FCC PART 90 TYPE APPROVAL
EMI MEASUREMENT AND TEST REPORT

For

SPECTRA ENGINEERING PTY LTD

9 Trade Rd Malaga, Perth, Western Australia
Australia, 6090

FCC ID: OKRMX920

This Report Concerns:	**Equipment Type:**
☒ Original Report	Desktop Base Station / Repeater

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Report No.:	R0403267
Report Date:	2004-05-24
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GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *Spectra Engineering PTY LTD's* Model: *MX920* or the "EUT" as referred to in this report is a Desktop Base Station / Repeater, which measured approximately 12cmL x 35cmW x 35cmH.

The EUT operates at 5 bands as follows:

148 - 174 MHz with maximum power of 47.05 dBm (50.69 W), frequency tolerance 1.5ppm, emission designator 11K0F3E, 11K0F9W, 16K0F3E, 16K0F9W.
400 - 435 MHz with maximum power of 47.01 dBm (50.23 W), frequency tolerance 1.5ppm, emission designator 11K0F3E, 11K0F9W, 16K0F3E, 16K0F9W.
435 - 470 MHz with maximum power of 47.03 dBm (50.47 W), frequency tolerance 1.5ppm, emission designator 11K0F3E, 11K0F9W, 16K0F3E, 16K0F9W.
450 - 485 MHz with maximum power of 46.99 dBm (50.03 W), frequency tolerance 1.5ppm, emission designator 11K0F3E, 11K0F9W, 16K0F3E, 16K0F9W.
485 - 520 MHz with maximum power of 47.01 dBm (50.23 W), frequency tolerance 1.5ppm, emission designator 11K0F3E, 11K0F9W, 16K0F3E, 16K0F9W.

**The test data gathered are from production sample serial number 040400249 - 040400253 provided by the manufacturer.*

Objective

This type approval report is prepared on behalf of *Spectra Engineering PTY LTD* in accordance with Part 2 and Part 90 of the Federal Communication Commissions rules.

The objective of the manufacturer is to determine compliance with FCC rules for output power, modulation characteristic, occupied bandwidth, spurious emission at antenna terminal, band edge, conducted and radiated margin.

Related Submittal(s)/Grant(s)

No Related Submittals

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 individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA EIA 137-A, TIA EIA 98-C, TIA/EIA-603, ANSI 63.4-2001, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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.

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, IEC/CISPR 22: 1998, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167.

SYSTEM TEST CONFIGURATION

Justification

The host system was configured for testing according to ANSI C63.4-2001.

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

Block Diagram

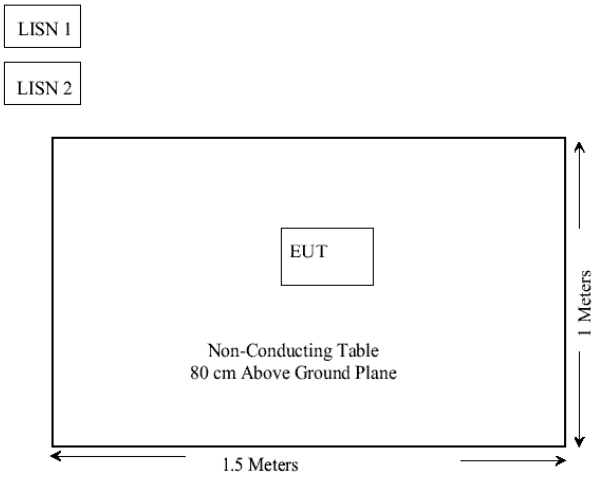
Please refer to Exhibit D.

Equipment Modifications

No modifications were made to the EUT.

Test Setup Block Diagram

The EUT is a standalone device.



Power Supply Information

Manufacturer	Description	Model	Serial Number	FCC ID
Sorensen	DC Power Supply	DCR 60-45B2	9540285	None

SUMMARY OF TEST RESULTS

FCC RULE	DESCRIPTION OF TEST	RESULT
§ 2.1046, § 90.205	RF power output	N/A
§ 2.1047 § 90.207	Modulation Characteristics	Compliant
§ 2.1049 § 90.209	Emission, Occupied Bandwidth	Compliant
§ 2.1051 § 90.210	Spurious emissions at antenna terminals	Compliant
§ 2.1053 § 90.210	Field strength of spurious radiation	Compliant
§ 2.1055 § 90.213	Frequency stability vs. temperature Frequency stability vs. voltage	Compliant
§ 90.214	Transient Frequency Behavior	Compliant

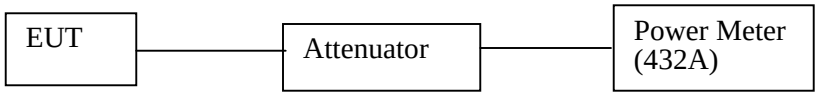
§2.1046 and §90.205 - CONDUCTED OUTPUT POWER

Provision Applicable

Per FCC §2.1046 and §90.205: maximum ERP is dependent upon the station's antenna HAAT and required service area.

Test Procedure

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



Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Hewlett Packard	Power Meter	432A	1507A14038	2003-09-22
Weinschel	Attenuator	ML015	58633	N/A

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

Environmental Conditions

Temperature:	24° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

The testing was performed by Benjamin Jin on 2004-05-04.

Test Results

Freqyency	Output Power in dBm	Output Power in W
164.075	47.05	50.69
412.950	47.01	50.23
459.075	47.03	50.47
484.075	46.99	50.03
519.200	47.01	50.23

Note: The power output may depend on the intended use of the EUT. For all tests, the EUT was set to maximum conditions.

§2.1047, §90.207 - MODULATION CHARACTERISTIC

Applicable Standard

§2.1047 & §90.205:

(a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.

