

# FCC PART 95 EMI MEASUREMENT AND TEST REPORT



For

## Midland Radio Corporation

1120 Clay Street  
North Kansas City, MO 64116

**FCC ID: MMA1001**

2003-09-15

<b>This Report Concerns:</b> <input checked="" type="checkbox"/> Original Report	<b>Equipment Type:</b> MOBILE CB RADIO
<b>Test Engineer:</b> Ling Zhang / 	
<b>Report Number:</b> R0308113	
<b>Test Date:</b> 2003-09-03	
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**Note:** This test report is specially limited to the above client company and product model. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

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## 1 - GENERAL INFORMATION

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### 1.1 Product Description for Equipment Under Test (EUT)

The *Midland Radio Corporation's* Model: *1001Z* or the "EUT" as referred to in this report is mobile CB radio which measured approximately 6.5"L x 4.875"W x 1.5"H.

The EUT operates at 26.965 ~ 27.405 MHz with maximum power of 3.76W.

*\*The test data gathered are from typical production samples provided by the manufacturer.*

### 1.2 Objective

This report is prepared on behalf of *Midland Radio Corporation* in accordance with Part 95 Subpart D and Subpart E of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for effective radiated power, modulation characteristics, occupied bandwidth, radiated spurious emissions, AC line conducted emissions and frequency stability.

### 1.3 Related Grant/Submission

No Related Submittals.

### 1.4 Test Methodology

Measurements contained in this report were also conducted with TIA/EIA Standard 603, Telecommunications Industry Association Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.

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

### 1.5 Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation 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 has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2001.

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

Additionally, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, CISPR 22: 1997, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167-0.

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## **2 - SYSTEM TEST CONFIGURATION**

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### **2.1 Justification**

The EUT was tested under typical operating modes to represent the worst-case results during the final qualification test.

### **2.2 EUT Test Configuration**

The EUT was powered and fully operated by pushing PTT (Push To Talk) button and then change the channel to Low, Middle, and High by using up and down buttons.

### **2.3 Special Accessories**

As shown in section 2.7, no special accessories were used.

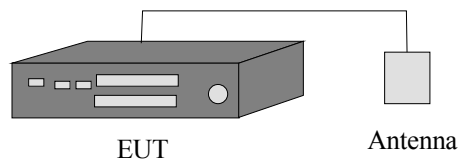
### **2.4 Schematics / Block Diagram**

Please refer to Appendix D.

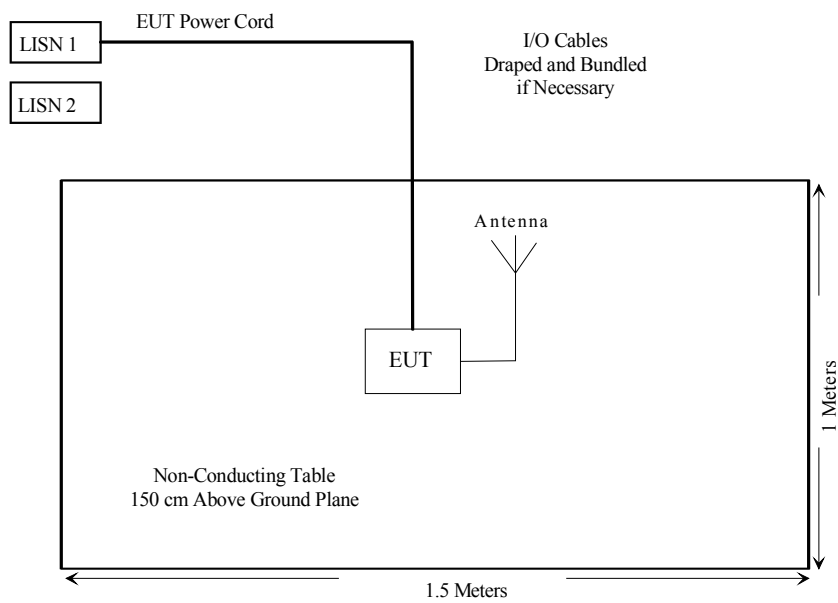
### **2.5 Equipment Modifications**

No modifications were made by BACL to ensure EUT to comply with the applicable limits and requirements.

## 2.6 Configuration of Test System



## 2.7 Test Setup Block Diagram



### 3 - REQUIREMENTS OF PROVISIONS

#### 3.1 Test Summary

FCC Rules	Rules Description	Requirement	Result
2.1046 95.639 (c) (1)	Conducted Output Power	4W	Complied
2.1047 95.637 (d) 95.637 (c)	Modulation Characteristics A3E analog device Audio Frequency Response Modulation Limiting Over Modulation Transient Response	85% < Amplitude Modulation < 100%	Complied
2.1049 95.633 (a)	Occupied Bandwidth	8KHz	Complied
2.1053 15.109 (a)	Field Strength of Spurious Radiation	Worst Case < 48dB	Complied
95.635(a) 2.1053 (a)	Spurious Emission	Complied	Complied
2.1055 95.625 (b)	Frequency Stability Vs. Temperature Vs. Voltage	< 0.005%	Complied

#### 3.2 Labeling Requirement

Each equipment for which a type acceptance applications is filed on or after May 1, 1981, shall bear an identification plate or label pursuant to §2.295 (Identification of Equipment) and §2.926 (FCC identifier)

In August 1996 the Federal Communications Commissions (FCC) adopted RF exposure guidelines with safety levels for mobile vehicle mount radio devices.

Generally users manual contains a RF exposure statement to indicate compliance with FCC requirements.

The users manual should also contain required information and instruction pursuant to 95.653.



## 4 – CONDUCTED OUTPUT POWER

### 4.1 Provision Applicable

Per FCC §2.1046 and FCC § 95.639 (c)(1), no CB transmitter, under any condition of modulation, shall exceed 4W Carrier power when transmitting emission type A3E or A1D.

### 4.2 Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Connect a low loss RF cable from the antenna port to an attenuator .
3. Connect a low loss RF cable from the antenna port to a spectrum analyzer.

