



FCC PART 95
TEST AND MEASUREMENT REPORT

For

Midland Radio Corporation

5900 Parretta Drive,
Kansas City, MO 64120, USA

Model: GXT5000
FCC ID: MMAGXT5000

Report Type: Original Report	Product Type: FRS/GMRS Handheld 2-Way Radio
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Report Number: R1008022-95	
Report Date: 2010-09-07	
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* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk “*” (Rev.2)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1008022-95	Original	2010-09-07

1. General Information

1.1 Product Description for Equipment under Test (EUT)

This Bay Area Compliance Laboratories Corp. test report has been prepared on behalf of *Midland Radio Corporation* and their product, GXT5000 (FCC ID: *MMAGXT5000*) or the EUT (Equipment Under Test) as referred to in the rest of this report. The EUT is a GMRS/FRS Portable Transceiver.

The EUT is a FRS/GMRS radio self-contained transceiver unit with integral antenna intended for use as a general communication tool. It is designed to operate on all 22 channels allocated by the FCC. It features a CTCSS system with 38 pre-define, DCS System with 83 pre-define, user selectable sub-audible tones for channel quieting. The useable range, while dependent upon terrain and other radio propagation principles, is typically ten miles. The GXT5000 uses the maximum transmit power allowed to help ensure the maximum communication range.

Features include: 22 GMRS Channels with 38 CTCSS codes, 83 DCS Code, Receive Volume Control, Channel Monitor, Page and LCD Display. The unit is equipped with an external Headset option connector. A 1100mAh NiMH Battery Pack or a 2200mAh Li-ion Battery Pack that are supplied with the radio supply operating power. An automatic power savings feature allows the typical standby battery life to extend to more than 5 days.

Item	Content
Modulation	FM
Frequency Band	FRS: 462.5625 ~ 467.7125 MHz GMRS: 462.5625 ~ 462.7125 MHz 462.5500 ~ 462.7250 MHz
Power Source	1100mAh/2200mAh NiMH Battery Pack
Normal Operation	Face-held and Body-worn (Belt Clip)

1.2 Mechanical Description

The EUT measures approximately 6 cm (L) x 3cm (W) x 21 cm (H) and weights approximately 328.5g.

The data gathered are from a typical production sample provided by the manufacturer, serial number: 1006000001

1.3 Objective

This type approval report is prepared on behalf of *Midland Radio Corporation* in accordance with Part 2, Subpart J and Part 95 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for RF output power, modulation characteristic, occupied bandwidth, spurious emission at antenna terminal, field strength of spurious radiation, frequency stability, band edge, and conducted and radiated margin.

1.4 Related Submittal(s)/Grant(s)

None.

1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 95A: General Mobile Radio Service (GMRS)

Part 95B: Family Radio Service (FRS)

Applicable Standards: TIA 603-C, ANSI C63.4-2003.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from ± 2.0 for Conducted Emissions tests and ± 4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

1.7 Test Facility

The test site used by Bay Area Compliance Laboratories Corp. to collect radiated and conducted emission measurement data is located at their facility in Sunnyvale, California 94089, USA.

The test site at Bay Area Compliance Laboratories Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules and Article 8 of the VCCI regulations. The facility also complies with the test methods and procedures set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference have the reports on file and are listed under FCC file 31040/SIT 1300F2, IC registration number: 3062A, and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at <http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm>

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA-603-C.

2.2 EUT Exercise Software

Burn test software to exercise the unit was provided by the client.

2.3 Special Equipment

N/A

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Midland	Rechargeable Ni-MH Battery Pack	BATT5000	-
Midland	Switch Power Supply	S036BP0950300	-
Midland	Desk Top Charger	18CVP5000	-

2.6 Interface Ports and Cabling

Cable Description	Length (m)	From	To
Audio cable	0.5	Microphone	EUT

2.7 Internal PCB Assembly List and Details

Manufacturers	Description	Model	Serial Numbers
Midland	PCB	GMRS450_X1	-

3 Summary of Test Results

FCC Rules	Description Of Test	Result
§2.1047, §95.637	Modulation Characteristics	Compliant
§2.1053, §95.635	Field Strength of Spurious Radiation	Compliant
§2.1046 ; §95.639	RF Output Power	Compliant
§2.1049; §95.633; §95.635	Occupied Bandwidth & Emission Mask	Compliant
§2.1051, §95.635	Spurious Emissions at Antenna Terminals	Compliant
§2.1055 (a);§2.1055 (d) §95.621; §95.627	Frequency stability vs. temperature Frequency stability vs. voltage	Compliant
§2.1093	RF Exposure	Compliant ¹

Note¹: Please refer to SAR report, report number: R1008022-SAR.

4 FCC §2.1046 & §95.639 – RF Output Power

4.1 Applicable Standard

(a) No GMRS transmitter, under any condition of modulation, shall exceed:

(1) 50 Watt (47dBm) Carrier power (average TP during one unmodulated RF cycle) when transmitting emission type A1D, F1D, G1D, A3E, F3E or G3E.

