

FCC PART 25 TYPE APPROVAL EMI MEASUREMENT AND TEST REPORT

For

Globalstar USA, LLC

461 S. Milpitas Blvd.
Milpitas, CA 95035, U.S.A.

FCC ID: TSEMCM-4

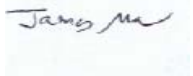
This Report Concerns: ☒ Original Report	Product name: Single Antenna Multi Channel Modem
Test Engineer: Snell Leong 	
Report No.: R0604112	
Report Date: 2006-05-10	
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GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *Globalstar USA, LLC's* product, FCC ID: TSEMCM-4, model number: MCM-4e or the "EUT" as referred to in this report is a *Single Antenna Multi Channel Modem*. The MCM-4e provides you with data access over the Globalstar satellite network. In some geographic areas setup, configuration and usage may be slightly different. Subject to certain constraints, the MCM-4e is capable of dial up packet or asynchronous operation in any Globalstar service area.

The MCM-4e provides the ability to establish up to four concurrent satellite connections each providing 7.2 Kbps of raw symmetrical bandwidth. The MCM-4e provides the combined bandwidth to the user via a single standard Ethernet connection. The MCM-4e is a full duplex device and can be configured to allow other data terminals to initiate a data communications connection. For this purpose, any of the four SDMs may be configured to receive an incoming asynchronous data call from a PSTN modem. The MCM-4e unit can be connected to a second MCM-4e unit to provide the combined bandwidth of up to eight concurrent satellite connections.

The MCM-4e is comprised of two modules: the Antenna and the Multi Channel Modem (MCM-4e). The Antenna is mounted on an external surface. The MCM-4e contains an ML-IP ePipe 2188 and four QUALCOMM GSP-1620 Satellite Data Modems (SDM). The MCM-4e also includes a Ethernet 10 Base-T port, power supplies, converters, and management functions.

The 10/100 BaseT Ethernet port can be connected to multiple remote client terminals through a suitable hub or switch. It provides the path through the Globalstar network for your remote client terminal(s) to communicate. Your connection may be to a public server site or you may be connected to a private site such as a Virtual Private Network (VPN).

In normal operation the MCM-4e provides you with a PATH to and from the Internet, which allows your mobile platform to be connected without having wires attached to it. You operate the remote client terminal exactly the same way you would if it were connected to any other Ethernet LAN. When the MCM-4e is operating normally, it provides the path to and from the Internet and will be transparent to you.

Mechanical Description

The *Globalstar USA, LLC's* product, *Model: MCM-4e* or the "EUT" as referred to in this report is a *Single Antenna Multi Channel Modem*, which measures approximately 300mmL x 175mmW x 525mmH.

** The test data gathered are from production sample, serial number: 0104, provided by the manufacturer.*

EUT Photo



Objective

This type approval report is prepared on behalf of *Globalstar USA, LLC* in accordance with Part 2, Subpart J, and Part 25, Subparts C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for Radiated Emission, Frequency Tolerance, Emission Limitation (out of band), Power Density, Emission Limitation (in band), and Power Limit.

Related Submittal(s)/Grant(s)

No Related Submittals.

Test Methodology

All measurements contained in this report were conducted with TIA/EIA 603-C.

All radiated and conducted emissions measurements were performed at Bay Area Compliance Laboratory, Corp.

Test Facility

The Test site used by BACL Corp. to collect radiated and conducted emission measurement data is located at it's facility in Sunnyvale, California, USA.

Test site at BACL 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 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 test methods and procedures set forth in ANSI C63.4-2003& TIA/EIA-603-C.

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>

SYSTEM TEST CONFIGURATION

Justification

The host system was configured for testing according to TIA/EIA 603-C.

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

EUT Exercise Software

The EUT operates max power mode during radiated and conducted testing.

Special Accessories

N/A

Equipment Modifications

No modifications were made to the EUT.

Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
IBM	Laptop	560	78-HN065 97/04
Anritsu	Global Star User terminal tester	MT8803G	MB06886
Anritsu	Global Star User terminal tester	MT8803G	MB08587
Dell	Laptop	300M	N/A

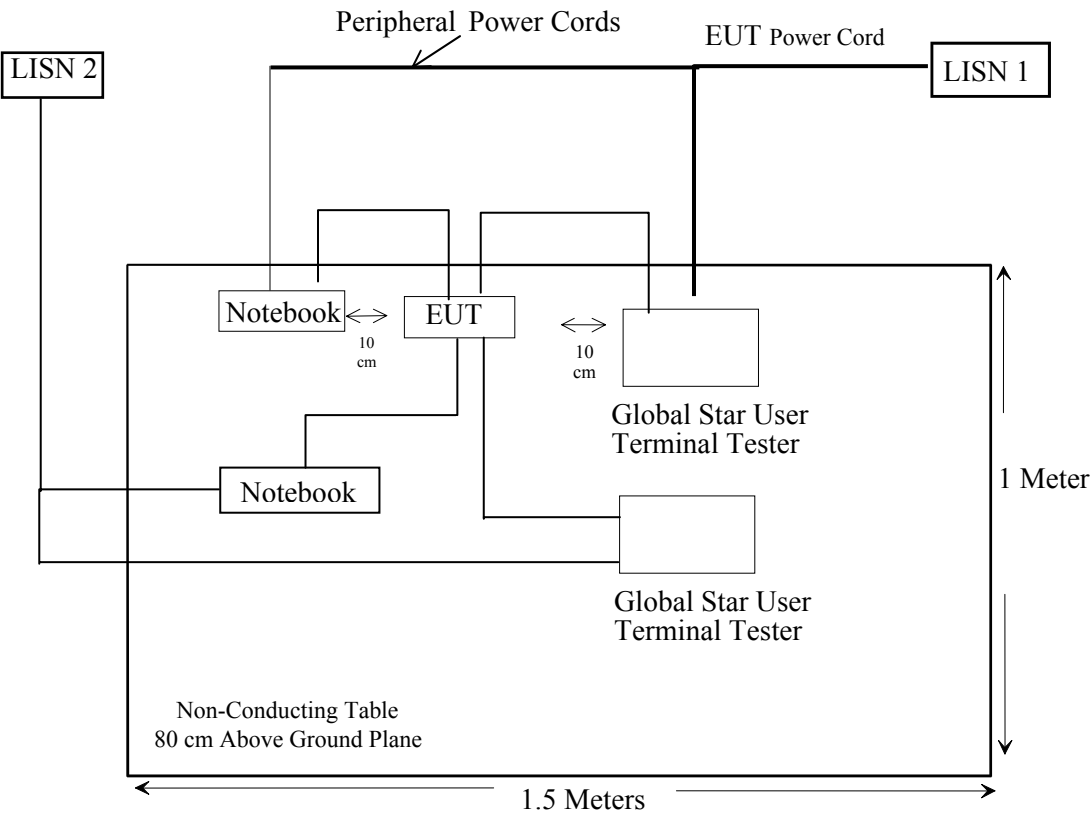
Power Supply Information

Manufacturer	Description	Model	Serial Number
GUI Inc	ADC power supply	EA1050A-120	DTS-120500UC-p-ET

External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Serial cable	1.5	Laptop (IBM)	EUT (SDM1)
Serial cable	1.5	Laptop (dell)	EUT (SDM2)

Test Setup Block Diagram



SUMMARY OF TEST RESULTS

Results reported relate only to the product tested.

FCC Rules	Description of Test	Result
§1.1307(b)(1) & §2.1091	RF Exposure	Compliant
§2.1047	Modulation Characteristic	Compliant
§2.1051	Spurious Emission at Antenna Terminals	Compliant
§15.107	AC Line Conducted Emission	Compliant
§2.1055 & §25.202(d)	Frequency Stability	Compliant
§2.1053 & §25.202(f)	Field Strength of Spurious Radiation	Compliant
§25.202	Emission Mask	Compliant
§25.216 (b) & (g)	Emission from Mobile Earth Station for Protection of Aeronautical Radio navigation-Satellite Service	Compliant
§2.1046 & §25.204	Power Output	Compliant

§1.1307(b)(1) & §2.1091 - RF EXPOSURE

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

MPE Prediction

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal: 33.19(dBm)

Maximum peak output power at antenna input terminal: 2084.49 (mW)

Prediction frequency: 1620.57 (MHz)

Antenna Gain (typical): 2.3(dBi)

Antenna gain: 1.698 (numeric)

Power Density at Prediction Distance: 1 (mW/cm²)

Prediction Distance: 20.00 cm

MPE limit for uncontrolled exposure at prediction frequency: 0.7 (mW/cm²)

Test Result

The EUT is a mobile device. The prediction distance is 20.00 cm.

§2.1047 – MODULATION CHARACTERISTICS

The EUT uses digital modulation techniques only which were employed during the tests for occupied bandwidth.

§2.1051 – SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Standard Applicable

Protection of the radio-navigation-satellite service. Mobile earth stations operating in the 1610-1626.5 MHz band shall limit out-of-band emissions in the 1574.397-1576.443 MHz band so as not to exceed an e.i.r.p. density level of -70 dB (W/MHz) averaged over any 20 ms period. The e.i.r.p. of any discrete spurious emission (i.e., bandwidth less than 600 Hz) in the 1574.397-1576.443 MHz band shall not exceed -80 dBW.

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment by more than 250% of the authorized bandwidth (1.23MHz), at least

$43 + 10 \log (P_{\text{watts}})$ attenuation below the mean power of the transmitter.

For Lowest Channel = $43 + 10 \log (0.282\text{W}) = 47.5$ dBc

For Highest Channel = $43 + 10 \log (0.355\text{W}) = 48.5$ dBc

Measurement Procedure

Spurious emissions appearing at the antenna terminals were measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer.

