FCC PART 90
TEST AND MEASUREMENT REPORT

For

Raveon Technologies Corporation

1750 Bella Laguna Ct.,

Encinitas, CA 92024, USA

FCC ID: SRS-M8S-VC

Report Type:	Product Type:
Original Report	UHF OEM Radio Modem (Module)

Prepared By: Simon Ma

Report Number: R1406123-90 Rev B

Report Date: 2014-09-09

Reviewed By: Bo Li, Test Engineer

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1406123-90	Original Report	2014-08-15
1	R1406123-90 Rev A	Revised Report	2014-08-19
2	R1406123-90 Rev B	Revised Report per TE's comments	2014-09-09

1 General Information

1.1 Product Description for Equipment under Test (EUT)

The Raveon Technologies Corporation's product, FCC: SRS-M8S-VC, model: RV-M8S-VC or the "EUT" as referred to in this report, is an OEM data radio modem module. The EUT is 3 watts transceiver sends and receives digital data over the frequency range 216-220 MHz, Modulation type is GFSK and channel bandwidth is 12.5 kHz and 25 kHz.

1.2 Mechanical Description

The EUT dimension is approximately 9.9cm (L) x 6cm (W) x 0.9cm (H) and weighs approximately 0.1 kg.

The test data gathered are from production sample. Serial number: Y2VJ4X, assigned by BACL.

1.3 Objective

This type approval report is prepared on behalf of *Raveon Technologies Corporation* in accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 90 of the Federal Communication Commission rules.

The objective of the manufacturer is to determine compliance with following FCC Part 90 rules:

- RF Exposure (MPE)
- Conducted Output Power
- Frequency Stability
- Field Strength of Spurious Radiation
- Spurious Emission at Antenna Port
- Occupied Bandwidth & Emission Mask

1.4 Related Submittal(s)/Grant(s)

No Related Submittals

1.5 Test Methodology

Applicable Standards: TIA/EIA-603-D and ANSI C63.4-2009 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.

1.6 Measurement Uncertainty

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

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:
1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The 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 have 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 test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. 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, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b3678l6b

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to FCC CFR 47 part 2, FCC CFR 47 Part 90, and TIA 603

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

2.2 EUT Exercise Software

EUT is in normal working condition, the data comes in its serial port which connected to the test board provided by *Raveon Technology Corporation*. Commands typed in laptop and data transmit into RS232 port on the test board to configure setting of EUT.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 EUT Internal Configuration

N/A

2.5 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Raveon Technologies Corporation	Wireless Module Evaluation Kit	-	-
Dell	Laptop	Latitude	-

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Raveon Technologies Corporation	OEM data radio modem module	RV-M8S-VC	-

2.7 External I/O Cabling List and Details

Cable Description	Length (m)	From	To
USB to RS232 9 Foot cable	<1m	Laptop	Test Board
DC power Cable	<1m	DC Power Source	Test Board
RF Cable	<1m	EUT	PSA

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1091	RF Exposure (MPE)	Compliant
§2.1046, §90.205	Conducted Output Power	Compliant
§2.1055, §90.213	Frequency Stability	Compliant
§2.1053, §90.210	Field Strength of Spurious Radiation	Compliant
§2.1051, §90.210	Spurious Emission at Antenna Port	Compliant
§2.1049, §90.209, §90.210	Occupied Bandwidth, Emission Mask	Compliant

4 FCC §2.1046 & §90.205 – Output Power

4.1 Applicable Standards

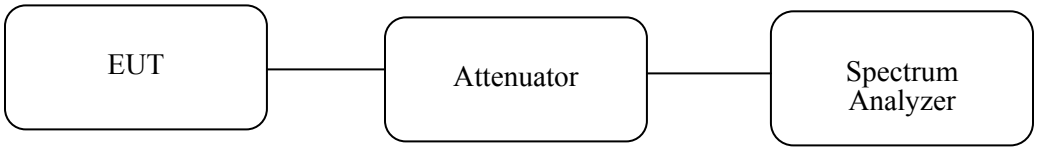
According to FCC §90.205 (s), the output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with §90.203 (a) (1)] for transmitters included in this list or not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

4.2 Test Procedure

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

Spectrum analyzer setting:

Resolution bandwidth: 100 kHz
Video bandwidth: 300 kHz



4.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US 422221851	2014-04-09	1 year
BK Precision	Source, DC	1740	26502000233	-	-

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

4.4 Test Environmental Conditions

Temperature:	25 ºC
Relative Humidity:	41 %
ATM Pressure:	101.7 kPa

The testing was performed by Simon Ma on 2014-07-10 in the RF Site.

4.5 Test Results

Channel Spacing	Bit Rate (bps)	Conducted Output Power (dBm)		
		Low CH	Middle CH	High CH
12.5 kHz	9600	34.85	34.81	34.84
	4800	35.1	35.03	34.86
25 kHz	19200	35.09	34.95	34.79
	9600	34.78	34.74	34.9

Note: the output power declared by manufacturer is 3 Watts (34.77 dBm)

5 FCC §2.1055 & §90.213– Frequency Stability

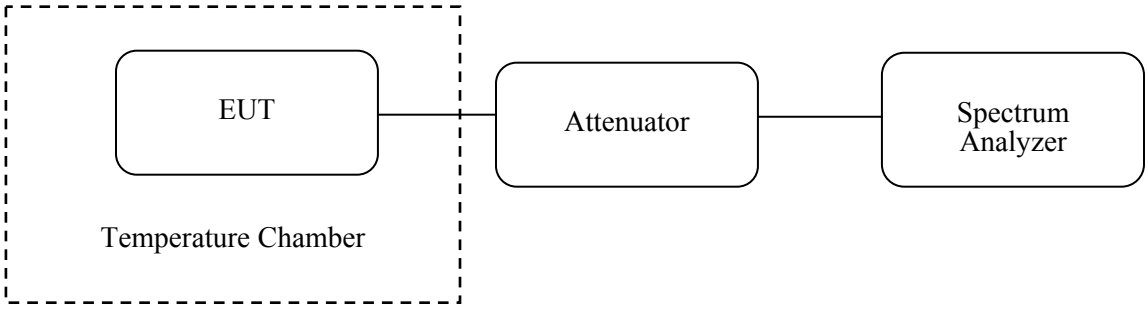
5.1 Applicable Standards

According to FCC §90.213, for fixed and base stations frequency band fall in 216-220 MHz, the minimum frequency stability is 1 ppm.