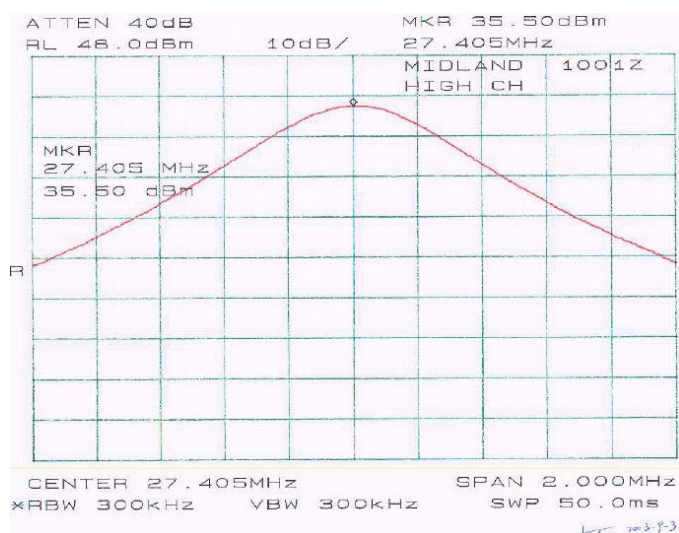
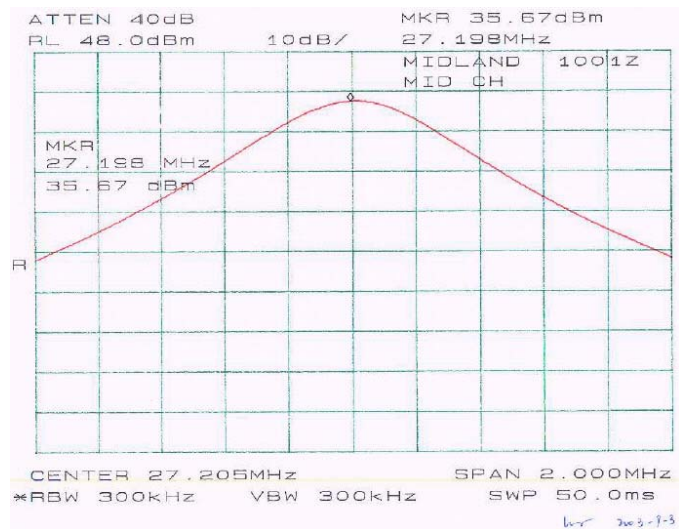
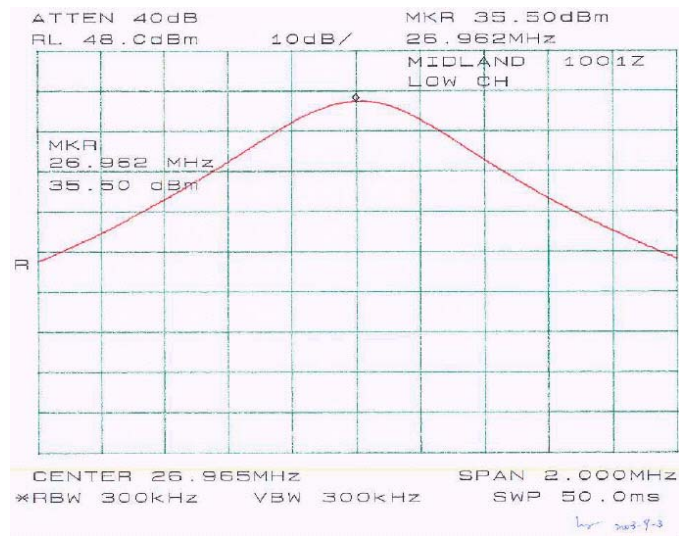
### 4.3 Test equipment

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8568B	2517A01610	2003-10-30

### 4.4 Test Results

Channel	Output Power in dBm	Cable Loss in dB	Corrected Output Power in dBm	Output Power in W	Limit in W
Low	35.50	0.1	35.60	3.63	4
Middle	35.67	0.1	35.77	3.78	4
High	35.50	0.1	35.65	3.67	4

Please refer to the following plots.



## 5 - MODULATION CHARACTERISTICS

### 5.1 Provision Applicable

Per FCC § 2.1047 and FCC §95.637 (c), when emission type A3E is transmitted, the modulation must be greater than 85% but most not exceed 100%. Simultaneous amplitude modulation and frequency or phase modulation of a transmitter are not permitted. The transients must have a duration of less than 100 milliseconds & be attenuated by at least 26dB.

### 5.2 Test Procedure

#### 5.2.1 Audio Frequency Response

The RF output of the transceiver was connected to the input of a FM deviation meter through sufficient attenuation so as not to overload the meter or distort the reading. An audio signal generator was coupled into the external microphone jack of the transceiver, or alternatively, the microphone element was removed the generator output was connected to the microphone connectors.

The audio signal input level was adjusted to obtain 20% of the maximum rated system deviation at 1 kHz, and recorded as DEV<sub>REF</sub>. With the audio signal generator level unchanged, set the generator frequency between 100 Hz to 5000 Hz. The transmitter deviations (DEV<sub>FREQ</sub>) were measured and the audio frequency response was calculated as

$$20\log_{10} [\text{DEV}_{\text{FREQ}} / \text{DEV}_{\text{REF}}]$$

#### 5.2.2 Audio Low-Pass Filter Response

An audio signal generator and an audio spectrum analyzer were connected to the input and output of the post limiter low pass filter respectively. The audio signal generator frequency was set between 1000 Hz and the upper low pass filter limit. The audio frequency response at test frequency was calculated as

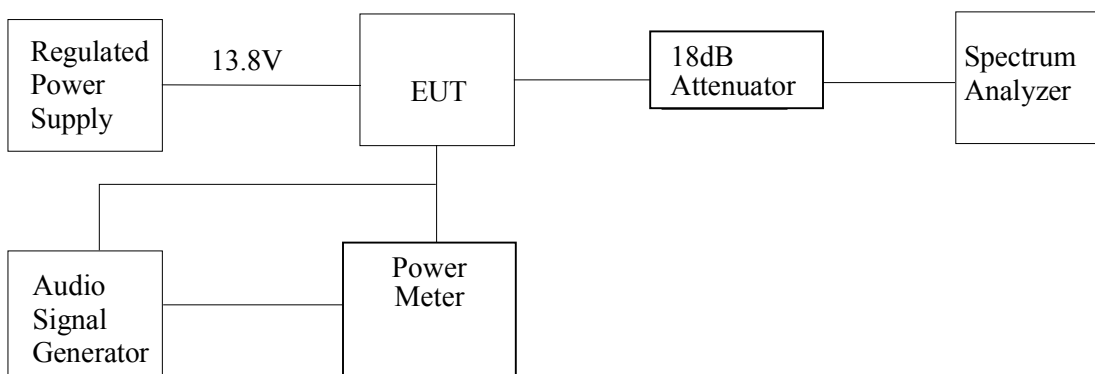
$$\text{LEV}_{\text{FREQ}} - \text{LEV}_{\text{REF}}$$

#### 5.2.3 Modulation Limiting

With the same setup as section 5.2.1 above, at three different modulating frequencies, the output level of the audio generator was varied and the FM deviation level was recorded.

