power Measurements.

This method captured not only spurious emissions at the antenna terminals and then radiated, but emissions that may be radiating from the FRS-4000 plastic enclosure itself. When the maximum permissible level of spurious emissions was expressed as a field strength, a dipole antenna was used to produce an equivalent signal.

See the Excel spreadsheets in the effective radiated power & spurious emission measurements section located earlier in this report.

EMI TEST PROCEDURES
FREQUENCY STABILITY MEASUREMENTS

Part 2; section 2.1055 of the FCC title 47 rules requires a measurement of the carrier frequency stability under temperature and power voltage variations.

For producing temperature variations, a refrigerator partially loaded with dry ice was used to produce the coldest temperatures. To reach warmer temperatures, a portable heater was used. A thermocouple and its multimeter-based measuring device as well as a thermohygrometer were used to observe the temperatures of the EUT during all phases of the test for acceptable accuracy. One thermocouple will be mounted on the EUT as describe below, while a second one was suspended in the refrigerated cavity to monitor its' air temperature.

For this project, the FRS transceiver board was removed from the enclosure and the same RG-223 coaxial cable used for the occupied bandwidth measurements was screwed to the antenna port. The 4.5 VDC power was delivered by a twisted wire pair from a DC power supply. The wires were soldered to the battery pack terminals.

The thermocouple sensor wire was fixed to the voltage controlled oscillator side of the transceiver board under several wraps of electrical tape. This tape also served to hold the Push-to-talk button down. This way, when the power was applied by the supply, the FRS-4000 would immediately begin transmission at whatever frequency was used previously. The FRS-4000 could also be powered off while it was attaining thermal equilibrium inside the refrigerator (necessary because the thermocouples are very sensitive to any EMI). All cables were bundled into a single group with more tape.

Once the desired temperature was reached, the FRS-4000 was powered for about a minute while the spectrum analyzer completed its slow sweep. There appear to be no temperature compensating circuits on the transceiver board.

The data was entered into the tables on the following pages. Measurements are taken every 10°C until the highest temperature of the test is reached. The measurements are put into tabular form. The total frequency change tolerance allowed by the standard is expressed in terms of parts-per-million. The unmodulated carrier frequency is measured with the Advantest R3361A spectrum analyzer "counter" function operating over a 100 kHz frequency span that has precision to 0.000001 MHz.

Frequency stability was measured in much the same way while varying the power input voltage from 85% to 115% of nominal. The DC power supply was used to produce the battery voltage. Measurements were made at every 5% change in power voltage. All results were entered into the following tables for all three test frequencies.

EMI TEST PROCEDURES
FREQUENCY STABILITY MEASUREMENT RESULTS

The frequency stability due to the -30°C to 50°C temperature and 80% to 115% power supply voltage variation for channels 1, 8 and 14 the tables below. The FRS-4000 was unmodulated during these measurements.

Channel 1, 462.5625 MHz:

Power Supply %	Voltage	Measured Carrier Frequency, MHz
80%:	3.60	462.562214
85%:	3.83	462.562313
90%:	4.05	462.562332
95%:	4.28	462.562302
100%:	4.50	462.562325
105%	4.73	462.562305
110%	4.95	462.562300
115%	5.17	462.562210

Channel 1, 462.5625 MHz:

Temperature °C	Measured Carrier Frequency, MHz
-20	462.561340
-10	462.561360
0	462.561990
10	462.562100
20	462.561730
30	462.561700
40	462.561390
50	462.561360

The FRS-4000 was not within the 2.5 p.p.m. tolerance for -30°C. The carrier was typically at 467.7110x MHz at –30°C.

For all measurements, FCC Rule 90.213 specifies a frequency stability of 2.5 p.p.m. (2.5×10^{-6}), which when multiplied by the carrier is +/- 0.001156 MHz, corresponding to:

High Limit 462.563656 MHz
Low Limit 462.561344 MHz

EMI TEST PROCEDURES
FREQUENCY STABILITY MEASUREMENT RESULTS, Cont.

Channel 8, 467.5625 MHz:

Power Supply %	Voltage	Measured Carrier Frequency, MHz
80%:	3.60	467.562282
85%:	3.83	467.562210
90%:	4.05	467.562240
95%:	4.28	467.562210
100%:	4.50	467.562262
105%	4.73	467.562270
110%	4.95	467.562410
115%	5.17	467.562430

Channel 8, 467.5625 MHz:

Temperature °C	Measured Carrier Frequency, MHz
-20	467.561360
-10	467.561410
0	467.562010
10	467.5623040
20	467.562070
30	467.561560
40	467.561390
50	467.561590

The FRS-4000 was not within the 2.5 p.p.m. tolerance for -30°C. The carrier was typically at 467.7110x MHz at –30°C.