5.2 Test Procedure

ANSI/TIA/EIA 603 clause 2.3.1 and 2.3.2

According to FCC §2.1055 (a) (1), the frequency stability shall be measured with variation of ambient temperature as follows: (1) from -30℃ to +50℃ centigrade for all equipment except that specified in paragraphs (a) (2) and (3)of this section.



5.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year
Tenney	Chamber, Environmental	TUJR	27445-06	2013-07-09	1 year
BK Precision	Source, DC	1740	26502000233	-	-

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

5.4 Test Environmental Conditions

Temperature:	22-26° C
Relative Humidity:	38-45 %
ATM Pressure:	100.9-101.3 kPa

The testing was performed by Simon Ma from 2014-06-30 to2014-07-09 at RF Site.

5.5 Test Results

DC power 12 V:

Temperature (℃)	Channel Frequency (MHz)	Measured Frequency (MHz)	Frequency Tolerance (ppm)	Limit (ppm)
-30	219	218.999969	0.141552511	1.0
-20	219	219.000022	0.100456621	1.0
-10	219	219.000022	0.100456621	1.0
0	219	219.000046	0.210045662	1.0
10	219	219.000039	0.178082192	1.0
20	219	219.000029	0.132420091	1.0
25	219	218.999988	0.054794521	1.0
30	219	219.000006	0.02739726	1.0
40	219	219.000006	0.02739726	1.0
50	219	218.999985	0.068493151	1.0

Temperature 25℃:

Voltage (Vdc)	Channel Frequency (MHz)	Measured Frequency (MHz)	Frequency Tolerance (ppm)	Limit (ppm)
10.2	219	219.000012	0.05479452	1.0
13.8	219	219.000028	0.127853881	1.0

6 FCC §2.1051 & §90.210 – Spurious Emission at Antenna Port

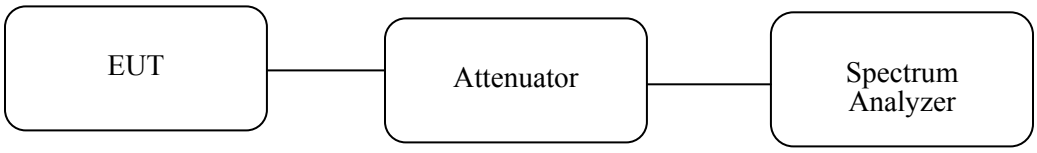
6.1 Applicable Standard

According to FCC §90.210 (b) (3), on any frequency removed from the assigns frequency by more than 250 percent of the authorized bandwidth: at least 43 + 10log(P) dB.

According to FCC §90.210 (d) (3), on any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: at least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

6.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz for below 1G at 1MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2013-11-07	1 year
BK Precision	Source, DC	1740	26502000233	-	-

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

6.4 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	47 %
ATM Pressure:	101.6 kPa

The testing was performed by Simon Ma on 2014-06-25 at RF Site.

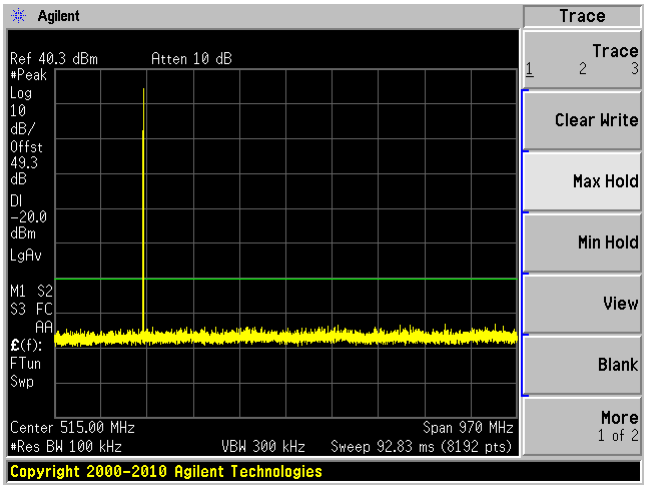
6.5 Test Results

Please refer to the plots hereinafter.