#### 5.2.4 Over Modulation Transient Response

1. Set up the test equipment in the following configuration:



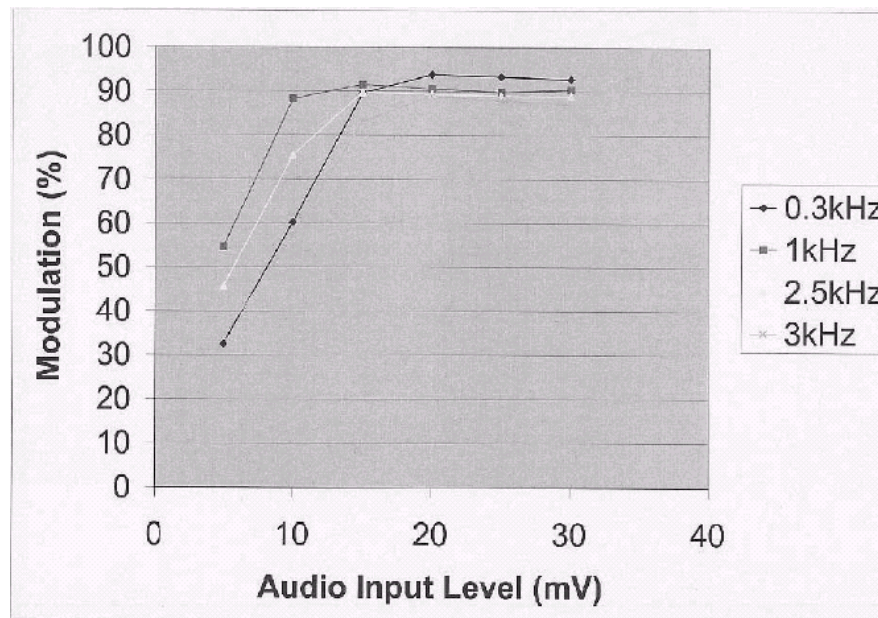
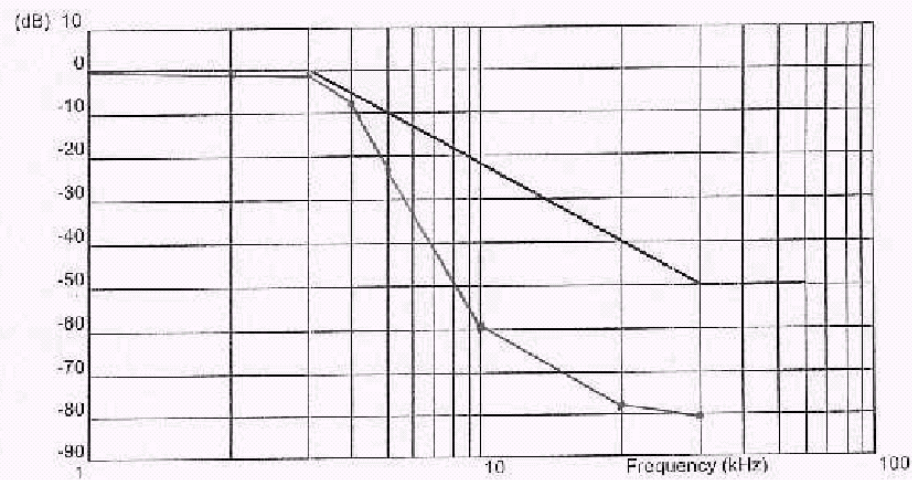
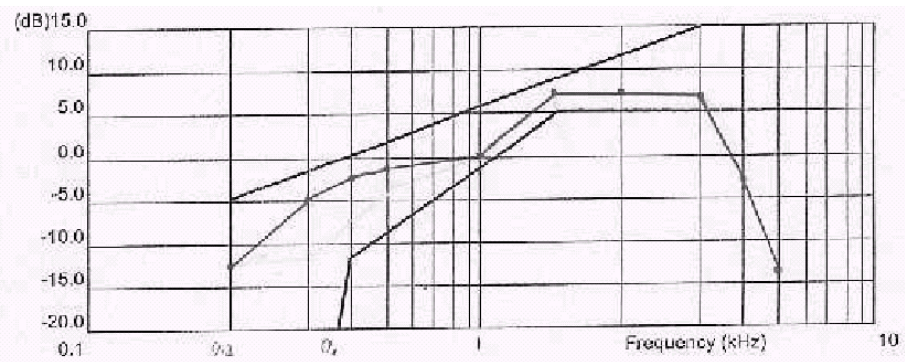
2. Set the frequency of the audio signal generator to 2.5kHz at level 16dB greater than required for 50% modulation.
3. Use the other audio signal generator pulse the previous signal at on P.P.S. with pulse width of 0.5 second.
4. Tune the spectrum analyzer to the channel on which the transmitter is set and adjust the setting as for the measurement of occupied bandwidth.
5. And then tune the spectrum analyzer to adjacent channel (+/-10kHz) and use "Zero-scan" to observe the transients caused by the amplitude modulation.

### 5.3 Test Equipment

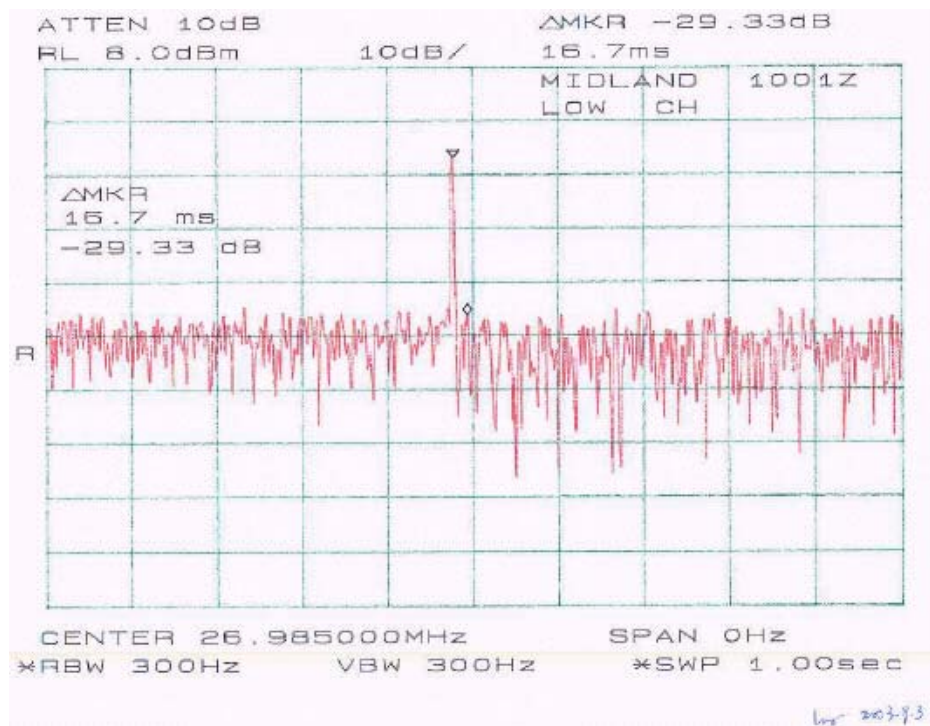
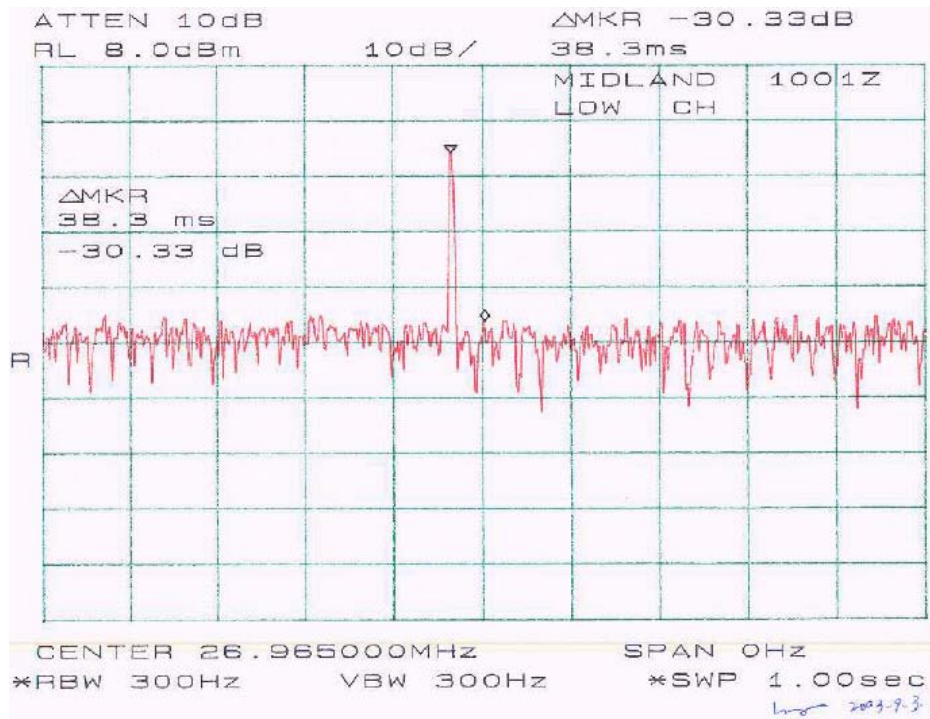
Manufacturer	Description	Model	Serial Number	Cal. Due Date
Nan Yan	Audio Signal Generator	NY2201	420	Not Required
HP	Power meter	432A	1507A14038	20034-08-16
HP	Modulation Analyzer	8901A	2026A00847	2004-08-26
Agilent	Spectrum Analyzer 9KHz-40 GHz	8564E	3943A01781	2004-08-25
FLUKE	TRUE RMS Multimeter189	189	18485-38	2004-07-18