Equipment Lists

Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

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

Measurement Result

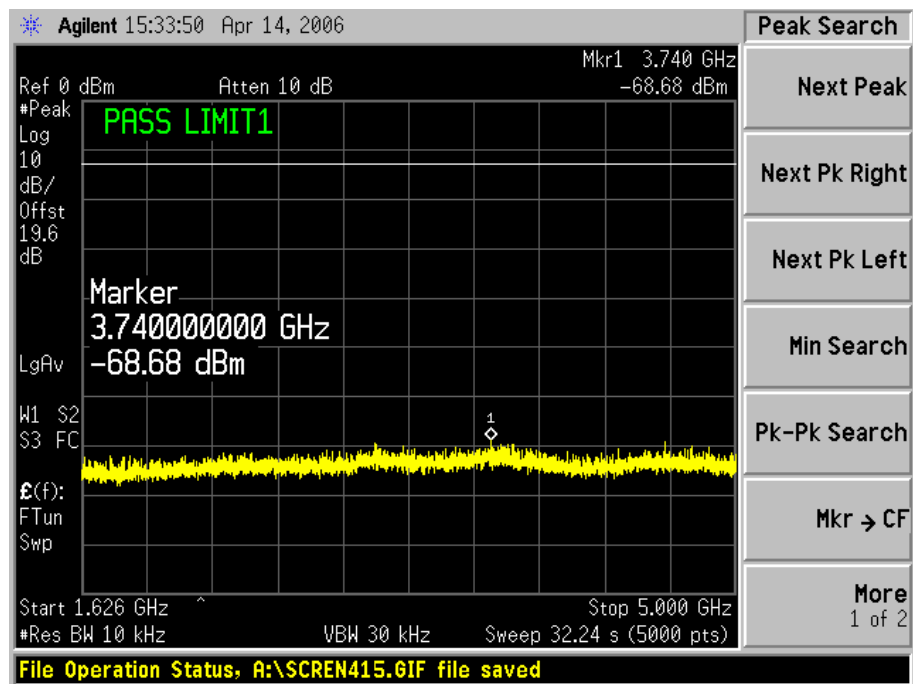
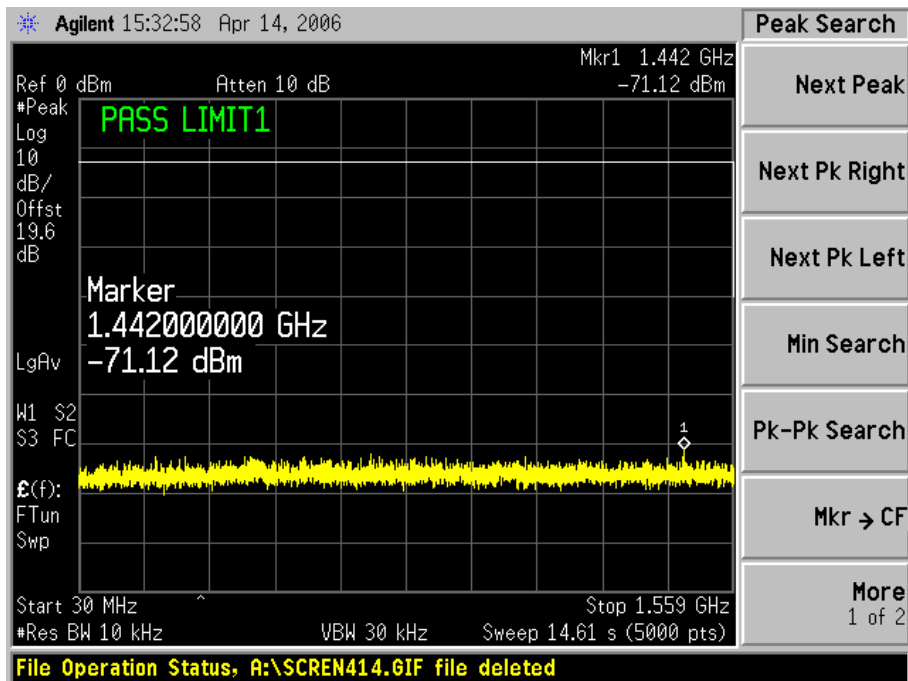
Environmental Conditions

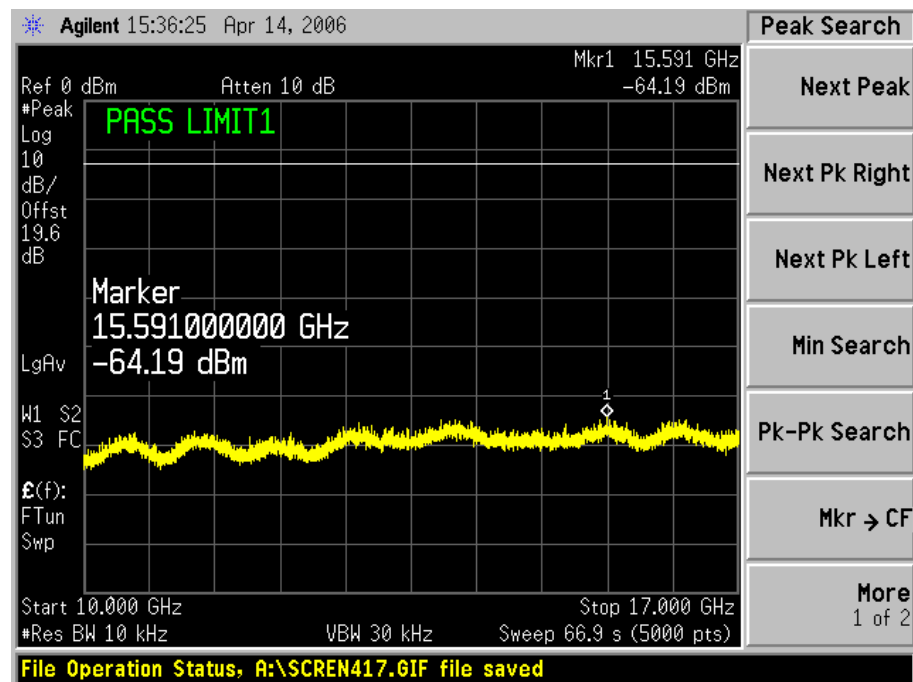
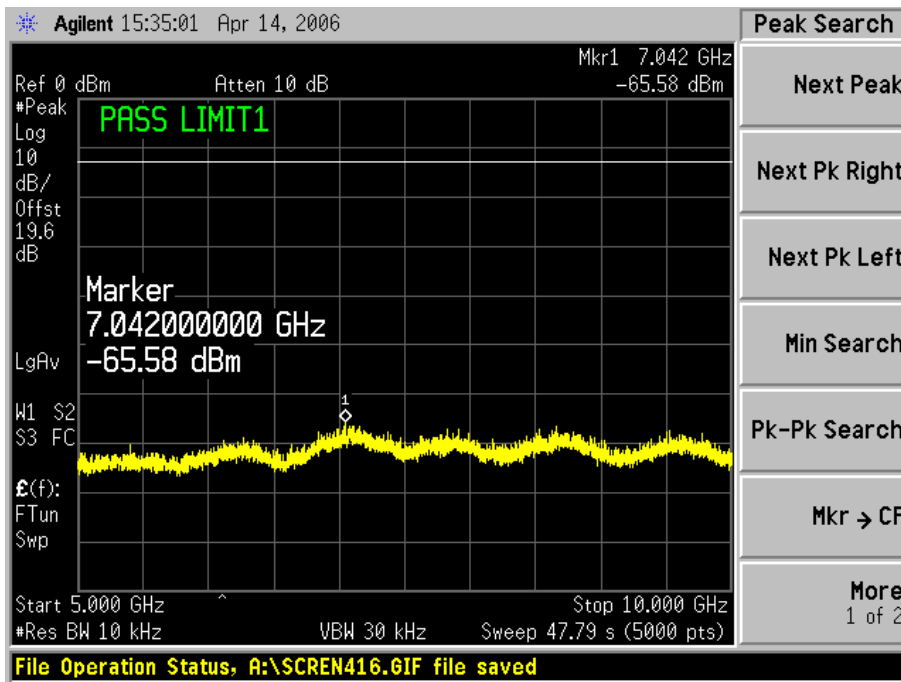
Temperature:	23° C
Relative Humidity:	65%
ATM Pressure:	1025 mbar

* *The testing was performed by Snell Leong on 2006-04-18.*

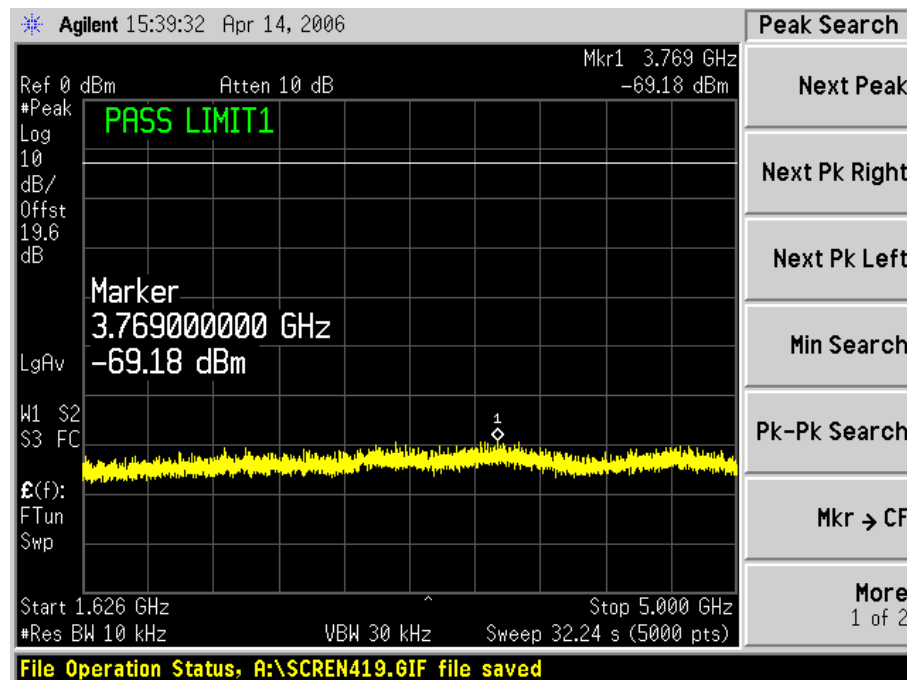
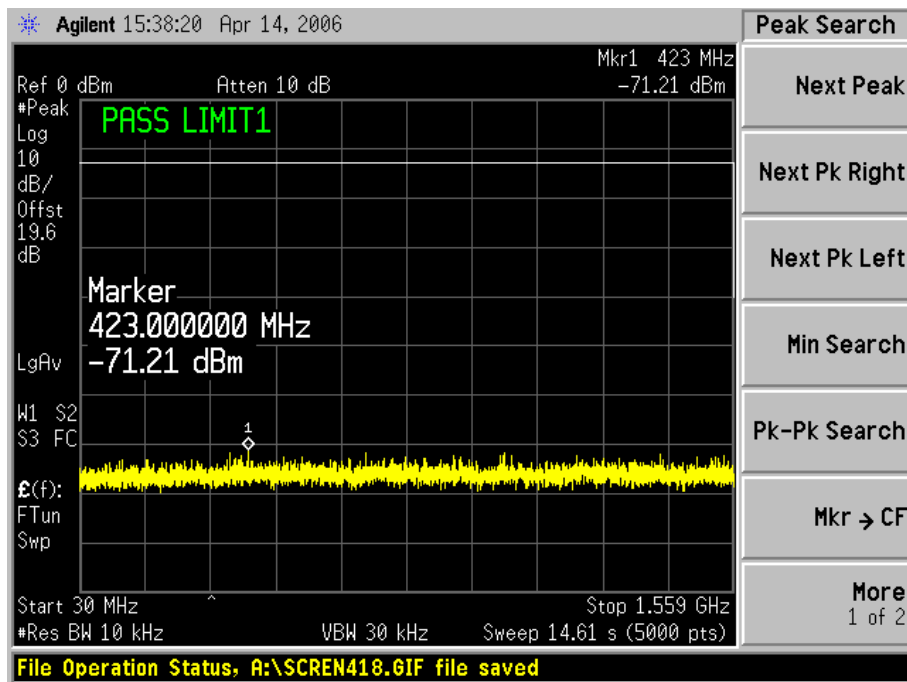
The following plots show that all emissions are at least 48.5 dB below the fundamental.

