

FCC PART 90 TYPE APPROVAL EMI MEASUREMENT AND TEST REPORT



For

GENEX TELECOM CO., LTD.

6F FARMAX B/D 796-27 Bangbae-Dong, Seocho-Gu,
Seoul, 137-830, Korea

FCC ID: PM3GX90

2004-03-09

This Report Concerns: <input checked="" type="checkbox"/> Original Report	Equipment Type: Transceiver, UHF, PTT
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Report No.: R0402183	
Test Date: 2004-02-20	
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GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *GENEX Telecom CO., LTD.* 's Model: *GX-90* or the "EUT" as referred to in this report is a transceiver, UHF, PTT, which measured approximately 9.9"L x 2.5"W x 1.75"H.

The EUT operates at 430 – 470 MHz with maximum power of 4.819 W, frequency tolerance 2.5ppm, emission designator 6K00F3E.

**The test data gathered are from production sample serial number 00000001 provided by the manufacturer.*

Objective

This type approval report is prepared on behalf of *GENEX Telecom CO., 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

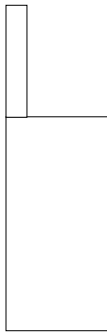
Please refer to Exhibit D.

Equipment Modifications

No modifications were necessary for the EUT to comply with the applicable limits and requirements.

Test Setup Block Diagram

The EUT is a standalone device.



EUT

SUMMARY OF TEST RESULTS

FCC RULE	DESCRIPTION OF TEST	RESULT
§ 2.1046, § 90.205	RF power output	Compliant
§ 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 – RF POWER OUTPUT

Applicable Standard

§2.1046

§90.205: Power dependent upon station's antenna HAAT and required service area and may be from 1 to 500 watts.

Test Procedure

1. The EUT was placed at 1.5m height turnaround table and in a position for normal use declared by the manufacturer.
2. The test antenna was oriented initially for vertical position with 3m away from EUT.
3. The output of the antenna was connected to the measuring receiver and the quasi-peak detector is used for the measurement.
4. The transmitter was turned on and the measuring receiver was tuned to the frequency of the transmitter under the testing.
5. The test antenna was raised and lowered through specified ranged of height until the maximum signal level was detected by the measuring receiver.
6. The transmitter was rotated through 360° in the horizontal plane until the maximum signal level was detected.
7. The transmitter was then replaced by a dipole which is a substitution antenna.
8. The substitution antenna was oriented for vertical polarization and then connected to a calibrated signal generator.
9. The input attenuator of measuring receiver was adjusted to increased the sensitivity.
10. The substitution antenna was raised and lowered to ensure the maximum signal level was detected.
11. The input signal to the substitution antenna was adjusted to the level to produce a level which was equal to the level noted while the transmitter radiated power was measured, corrected for the change of the input attenuator of the measuring receiver.
12. The input level to the substitution antenna was recorded as power level in dBm, corrected for any change of input attenuator of the measuring receiver.
13. The measurement was repeated with the test antenna and the substitution antenna oriented for horizontal polarization.
14. The measure of the radiated output power is the larger one of the two level recorded, at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Signal Generator	OPT001	3217A04699	2004-02-05
Com Power Corporation	Dipole Antenna	AD-100	02222	2003-07-23

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

Environmental Conditions

Temperature:	14° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

Test Results

Substitution		Generator			Absolute Level dBm
		Polar H/V	Antenna Gain Corrected	Cable Loss DB	
Frequency MHz	Level dBm				
Low Channel					
430.9875	36.5	v	0	0.1	36.4
430.9875	2.2	h	0	0.1	2.1
Mid Channel					
455.075	29.4	v	0	0.1	29.3
455.075	0.5	h	0	0.1	0.4
High Channel					
470	37.2	v	0	0.1	37.1
470	2.3	h	0	0.1	2.2

§2.1046 and §90.265(b)(2) - CONDUCTED OUTPUT POWER

Provision Applicable

Per FCC §2.1046 and §90.265(b)(2): the output power shall not exceed 50mW.

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. Due Date
Hewlett Packard	Spectrum Analyzer	HP8565C	06042	2004-05-03
Hewlett Packard	Plotter	HP7470A	N/A	N/A