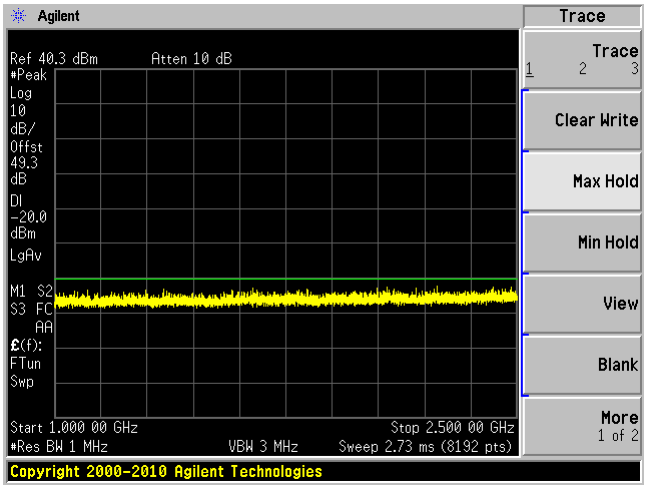
12.5 kHz, 9600 bps

Low Channel

30 MHz to 1 GHz

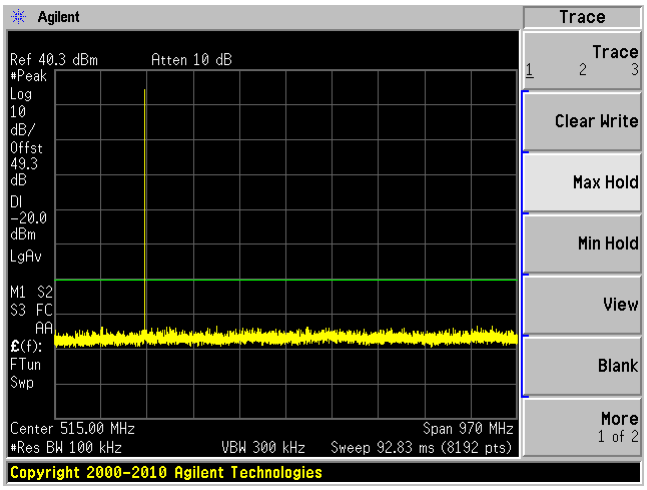


1 GHz to 2.5GHz

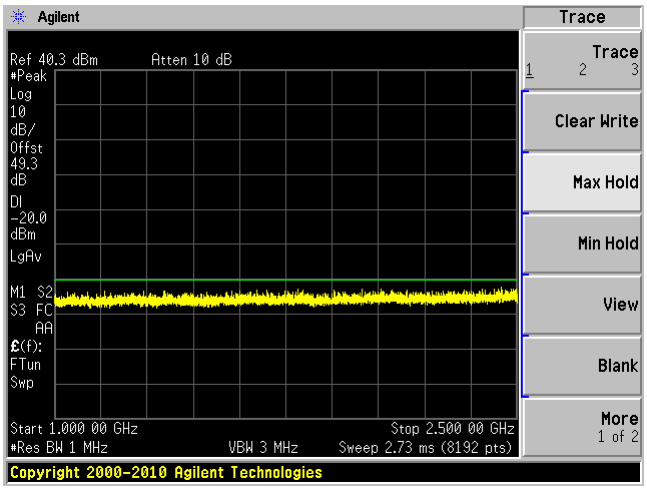


Middle Channel

30 MHz to 1GHz

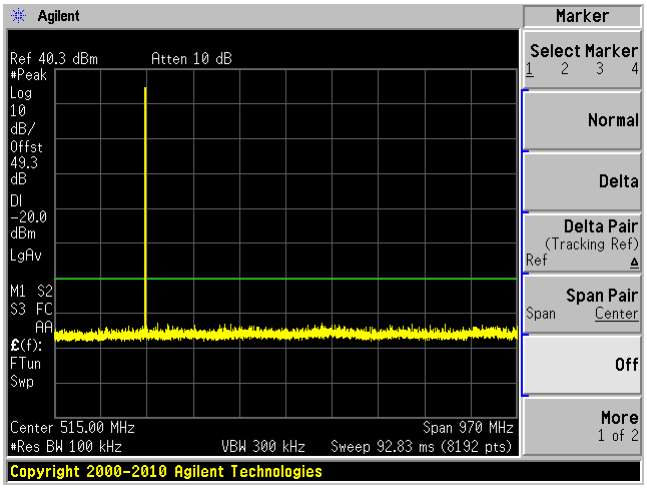


1 GHz to 2.5 GHz

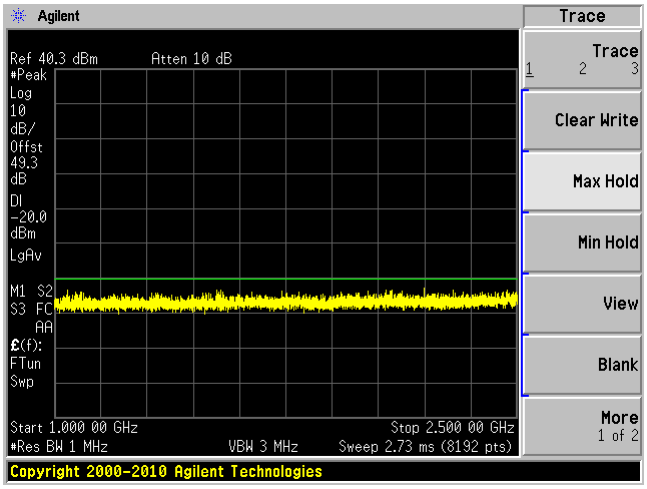


High Channel

30 MHz to 1GHz



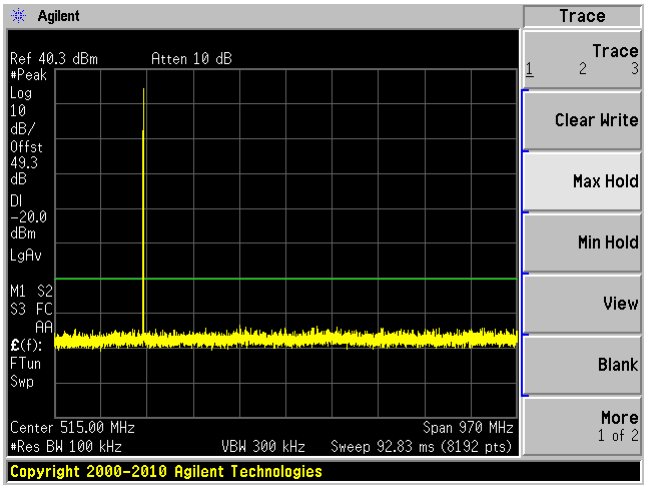
1 GHz to 2.5 GHz



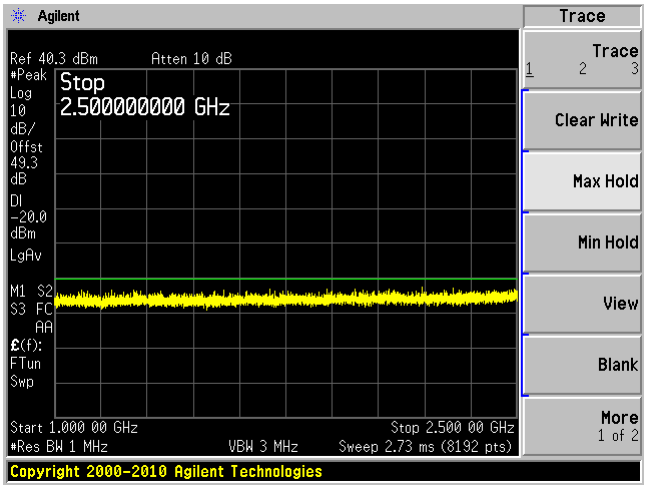
12.5 kHz, 4800 bps