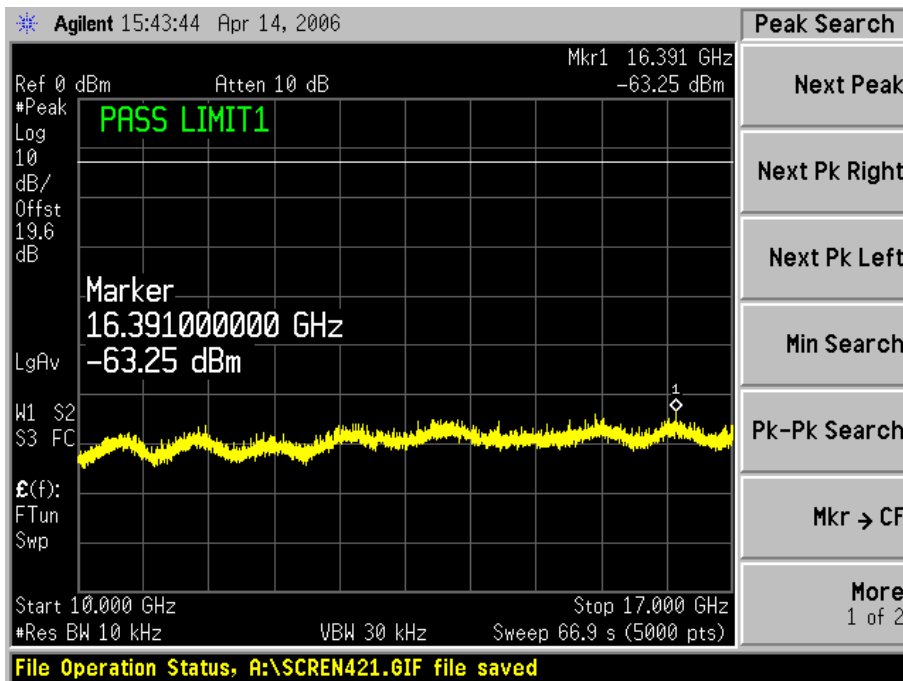
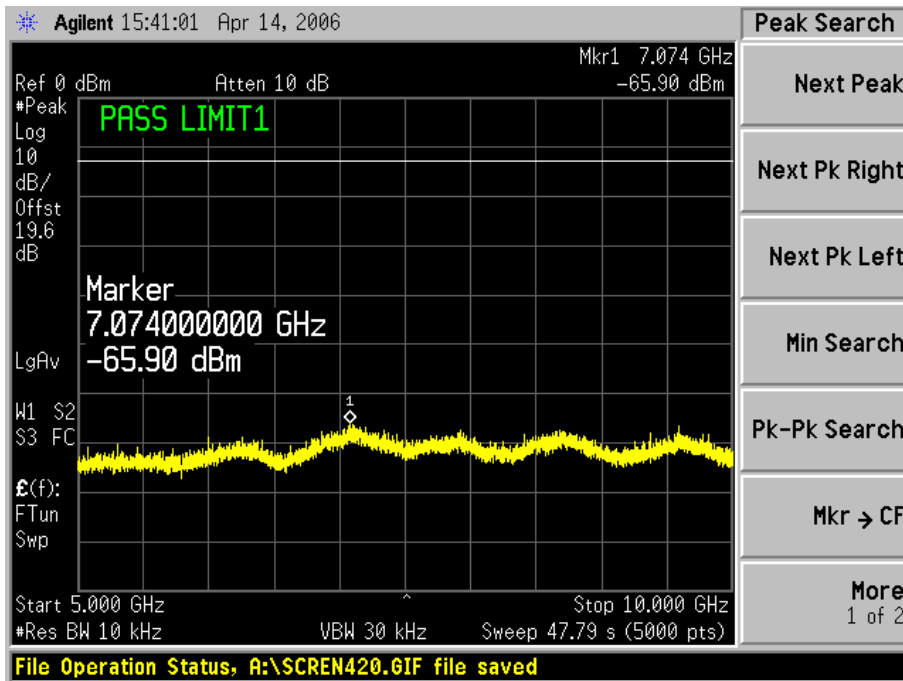
Low Channel



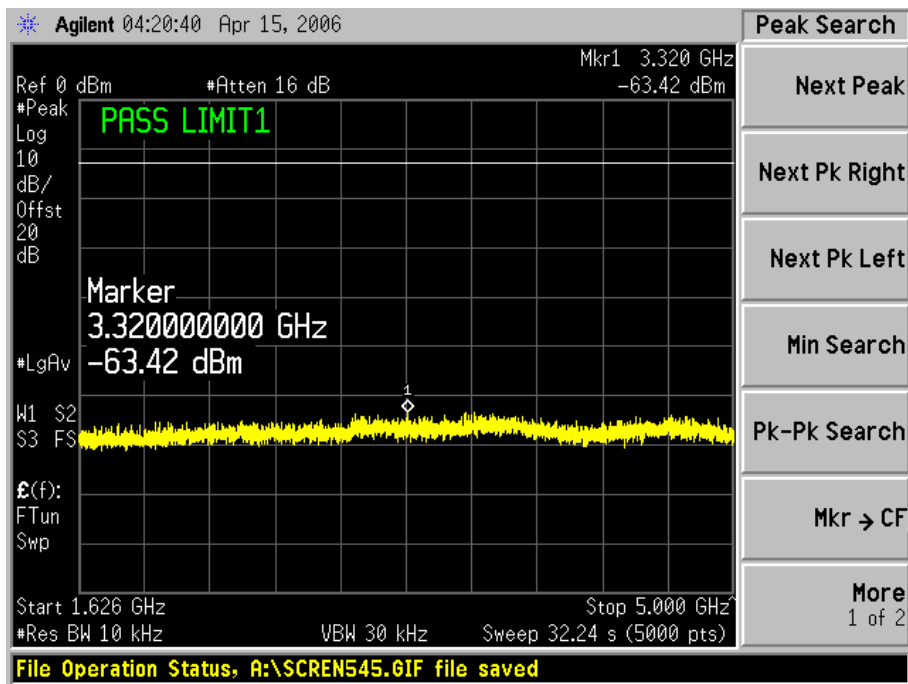
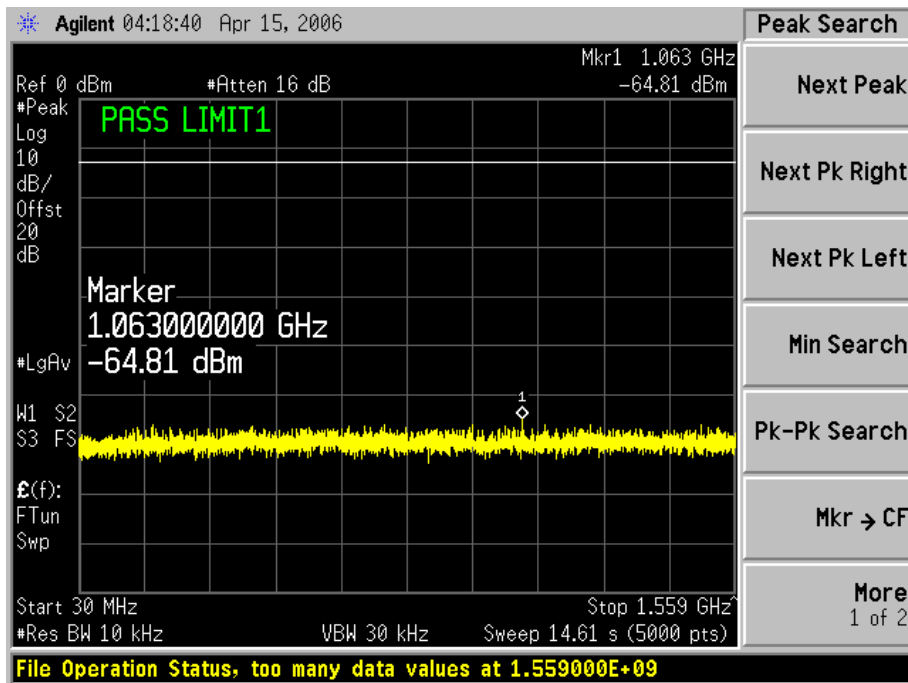