(b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

Test Procedure

Test Method: TIA/EIA-603 2.2.3

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Spectrum Analyzer	8565EC	3946A00131	2003-06-30
Hewlett Packard	Modulation Analyzer	8901A	2026A00847	2003-08-19

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

Environmental Conditions

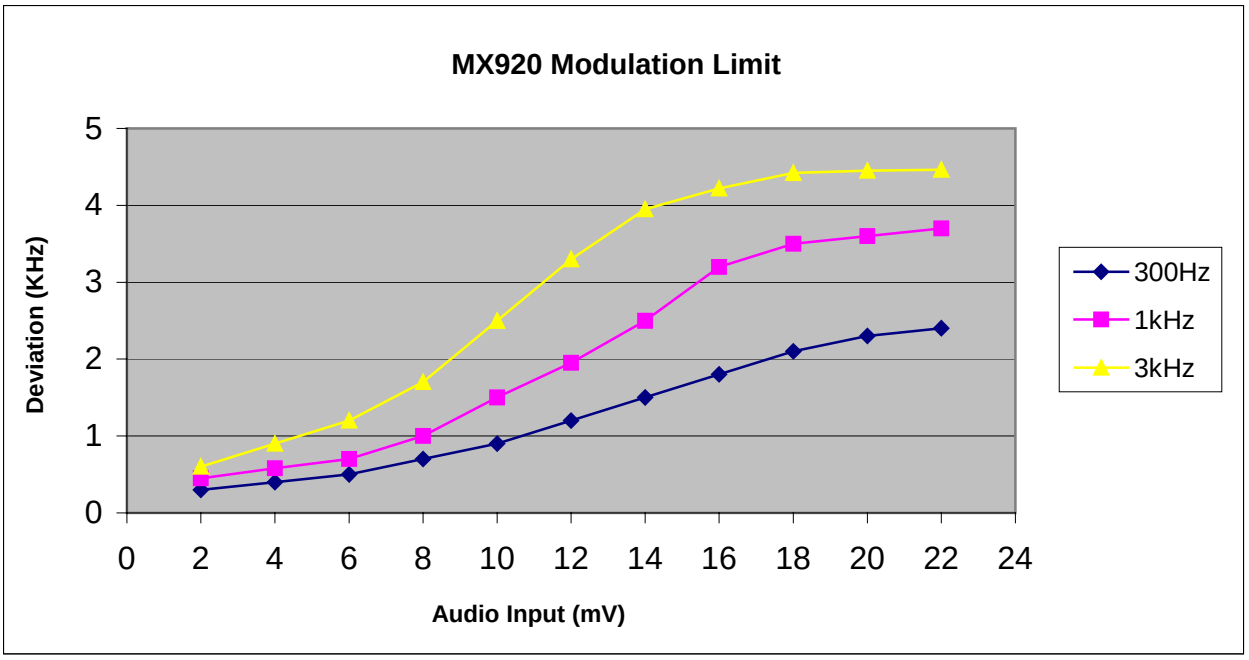
Temperature:	24° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

The testing was performed by Benjamin Jin on 2004-05-04.