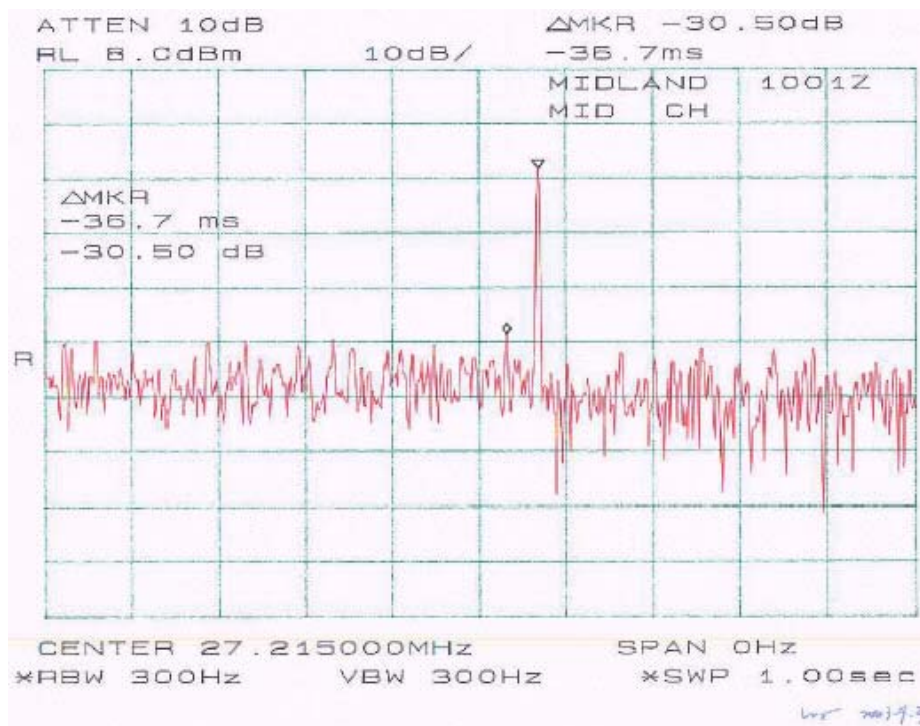
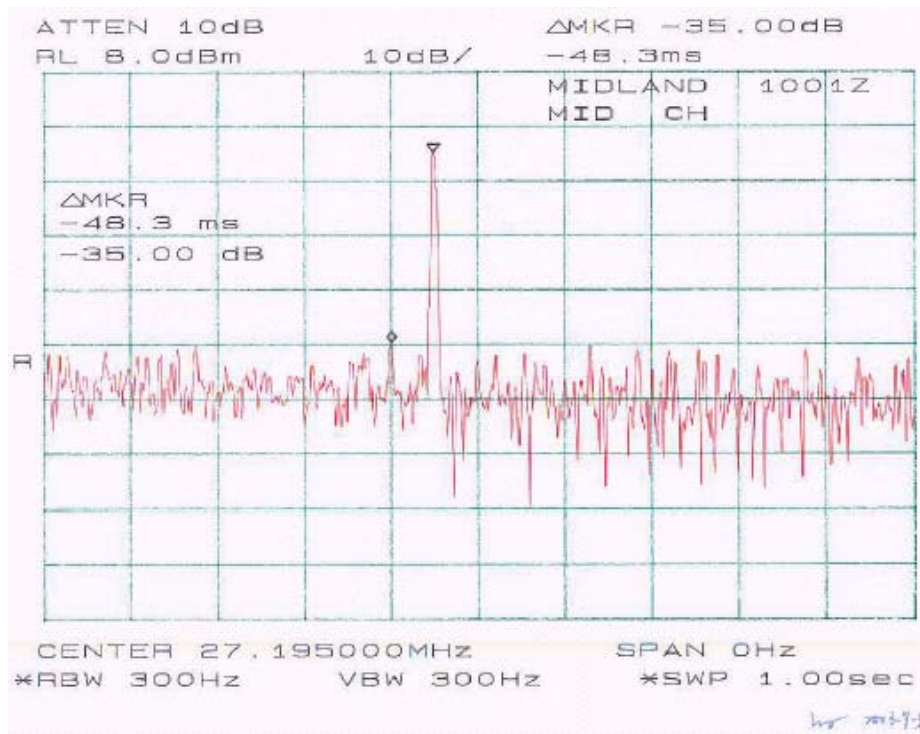
### 5.4 Test Results

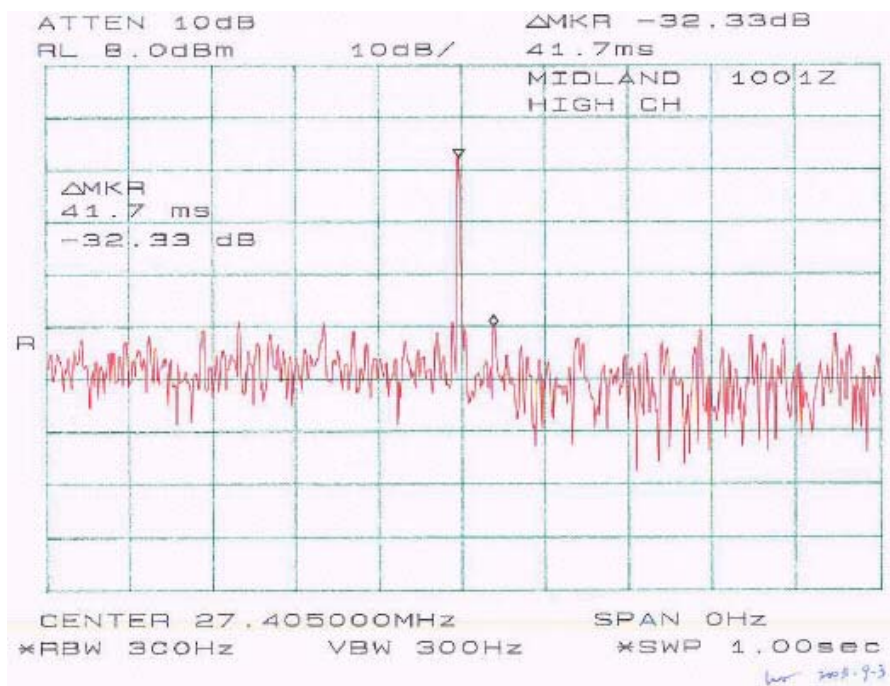
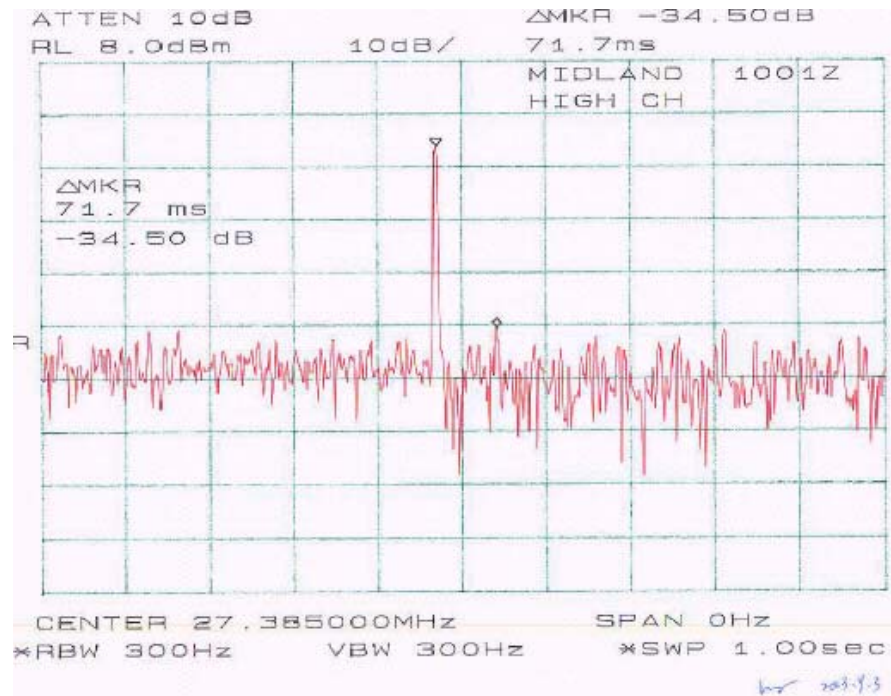
The plots of modulation characteristic and over modulation limit are presented hereinafter as reference.