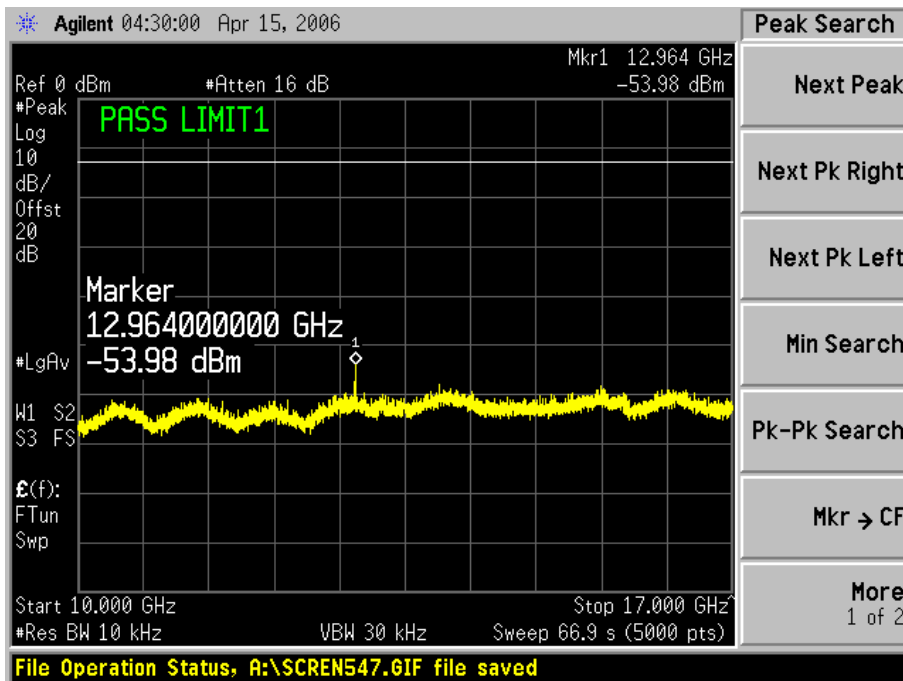
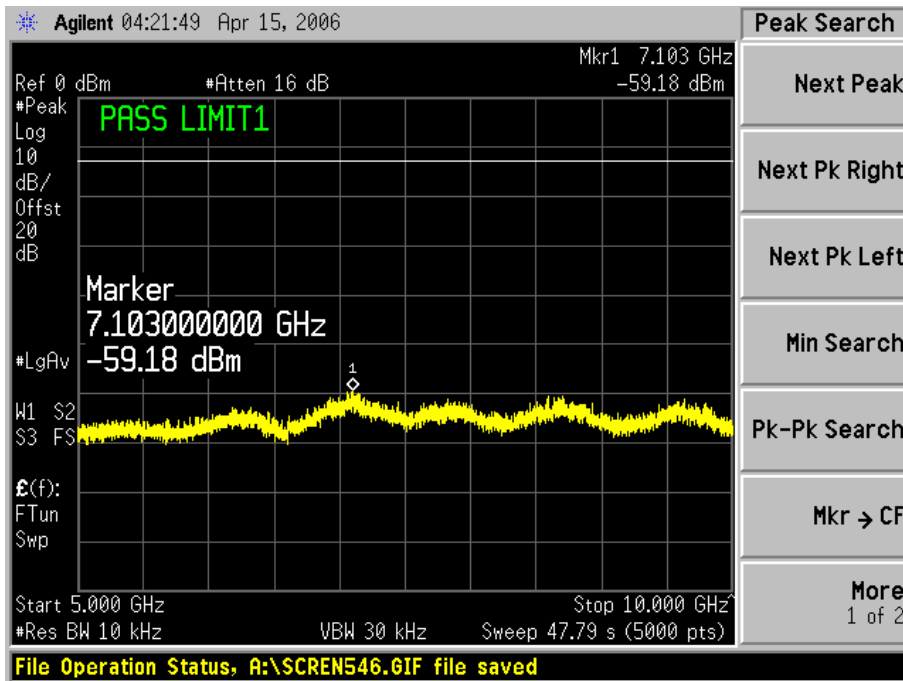
Middle Channel:



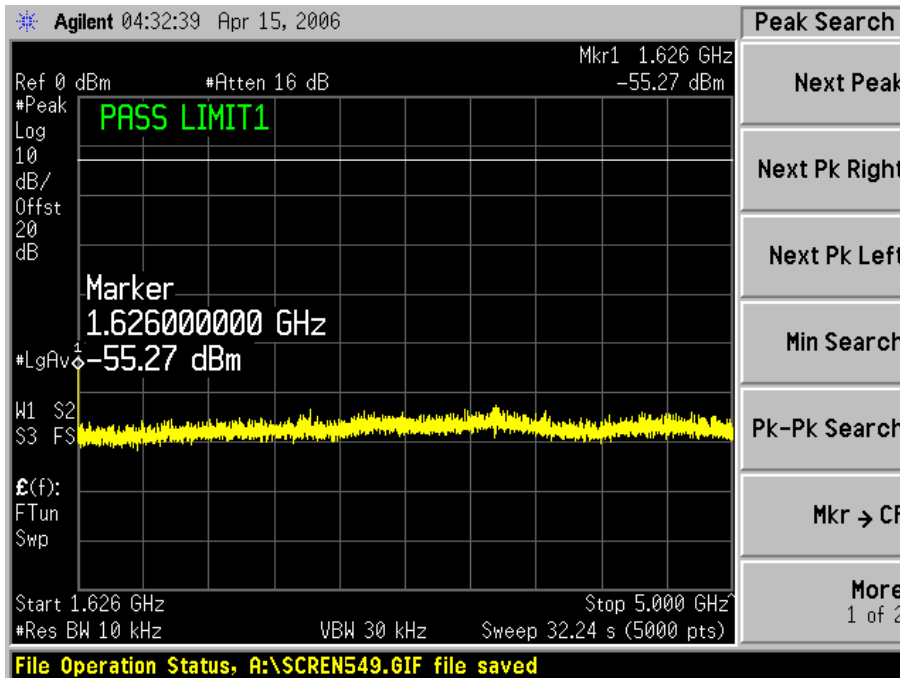
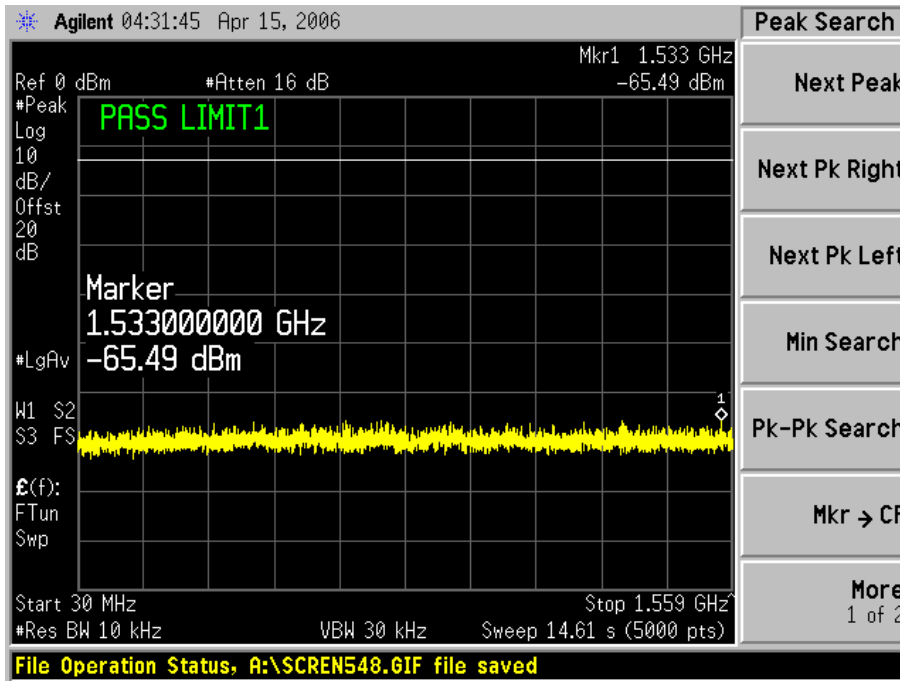


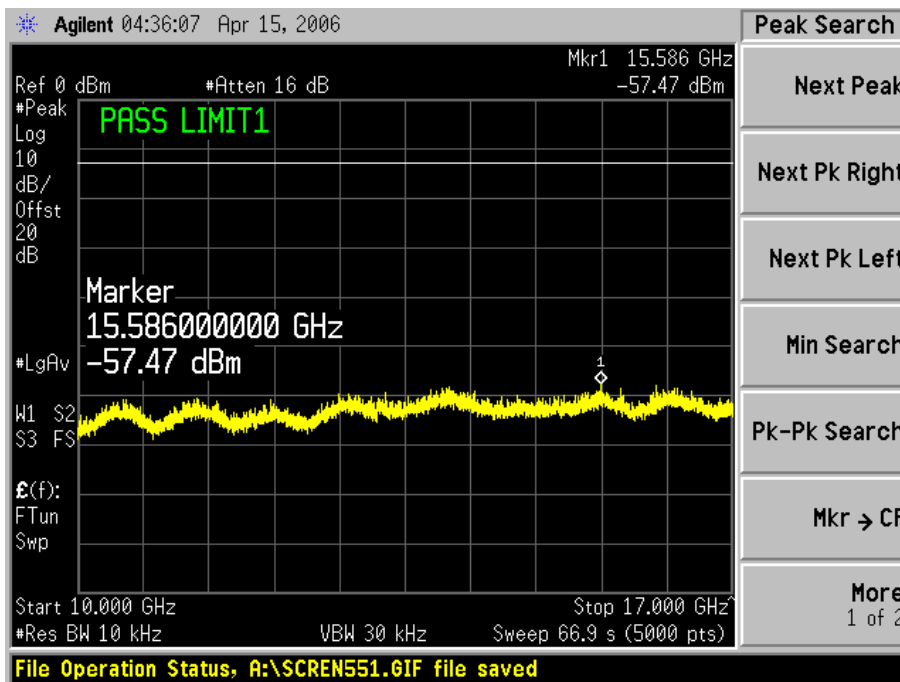
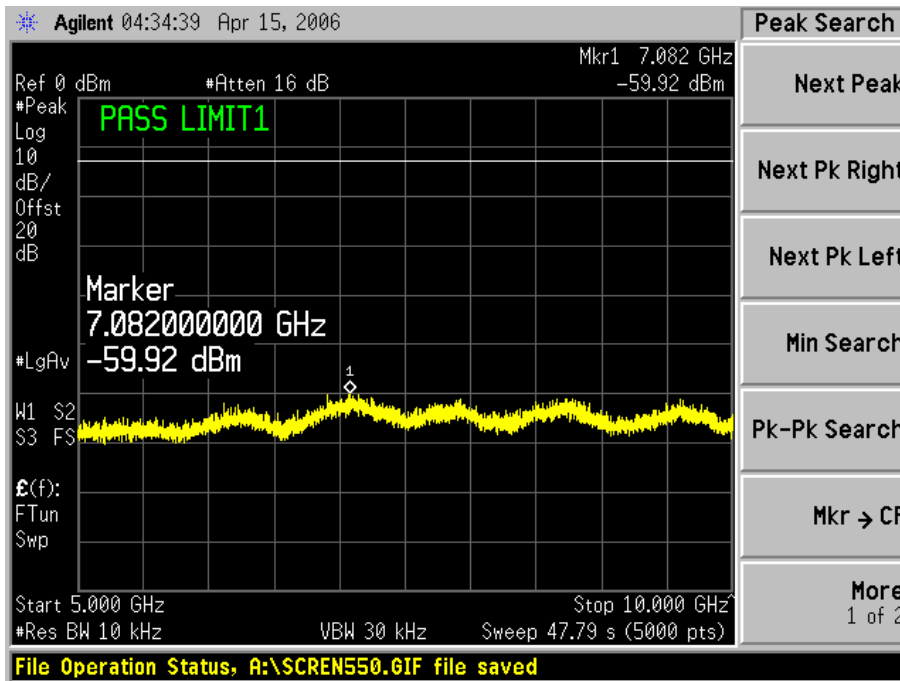
High Channel