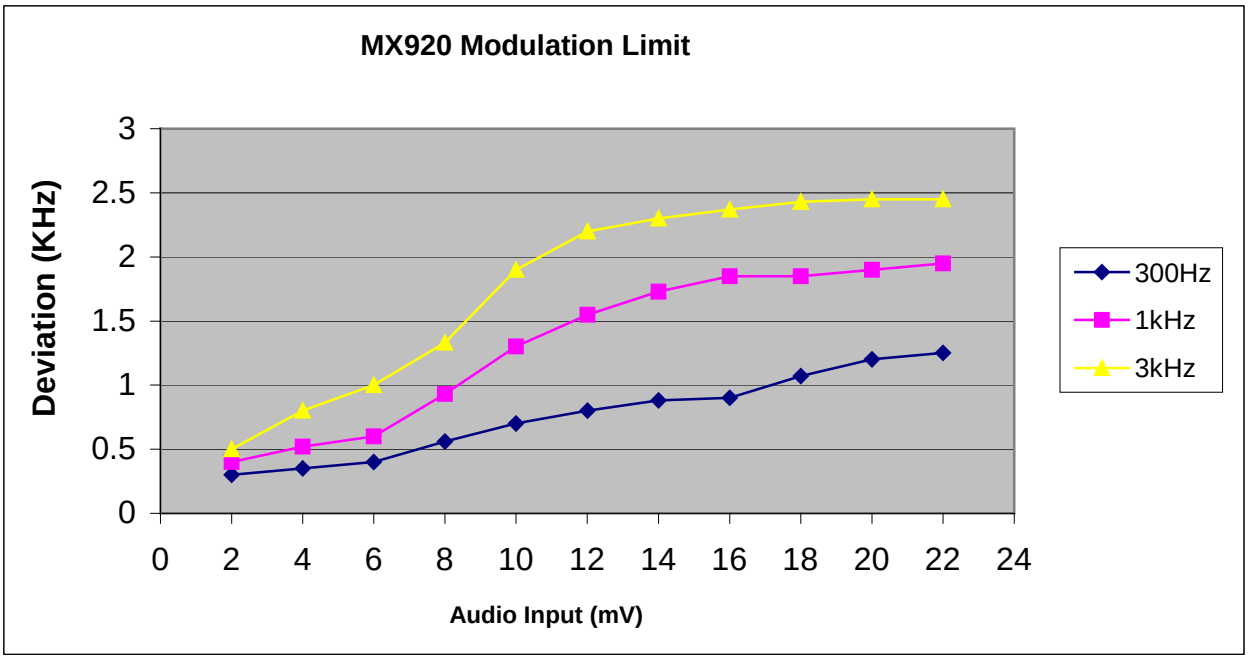
Test Results

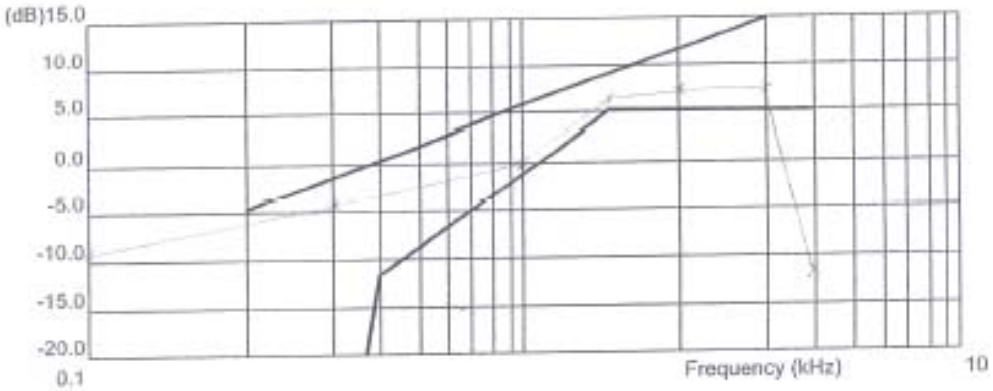
The plot(s) of modulation characteristic is presented hereinafter as reference.

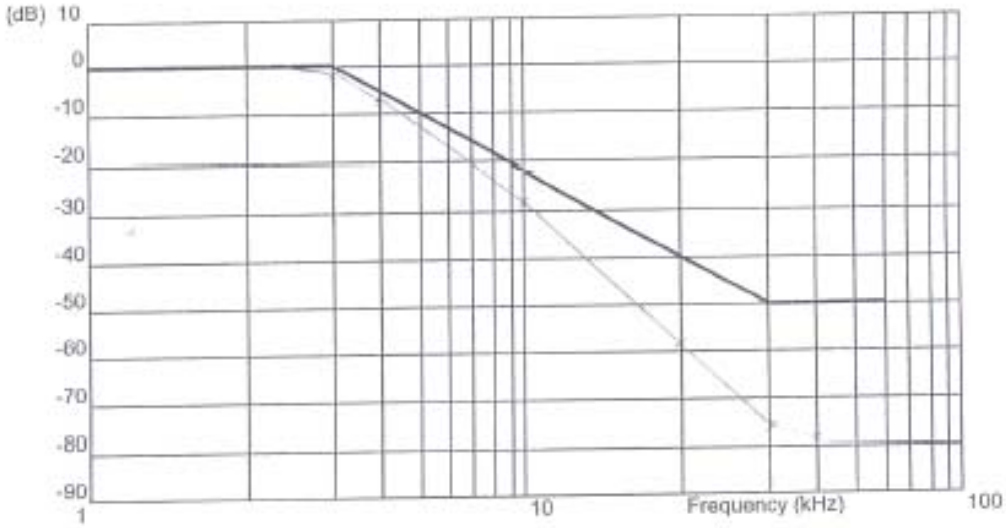
For 25KHz Channel Spacing:



For 12.5KHz Channel Spacing:




(dB)15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
0.1
Frequency (kHz)
10


(dB) 10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1
10
Frequency (kHz)
100

§2.1049, and § 90.209 – OCCUPIED BANDWIDTH

Applicable Standard

§2.1049, §90.209 and §90.210

12.5kHz bandwidth:
For any frequency removed from the center of the authorized bandwidth f_0 to 5.625kHz removed from f_0, 0dB.

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.626kHz but no more than 12.5kHz, at least 7.27 (f_d –2.88kHz) dB.

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5kHz at least:

50+l0logP=50+10log(50.69)=67.05dB

25kHz bandwidth:
For any frequency removed from the center of the assigned channel by more than 50 percent up to and including 100 percent of the authorized bandwidth, at least 25 dB.

On any frequency removed from the center of the assigned channel by more than 100 percent up to and including 250 percent, at least 35 dB.

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

43+l0logP=43+10log(50.69)=60.05dB

The resolution bandwidth was 300Hz or greater for measuring up to 250kHz from the edge of the authorized frequency segment, and 30kHz or greater for measuring more than 250kHz from the authorized frequency segment.

Test Procedure

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

The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band ±50 KHz from the carrier frequency.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	8565EC	3946A00131	2003-06-30
Hewlett Packard	Plotter	HP7470A	N/A	N/A
NAAYAN	Audio Generator	NY2201	00042	N/A

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

Environmental Conditions

Temperature:	24° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

The testing was performed by Benjamin Jin on 2004-05-04.

Test Results

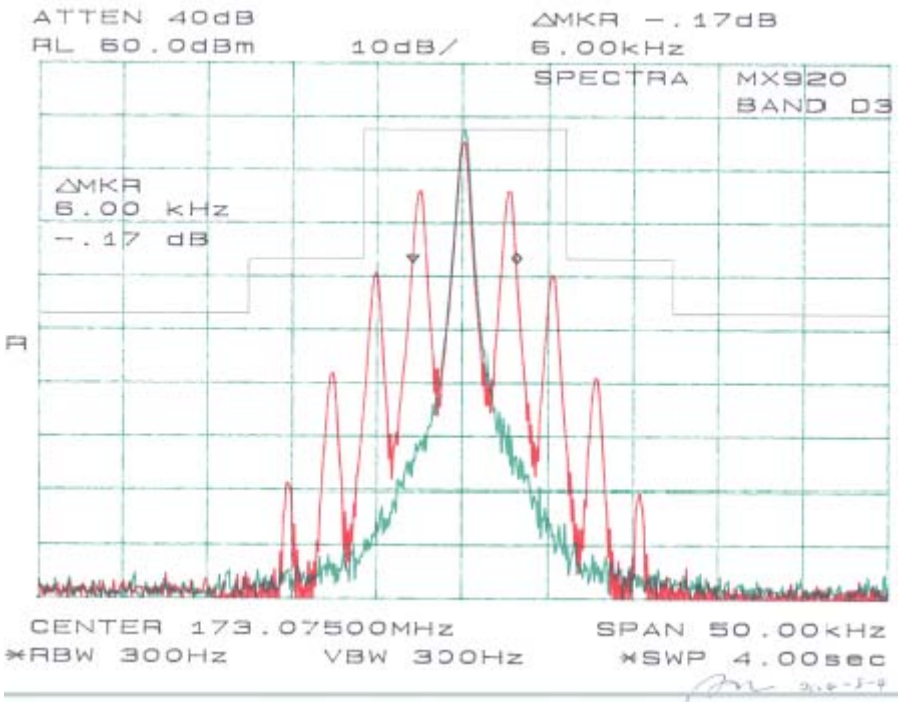
Please refer to the hereinafter plots.