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

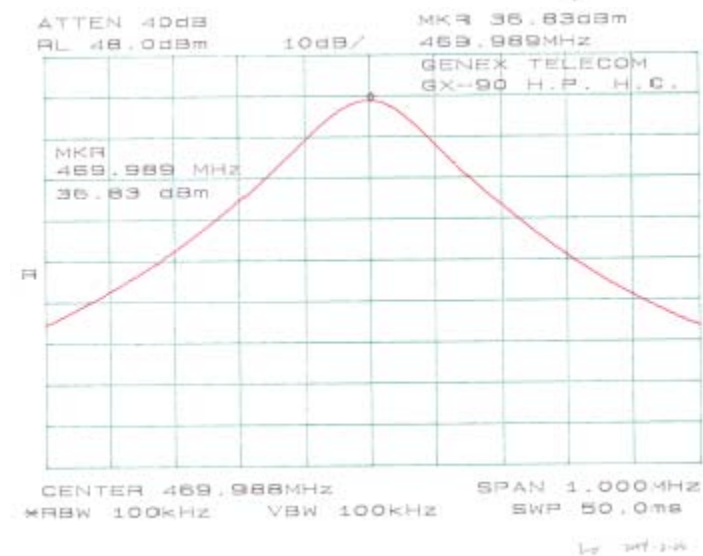
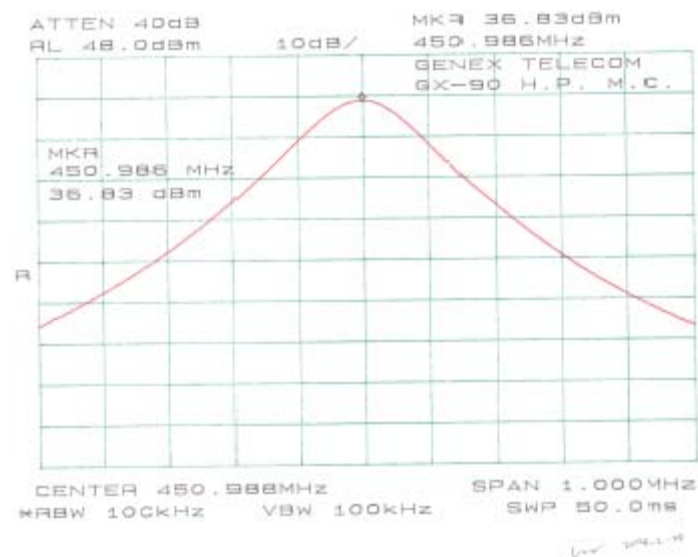
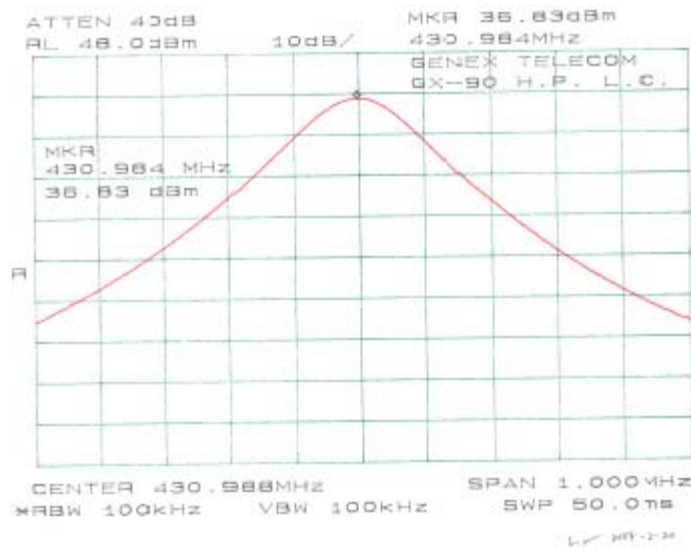
Environmental Conditions

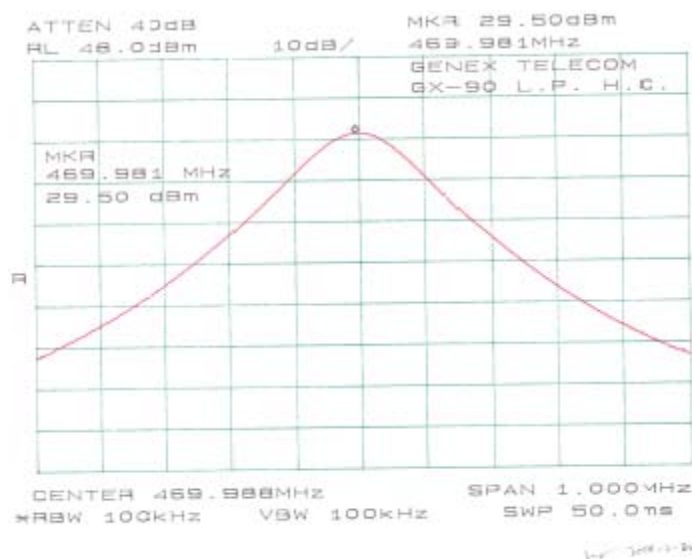
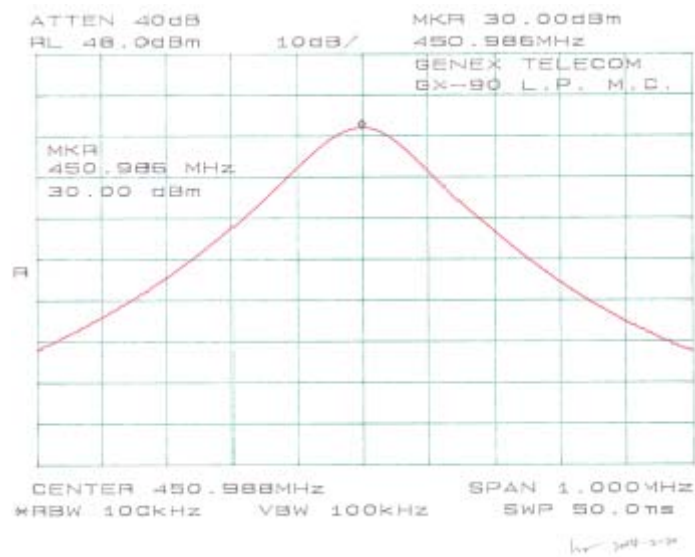
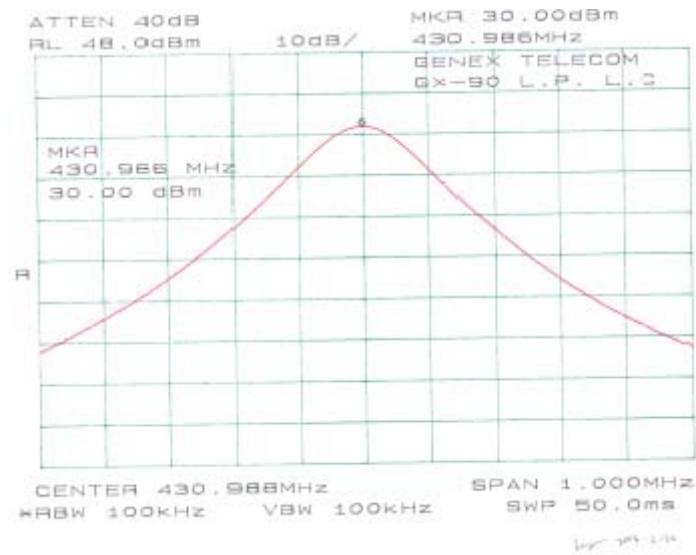
Temperature:	14° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