For all measurements, FCC Rule 90.213 specifies a frequency stability of 2.5 p.p.m. (2.5×10^{-6}), which when multiplied by the carrier is +/- 0.001169 MHz, corresponding to:

High Limit 467.563669 MHz
Low Limit 467.561331 MHz

EMI TEST PROCEDURES
FREQUENCY STABILITY MEASUREMENT RESULTS, Cont.

Channel 14, 467.7125 MHz:

Power Supply %	Voltage	Measured Carrier Frequency, MHz
80%:	3.60	467.712440
85%:	3.83	467.712300
90%:	4.05	467.712325
95%:	4.28	467.712318
100%:	4.50	467.712308
105%	4.73	467.712270
110%	4.95	467.712300
115%	5.17	467.712240

Channel 14, 467.7125 MHz:

Temperature °C	Measured Carrier Frequency, MHz
-20	467.711470
-10	467.712010
0	467.711164
10	467.712366
20	467.711640
30	467.717300
40	467.711332
50	467.71300

The FRS-4000 was not within the 2.5 p.p.m. tolerance for -30°C. The carrier was typically at 467.7110x MHz at –30°C.

For all measurements, FCC Rule 90.213 specifies a frequency stability of 2.5 p.p.m. (2.5×10^{-6}), which when multiplied by the carrier is +/- 0.001169 MHz, corresponding to:

High Limit 467.713669 MHz
Low Limit 467.711331 MHz

EMI TEST PROCEDURES
RADIATION EXPOSURE LIMITS FOR MOBILE DEVICES

Part 2, section 2.1091 of the FCC title 47 rules requires a measurement of the radiation exposure an operator would be exposed to while using radio frequency devices in close proximity to his/her head. An example of this kind of EUT would be a cellular phone. The test that is used to perform this measurement is known as "SAR".

At this time, there are no requirements for radiation exposure limits for Family Radio Service units.

EMI TEST PROCEDURES
TRANSIENT FREQUENCY BEHAVIOUR

Section 90.214 requires transmitters designed to operate in the 150-174 MHz and 421-512 MHz bands to control transient frequency effects within defined time intervals and frequency differences. Section 90.214 requires a 1 kHz test signal to be used as the modulating signal instead of the modulation signal that had been used for the other measurements. The purpose is to measure the frequency difference between the actual and assigned carrier transmitter frequency that is caused by turning the transmitter on and off.

For this project, the 1 kHz modulating test signal was injected into the FRS-4000 by soldering the leads of the audio oscillator across the speaker/microphone terminals, just as was done for the occupied bandwidth measurements. The only difference is the use of a 1 kHz modulating test signal.

With this arrangement, the 1 kHz test signal would modulate the FRS-4000 carrier instead of the normal voice modulation. The frequency displacement was measured by the Advantest R3361A spectrum analyzer "Marker" and "Max Hold" features. A 27 dB test signal was used from the signal generator to produce a maximum FM effect.

When the transmitter is keyed, the carrier frequency with modulation appears briefly displaced from where it had been centered without modulation. Because power was never removed from the FRS-4000, the frequency displacement is due to the capture of the 1 kHz modulating test signal. The measurements for all three test frequencies are described in the table below.

Nominal Unmodulated Carrier Frequency (MHz)	Maximum Frequency, Deviation (MHz)
Channel 1: 462.5625	0
Channel 8: 462.5625	0
Channel 14: 462.5625	0

SUMMARY
21st CENTURY INNOVATIVE PRODUCTS/HANYANG ELECTRONICS, Ltd.
FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO

The FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO, the EUT, was tested for RF emissions in accordance with the applicable agency rules and guidelines.

The EUT was subjected to Part 15 RADIATED ELECTRIC FIELD ANALYSIS.
No EUT signals could be detected when the EUT was in the receive mode.

The EUT was subjected to PART 95 RADIATED ELECTRIC FIELD ANALYSIS, for the Family Radio Service when it is transmitting.
The frequency closest to the limits was 612 MHz, with a 1.0 dB margin.
This was measured with the FRS-4000 transmitting on channel 14.

The EUT meets the frequency stability requirements for -20° to 50°C and 3.6 to 5.17 VDC ranges, spurious emissions, transient frequency behavior and occupied bandwidth requirements of FCC Part 2.

The 21st CENTURY INNOVATIVE PRODUCTS/HANYANG ELECTRONICS, Ltd. FRS-4000 "WALK & TALK" UHF TWO-WAY RADIO complies with the essential technical requirements of FCC Parts 15 for Class B, Part 95, the Family Radio Service and Part 2 without modifications.