Low Channel

30 MHz to 1 GHz

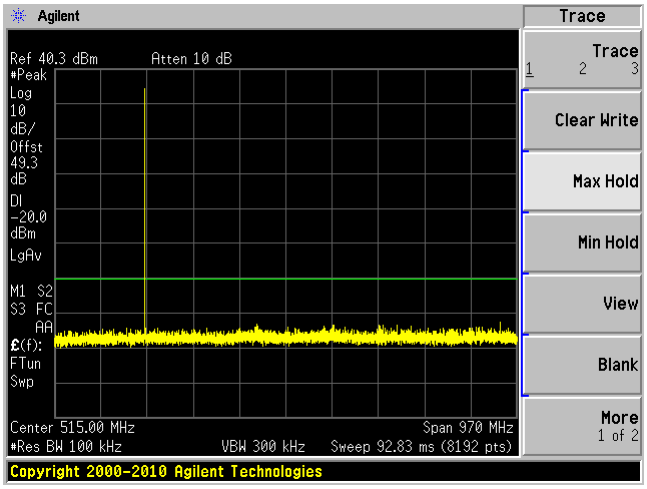


1 GHz to 2.5GHz

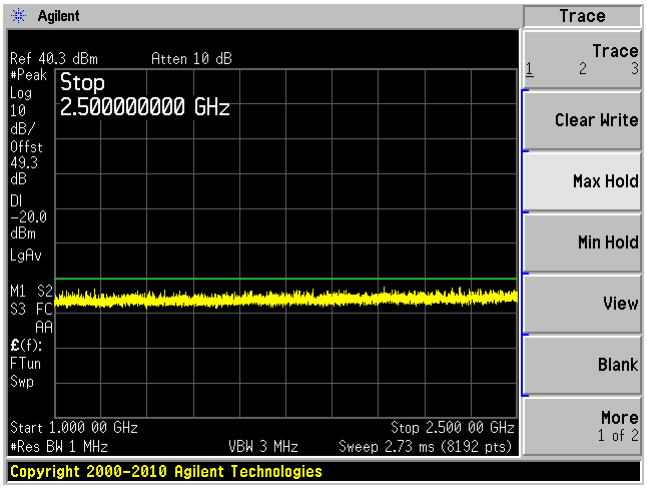


Middle Channel

30 MHz to 1GHz

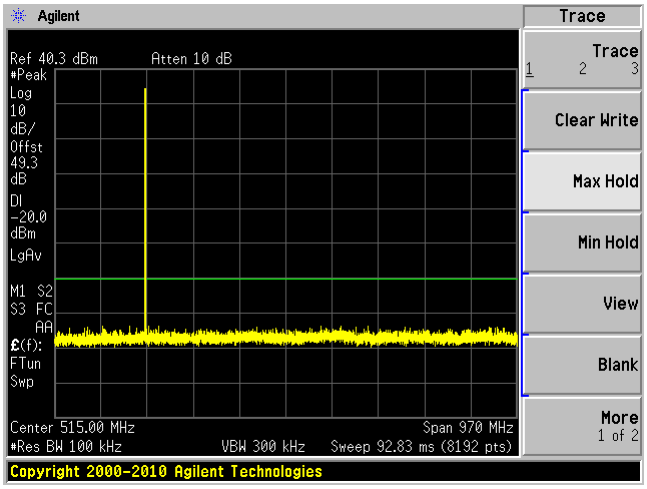


1 GHz to 2.5 GHz

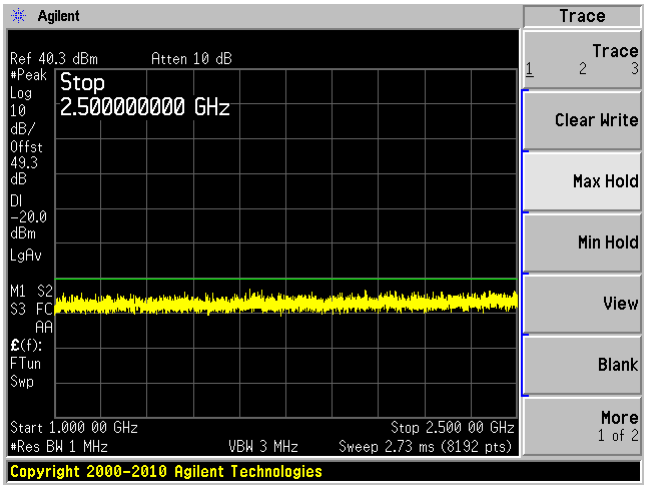


High Channel

30 MHz to 1GHz



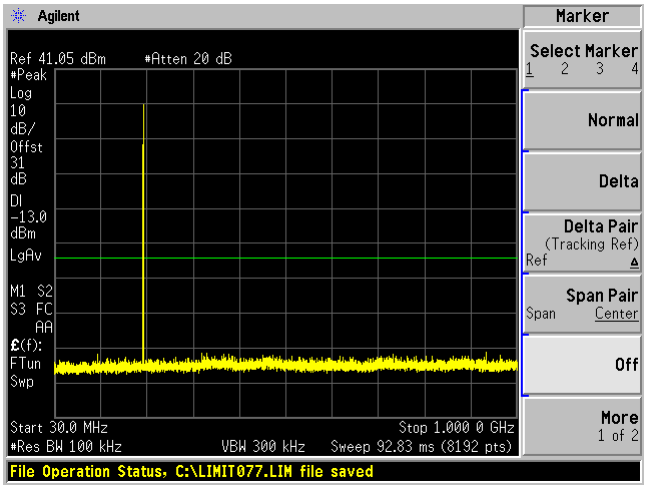
1 GHz to 2.5 GHz



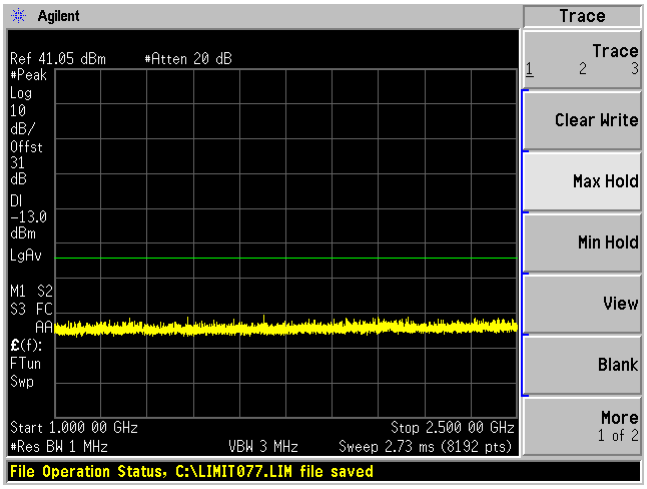
25 kHz, 19200 bps

Low Channel

30 MHz to 1 GHz