Test Results

Power Level	Channel	Output Power in dBm	Output Power in W
High Power	430.988	36.83	4.819
	450.988	36.83	4.819
	469.988	36.83	4.819
Low Power	430.988	30.00	1.000
	450.988	30.00	1.000
	469.988	29.50	0.891

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:

- (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.

§90.205

Transmitters utilizing analog emissions that are equipped with an audio low-pass filter must meet the emission limitations and must meet proper emissions mask of 90.210.

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

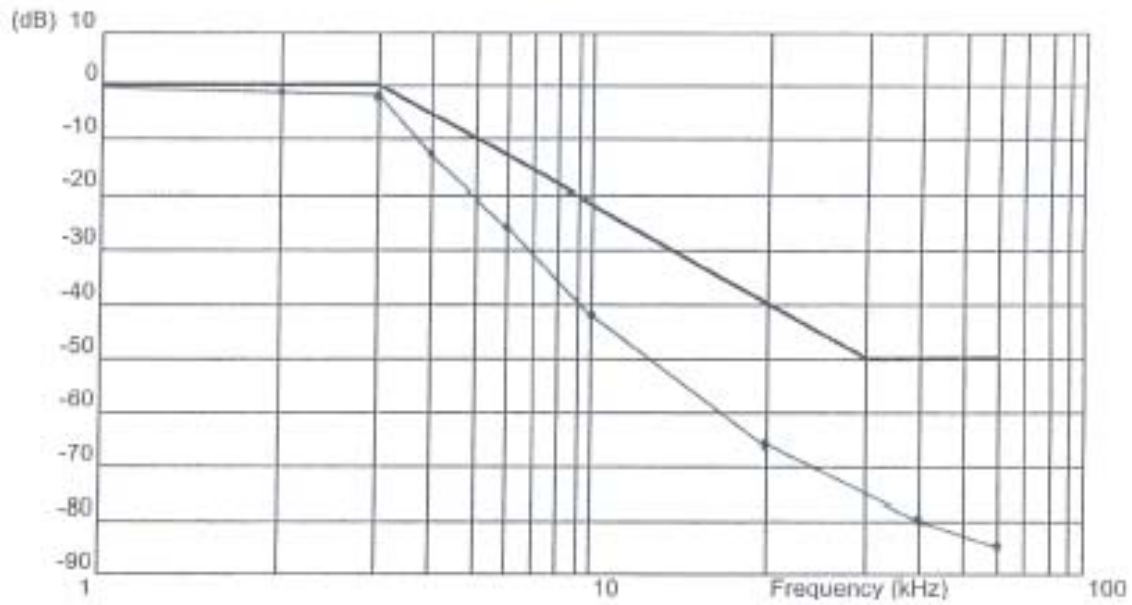
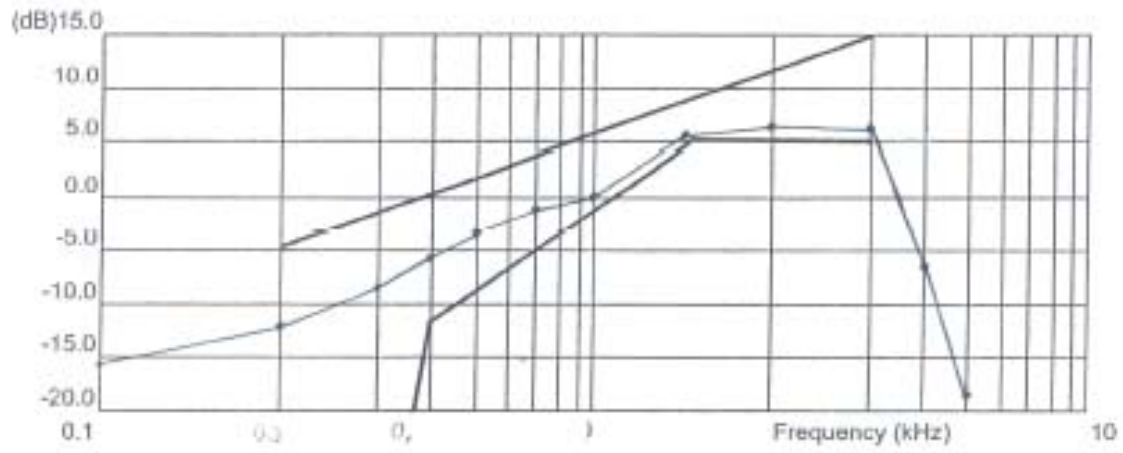
* **Statement of Traceability:** BACL Corp. certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