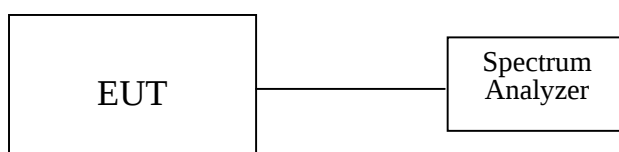
(2) 50 Watt (47dBm) peak envelope TP when transmitting emission type H1D, J1D, R1D, H3E, J3E or R3E.

(d) No FRS unit, under any condition of modulation, shall exceed 0.500 Watt (27dBm) effective radiated power (ERP).

4.2 Test Procedure and Block Diagram

TIA-603-C clause 2.2.17.2

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation.



4.3 Test Equipment List and Details

Manufacturer	Type	Models	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4440A	MY44303352	2010-05-09

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

4.4 Test Environmental Conditions

Temperature:	25 ° C
Relative Humidity:	64 %
ATM Pressure:	102.4 kPa

The testing was performed by Jerry Huang on 2010-08-13 in RF Site.

4.5 Test Results

Conducted Output Power:

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Conducted Output Power (Watt)	Limit (Watt)
GMRS (462.6375 MHz)				
CH 4	462.6375	36.72	4.70	50
FRS (462.6375 MHz)				
CH 4	462.6375	25.68	0.372	0.5
FRS (467.6375 MHz)				
CH 11	467.6375	26.92	0.492	0.5

ERP:

Indicated		Table Azimuth (degrees)	Test Antenna		Substitution				Absolute Level (dBm)	FCC Part 95	
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polar (H/ V)	Frequency (MHz)	Level (dBm)	Antenna Gain	Cable Loss (dB)		Limit (dBm)	Margin (dB)
GMRS CH-4											
462.6375	116.36	0	173	V	462.6375	37.33	0	1.34	35.99	47	-11.01
FRS CH-4											
462.6375	107.03	0	181	V	462.6375	28	0	1.34	26.66	27	-0.34
FRS CH-11											
467.6375	106.83	275	170	V	467.6375	27.09	0	1.34	25.75	27	-1.25

5 FCC §2.1047 & §95.637 - Modulation Characteristics

5.1 Applicable Standard

FCC §2.1047(d) and §95.637.

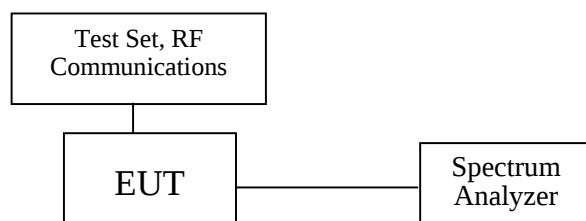
(a) A GMRS transmitter that transmits emission types F1D, G1D, or G3E must not exceed a peak frequency deviation of plus or minus 5 kHz. A GMRS transmitter that transmits emission type F3E must not exceed a peak frequency deviation of plus or minus 5 kHz. A FRS unit that transmits emission type F3E must not exceed a peak frequency deviation of plus or minus 2.5 kHz, and the audio frequency response must not exceed 3.125 kHz.

(b) Each GMRS transmitter, except a mobile station transmitter with a power output of 2.5 W or less, must automatically prevent a greater than normal audio level from causing overmodulation. The transmitter also must include audio frequency low pass filtering, unless it complies with the applicable paragraphs of §95.631 (without filtering.) The filter must be between the modulation limiter and the modulated stage of the transmitter. At any frequency (f in kHz) between 3 and 20 kHz, the filter must have an attenuation of at least $60 \log_{10}(f/3)$ dB greater than the attenuation at 1 kHz. Above 20 kHz, it must have an attenuation of at least 50 dB greater than the attenuation at 1 kHz.

5.2 Test Procedure and Block Diagram

At different modulating frequencies, the output level of the audio generator was varied and the AM deviation level was recorded.

TIA-603-C section 2.2.3, 2.2.6



5.3 Test Equipment List and Details

Manufacturer	Equipment Description	Models	Serial Numbers	Last Calibration
Agilent	PSA Series Spectrum Analyzer	E4440A	MY44303352	2010-05-09
HP	Test Set, RF Communications	8920A	3438A05338	2010-05-18