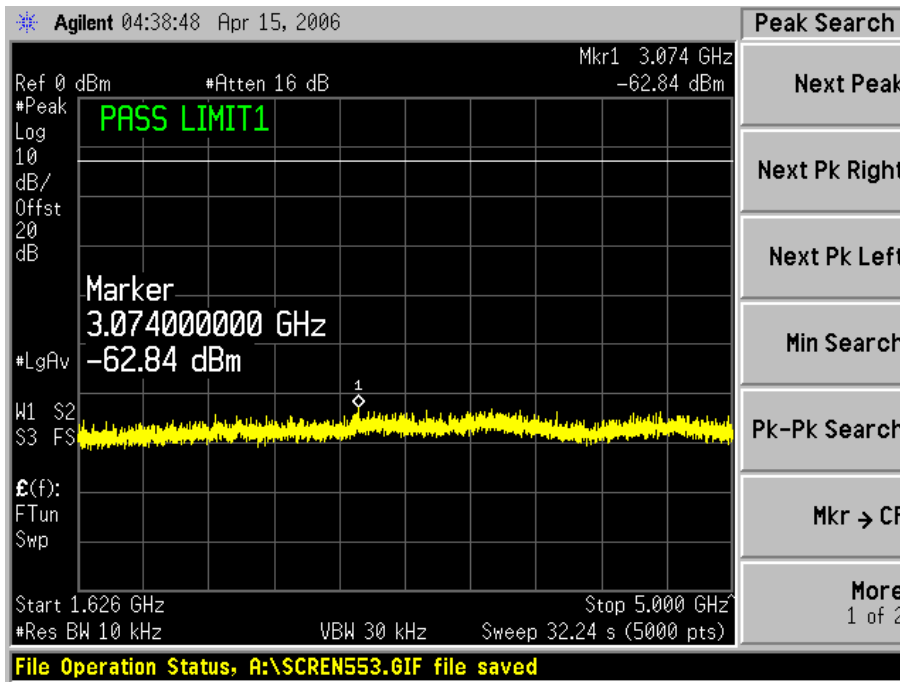
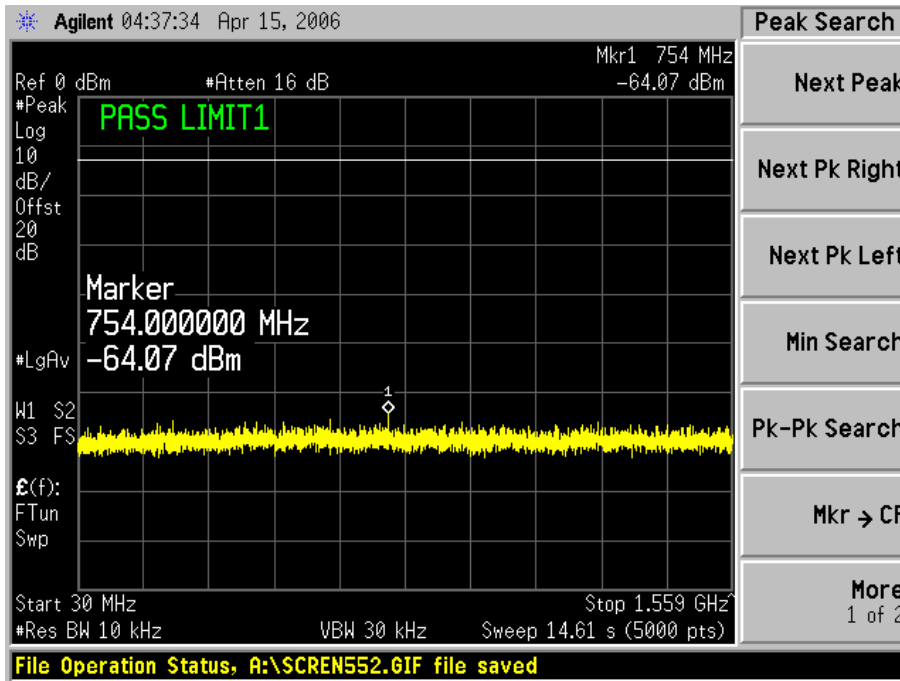


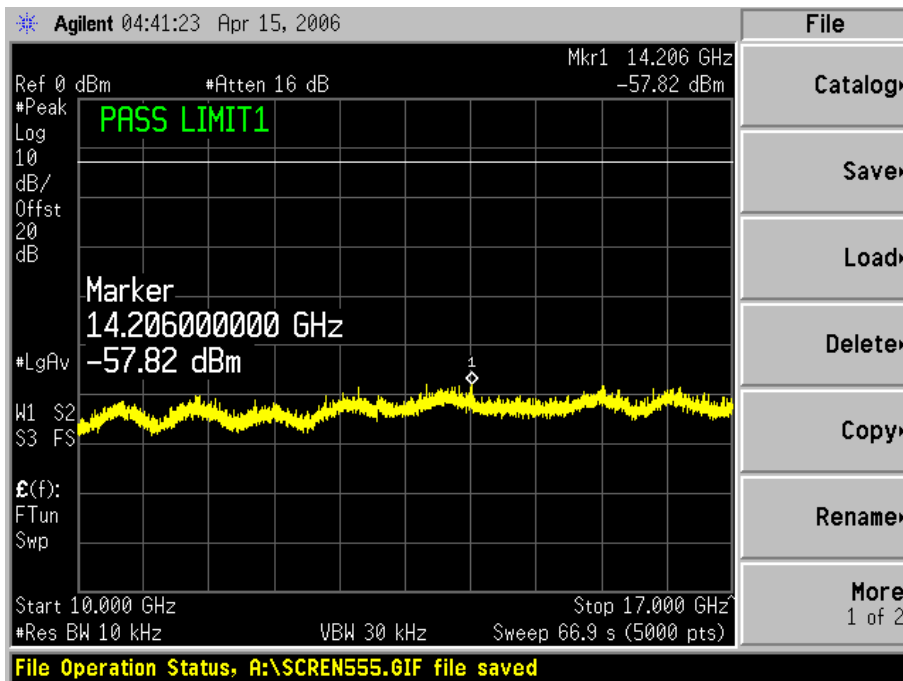
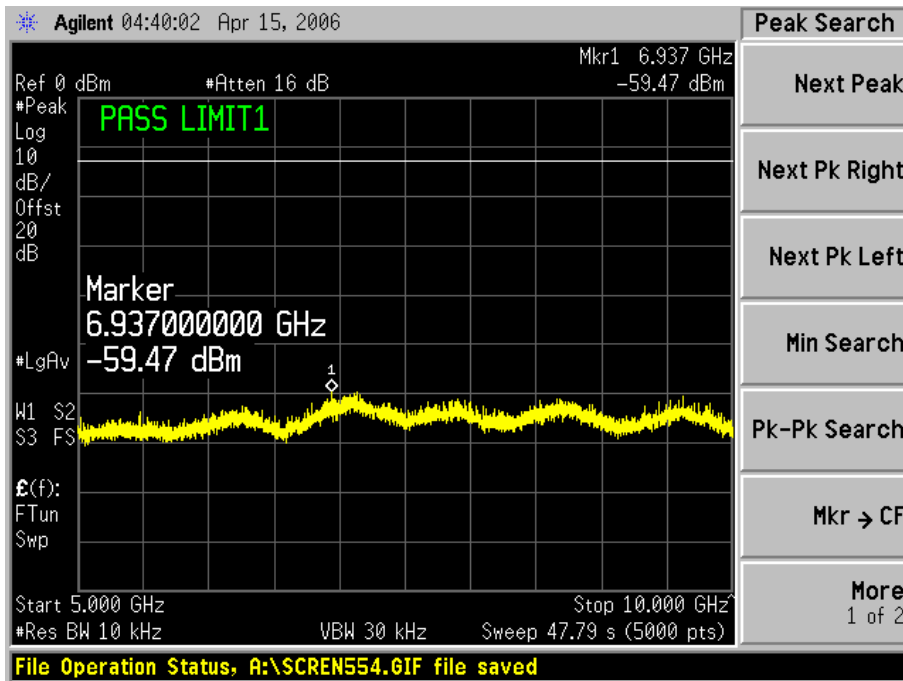
Intermodulation Port Emission Channel 1-5





Intermodulation Port Emission Channel 5-9





§15.107 - CONDUCTED EMISSIONS

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are receiver, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is ± 2.4 dB.

EUT Setup

The measurement was performed in the shielded room, using the same setup per ANSI C63.4-2003 measurement procedure. The specification used was FCC 15 Class B limits.

The spacing between the peripherals was 10 cm.

The external I/O cables were draped along the test table and bundled as required.

The EUT was connected to 120VAC/60Hz power source.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
R&S	Receiver, EMI Test	ESCS30	100176	2006-03-13
R&S	LISN, Artificial Mains	ESH2-Z5	871884/039	2005-08-16

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

Test Procedure

During the conducted emission test, the power cord of the EUT was connected to the mains outlet of the LISN-1, the power cord of the monitor and modem were connected to the LISN-2.

Maximizing procedure was performed on the six (6) highest provided emissions of the EUT.

All data was recorded in the quasi-peak and average detection mode. Quasi-Peak readings are distinguished with an "QP". Average readings are distinguished with an "Ave".