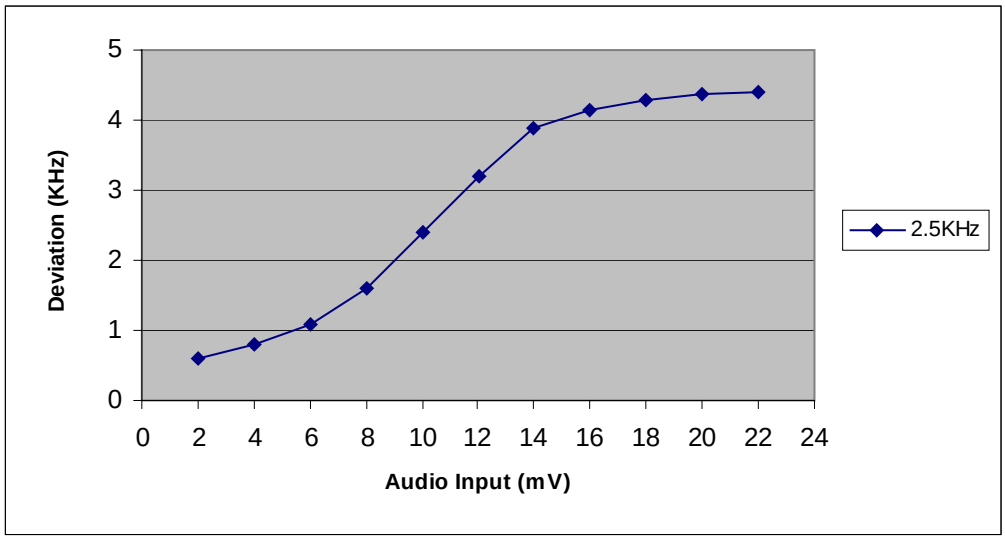
Emission Designator:

For 12.5KHz Channel Spacing: 2M+2D = 2x3+2x2.5 = 11K0F3E, 11K0F9W

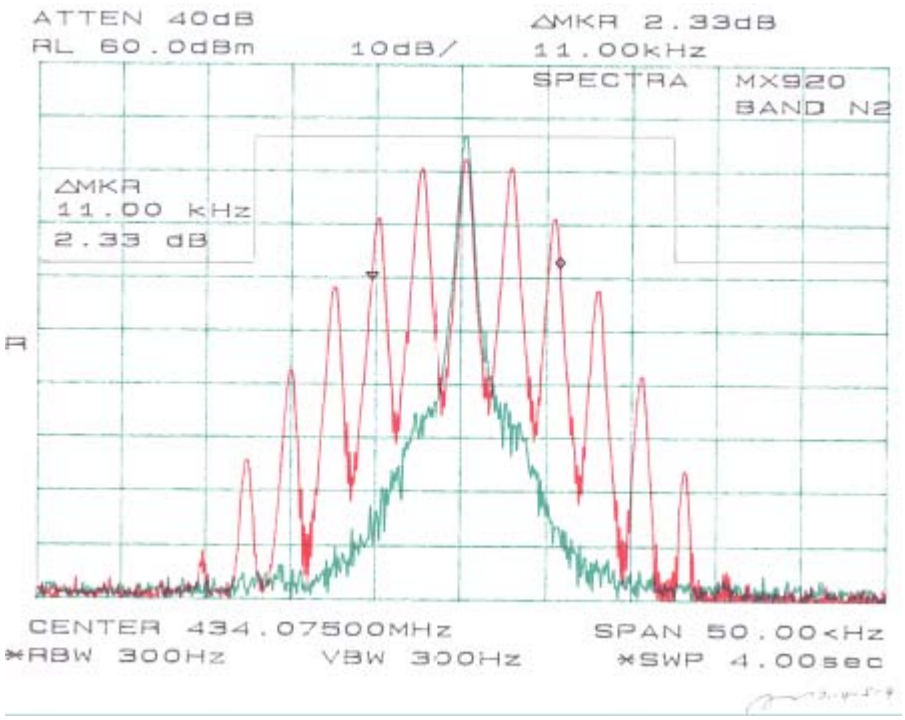
For 25 KHz Channel Spacing: 2M+2D = 2x3+2x5 = 16K0F3E, 16K0F9W