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

5.4 Test Environmental Conditions

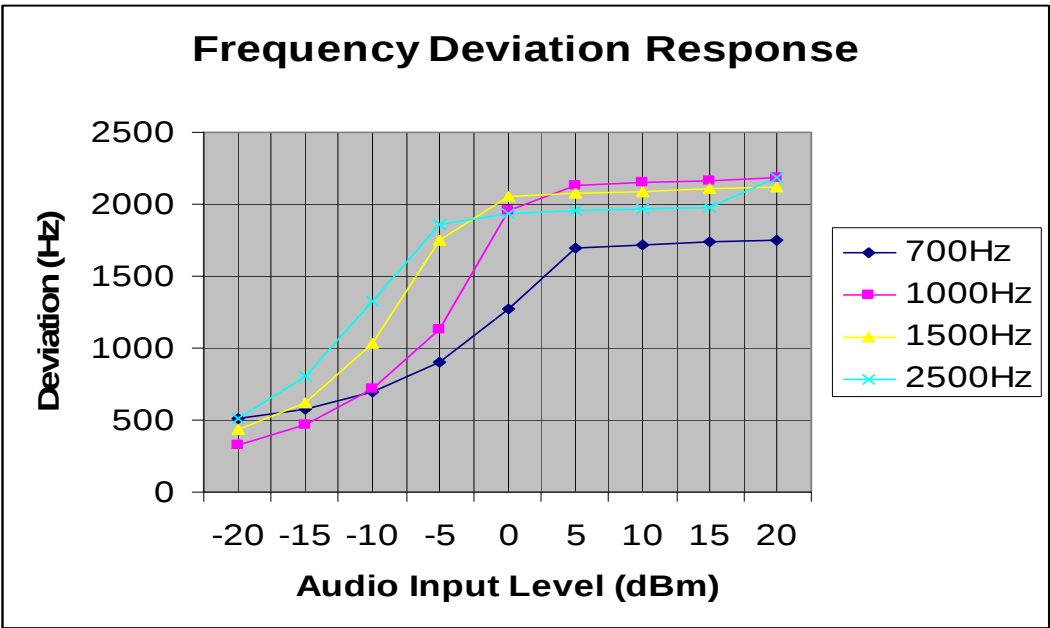
Temperature:	26 ° C
Relative Humidity:	44 %
ATM Pressure:	103.4 kPa

The testing was performed by Jerry Huang on 2010-08-18 in RF Site

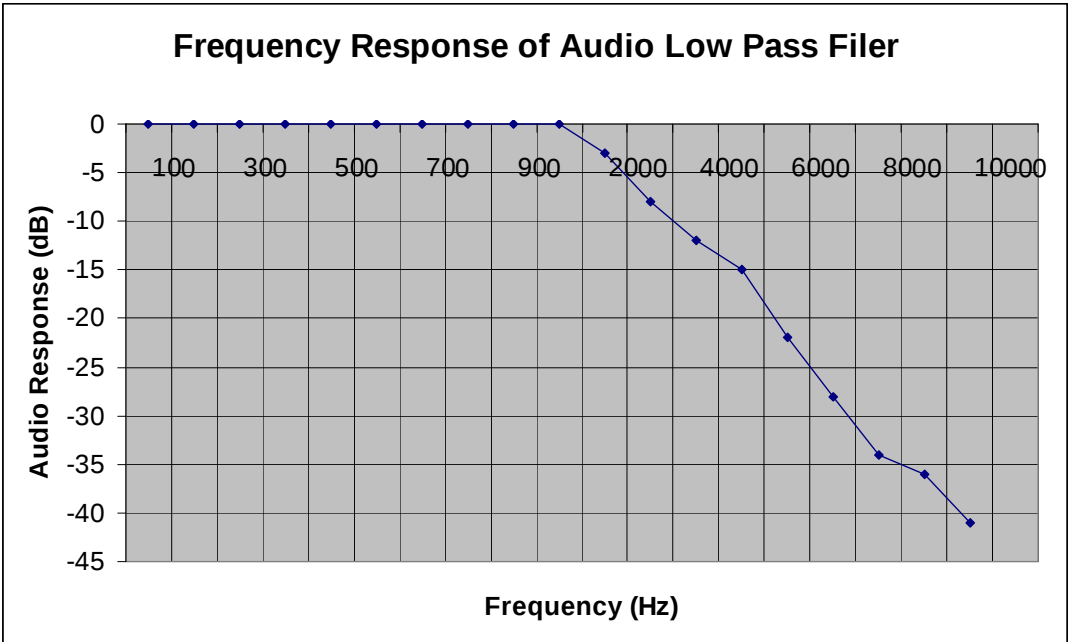
5.5 Test Results

Please refer to the plots.

Modulation Limiting



Frequency Response of Audio Low Pass Filter



6 FCC §2.1049, §95.633 & §95.635 – Occupied Bandwidth & Emission Mask

6.1 Applicable Standards

FCC §2.1049 and §95.633 (a) (c).

(a) The authorized bandwidth (maximum permissible bandwidth of a transmission) for emission type H1D, J1D, R1D, H3E, J3E or R3E is 4 kHz. The authorized bandwidth for emission type A1D or A3E is 8 kHz. The authorized bandwidth for emission type F1D, G1D, F3E or G3E is 20 kHz.

(b) The authorized bandwidth for emission type F3E or F2D transmitted by a FRS unit is 12.5 kHz.