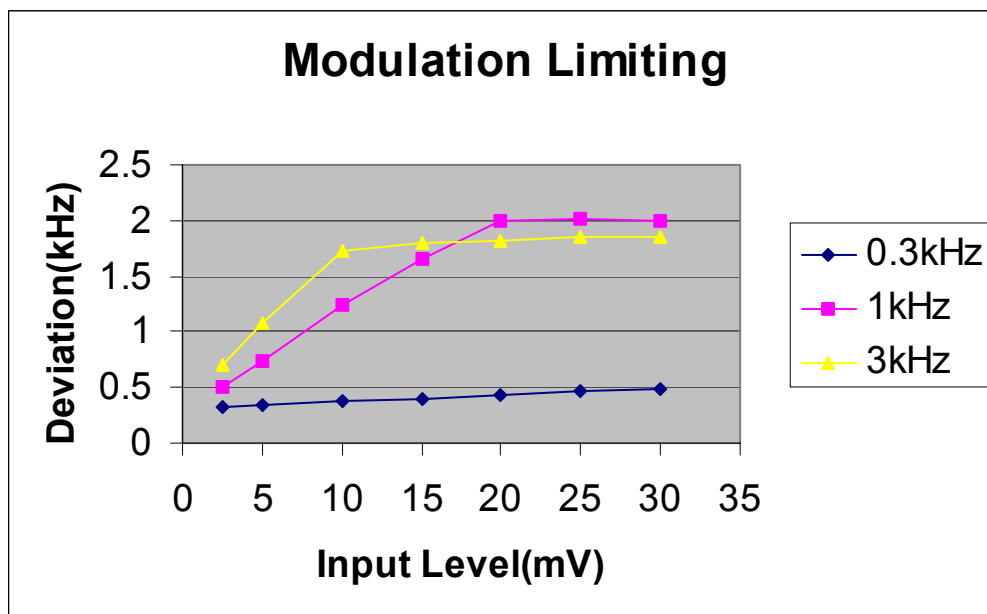
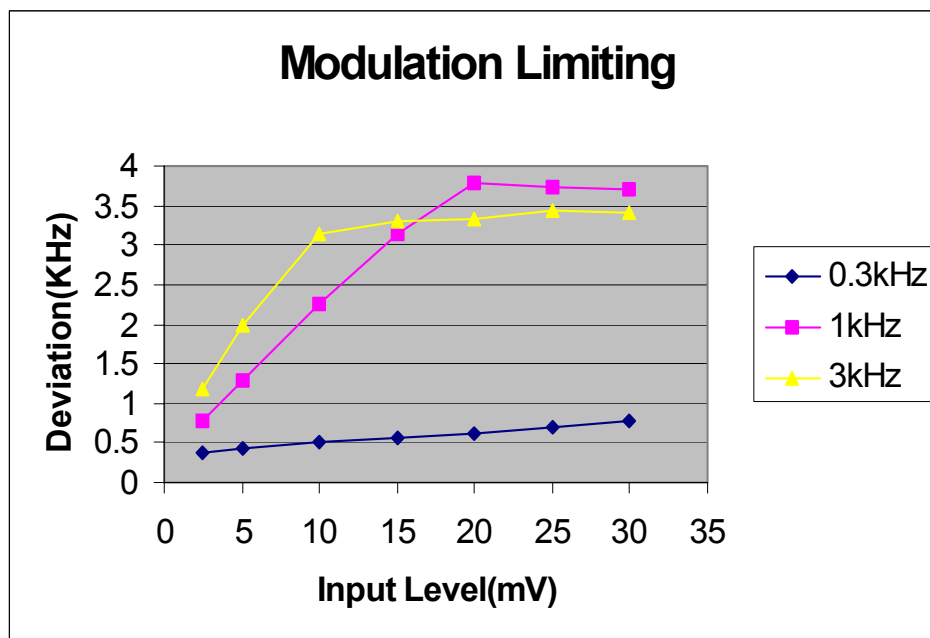
Environmental Conditions

Temperature:	14° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

Test Results

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





§2.1049, and § 90.209 – OCCUPIED BANDWIDTH

Applicable Standard

§2.1049 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 ($f_d - 2.88$ kHz) 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:

Low: $50 + 10\log P = 50 + 10\log(4.4) = 56.4$ dB

Middle: $50 + 10\log P = 50 + 10\log(4.1) = 56.1$ dB

High: $50 + 10\log P = 50 + 10\log(3.9) = 55.9$ dB

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:

Low: $43 + 10\log P = 43 + 10\log(4.4) = 49.4$ dB

Middle: $43 + 10\log P = 43 + 10\log(4.1) = 49.1$ dB

High: $43 + 10\log P = 43 + 10\log(3.9) = 48.9$ dB

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 30 KHz 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