Test Results Summary

According to the recorded data, the EUT complies with the FCC Conducted limits for a Class B device, with the worst margin reading of:

-3.2 dB at 19.678000 MHz at Line mode at 150 kHz to 30 MHz

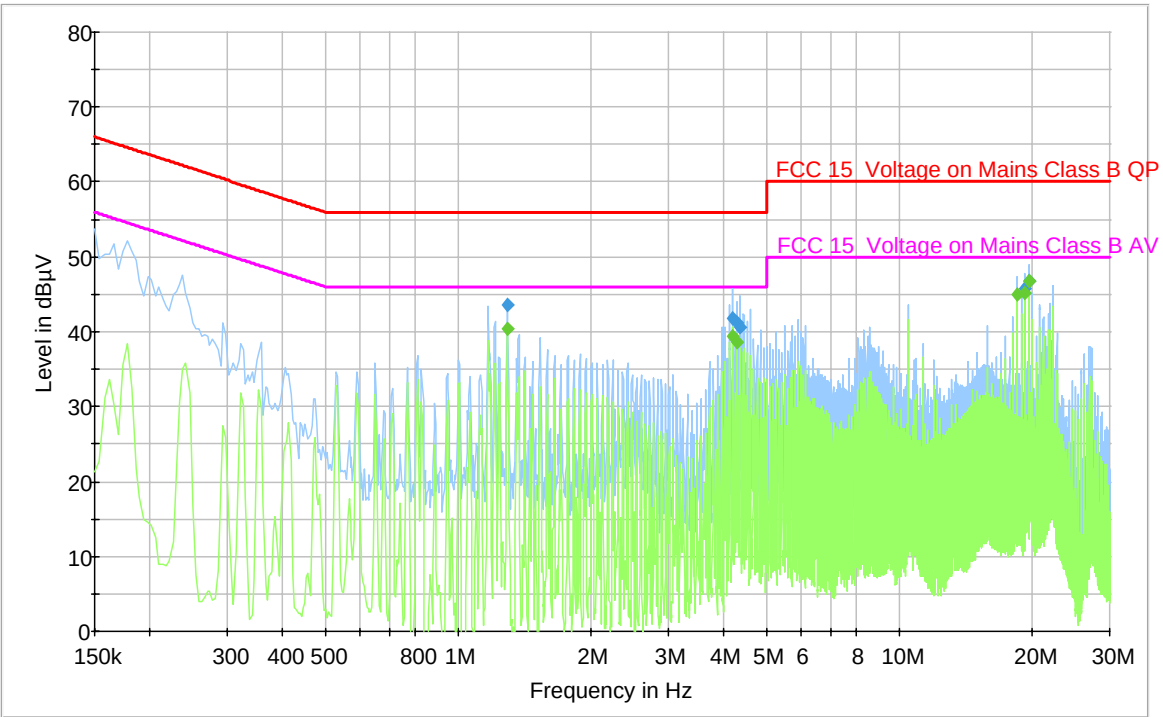
Conducted Emissions Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	65%
ATM Pressure:	1025mbar

**The testing was performed by Snell Leong on 2006-04-18.*

FCC CLASS B - Line



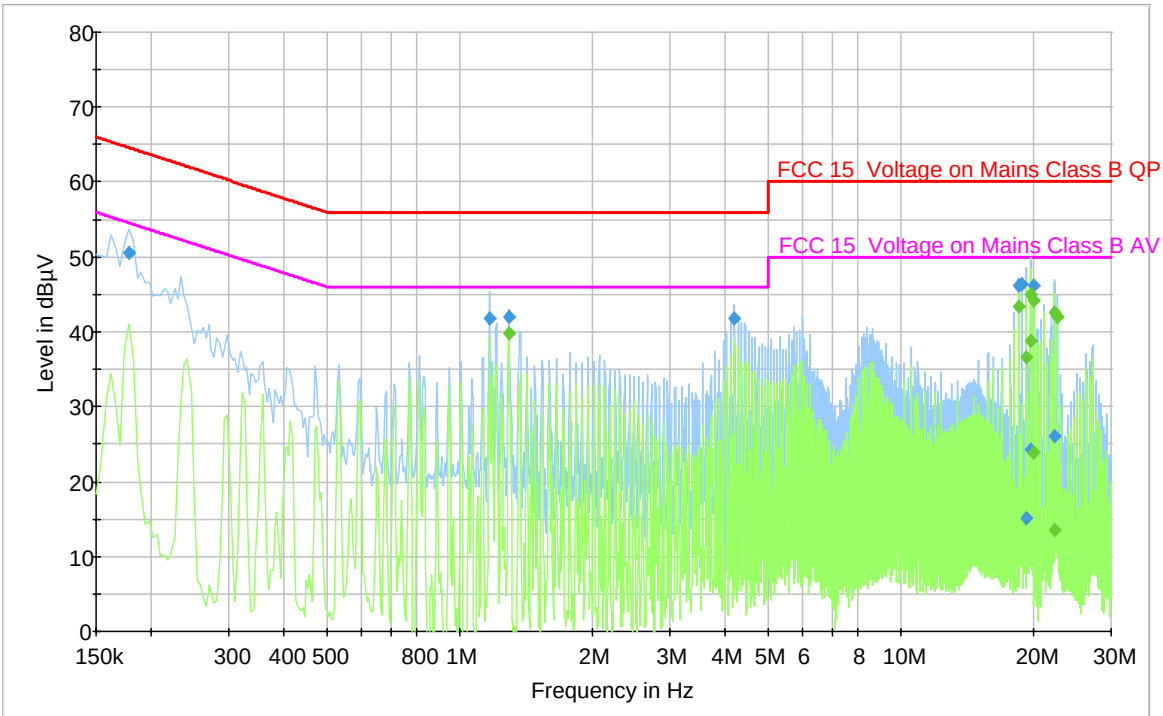
Average Measurements

Frequency (MHz)	Average (dBuV)	Line	Margin (dB)	Limit (dBuV)
19.678000	46.8	L1	3.2	50.0
19.294000	45.2	L1	4.9	50.0
18.522000	45.0	L1	5.0	50.0
1.294000	40.4	L1	5.6	46.0
4.202000	39.3	L1	6.7	46.0
4.282000	38.5	L1	7.5	46.0

QP Measurements

Frequency (MHz)	Quasi Peak (dBuV)	Line	Margin (dB)	Limit (dBuV)
1.294000	43.6	L1	12.4	56.0
19.686000	46.8	L1	13.2	60.0
19.294000	45.9	L1	14.1	60.0
4.202000	41.9	L1	14.2	56.0
4.282000	41.2	L1	14.8	56.0
4.366000	40.6	L1	15.4	56.0

FCC CLASS B - Neutral



Average Measurements

Frequency (MHz)	Average (dBuV)	Line	Margin (dB)	Limit (dBuV)
19.642000	45.1	N	4.9	50.0
20.026000	44.2	N	5.8	50.0
1.294000	39.7	N	6.3	46.0
18.486000	43.4	N	6.6	50.0
22.338000	42.7	N	7.4	50.0
22.722000	42.0	N	8.0	50.0
19.654000	38.9	N	11.1	50.0
19.298000	36.6	N	13.5	50.0
20.062000	23.9	N	26.1	50.0
22.354000	13.5	N	36.5	50.0

QP Measurements

Frequency (MHz)	Quasi Peak (dBuV)	Line	Margin (dB)	Limit (dBuV)
18.874000	46.3	N	13.7	60.0
20.026000	46.2	N	13.8	60.0
0.178000	50.6	N	13.9	64.6
1.294000	42.1	N	13.9	56.0
18.486000	46.1	N	13.9	60.0
1.170000	41.8	N	14.2	56.0
4.202000	41.7	N	14.3	56.0
22.354000	26.1	N	33.9	60.0
19.654000	24.2	N	35.8	60.0
19.310000	15.1	N	44.9	60.0

§ 2.1053 & §25.202 (f) – FIELD STRENGTH OF SPURIOUS RADIATION

Standard Applicable

Requirements: CFR 47, § 25.202(f). The mean power of emission shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

Measurement Procedure

The testing procedure was set according to TIA/EIA 603-C.

Equipment Lists

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Analyzer, Spectrum	8565EC	3946A00131	2006-01-11

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

Measurement Result

Environmental Conditions

Temperature:	23° C
Relative Humidity:	65%
ATM Pressure:	1025 mbar

* *The testing was performed by Snell Leong on 2006-04-18.*

Out of Band (Carrier On)

Final Scan 1GHz – 16.5GHz (Lowest Channel: 1610.73 MHz)

$43 + 10 \cdot \log(P) = 46 \text{ dBc}$,

Indicated		Table	Test Antenna		Substituted		Antenna	Cable	Absolute	Limit	Margin	
Frequency	Ampl.	Angle	Height	Polar	Frequency	Level	Gain	Loss	Level			
MHz	dBuV/m	Degree	Meter	H/V	MHz	dBm	Correction	dB	dBm	nW	dBm	dB
3221.46	36.5	180	1.4	v	3221.46	-68.88	9.6	2.4	-61.7	0.679	-13	-48.7
3221.46	35.5	330	1.2	h	3221.46	-71.28	9.6	2.4	-64.1	0.391	-13	-51.1
4832.19	37.1	90	1.2	v	4832.19	-77.76	11.8	5.07	-71.0	0.079	-13	-58.0
4832.19	36.5	0	1.4	h	4832.19	-79.44	11.8	5.07	-72.7	0.054	-13	-59.7

Final Scan 1GHz – 16.5GHz (Middle Channel: 1615.65 MHz)

Indicated		Table	Test Antenna		Substituted		Antenna	Cable	Absolute	Limit	Margin	
Frequency	Ampl.	Angle	Height	Polar	Frequency	Level	Gain	Loss	Level			
MHz	dBuV/m	Degree	Meter	H/V	MHz	dBm	Correction	dB	dBm	nW	dBm	dB
3231.3	36.4	180	1.4	v	3231.3	-68.88	9.6	2.4	-61.7	0.679	-13	-48.7
3231.3	35.4	330	1.2	h	3231.3	-71.28	9.6	2.4	-64.1	0.391	-13	-51.1
4846.95	36.8	90	1.2	v	4846.95	-77.76	11.8	5.07	-71.0	0.079	-13	-58.0
4846.95	36.4	0	1.4	h	4846.95	-79.44	11.8	5.07	-72.7	0.054	-13	-59.7

Final Scan 1GHz – 16.5GHz (Highest Channel: 1620.57 MHz)

Indicated		Table	Test Antenna		Substitute d		Antenna	Cabl e	Absolute		Limit	Margin
Frequenc y	Ampl.	Angle	Height	Pola r	Frequenc y	Level	Gain	Loss	Level			
MHz	dBuV /m	Degre e	Meter	H/V	MHz	dBm	Correcti on	dB	dBm	nW	dBm	dB
3221.46	35.6	180	1.4	v	3221.46	-68.88	9.6	2.4	-61.7	0.679	-13	-48.7
3221.46	36.7	330	1.2	h	3221.46	-71.28	9.6	2.4	-64.1	0.391	-13	-51.1
4861.71	36.2	90	1.2	v	4861.71	-77.76	11.8	5.07	-71.0	0.079	-13	-58.0
4861.71	36.7	0	1.4	h	4861.71	-79.44	11.8	5.07	-72.7	0.054	-13	-59.7