Transmitter	Emission type	Applicable paragraphs (b)
GMRS	A1D, A3E, F1D, G1D, F3E, G3E with filtering	(1), (3), (7).
	A1D, A3E, F1D, G1D, F3E, G3E without filtering	(5), (6), (7).
	H1D, J1D, R1D, H3E, J3E, R3E	(2), (4), (7).
FRS	F3E with filtering	(1), (3), (7).

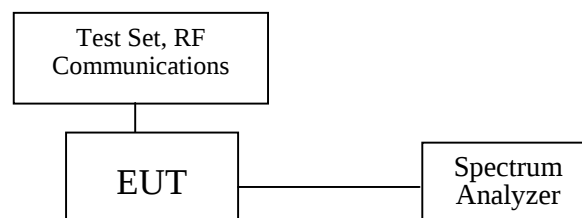
(1) At least 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.

(3) At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.

(7) At least $43 + 10 \log_{10}(T)$ dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

6.2 Test Procedure and Block Diagram

The RF output of the transmitter was connected to the simulator and the spectrum analyzer through sufficient attenuation.



6.3 Test Equipment List and Details

Manufacturer	Equipment Description	Models	Serial Numbers	Last Calibration
Agilent	PSA Series Spectrum Analyzer	E4440A	MY44303352	2010-05-09
HP	DC Power Supply	6236B	-	Not required
Agilent	Generator	33220A	MY43004878	2010-07-29

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

6.4 Test Environmental Conditions

Temperature:	25 °C
Relative Humidity:	64 %
ATM Pressure:	102.4 kPa

The testing was performed by Jerry Huang on 2010-08-13 in RF Site

6.5 Test Results

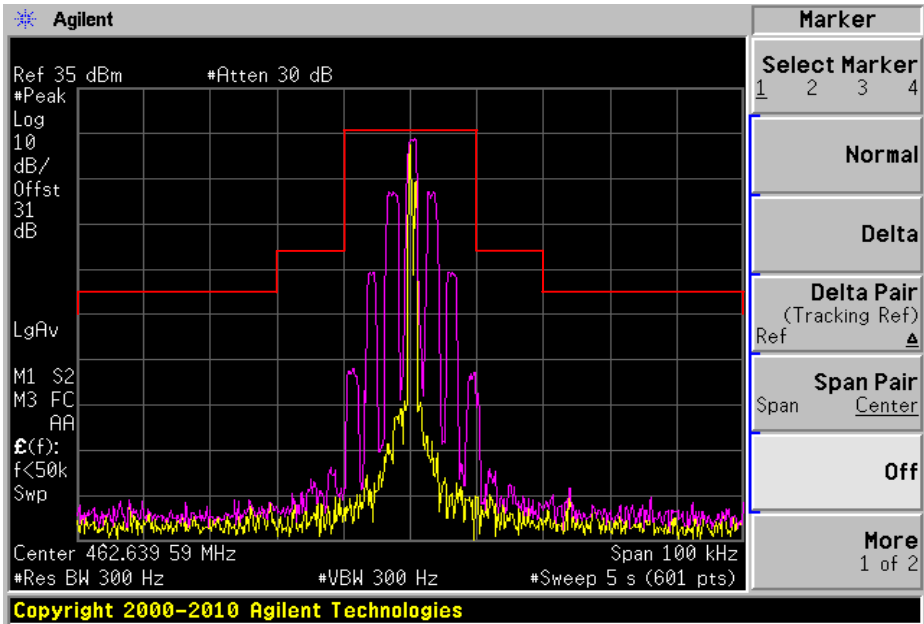
According to FCC §2.201 & §2.202

$B_n = 2M + 2DK$;
 $M = 3000$; $D = 2.5 \text{ k}$; $K = 1$

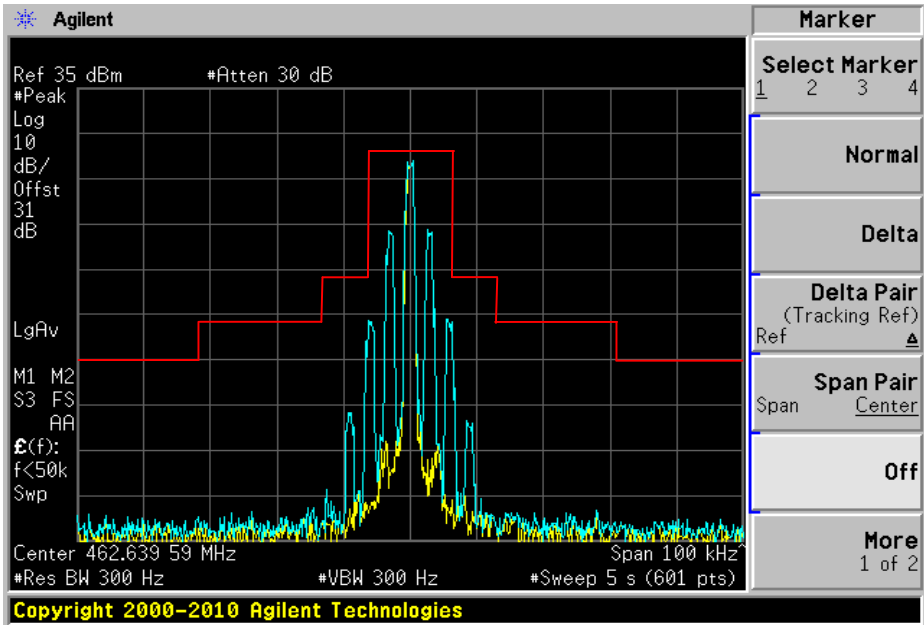
$B_n = 2(3000) + 2(2500) = 11\text{k}$; Type of Emission: 11k0F3E