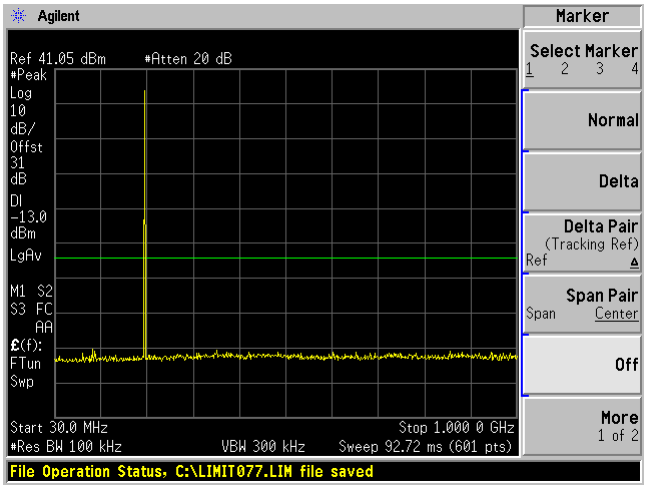


1 GHz to 2.5GHz

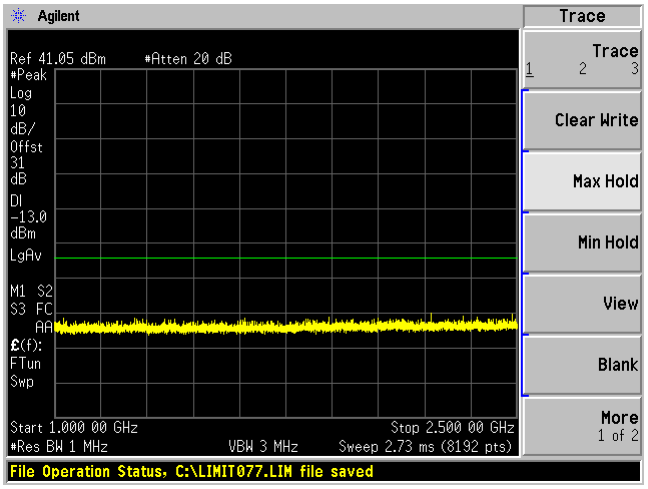


Middle Channel

30 MHz to 1GHz

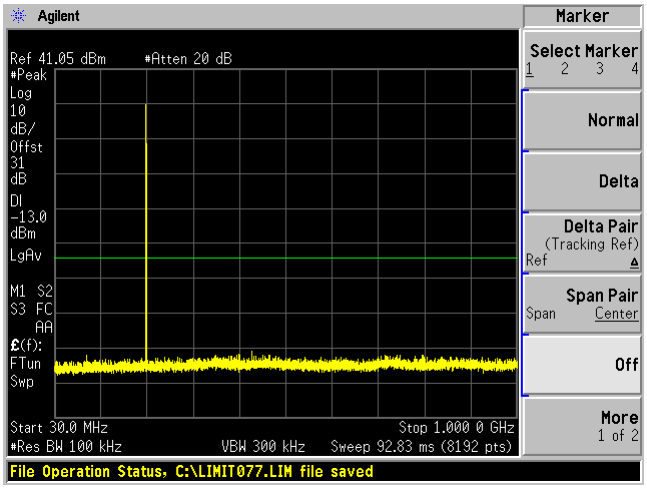


1 GHz to 2.5 GHz

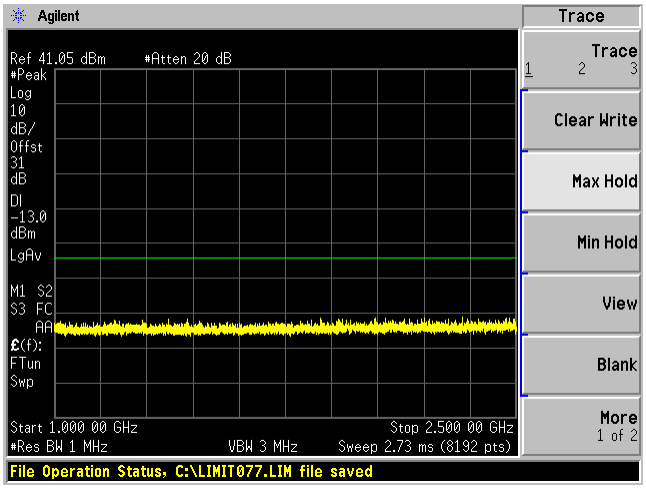


High Channel

30 MHz to 1GHz



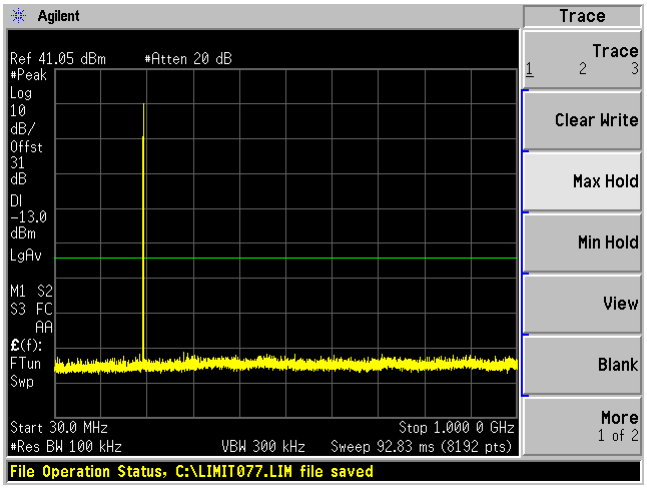
1 GHz to 2.5 GHz



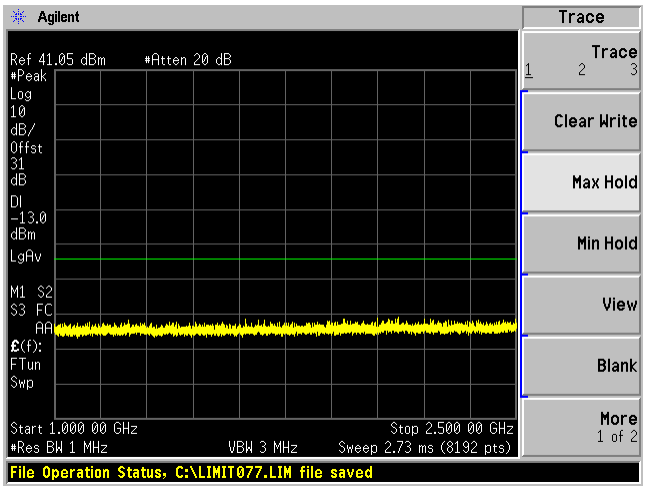
25 kHz, 9600 bps

Low Channel

30 MHz to 1 GHz

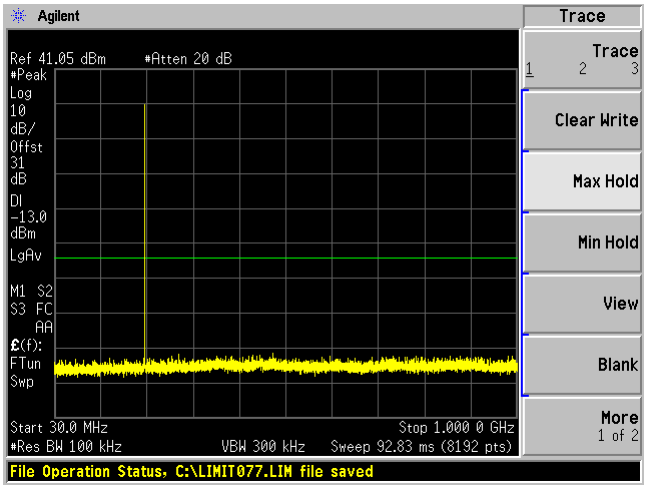


1 GHz to 2.5GHz