## 6 - OCCUPIED BANDWIDTH OF EMISSION

### 6.1 Provision Applicable

Per FCC §2.1049 and FCC §95.633 (a), the authorized bandwidth for emission type A3E transmitted is 8 kHz.

### 6.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

The RF output was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set up at least 10 times higher than the authorized bandwidth of the transmitter. With the transmitter keyed, the level of the unmodulated carrier was set to the full scale reference line of the spectrum analyzer. This is used as a 0dB reference for emission mask measurements.

The transmitter was then modulated with a 2500 Hz tone at an input level 20 dB greater than the necessary to produce 50% of rated system deviation. The resolution bandwidth of the spectrum analyzer was set up to 300 Hz and the spectrum of the transmitting signal was recorded. This spectrum was compared to the required emission mask.

### 6.3 Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Due Date
Nan Yan	Audio Signal Generator	NY2201	420	Not Required
Agilent	Spectrum Analyzer 9KHz-40 GHz	8564E	3943A01781	2004-08-25

### 6.4 Test Results

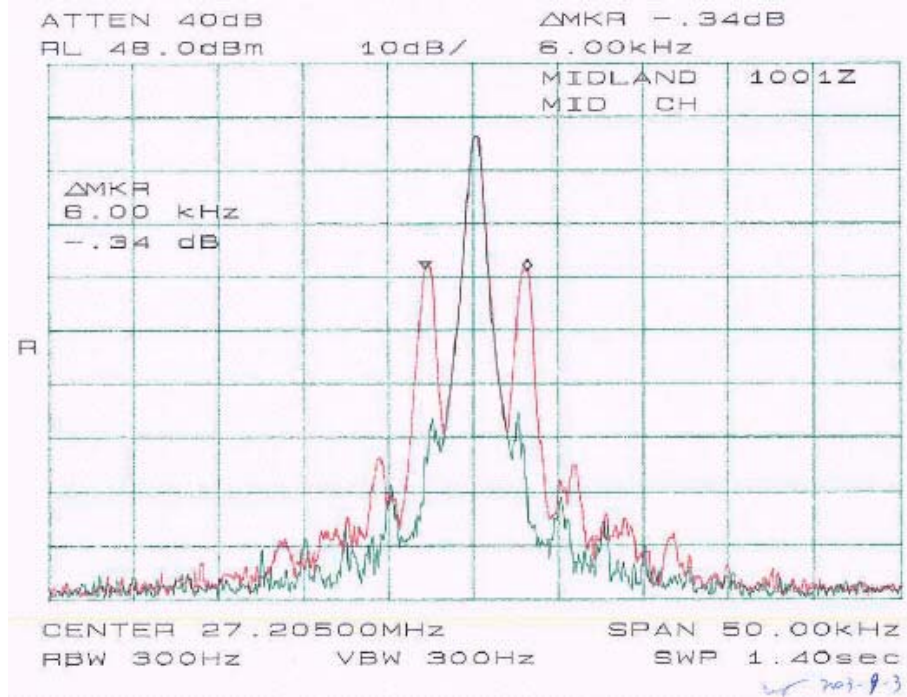
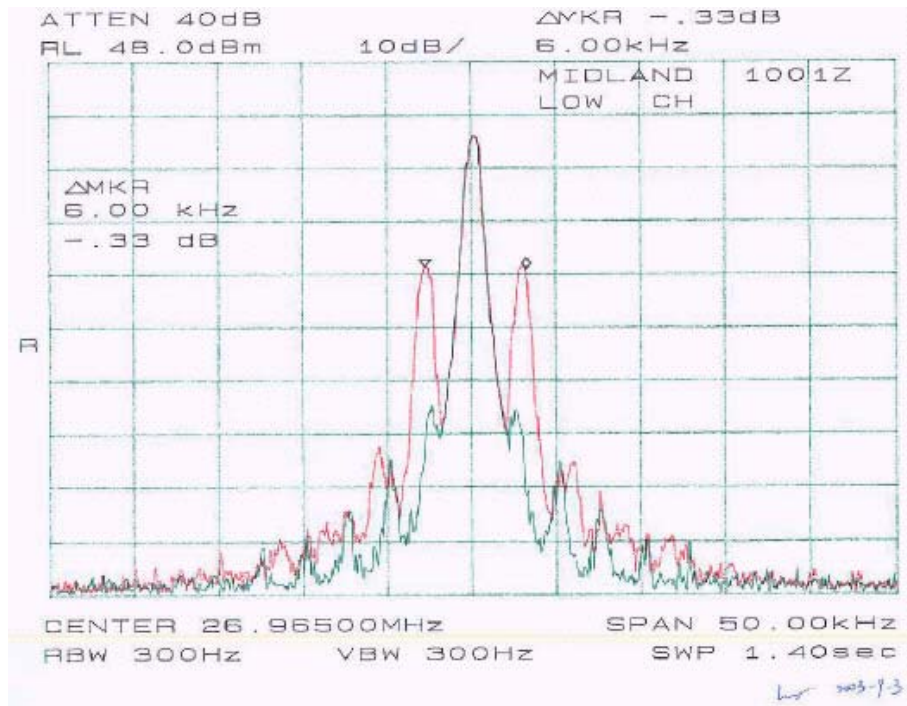
Test Result: Pass  
Please refer the following curve and plots.

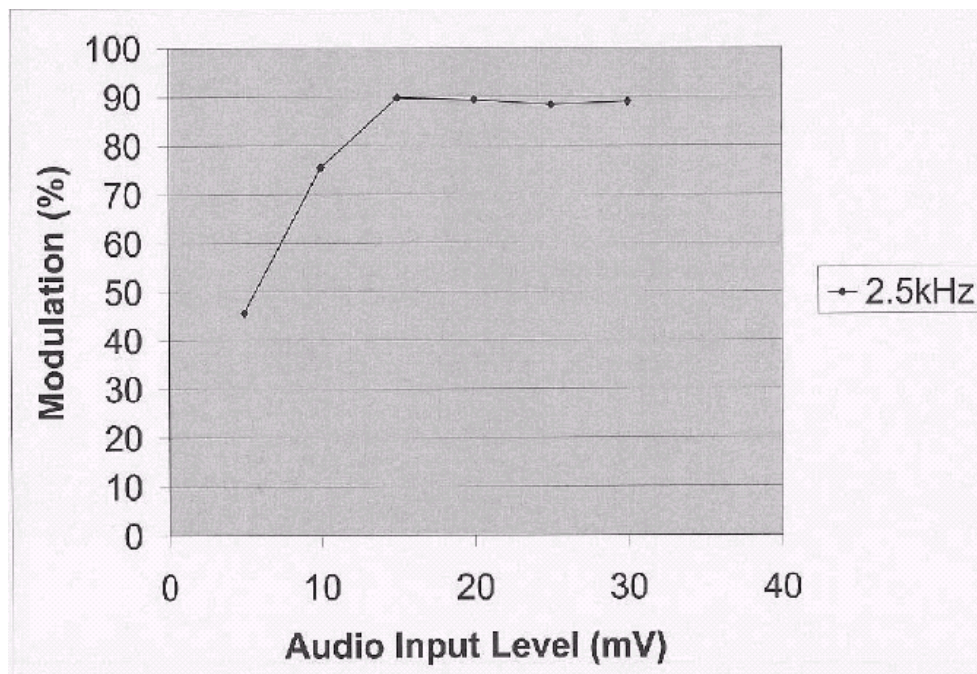
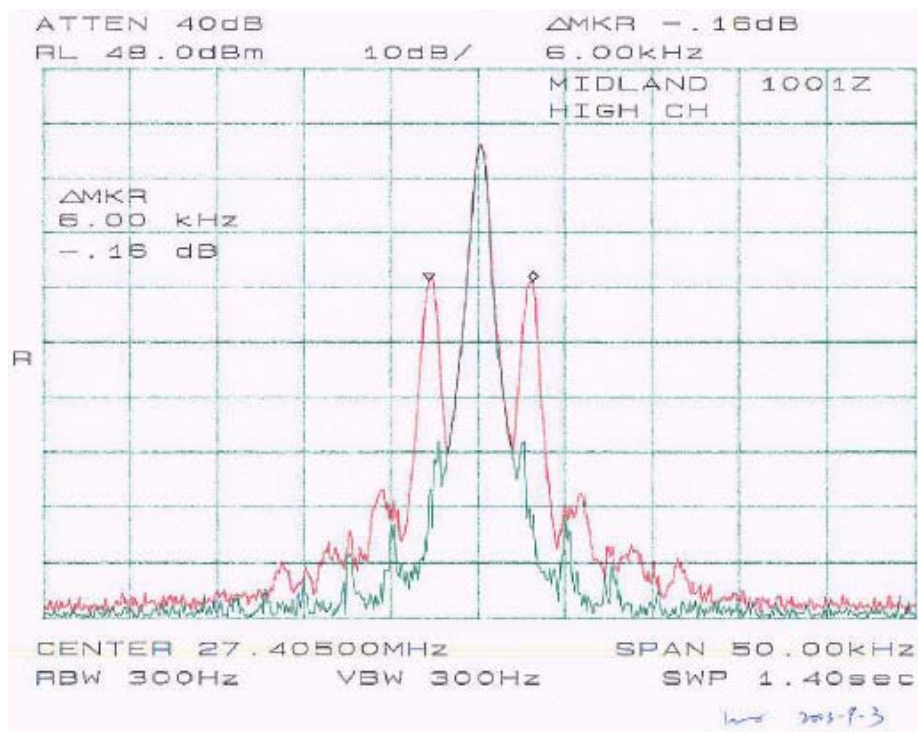
### 6.5 Emission Designator