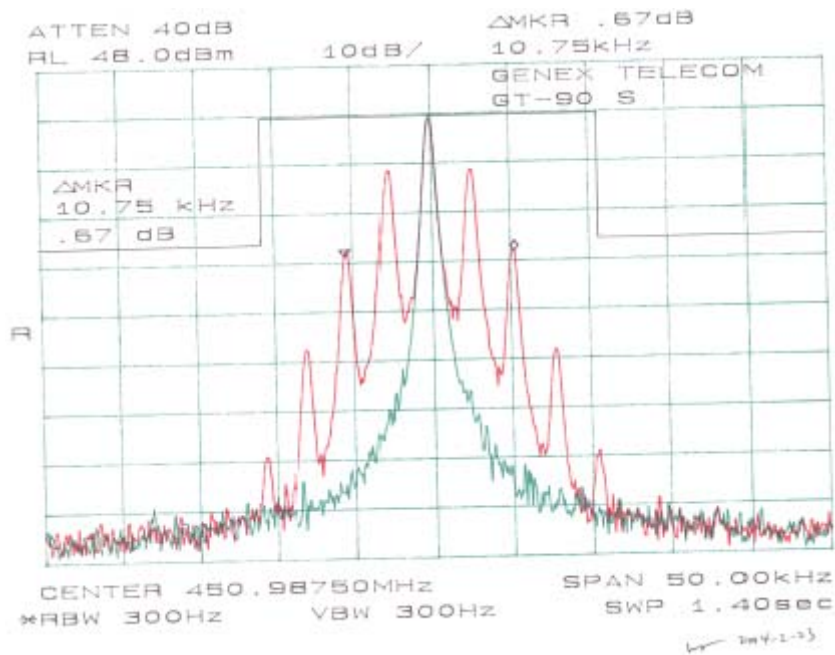
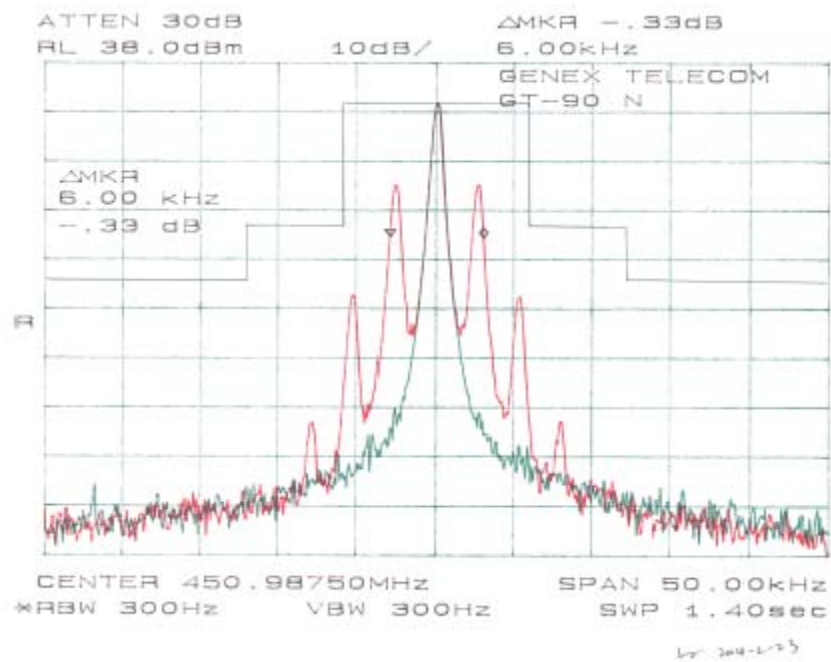
* **Statement of Traceability:** **BACL Corp.** certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

Environmental Conditions

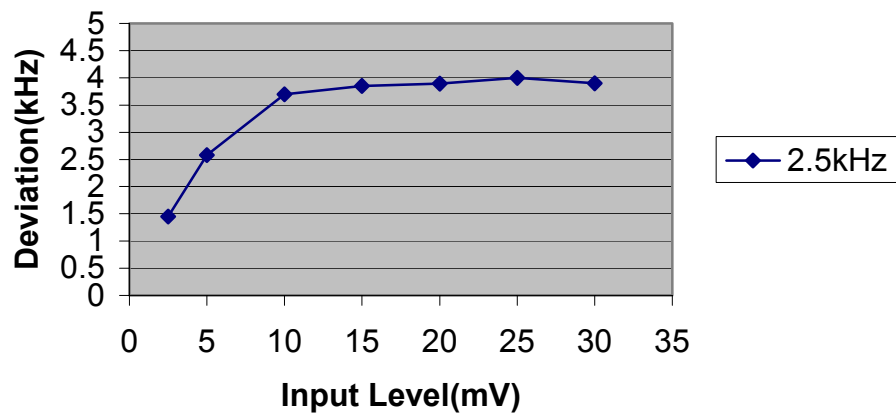
Temperature:	14° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