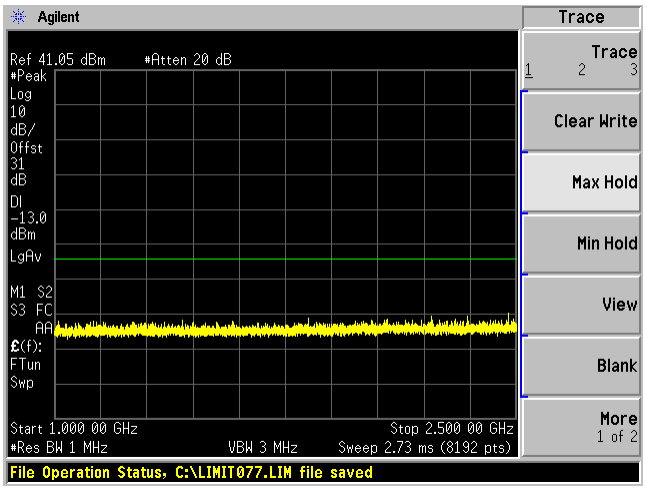


Middle Channel

30 MHz to 1GHz

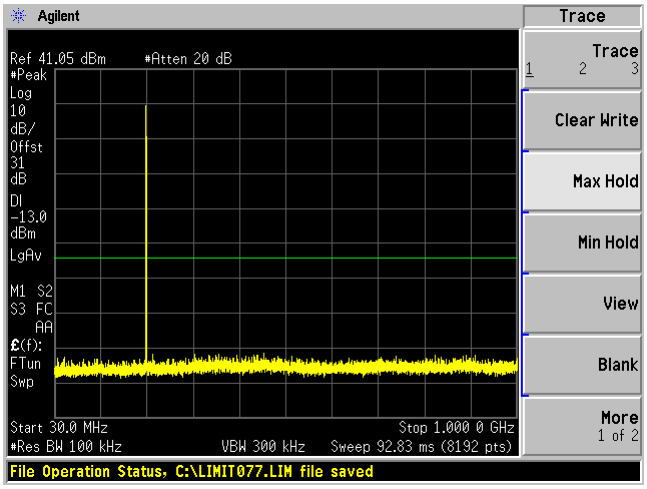


1 GHz to 2.5 GHz

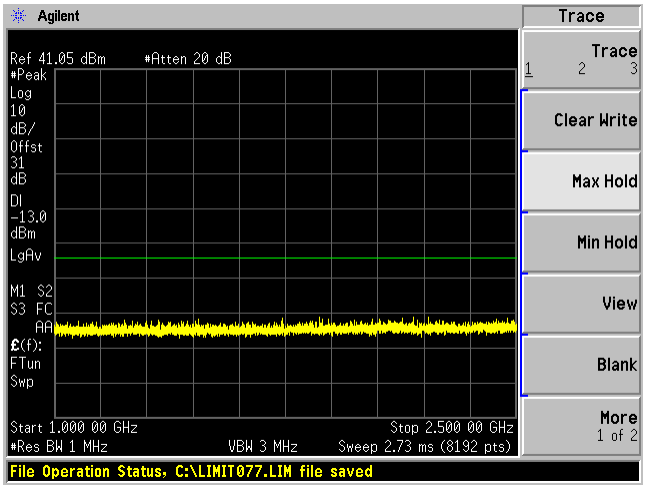


High Channel

30 MHz to 1GHz



1 GHz to 2.5 GHz



7 FCC §2.1053 & §90.210 – Field Strength of Spurious Radiation

7.1 Applicable Standards

According to FCC §90.210 (b)(3), on any frequency removed from the assigns frequency by more than 250 percent of the authorized bandwidth: at least 43+10log(P) dB.