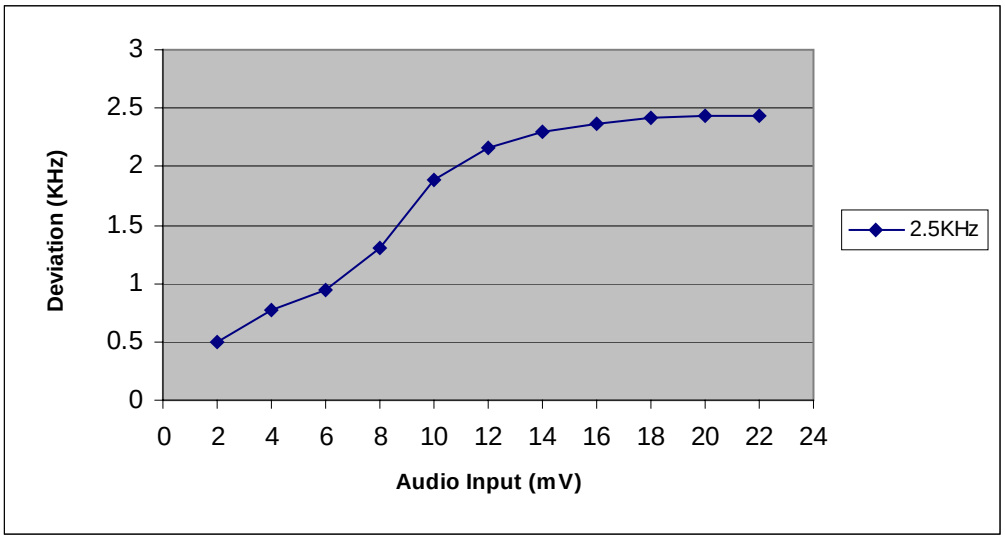
For 12.5 KHz Channel Spacing:





For 25 KHz Channel Spacing:





§2.1051 and §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standard

§2.1051and §90.210 (25kHz bandwidth only)

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

43+l0logP=43+10log(50.69)=60.05dB

§90.210 (12.5kHz bandwidth only)

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5kHz at least:

50+l0logP=50+10log(50.69)=67.05dB

Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 10 kHz. Sufficient scans were taken to show any out of band emissions up to 10^{th} harmonic.

Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	8565EC	3946A00131	2003-06-30

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

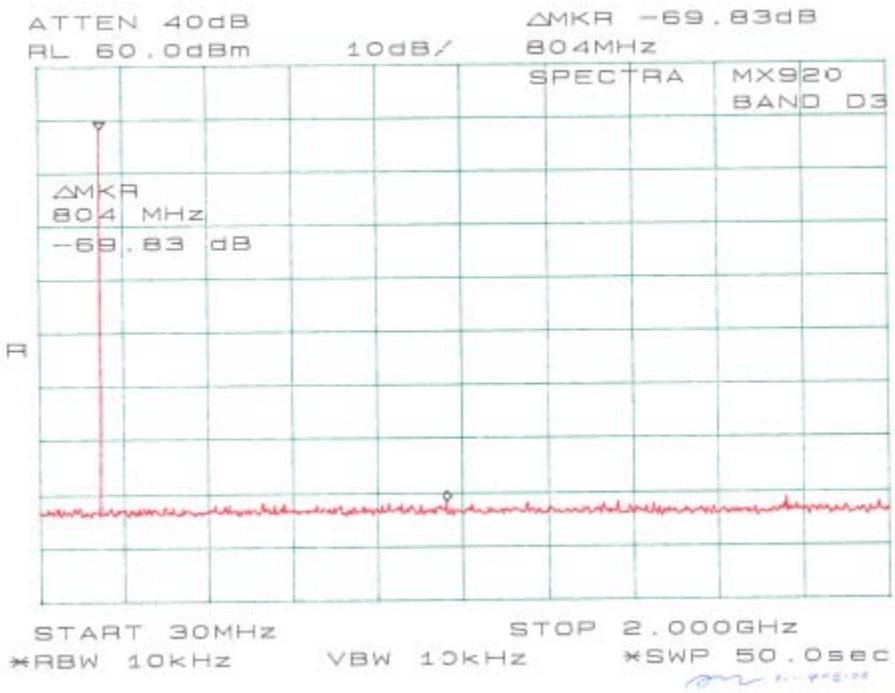
Environmental Conditions

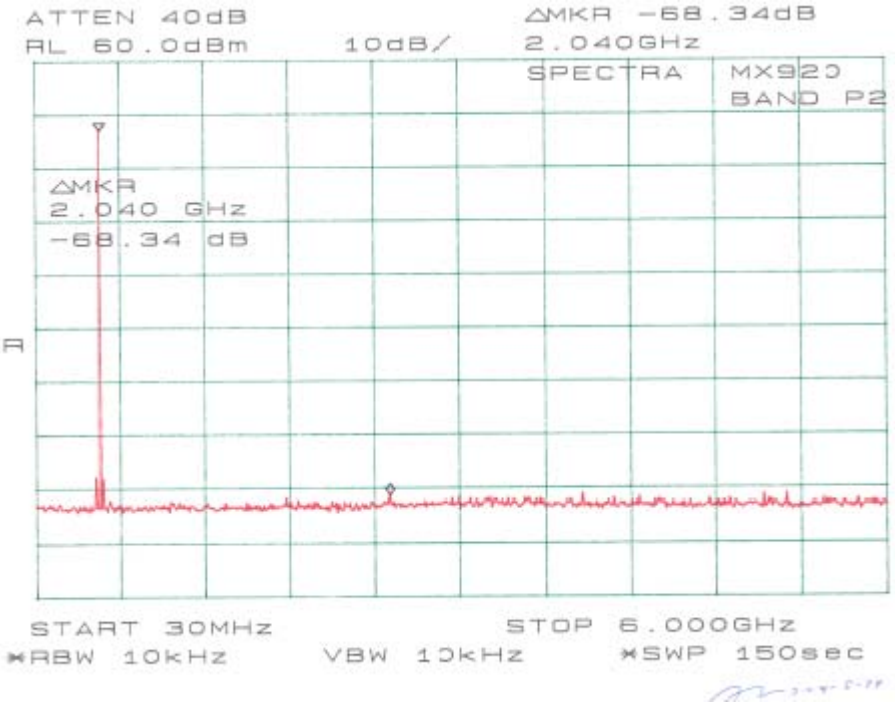
Temperature:	24° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

The testing was performed by Benjamin Jin on 2004-05-24.