Test Results

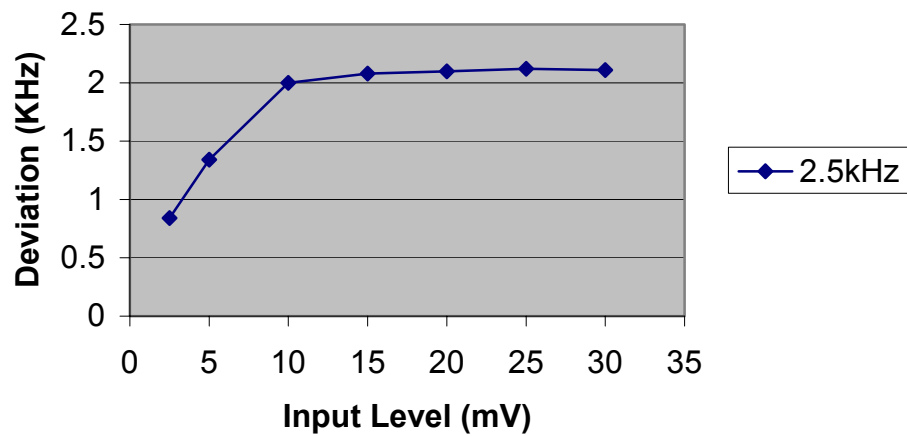
Please refer to the hereinafter plots.



2.5kHz Modulation Limiting



2.5kHz Modulation Limiting



§2.1051 and §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Procedure

§2.1051 and §90.210 (25kHz bandwidth only)

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

Low: $43+10\log P=43+10\log(4.4)=49.4\text{dB}$

Middle: $43+10\log P=43+10\log(4.1)=49.1\text{dB}$

High: $43+10\log P=43+10\log(3.9)=48.9\text{dB}$

§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:

Low: $50+10\log P=50+10\log(4.4)=49.4\text{dB}$

Middle: $50+10\log P=50+10\log(4.1)=49.1\text{dB}$

High: $50+10\log P=50+10\log(3.9)=48.9\text{dB}$

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 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Equipment

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

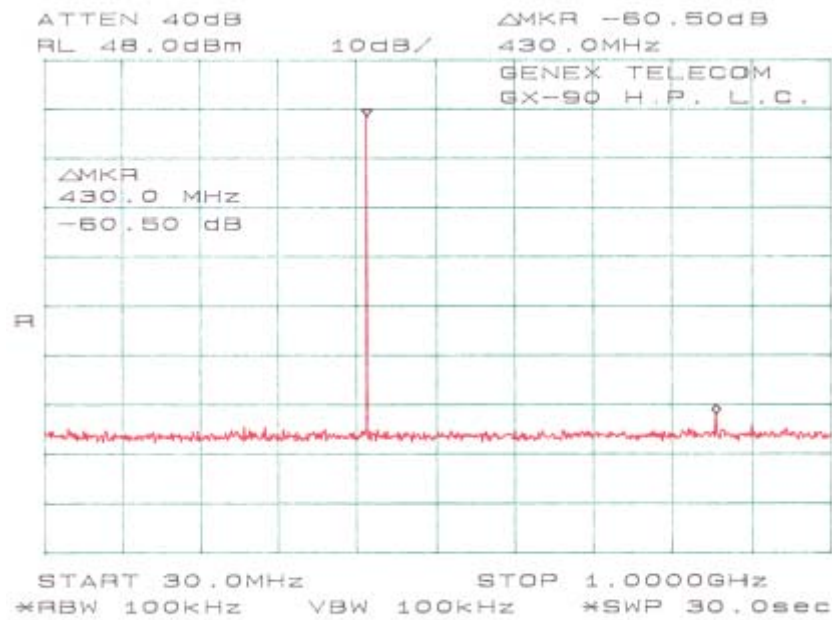
* **Statement of Traceability:** BACL Corp. certifies that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

Environmental Conditions

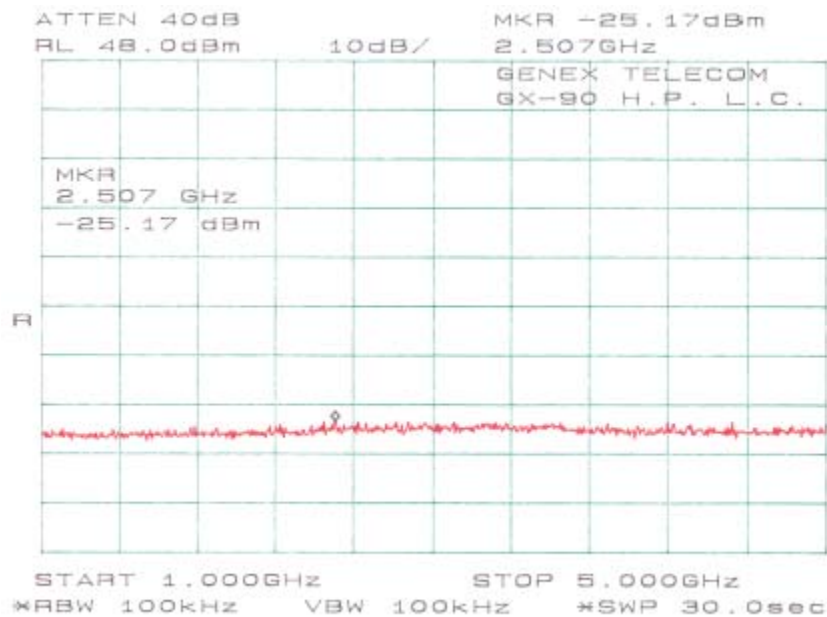
Temperature:	14° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