According to part 2.202 (e)(g), the calculation for Emission Designator is as following:

$$2M = 2 \times 3000 = 6K00A3E, \text{ where}$$

M= Maximum modulation Frequency in hertz





## 7 - RADIATED SPURIOUS EMISSION

### 7.1 Provision Applicable

According to FCC §2.1053, measurements shall be made to detect spurious emission that may be radiated directly from the cabinet, control circuits, power leads, or intermediated circuit elements under normal condition of installation and operation. Information submitted shall include the relative radiated power of spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from a halfwave dipole antenna.

### 7.2 Test Procedure

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 test was performed by placing the EUT on 3-orthogonal axis.

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

Remove the EUT and replace it with 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 =  $10 \lg(\text{TXpwr in Watts}/0.001)$  – the absolute level

Spurious attenuation limit in dB =  $53 + 10 \log_{10}(\text{power out in Watts})$

### 7.3 Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Due Date
Nan Yan	Audio Signal Generator	NY2201	420	Not Required
Agilent	Spectrum Analyzer 9KHz-40 GHz	8564E	3943A01781	2004-08-25
HP	Preamplifier 0.1-3000MHz	8447E	1937A01057	2004-08-04
HP	Preamplifier 0.1-3000MHz	8447E	1616A00554	2004-08-04
A. H. Systems	Antenna, DRG, Horn	SAS-200/571	2455-261	2004-08-01
A.R.A.	Antenna, DRG, Horn	DRG-1181A	1132	2004-09-02
ETS	Antenna, Biconical	3110B	9603-2315	2004-08-29
Narda	Non-radiating load	768	203596	Not Required

### 7.4 Test Result

Low Frequency: -9.9 dB at 53.93 MHz

Middle Frequency: -9.4 dB at 54.41 MHz

High Frequency: -9.0 dB at 54.81 MHz

EUT					Generator							Standard	
Indicated		Test Antenna			Substitution		Substitution Antenna		Antenna	Cable	Absolute	FCC	FCC
Frequency MHz	Ampl. dBuV/m	Angle Degree	Height Meter	Polar H/V	Frequency MHz	Level dBm	Half-wave cm	Polar H/V	Gain Corrected	Loss dB	Level dBm	Limit dBm	Margin DB
Low Channel													
26.965	109.8	150	1.2	v	26.965	32.6	5550	v	2.1	-0.5	34.2		
26.965	95.8	180	2.5	h	26.965	18.7	5550	h	2.1	-0.5	20.3		
53.93	44.3	330	1.2	v	53.93	-24.5	2780	v	2.1	-0.5	-22.9	-13	-9.9
80.895	51.3	180	1.4	v	80.895	-25.3	1850	v	2.1	-0.7	-23.9	-13	-10.9
80.895	49.3	30	1.5	h	80.895	-27.5	1850	h	2.1	-0.7	-26.1	-13	-13.1
53.93	40.8	45	2.2	h	53.93	-28.2	2780	h	2.1	-0.5	-26.6	-13	-13.6
107.86	45.63	180	1.5	v	107.86	-30.2	1390	v	2.1	-0.7	-28.8	-13	-15.8
107.86	42.47	180	1.8	h	107.86	-33.5	1390	h	2.1	-0.7	-32.1	-13	-19.1
Middle Channel													
27.205	108.5	180	1.2	v	27.205	31.5	5550	v	2.1	-0.5	33.1		
27.205	93	200	2.5	h	27.205	16.6	5550	h	2.1	-0.5	18.2		
54.41	44.83	180	1.5	v	54.41	-24.0	2780	v	2.1	-0.5	-22.4	-13	-9.4
81.615	51.83	200	1.6	v	81.615	-24.8	1850	v	2.1	-0.7	-23.4	-13	-10.4
54.41	42.17	250	2.5	h	54.41	-26.7	2780	h	2.1	-0.5	-25.1	-13	-12.1
81.615	49.67	150	1.8	h	81.615	-27.0	1850	h	2.1	-0.7	-25.6	-13	-12.6
108.82	44.3	30	1.2	v	108.82	-31.3	1390	v	2.1	-0.7	-29.9	-13	-16.9
108.82	41.67	200	1.5	h	108.82	-34.2	1390	h	2.1	-0.7	-32.8	-13	-19.8
High Channel													
27.405	108	150	1.5	v	27.405	31.0	5550	v	2.1	-0.5	32.6		
27.405	93.5	220	2.5	h	27.405	17.2	5550	h	2.1	-0.5	18.8		
54.81	44.33	250	1.4	v	54.81	-23.6	2780	v	2.1	-0.5	-22.0	-13	-9.0
82.215	50.83	180	1.5	v	82.215	-26.2	1850	v	2.1	-0.7	-24.8	-13	-11.8
54.81	40.33	220	2.5	h	54.81	-28.5	2780	h	2.1	-0.5	-26.9	-13	-13.9
82.215	48.17	200	2	h	82.215	-28.8	1850	h	2.1	-0.7	-27.4	-13	-14.4
109.62	44.67	45	1.5	v	109.62	-31.0	1390	v	2.1	-0.7	-29.6	-13	-16.6
109.62	42.1	60	1.8	h	109.62	-33.5	1390	h	2.1	-0.7	-32.1	-13	-19.1

**Compliance Statement:**

According to FCC Part 95, at 3-meter distance the emission from an intentional radiator shall not exceed the field strength level -13dBm on any frequency removed from center of the authorized bandwidth by more than 250%.

The levels of unwanted emission of this device were below the above limits. This device was compliant with the FCC Part 95.

**Result:** Pass

## 8 - SPURIOUS EMISSION

### 8.1 Standard Applicable

Per FCC §95.635 (b)(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.