Emission Mask

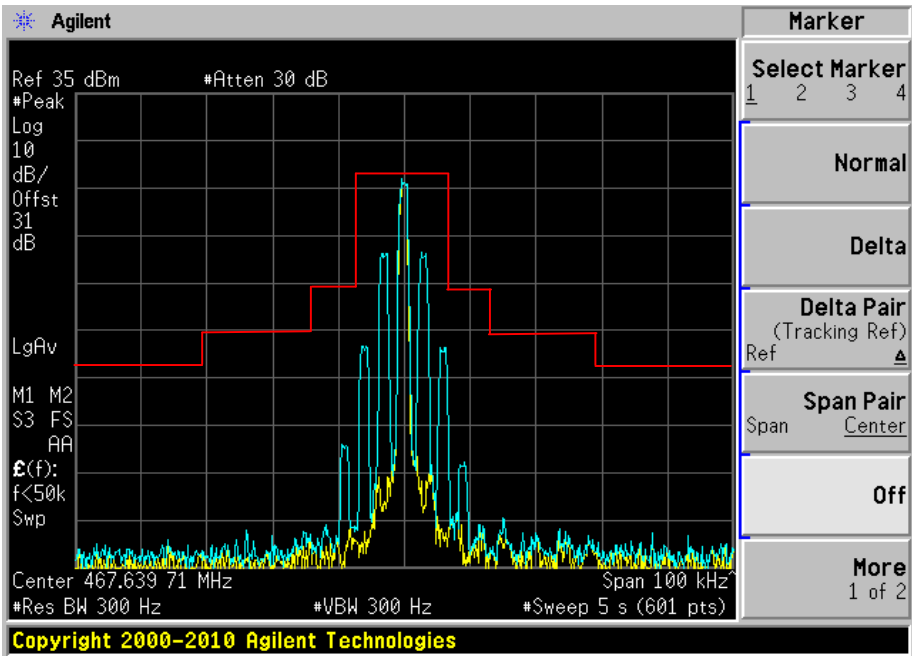
GMRS, CH 4



FRS, CH 4



FRS, CH 11



7 FCC §2.1051 & §95.635 – Spurious Emissions at Antenna Terminals

7.1 Applicable Standards

FCC §2.1051 and §95.635.

Transmitter	Emission type	Applicable paragraphs (b)
GMRS	A1D, A3E, F1D, G1D, F3E, G3E with filtering	(1), (3), (7).
	A1D, A3E, F1D, G1D, F3E, G3E without filtering	(5), (6), (7).
	H1D, J1D, R1D, H3E, J3E, R3E	(2), (4), (7).
FRS	F3E with filtering	(1), (3), (7).

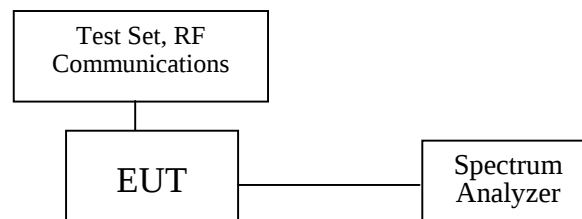
- (1) At least 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.
- (3) At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.
- (7) At least $43 + 10 \log_{10}(T)$ dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

7.2 Test Procedure and Block Diagram

Conducted:

TIA 603-C Clause 2.2.13

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation.



7.3 Test Equipment List and Details

Manufacturer	Equipment Description	Models	Serial Numbers	Last Calibration
Agilent	PSA Series Spectrum Analyzer	E4440A	MY44303352	2010-05-09
HP	DC Power Supply	6236B	-	Not required
Agilent	Generator	33220A	MY43004878	2010-07-29