Test Results

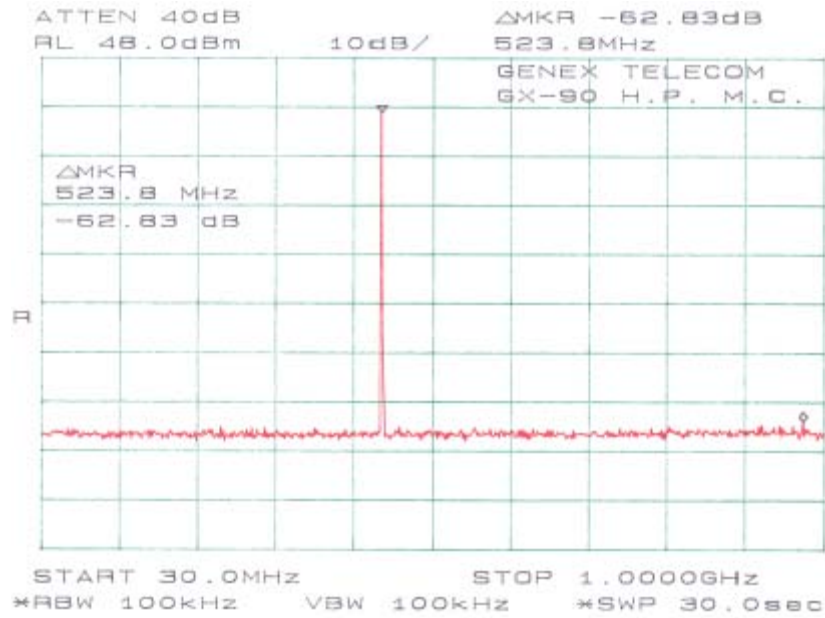
Please refer to the hereinafter plots.



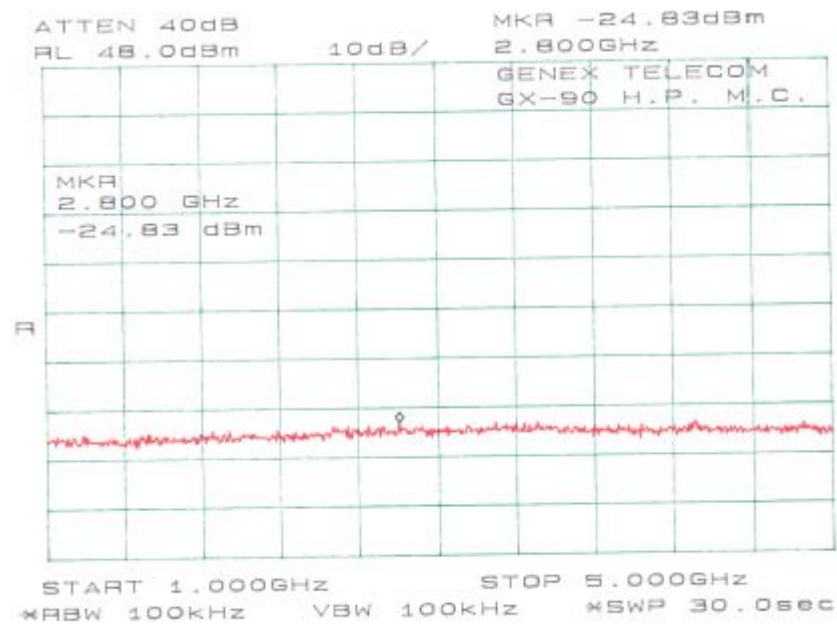
2014-7-30



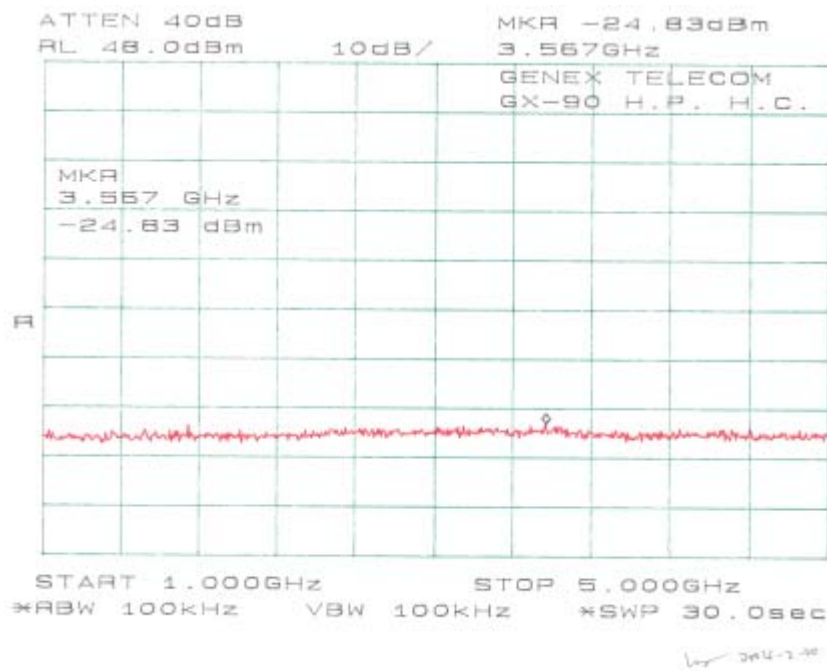
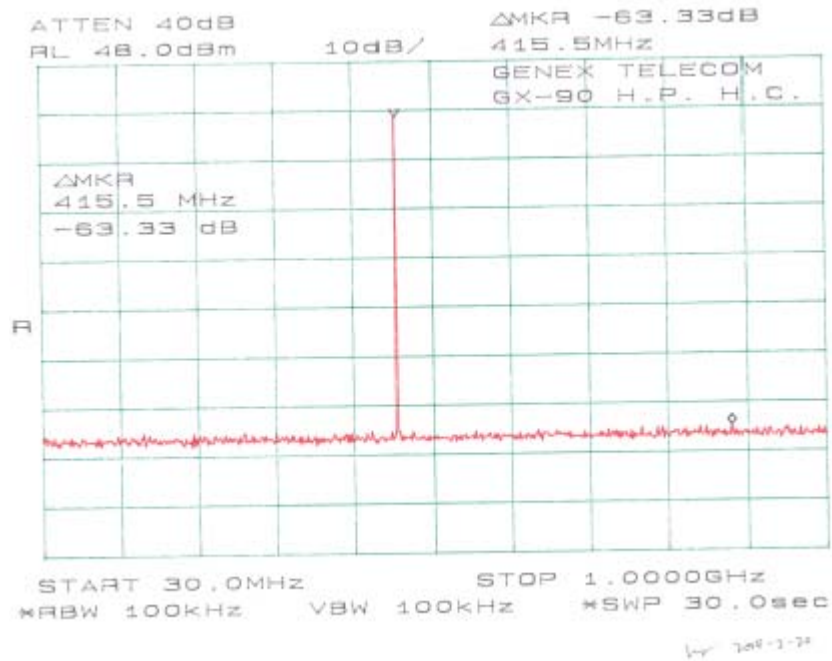
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2004-2-20