Per FCC §95.635 (b)(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.

Per FCC §95.635 (b)(8), at least  $53 + 10 \log_{10}(T)$  dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

Per FCC §95.635 (b)(9), at least 60dB on any frequency twice or greater than twice the fundamental frequency.

### 8.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.
6. Spurious attenuation limits in dB =  $43 + 10\text{Log}_{10}(\text{power out in Watts})$

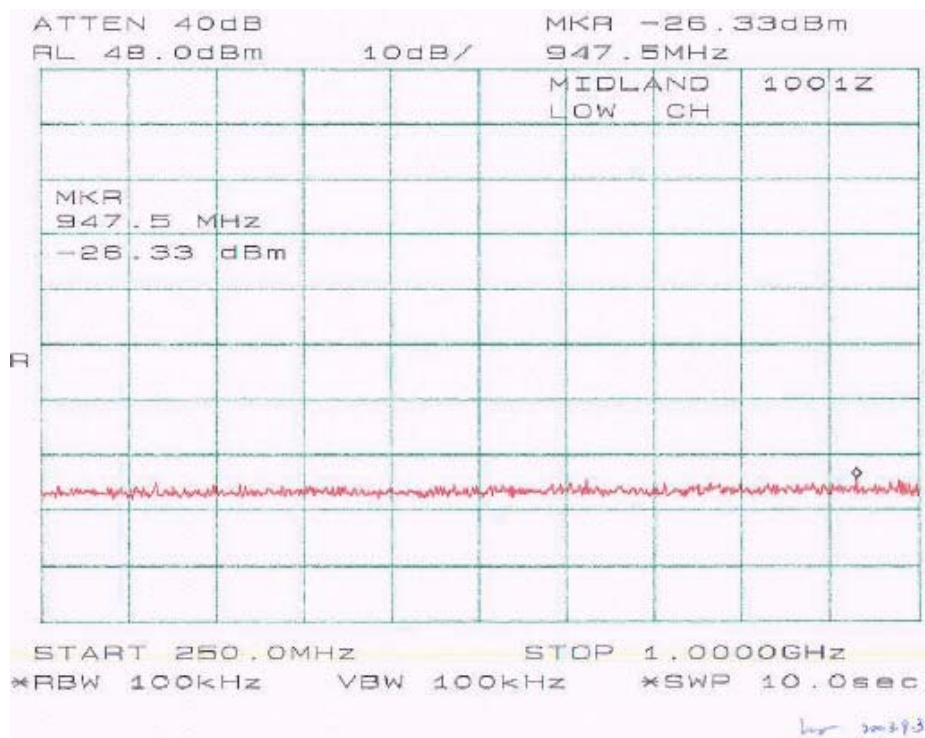
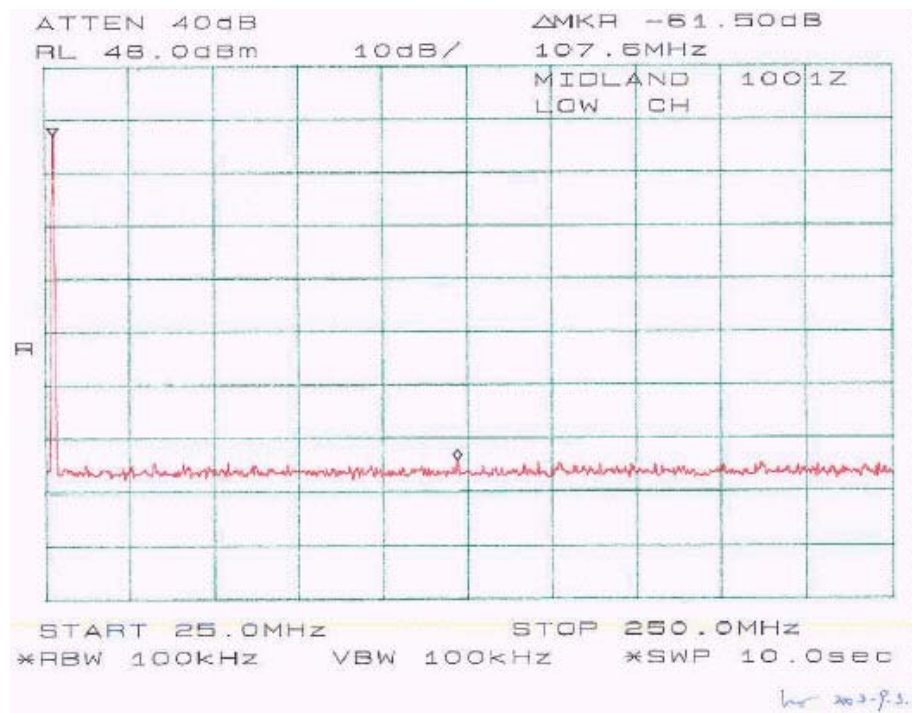
### 8.3 Test Equipment

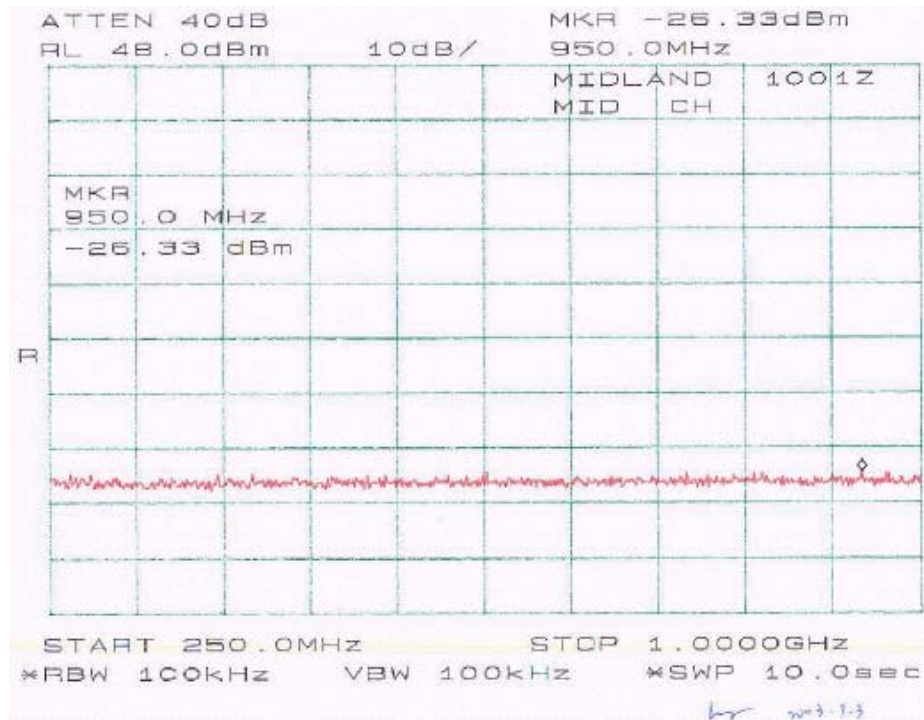
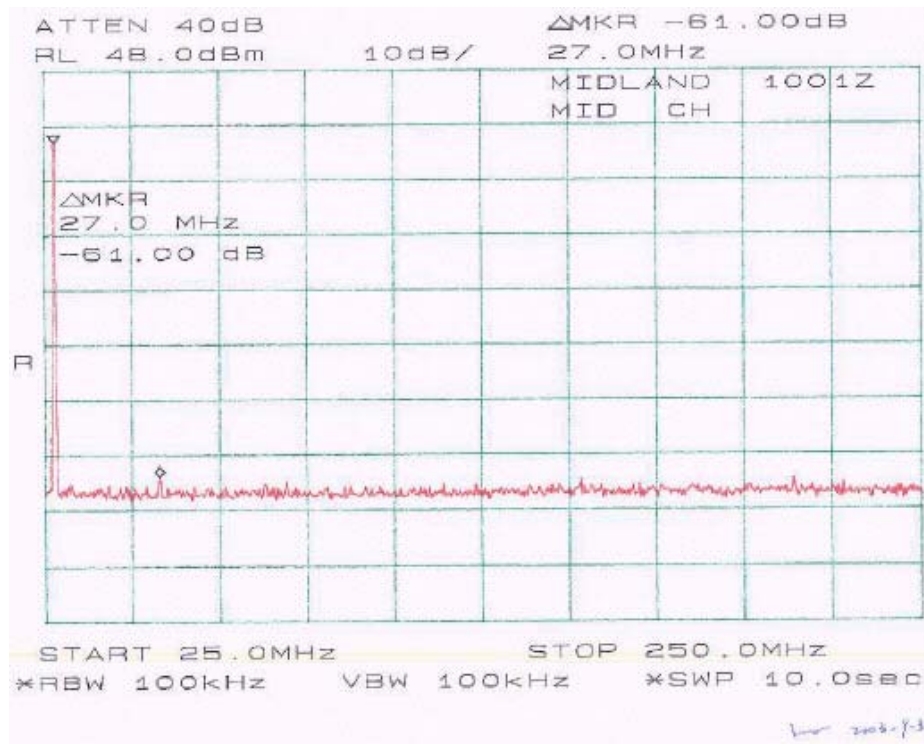
Manufacturer	Description	Model	Serial Number	Cal. Due Date
Nan Yan	Audio Signal Generator	NY2201	420	Not Required
Agilent	Spectrum Analyzer 9KHz-40 GHz	8564E	3943A01781	2004-08-25