§25.202 – EMISSION MASK

Standard Applicable

According to CFR 47, § 25.202. The mean power of emission shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and include 250 percent of the authorized bandwidth: 35 dB;

Measurement Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 4 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Equipment Lists

Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

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

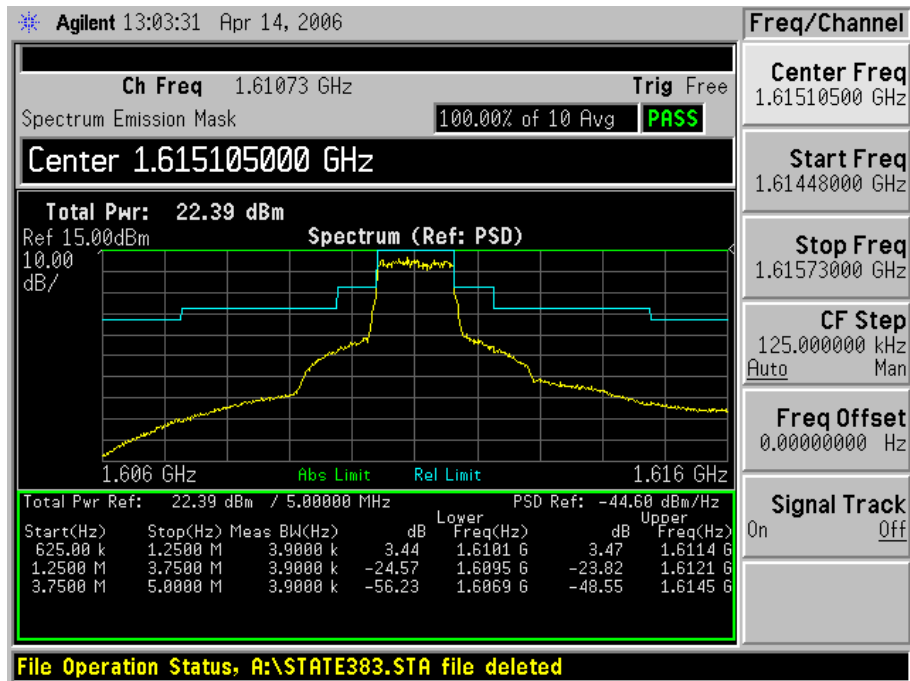
Measurement Result

Environmental Conditions

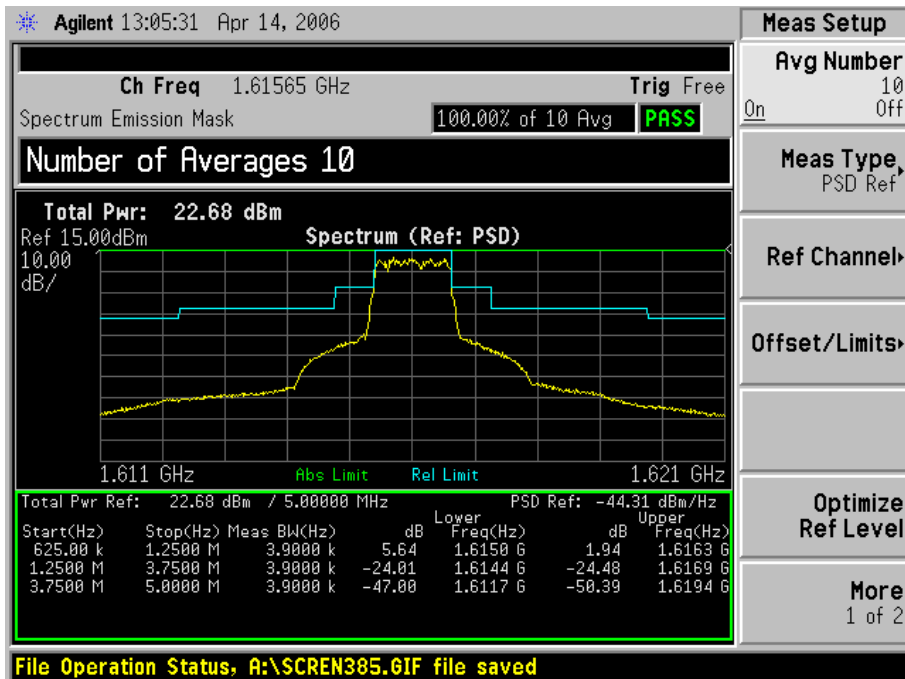
Temperature:	23° C
Relative Humidity:	65%
ATM Pressure:	1025 mbar

* *The testing was performed by Snell Leong on 2006-04-18.*

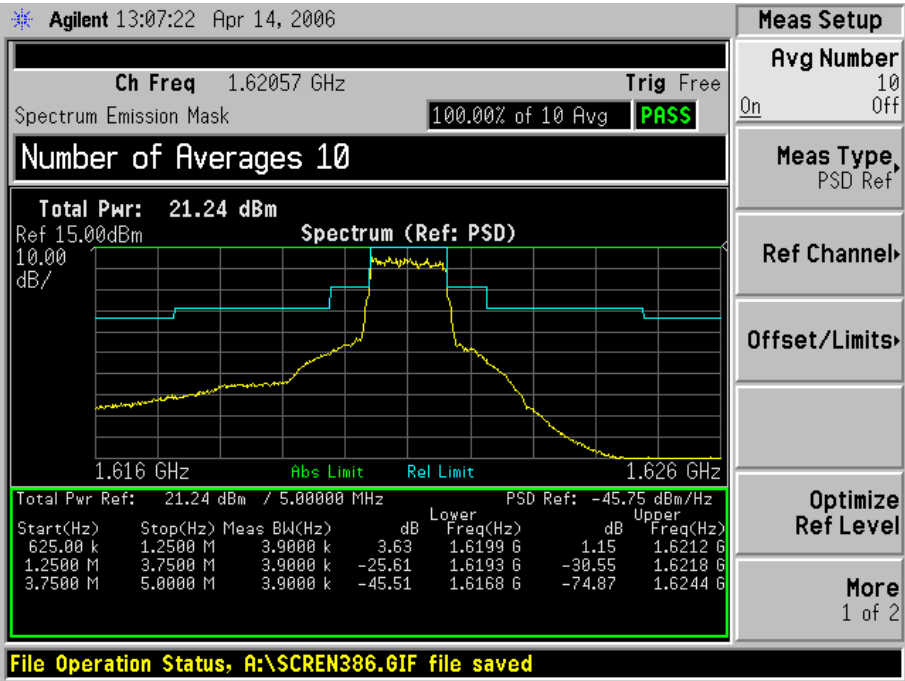
Low Channel



Middle Channel



High Channel



§2.1046 & §25.204 – POWER OUTPUT

Standard Applicable

According to §25.204 (a) In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station, other than an ESV, operating in frequency bands between 1 and 15 GHz, shall not exceed the following limits except as provided for in paragraph (c) of this section:

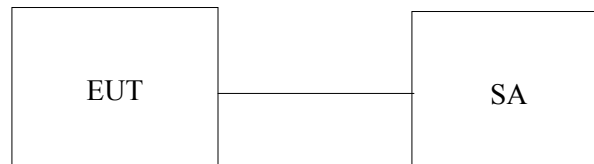
+40 dBW in any 4 kHz band for $\Theta \leq 0^\circ$

+40 + 3 Θ dBW in any 4 kHz band for $0^\circ < \Theta \leq 5^\circ$

where Θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.

Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.



Equipment Lists

Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

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

Measurement Result

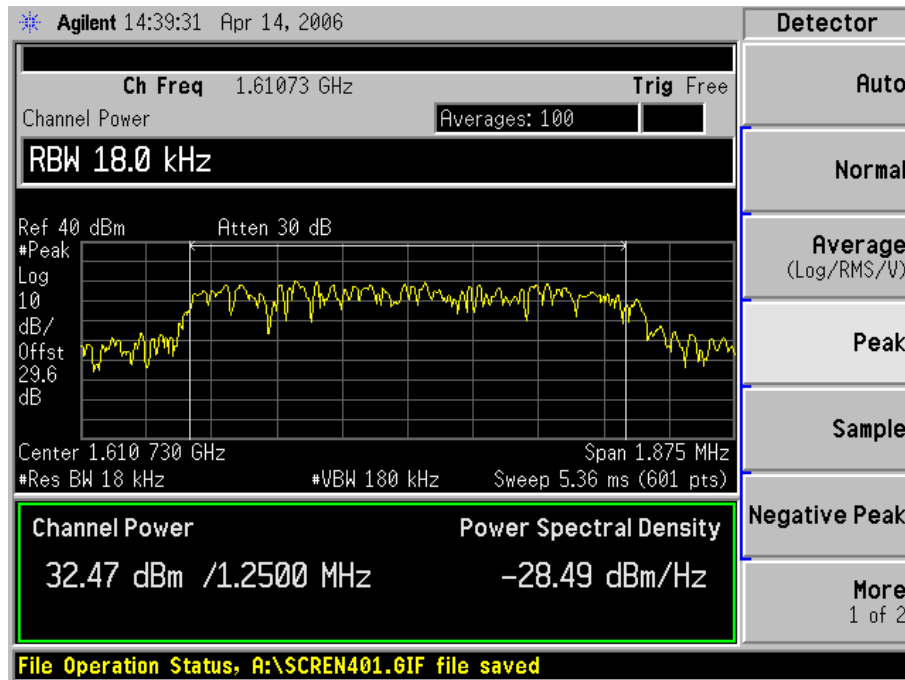
Environmental Conditions

Temperature:	23° C
Relative Humidity:	65%
ATM Pressure:	1025 mbar

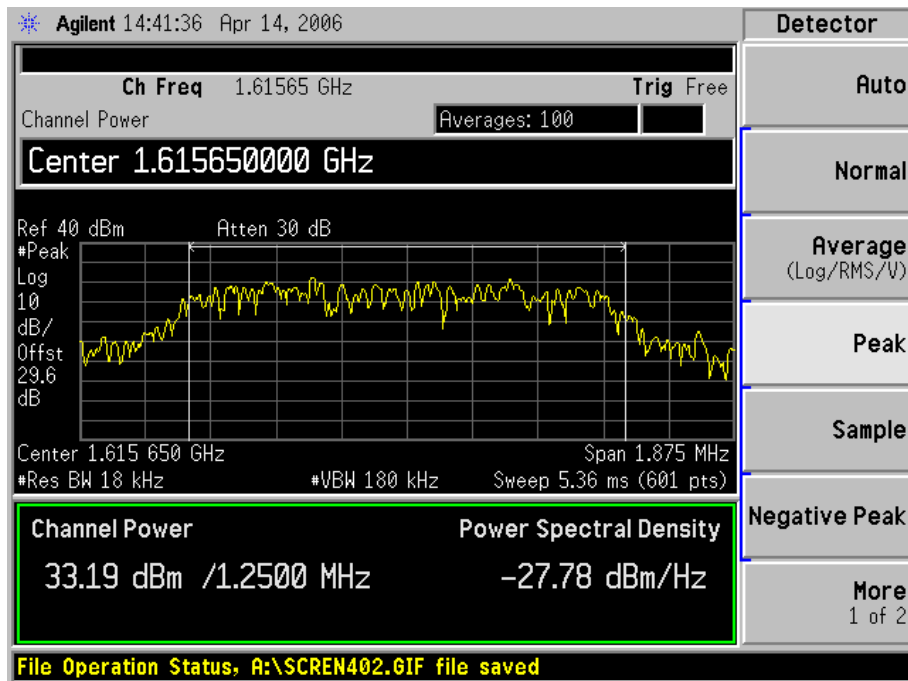
* The testing was performed by Snell Leong on 2006-04-18.