2004-2-20



§2.1053 and §90.210 - RADIATED SPURIOUS EMISSION

Test Procedure

§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 = $10 \lg (\text{TXpwr in Watts}/0.001)$ – the absolute level

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

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:	14° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

Test Result

Low Frequency: -5.6 at 861.975MHz
 Mid Frequency: -6.7dB at 901.975MHz
 High Frequency: -5.1dB at 939.975MHz

Test Data for High Power:

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
Low Channel												
430.9875	118.7	330	2	v	430.9875	36.5	v	0	0.1	36.4		
430.9875	82	180	2.2	h	430.9875	2.2	h	0	0.1	2.1		
861.975	56.83	220	1.8	v	861.975	-18.5	v	0	0.1	-18.6	-13	-5.6
1292.963	43.17	270	2	v	1292.963	-31.5	v	5	0.3	-26.8	-13	-13.8
1292.963	39.17	270	2.1	h	1292.963	-34.7	h	5	0.3	-30	-13	-17.0
861.975	28.5	180	2	h	861.975	-42.3	h	0	0.1	-42.4	-13	-29.4
Mid Channel												
450.9875	111.2	330	1.8	v	455.075	29.4	v	0	0.1	29.3		
450.9875	80	180	1.5	h	455.075	0.5	h	0	0.1	0.4		
901.975	55.67	180	1.7	v	910.15	-19.6	v	0	0.1	-19.7	-13	-6.7
1352.963	38.17	0	1.8	v	1365.225	-40.6	v	5	0.3	-35.9	-13	-22.9
1352.963	35.33	0	2	h	1365.225	-42	h	5	0.3	-37.3	-13	-24.3
901.975	26.83	270	2.3	h	910.15	-44.5	h	0	0.1	-44.6	-13	-31.6
High Channel												
469.9875	119.8	0	1.6	v	470	37.2	v	0	0.1	37.1		
469.9875	82.33	330	2	h	470	2.3	h	0	0.1	2.2		
939.975	57.33	300	1.7	v	940	-18	v	0	0.1	-18.1	-13	-5.1
1409.963	42.33	180	2.5	v	1410	-39.1	v	5	0.3	-34.4	-13	-21.4
1409.963	36.33	330	2.2	h	1410	-40.5	h	5	0.3	-35.8	-13	-22.8
939.975	28.83	0	2	h	940	-44.1	h	0	0.1	-44.2	-13	-31.2

Note: No pre-amplifier for the test.

Dipole antenna for frequency below 1000 MHz, Horn antenna for frequency above 1000 MHz.

§2.1055 (d) and §90.213- FREQUENCY STABILITY

Applicable Standard

§2.1055 (d)

§90.213

For output power > 2 watts, the limit is 2.5ppm.

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	2003-04-23
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:	14° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

Test Results

Reference Frequency: 450.9875 MHz, Limit: 2.5 ppm			
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
		MCF (MHz)	PPM Error
50	7.4	450.98683	-1.49
40	7.4	450.98690	-1.33
30	7.4	450.98750	0.00
20	7.4	450.98730	-0.44
10	7.4	450.98738	-0.27
0	7.4	450.98742	-0.18
-10	7.4	450.98751	0.02
-20	7.4	450.98698	-1.15
-30	7.4	450.98680	-1.55

Frequency Stability Versus Input Voltage

Reference Frequency: 450.9875 MHz, Limit: 2.5 ppm			
Power Supplied	Environment Temperature (°C)	MHz	ppm
6.4	20	450.98710	-0.89
8.5	20	450.98717	-0.73

§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:	14° C
Relative Humidity:	72%
ATM Pressure:	1015 mbar

Test Result

Please refer to the plot hereinafter.