### 8.4 Test Result

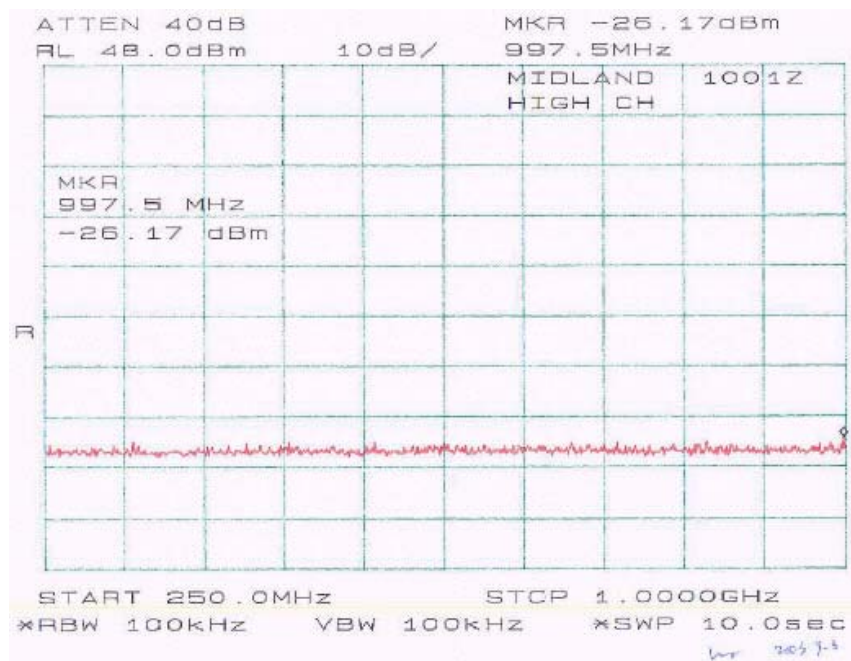
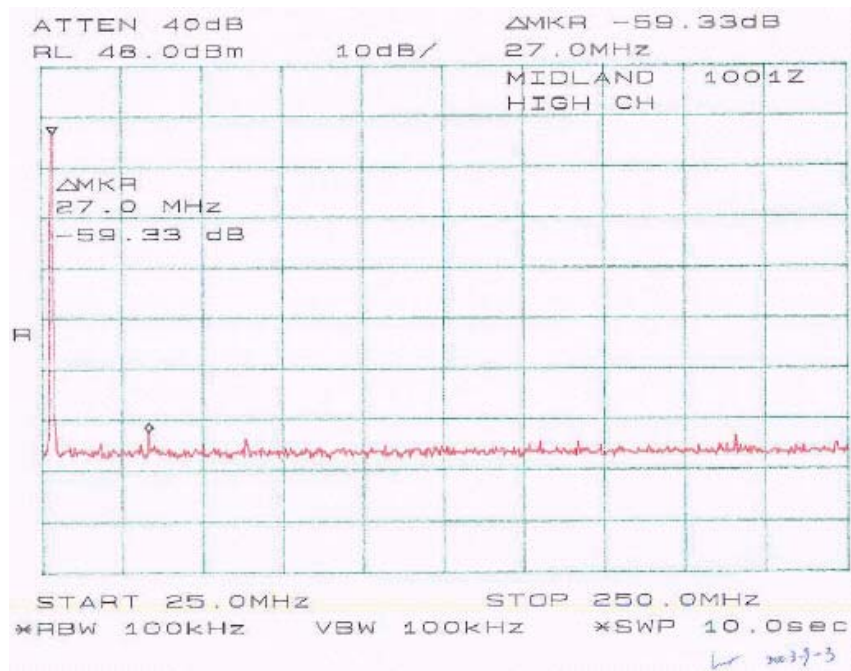
Please refer to following plots.











## 9 - AC LINE CONDUCTED EMISSIONS

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### 9.1 Applicable Requirements

According to ANSI C63.4 and FCC §15.107, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is connected back onto the AC power line on any frequency or frequencies within the band 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

### 9.2 Test Procedure

The EUT shall be connected to the DC power supply which shall be connected to the AC line through the first LISN. Both hot and neutral leads shall be tested.

### 9.3 Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Due Date
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2004-05-07

### 9.4 Test Results

Not applicable because of battery operation.

## 10 - FREQUENCY STABILITY MEASUREMENT

### 10.1 Provision Applicable

According to FCC §2.1055(a)(1), the frequency stability shall be measure with variation of ambient temperature from  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ , and according to FCC 2.1055(d)(2), the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point which is specified by the manufacturer.

According to FCC §95.625 (b), each CB transmitter must be maintained within a frequency tolerance of 0.005%.

### 10.2 Test Procedure

#### 10.2.1 Frequency stability versus environmental temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feedthrough attenuators. The EUT was placed inside the temperature chamber.

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

#### 10.2.2 Frequency Stability versus Input Voltage

At room temperature ( $25\pm 5^{\circ}\text{C}$ ), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

### 10.3 Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Due Date
Rohde & Schwarz	I/Q Modulation	AMIQ-K11	DE30565	2005-06-02
Agilent	Spectrum Analyzer 9KHz-40 GHz	8564E	3943A01781	2004-08-25

## 10.4 Test Results

Reference Frequency: 27.205 MHz, Limit: 0.005%			
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
		MCF (MHz)	% Error
50	13.8	27.2056	0.00221
40	13.8	27.2056	0.00221
30	13.8	27.2053	0.00110
20	13.8	27.2050	0.0000
10	13.8	27.2049	0.00037
0	13.8	27.2047	-0.00110
-10	13.8	27.2045	-0.00184
-20	13.8	27.2042	-0.00294
-30	13.8	27.2040	-0.00368

### *Frequency Stability Versus Input Voltage*

Reference Frequency: 27.205 MHz, Limit: 5ppm under 25°C						
Power Supplied (Vdc)	Frequency Measure with Time Elapsed					
	2 Minutes		5 Minutes		10 Minutes	
	MHz	ppm	MHz	ppm	MHz	ppm
11.7	27.2053	0	27.2051	3.67	27.2051	3.67
15.8	27.2049	3.67	27.2049	3.67	27.2049	3.67