Channel	Frequency MHz	Conducted Output Power (dBm)	Antenna Gain dBi	Corrected EIRP dBm	Limit (dBW)
Low	1610.73	32.47	2.3	34.77	40
Mid	1615.65	33.19	2.3	35.49	
High	1620.57	32.12	2.3	34.42	

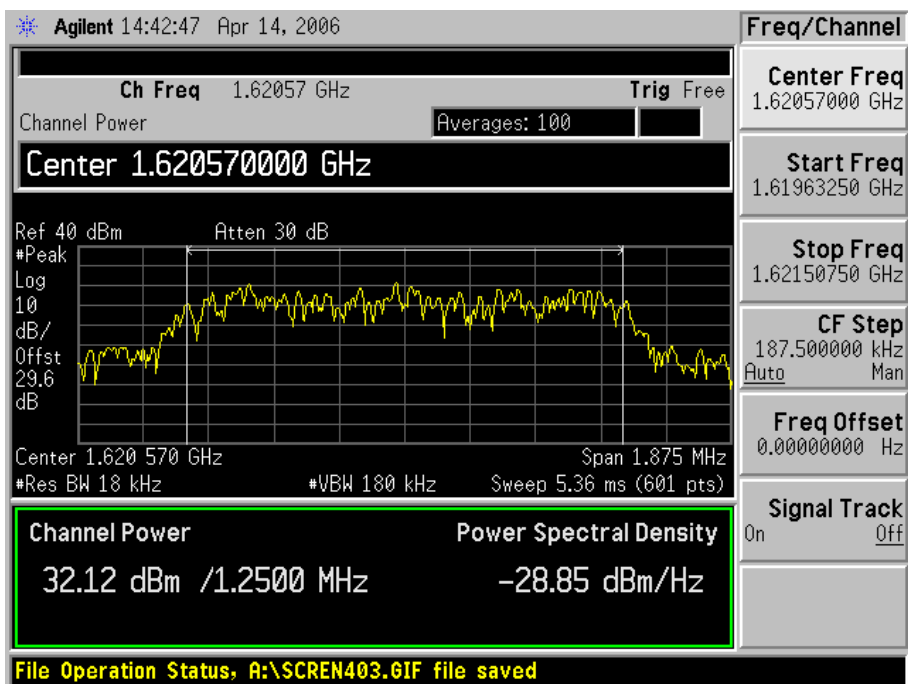
Low Channel



Middle Channel



High Channel



§25.216(b) & §25.216(g) – EMISSIONS FROM MOBILE EARTH STATIONS FOR PROTECTION OF AERONAUTICAL RADIONAVIGATION-SATELLITE SERVICE

Standard Applicable

According to §25.216(b), the e.i.r.p. density of emissions from mobile earth stations placed in service on or before July 21, 2002 with assigned uplink frequencies between 1610 MHz and 1626.5 MHz shall not exceed –64 dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1587.42–1605 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth generated by such stations shall not exceed –74 dBW, averaged over any 2 millisecond active transmission interval, in the 1587.42–1605 MHz band.

According to §25.216(g), mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03–283 with assigned uplink frequencies in the 1610–1626.5 MHz band shall suppress the power density of emissions in the 1605–1610 MHz band-segment to an extent determined by linear interpolation from –70 dBW/MHz at 1605 MHz to –10 dBW/MHz at 1610 MHz averaged over any 2 millisecond active transmission interval. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from –80 dBW at 1605 MHz to –20 dBW at 1610 MHz, averaged over any 2 millisecond active transmission interval.

Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set 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.

Equipment Lists

Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2006-03-06

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

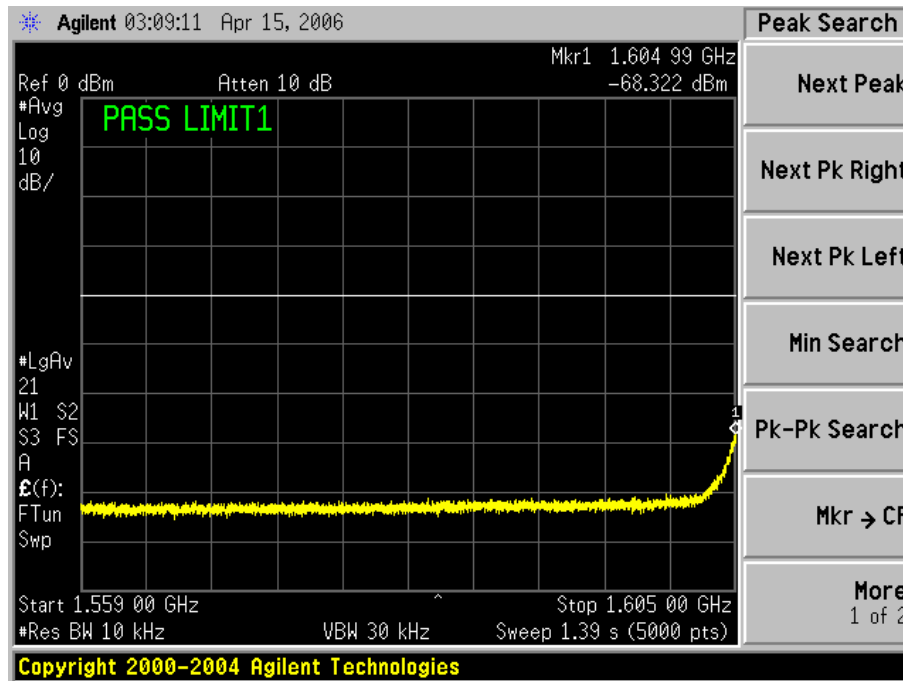
Measurement Result

Environmental Conditions

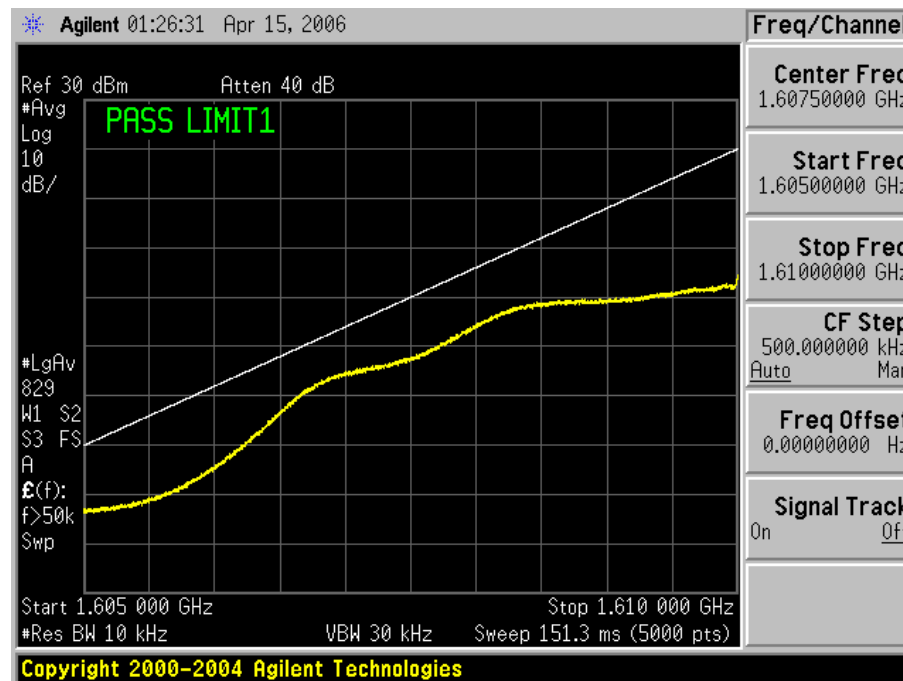
Temperature:	23° C
Relative Humidity:	65%
ATM Pressure:	1025 mbar

* The testing was performed by Snell Leong on 2006-04-18.

1559 MHz-1605 MHz



1605MHz-1610 MHz



§2.1055 & §25.202(d) – FREQUENCY STABILITY

Standard Applicable

According to §25.202(d) *Frequency tolerance, Earth stations*. The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent of the reference frequency.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
HP	Microwave Frequency Counter	5342A	2232A06380	2005-09-07
Tenney	Oven, Temperature	VersaTenn	12.222-193	2005-06-27

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

Measurement Result

Environmental Conditions

Temperature:	23° C
Relative Humidity:	65%
ATM Pressure:	1025 mbar

** The testing was performed by Snell Leong on 2006-04-18.*

Measurement Result

Reference Frequency: 1614.42MHz, Limit: 2.5 ppm				
Environment	Power	Measured	Error	Limit
Temperature(C)	Supply (V)	Freq (MHz)	ppm	ppm
50	120	1614.423450	2.13	2.5
40	120	1614.422720	1.68	2.5
30	120	1614.421250	0.77	2.5
20	120	1614.420850	0.52	2.5
10	120	1614.421016	0.62	2.5
0	120	1614.421060	0.66	2.5
-10	120	1614.422170	1.34	2.5
-20	120	1614.422610	1.62	2.5
-30	120	1614.423580	2.21	2.5

Frequency Stability vs Extreme Voltage

Reference Frequency: 1614.42MHz, Limit: 2.5 ppm				
Environment	Temperature	Measured	Error	Limit
Power Supply	C	Freq (MHz)	ppm	ppm
138	20	1614.420830	0.51	2.5
120	20	1614.420850	0.53	2.5
102	20	1614.420113	0.07	2.5