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

7.4 Test Environmental Conditions

Temperature:	25 °C
Relative Humidity:	64 %
ATM Pressure:	102.4 kPa

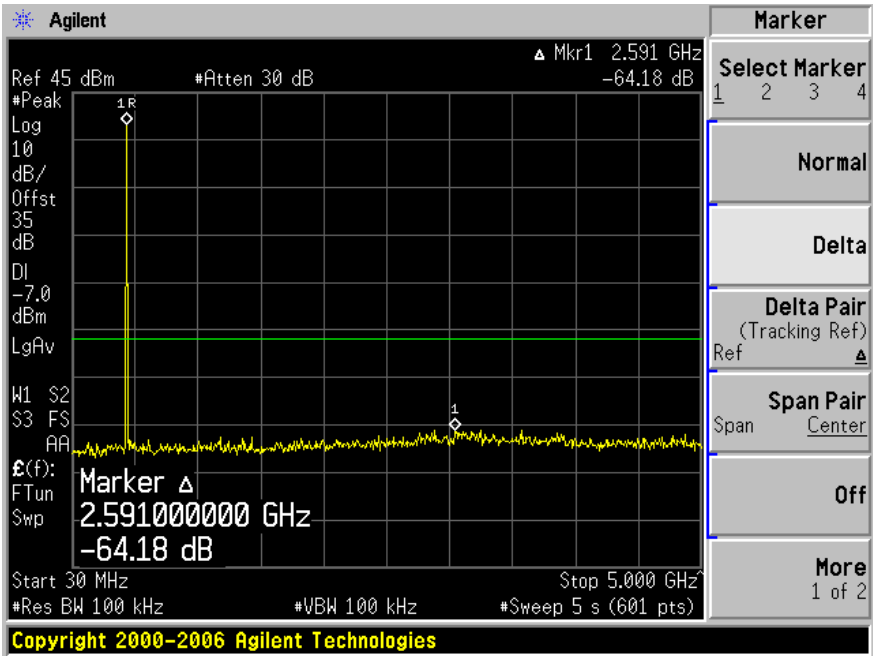
The testing was performed by Jerry Huang on 2010-08-13 in RF Room

7.5 Test Results

No non-compliance noted, please refer to the plots.

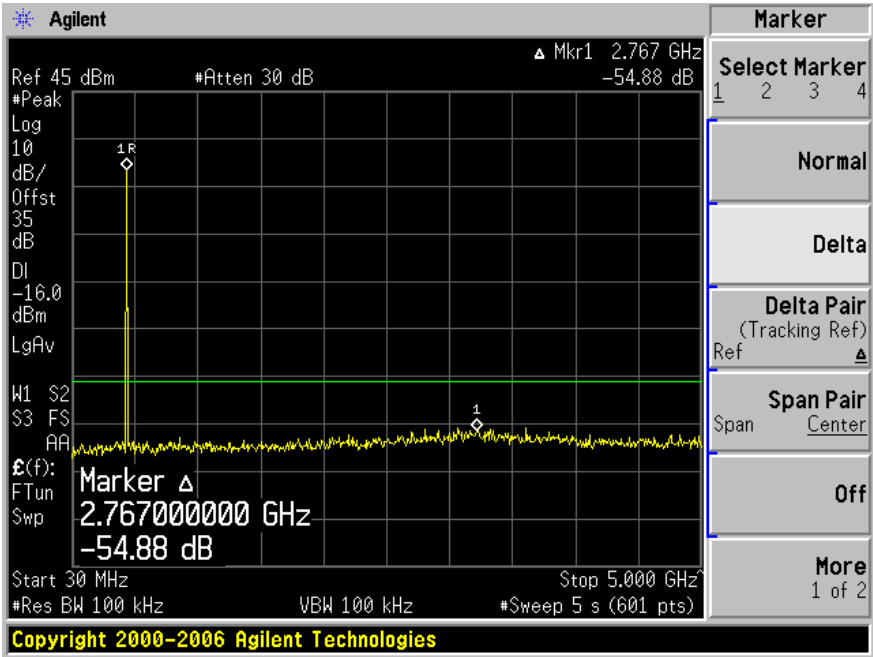
GMRS

CH4

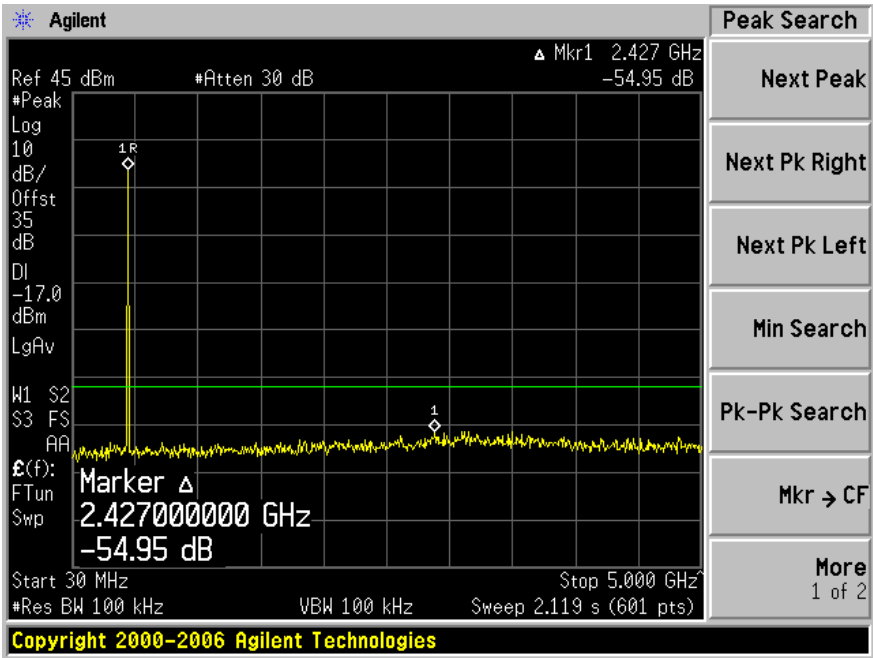


FRS

CH4



CH111



8 FCC §2.1053 & §95.635 – Spurious Radiated Emissions

8.1 Applicable Standards

FCC §2.1051 and §95.635.