Test Results

Please refer to the hereinafter plots.


ATTEN 40dB
RL 60.0dBm
10dB/
ΔMKR -69.83dB
804MHz
SPECTRA
MX920
BAND D3
ΔMKR
804 MHz
-69.83 dB
A
START 30MHz
STOP 2.000GHz
*RBW 10kHz
VBW 10kHz
*SWP 50.0sec


ATTEN 40dB
RL 60.0dBm
10dB/
ΔMKR -68.34dB
2.040GHz
SPECTRA
MX920
BAND P2
ΔMKR
2.040 GHz
-68.34 dB
A
START 30MHz
STOP 6.000GHz
*RBW 10kHz
VBW 10kHz
*SWP 150sec

§2.1053 and §90.210 - RADIATED SPURIOUS EMISSION

Applicable Standard

§2.1053 and §90.210 (25kHz bandwidth only)

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 (TXpwr in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 Log_{10} (power out in Watts)

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
EMCO	Biconical Antennas	3110B	9603-2315	2003-10-11
EMCO	Log-Periodic Antenna	3148	0004-1155	2003-10-11
A.H. System	Horn Antenna	SAS-200/571	2455-261	2003-08-02
Agilent	Spectrum Analyzer	8565EC	3946A00131	2003-06-30

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

Environmental Conditions

Temperature:	24° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

The testing was performed by Benjamin Jin on 2004-05-04.

Test Result

-24.1 at 519.225MHz, Primary scan at 173.08MHz
-18.1 at 1302.225MHz, Primary scan at 434.075MHz
-18.6 at 1356.150MHz, Primary scan at 452.05MHz
-19.3 at 1401.150MHz, Primary scan at 467.05MHz
-18.2 at 1506.150MHz, Primary scan at 502.05MHz

EUT					Generator						Standard	
Indicated		Table	Test Antenna		Substitution			Antenna	Cable	Absolute	FCC	FCC
Frequency MHz	Ampl. dBuV/m	Angle Degree	Height Meter	Polar H/V	Frequency MHz	Level dBm	Polar H/V	Gain Corrected	Loss DB	Level dBm	Limit dBm	Margin DB
Primary scan at 173.08MHz												
173.075	61.8	110	1.8	v								
173.075	72.9	180	2	h								
519.225	42.5	90	1.8	h	519.225	-36.9	h	0	0.2	-37.1	-13	-24.1
346.150	42.1	270	1.5	h	346.150	-37.2	h	0	0.2	-37.4	-13	-24.4
692.320	41.6	270	1.6	h	692.320	-37.1	h	0	0.3	-37.4	-13	-24.4
519.225	41.3	180	1.6	v	519.225	-37.8	v	0	0.2	-38.0	-13	-25.0
346.150	39.5	210	1.8	v	346.150	-38.7	v	0	0.2	-38.9	-13	-25.9
692.320	39.5	60	1.5	v	692.320	-38.9	v	0	0.3	-39.2	-13	-26.2
Primary scan at 434.075MHz												
434.075	65.7	270	1.8	v								
434.075	78.3	310	1.5	h								
1302.225	40.6	270	2.2	h	1302.225	-37.1	h	6.5	0.5	-31.1	-13	-18.1
868.150	34.5	150	2.2	h	868.150	-42.9	h	6.1	0.3	-37.1	-13	-24.1
868.150	34.1	330	2	v	868.150	-43.2	v	6.1	0.3	-37.4	-13	-24.4
1736.300	32.5	110	1.5	h	1736.300	-44.3	h	7.1	0.6	-37.8	-13	-24.8
1302.225	32.1	210	1.8	v	1302.225	-44.9	v	6.5	0.5	-38.9	-13	-25.9
1736.300	26.1	0	1.8	v	1736.300	-49.4	v	7.1	0.6	-42.9	-13	-29.9
Primary scan at 452.05MHz												
452.050	75.2	230	1.8	v								
452.050	78.7	30	1.5	h								
1356.150	41.9	180	2.2	h	1356.150	-37.6	h	6.5	0.5	-31.6	-13	-18.6
1356.150	41.5	100	2.2	v	1356.150	-38.4	v	6.5	0.5	-32.4	-13	-19.4
904.100	34.3	90	2.3	h	904.010	-43.4	h	6.3	0.3	-37.4	-13	-24.4
1808.200	32.7	60	2.2	h	1808.200	-44.1	h	7.1	0.6	-37.6	-13	-24.6
904.100	33.9	310	2	v	904.010	-43.7	v	6.3	0.3	-37.7	-13	-24.7
1808.200	26.2	90	1.5	v	1808.200	-49.2	v	7.1	0.6	-42.7	-13	-29.7