According to FCC §90.210 (d)(3), on any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: at least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

7.2 Test Procedure

The transmitter was placed on a 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 log (TX Power in Watts/0.001) – the absolute level
Spurious attenuation limit in dB = 43+10 Log_{10} (power out in Watts)

7.3 Test Equipment List and Details

Manufacturer	Description	Model Number	Serial Number	Calibration Date	Calibration Interval
HP	Generator, Signal	8648C	3847M00143	2012-11-29	2 years
Agilent	Analyzer, Spectrum	E4440A	US45303156	2012-08-22	2 years
Sunol Sciences	System Controller	SC99V	122303-1	N/R	N/R
HP	Pre-amplifier	8449B OPT HO2	3008A0113	2014-03-10	1 year
HP	Pre-amplifier	8447D	2944A06639	2014-06-09	1 year
EMCO	Antenna, Horn	3115	9511-4627	2014-01-06	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2014-03-28	1 year
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2012-07-24	2 years
COM-POWER	Antenna, Dipole	AD-100	721033DB1,721033DB2,721033DB3,721033DB4	2012-10-17	2 years

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

7.4 Test Environmental Conditions

Temperature:	23 ° C
Relative Humidity:	39 %
ATM Pressure:	101.3 kPa

The testing was performed by Simon Ma on 2014-07-31 at 5m Chamber3.

7.5 Test Results

12.5 kHz, 4800 bps

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degree)	Test Antenna		Substitution				Absolute Level (dBm)	FCC Part 90	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
Low Channel											
432.03	35.4	210	100	V	432.03	-56.07	0	0.33	-56.4	-20	-36.4
432.03	35.31	303	100	H	432.03	-44.78	0	0.33	-45.11	-20	-25.11
648.04	34.69	350	100	V	648.04	-52.23	0	0.4	-52.63	-20	-32.63
648.06	33.71	128	100	H	648.06	-47.04	0	0.4	-47.44	-20	-27.44
1079.84	54.7	150	100	V	1079.84	-60.21	4.418	0.4	-56.192	-20	-36.192
1080.04	55.46	65	100	H	1080.04	-57.38	4.418	0.4	-53.362	-20	-33.362
1296.23	56.14	72	100	V	1296.23	-54.25	4.824	0.56	-49.986	-20	-29.986
1296.24	53.27	232	100	H	1296.24	-59.4	4.824	0.56	-55.136	-20	-35.136
Middle Channel											
438	35.99	210	100	V	438	-55.01	0	0.33	-55.34	-20	-35.34
438	36.32	303	100	H	438	-42.37	0	0.33	-42.7	-20	-22.7
657	34.11	350	100	V	657	-53.29	0	0.39	-53.68	-20	-33.68
657	35.86	208	100	H	657	-44.89	0	0.39	-45.28	-20	-25.28
1094.88	54.38	212	100	V	1094.88	-59.24	4.418	0.4	-55.222	-20	-35.222
1094.82	56.76	52	100	H	1094.82	-54.83	4.418	0.4	-50.812	-20	-30.812
1314.1	55.5	51	100	V	1314.1	-56.07	5.354	0.59	-51.306	-20	-31.306
1314.13	53.99	230	100	H	1314.13	-57.65	5.354	0.59	-52.886	-20	-32.886
High Channel											
439.98	35.52	210	100	V	439.98	-55.48	0	0.32	-55.8	-20	-35.8
439.94	36	309	100	H	439.94	-42.69	0	0.32	-43.01	-20	-23.01
659.96	33.95	360	100	V	659.96	-53.37	0	0.41	-53.78	-20	-33.78
659.96	34.01	90	100	H	659.96	-46.74	0	0.41	-47.15	-20	-27.15
1100.05	53.65	294	100	V	1100.05	-58.61	4.566	0.44	-54.484	-20	-34.484
1100.22	54.72	56	100	H	1100.22	-57.17	4.566	0.44	-53.044	-20	-33.044
1320.4	55.29	39	100	V	1320.4	-56.15	5.354	0.61	-51.406	-20	-31.406
1319.99	54.99	80	100	H	1319.99	-57.31	5.354	0.61	-52.566	-20	-32.566

12.5 kHz, 9600 bps

Freq. (MHz)	S.A. Amp. (dBμV)	Table Azimuth (Degree)	Test Antenna		Substitution				Absolute Level (dBm)	FCC Part 90	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
Low Channel											
432.03	34.09	207	100	V	432.03	-57.38	0	0.33	-57.71	-20	-37.71
432.02	34.97	309	100	H	432.02	-45.12	0	0.33	-45.45	-20	-25.45
648	34.11	208	100	V	648	-52.81	0	0.4	-53.21	-20	-33.21
648.05	35.32	211	100	H	648.05	-45.43	0	0.4	-45.83	-20	-25.83
1080.2	54.66	80	100	V	1080.2	-60.25	4.418	0.4	-56.232	-20	-36.232
1079.8	55.46	74	100	H	1079.8	-57.38	4.418	0.4	-53.362	-20	-33.362
1295.96	55.3	78	100	V	1295.96	-55.09	5.354	0.56	-50.296	-20	-30.296
1295.95	54.09	170	100	H	1295.95	-58.58	5.354	0.56	-53.786	-20	-33.786
Middle Channel											
438	35.17	213	100	V	438	-55.83	0	0.33	-56.16	-20	-36.16
438	34.3	282	100	H	438	-44.39	0	0.33	-44.72	-20	-24.72
656.99	33.78	359	100	V	656.99	-53.62	0	0.39	-54.01	-20	-34.01
656.99	35.32	280	100	H	656.99	-45.43	0	0.39	-45.82	-20	-25.82
1094.93	53.4	349	100	V	1094.93	-60.22	4.418	0.4	-56.202	-20	-36.202
1095.01	56.26	60	100	H	1095.01	-55.33	4.418	0.4	-51.312	-20	-31.312
1314	55.22	50	100	V	1314	-56.35	5.354	0.59	-51.586	-20	-31.586
1314.02	53.66	101	100	H	1314.02	-57.98	5.354	0.59	-53.216	-20	-33.216
High Channel											
439.98	35.4	192	100	V	439.98	-55.6	0	0.32	-55.92	-20	-35.92
439.97	36	260	100	H	439.97	-42.69	0	0.32	-43.01	-20	-23.01
659.96	33.45	330	100	V	659.96	-53.87	0	0.41	-54.28	-20	-34.28
659.98	35.46	213	100	H	659.98	-45.29	0	0.41	-45.7	-20	-25.7
1099.91	53.64	217	100	V	1099.91	-58.62	4.566	0.44	-54.494	-20	-34.494
1100.05	54.23	60	100	H	1100.05	-57.66	4.566	0.44	-53.534	-20	-33.534
1319.91	55.55	39	100	V	1319.91	-55.89	5.354	0.61	-51.146	-20	-31.146
1319.93	54.91	80	100	H	1319.93	-57.39	5.354	0.61	-52.646	-20	-32.646