Transmitter	Emission type	Applicable paragraphs (b)
GMRS	A1D, A3E, F1D, G1D, F3E, G3E with filtering	(1), (3), (7).
	A1D, A3E, F1D, G1D, F3E, G3E without filtering	(5), (6), (7).
	H1D, J1D, R1D, H3E, J3E, R3E	(2), (4), (7).
FRS	F3E with filtering	(1), (3), (7).

- (1) At least 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.
- (3) At least 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.
- (7) At least $43 + 10 \log_{10}(T)$ dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

8.2 Test Procedure

TIA/EIA 603-C Clause 2.2.12

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

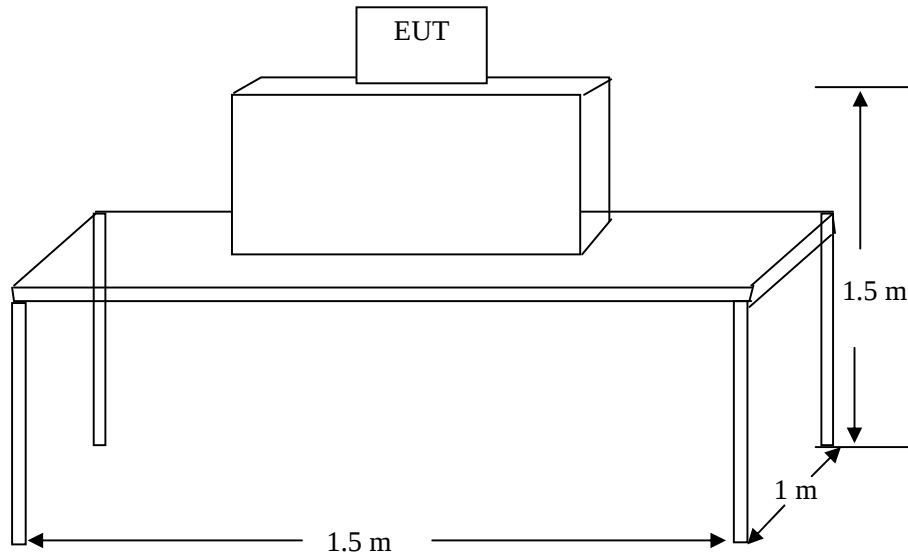
The frequency range up to tenth harmonic of the fundamental frequency was investigated.

The EUT Removed and replaced with a substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = $10 \log(\text{TXpwr in Watts}/0.001)$ – the absolute level

Spurious attenuation limit in dB = $43 + 10 \log_{10}(\text{power out in Watts})$

8.3 Test Block Diagram



8.4 Test Equipment List and Details

Manufacturer	Type	Model	Serial Number	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100038	2010-06-24
Solar Electronics	LISN	9252-R-24-BNC	511205	2010-06-25
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB1	A020106-3	2010-06-16
Agilent	Pre Amplifier	8447D	2944A10187	2010-03-26
HP	Generator, Signal	83650B	3614A00276	2010-06-21
A.R.A Inc.	Horn antenna	DRG-1181A	1132	2009-10-27
Agilent	PSA Series Spectrum Analyzer	E4440A	MY44303352	2010-05-09

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

8.5 Test Environmental Conditions

Temperature:	26 °C
Relative Humidity:	44 %
ATM Pressure:	103.4 kPa

The testing was performed by Jerry Huang on 2010-08-18 in 5m chamber 3

8.6 Test Results

GMRS Channel 4:

Indicated		Azimuth Degree	Test Antenna		Substitution					Limit (dBm)	Margin (dB)
Frequency (MHz)	Amp. (dBm)		Height (cm)	Polar (H/V)	Frequency MHz	Level (dBm)	Antenna Gain Cord.	Cable Loss (dB)	Absolute Level (dBm)		
925	64.88	219	156	H	925	-35.04	0	0.5	-35.54	-13	-22.54
925	66.91	265	120	V	925	-30.77	0	0.5	-31.27	-13	-18.27
1850	70.93	140	100	H	1850	-35.41	25.7	4.54	-14.25	-13	-1.25
1850	66.58	268	192	V	1850	-40.28	25.7	5.54	-20.12	-13	-7.12

FRS Channel 4:

Indicated		Azimuth Degree	Test Antenna		Substitution					Limit (dBm)	Margin (dB)
Frequency (MHz)	Amp. (dBm)		Height (cm)	Polar (H/V)	Frequency MHz	Level (dBm)	Antenna Gain Cord.	Cable Loss (dB)	Absolute Level (dBm)		
925	55.71	92	156	H	925	-44.21	0	0.5	-44.71	-13	-31.71
925	56.14	175	145	V	925	-41.54	0	0.5	-42.04	-13	-29.04

FRS Channel 11:

Indicated		Azimuth Degree	Test Antenna		Substitution					Limit (dBm)	Margin (dB)
Frequency (MHz)	Amp. (dBm)		Height (cm)	Polar (H/V)	Frequency MHz	Level (dBm)	Antenna Gain Cord.	Cable Loss (dB)	Absolute Level (dBm)		
935	56.24	299	115	H	935	-41.82	0	0.5	-42.32	-13	-29.32
935	57.97	69	141	V	935	-38.25	0	0.5	-38.75	-13	-25.75

9 FCC §2.1055, §95.621 & §95.627 – Frequency Stability

9.1 Applicable Standard

FCC §2.1055, §95.621 (b), §95.627 (b)

§95.621 (b) Each GMRS transmitter for mobile station, small base station and control station operation must be maintained within a frequency tolerance of 0.0005%. Each GMRS transmitter for base station (except small base), mobile relay station or fixed station operation must be maintained within a frequency tolerance of 0.00025%.

§95.627 (b) Each FRS unit must be maintained within a frequency tolerance of 0.00025%.

9.2 Test Procedure

Frequency Stability vs. Temperature:

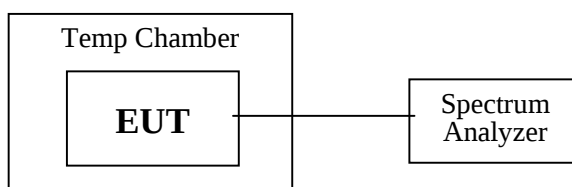
The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed through attenuators. EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the frequency counter.

Frequency Stability vs. Voltage:

An external variable DC power supply was connected to the EUT, The voltage was set to 115%, 100%, and 85% of the nominal operating input voltage, and the frequency output was recorded from the frequency counter.

9.3 Test Block Diagram



9.4 Test Equipment List and Details

Manufacturer	Equipment Description	Models	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2010-05-09
Tenney	Temperature Oven	VersaTenn	27445-06	2010-06-28

Statement of Traceability: *BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.*

9.5 Test Environmental Conditions

Temperature:	25 °C
Relative Humidity:	64 %
ATM Pressure:	102.4 kPa

The testing was performed by Jerry Huang on 2010-08-13 in RF Room

9.6 Test Results

GMRS

Frequency stability versus temperature:

Reference Frequency 462.6375 MHz, Limit : 0.00025% or 2.5 PPM			
Environment Conditions		Frequency Measure with Time Elapsed	
Temperature (°C)	Power supplied (Vdc)	Measured Frequency (MHz)	Error (%)
50	7.4	462.6396	0.0004539
40	7.4	462.6396	0.0004539
30	7.4	462.6394	0.0004107
20	7.4	462.6391	0.0003458
10	7.4	462.6380	0.0001081
0	7.4	462.6395	0.0004323
-10	7.4	462.6395	0.0004323
-20	7.4	462.6385	0.0002162
-30	7.4	462.6380	0.0001081

Frequency Stability versus Voltage:

Reference Frequency 462.6375 MHz, Limit : 0.00025% or 2.5 PPM			
Environment Conditions		Frequency Measure with Time Elapsed	
Temperature (°C)	Power supplied (Vdc)	Measured Frequency (MHz)	Error (%)
20	8.48	462.6387	0.00026
20	6.32	462.6367	0.00017

FRS

Frequency stability versus temperature:

Reference Frequency 467.6500 MHz, Limit : 0.00025% or 2.5 PPM			
Environment Conditions		Frequency Measure with Time Elapsed	
Temperature (^o C)	Power supplied (Vdc)	Measured Frequency (MHz)	Error (%)
50	7.4	467.6612	0.0023950
40	7.4	467.6609	0.0023308
30	7.4	467.6609	0.0023308
20	7.4	467.6604	0.0022239
10	7.4	467.6601	0.0021597
0	7.4	467.6597	0.0020742
-10	7.4	467.6592	0.0019673
-20	7.4	467.6591	0.0019459
-30	7.4	467.6588	0.0018817

Frequency Stability versus Voltage:

Reference Frequency 462.6500 MHz, Limit : 0.00025% or 2.5 PPM			
Environment Conditions		Frequency Measure with Time Elapsed	
Temperature (^o C)	Power supplied (Vdc)	Measured Frequency (MHz)	Error (%)
20	8.48	462.712484	0.0000035
20	6.32	462.712490	0.0000021