EUT					Generator						Standard	
Indicated		Table	Test Antenna		Substitution			Antenna	Cable	Absolute	FCC	FCC
Frequency MHz	Ampl. dBuV/m	Angle Degree	Height Meter	Polar H/V	Frequency MHz	Level dBm	Polar H/V	Gain Corrected	Loss DB	Level dBm	Limit dBm	Margin DB
Primary scan at 467.05MHz												
467.050	63.2	60	1.8	v								
467.050	70.8	0	1.5	h								
1401.150	39.1	180	2.2	h	1401.150	-38.3	h	6.5	0.5	-32.3	-13	-19.3
1401.150	36.9	210	1.8	v	1401.150	-40.5	v	6.5	0.5	-34.5	-13	-21.5
1868.200	35.2	90	1.5	v	1868.200	-41.7	v	7.1	0.6	-35.2	-13	-22.2
934.100	34.1	180	2.3	h	934.100	-43.6	h	6.3	0.3	-37.6	-13	-24.6
934.100	33.7	270	1.5	v	934.100	-43.9	v	6.3	0.3	-37.9	-13	-24.9
1868.200	32.2	310	1.5	h	1868.200	-44.6	h	7.1	0.6	-38.1	-13	-25.1
Primary scan at 502.05MHz												
502.050	63.2	90	1.6	v								
502.050	70.8	0	1.5	h								
1506.150	40.1	180	2.2	h	1506.150	-37.2	h	6.5	0.5	-31.2	-13	-18.2
1506.150	39.9	290	1.5	v	1506.150	-37.5	v	6.5	0.5	-31.5	-13	-18.5
1004.100	35.1	120	1.5	h	1004.100	-38.7	h	6.1	0.3	-32.9	-13	-19.9
1004.100	34.2	270	1.5	v	1004.100	-39.9	v	6.1	0.3	-34.1	-13	-21.1
2008.200	34.5	180	1.7	h	2008.200	-42.3	h	6.9	0.6	-36.0	-13	-23.0
2008.200	32.2	310	1.5	v	2008.200	-44.1	v	6.9	0.6	-37.8	-13	-24.8

Note: The transmitter output was terminated by a load.

§2.1055 (d) and §90.213- FREQUENCY STABILITY

Applicable Standard

§2.1055 (d)

§90.213
The limit is 1.5ppm.

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. The 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 counter.

Frequency Stability vs. Voltage: An external variable DC power supply was connected to the battery terminals of the equipment under test. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the battery end point. The output frequency was recorded for each battery voltage.

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Tenney	Temperature Chamber -50^0 to $+100^0$C	Versa	12.222-193	2004-04-23
Agilent	Spectrum Analyzer	8565EC	3946A00131	2003-06-30

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

Environmental Conditions

Temperature:	24° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

The testing was performed by Benjamin Jin on 2004-05-04.

Test Results

Reference Frequency: 502.0500 MHz, Limit: 1.5 ppm			
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
		MCF (MHz)	PPM Error
50	13.8	502.0499	-0.19
40	13.8	502.0501	0.20
30	13.8	502.0501	0.20
20	13.8	502.0502	0.39
10	13.8	502.0502	0.39
0	13.8	502.0502	0.39
-10	13.8	502.0503	0.60
-20	13.8	502.0503	0.60
-30	13.8	502.0503	0.60

Frequency Stability Versus Input Voltage

Reference Frequency: 502.0500 MHz, Limit: 1.5 ppm		
Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
	Frequency (MHz)	Error (ppm)
16.5	502.0501	0.20
11.1	502.0502	0.39

Note: Limit 1.5ppm is for EUT operating with 12.5KHz channel bandwidth.

§90.214 - TRANSIENT FREQUENCY BEHAVIOR

Standard Applicable

§90.214

Test Method

TIA/EIA-603 2.2.19

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Tektronix	Oscilloscope	TDS7104	B020557	2003-10-09
NAA YAN	Audio Generator	NY2201	00042	N/A
HP	Modulation Analyzer	8901A	2026A00847	2003-08-09

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

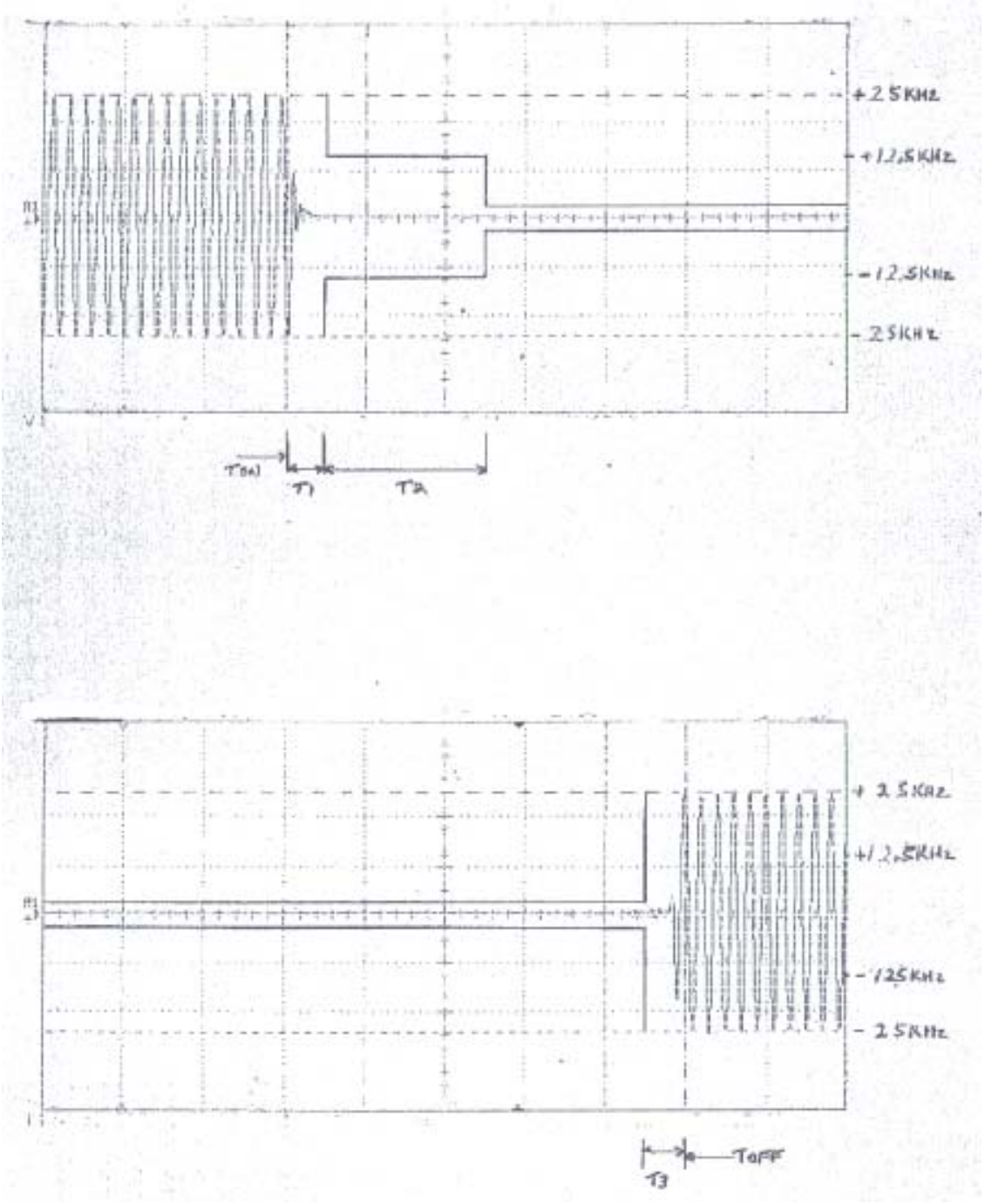
Environmental Conditions

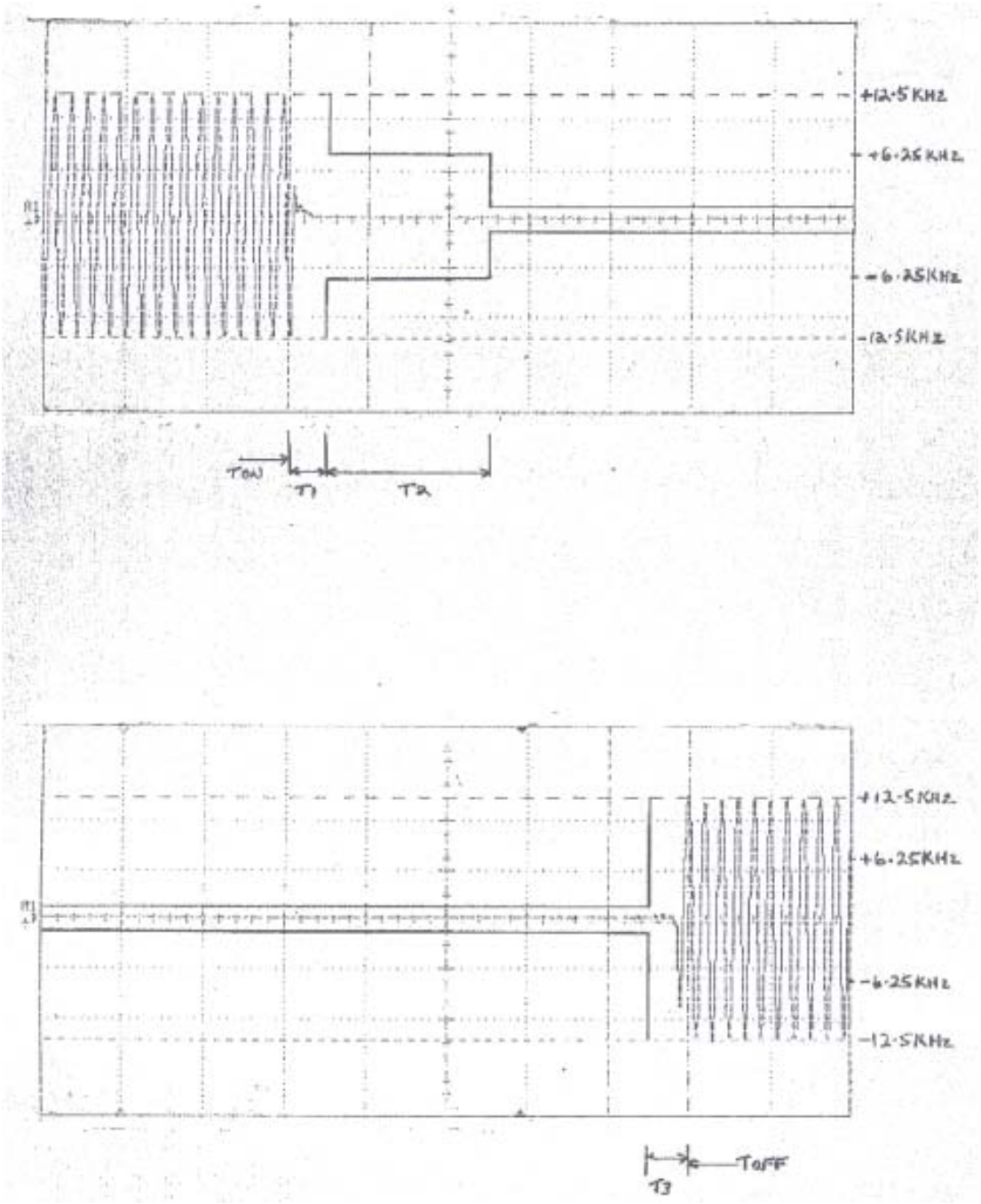
Temperature:	24° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

The testing was performed by Benjamin Jin on 2004-05-04.

Test Result

Please refer to the plot hereinafter.


+2.5KHz
+12.5KHz
-12.5KHz
-2.5KHz
T1
T2
+2.5KHz
-12.5KHz
-2.5KHz
T3
TOFF


+12.5 KHz
+6.25 KHz
-6.25 KHz
-12.5 KHz
T1
T2
+12.5 KHz
+6.25 KHz
-6.25 KHz
-12.5 KHz
T3
TOFF