25 kHz, 9600 bps

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degree)	Test Antenna		Substitution				Absolute Level (dBm)	FCC Part 90	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
Low Channel											
432	33.21	200	100	V	432	-58.26	0	0.33	-58.59	-13	-45.59
431.98	33.91	290	100	H	431.98	-46.18	0	0.33	-46.51	-13	-33.51
647.99	33.67	308	100	V	647.99	-53.25	0	0.4	-53.65	-13	-40.65
648	35.34	210	100	H	648	-45.41	0	0.4	-45.81	-13	-32.81
1080	55.01	267	100	V	1080	-59.9	4.418	0.4	-55.882	-13	-42.882
1079.85	55.08	150	100	H	1079.85	-57.76	4.418	0.4	-53.742	-13	-40.742
1295.89	55.11	43	100	V	1295.89	-55.28	5.354	0.56	-50.486	-13	-37.486
1296.11	55.2	138	100	H	1296.11	-57.47	5.354	0.56	-52.676	-13	-39.676
Middle Channel											
438.01	35.39	30	100	V	438.01	-55.61	0	0.33	-55.94	-13	-42.94
438	35.91	290	100	H	438	-42.78	0	0.33	-43.11	-13	-30.11
657	33.89	360	100	V	657	-53.51	0	0.39	-53.9	-13	-40.9
657	35.1	228	100	H	657	-45.65	0	0.39	-46.04	-13	-33.04
1094.94	54.3	333	100	V	1094.94	-59.32	4.418	0.4	-55.302	-13	-42.302
1095.06	54.17	83	100	H	1095.06	-57.42	4.418	0.4	-53.402	-13	-40.402
1314.13	53.18	340	100	V	1314.13	-58.39	5.354	0.59	-53.626	-13	-40.626
1313.85	54.27	73	100	H	1313.85	-57.37	5.354	0.59	-52.606	-13	-39.606
High Channel											
440	35.19	202	100	V	440	-55.81	0	0.32	-56.13	-13	-43.13
440	34.51	129	100	H	440	-44.18	0	0.32	-44.5	-13	-31.5
660.01	33.73	360	100	V	660.01	-53.59	0	0.41	-54	-13	-41
659.99	35.5	228	100	H	659.99	-45.25	0	0.41	-45.66	-13	-32.66
1100	54.02	285	100	V	1100	-58.24	4.566	0.44	-54.114	-13	-41.114
1100	52.64	76	100	H	1100	-59.25	4.566	0.44	-55.124	-13	-42.124
1320.16	55.05	41	100	V	1320.16	-56.39	5.354	0.61	-51.646	-13	-38.646
1320.06	54.88	75	100	H	1320.06	-57.42	5.354	0.61	-52.676	-13	-39.676

25 kHz, 19200 bps

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degree)	Test Antenna		Substitution				Absolute Level (dBm)	FCC Part 90	
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Ant. Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
Low Channel											
432.01	33.48	360	100	V	432.01	-57.99	0	0.33	-58.32	-13	-45.32
432.02	34.48	340	100	H	432.02	-45.61	0	0.33	-45.94	-13	-32.94
648	34.14	347	100	V	648	-52.78	0	0.4	-53.18	-13	-40.18
648.01	33.79	118	100	H	648.01	-46.96	0	0.4	-47.36	-13	-34.36
1079.97	54.97	103	100	V	1079.97	-59.94	4.418	0.4	-55.922	-13	-42.922
1080.14	54.6	87	100	H	1080.14	-58.24	4.418	0.4	-54.222	-13	-41.222
1295.98	55.33	80	100	V	1295.98	-55.06	5.354	0.56	-50.266	-13	-37.266
1295.86	54.08	270	100	H	1295.86	-58.59	5.354	0.56	-53.796	-13	-40.796
Middle Channel											
437.98	32.57	0	100	V	437.98	-58.43	0	0.33	-58.76	-13	-45.76
438	37.03	308	100	H	438	-41.66	0	0.33	-41.99	-13	-28.99
656.98	33.5	360	100	V	656.98	-53.9	0	0.39	-54.29	-13	-41.29
657	35.29	221	100	H	657	-45.46	0	0.39	-45.85	-13	-32.85
1094.88	54.1	340	100	V	1094.88	-59.52	4.418	0.4	-55.502	-13	-42.502
1095.26	54.21	55	100	H	1095.26	-57.38	4.418	0.4	-53.362	-13	-40.362
1313.8	54.65	43	100	V	1313.8	-56.92	5.354	0.59	-52.156	-13	-39.156
1314.34	54.18	73	100	H	1314.34	-57.46	5.354	0.59	-52.696	-13	-39.696
High Channel											
440.02	32.6	348	100	V	440.02	-58.4	0	0.32	-58.72	-13	-45.72
440	37.41	313	100	H	440	-41.28	0	0.32	-41.6	-13	-28.6
660	33.47	332	100	V	660	-53.85	0	0.41	-54.26	-13	-41.26
660	36.76	218	100	H	660	-43.99	0	0.41	-44.4	-13	-31.4
1100.01	53.95	301	100	V	1100.01	-58.31	4.566	0.44	-54.184	-13	-41.184
1100.4	52.84	47	100	H	1100.4	-59.05	4.566	0.44	-54.924	-13	-41.924
1320.13	54.67	35	100	V	1320.13	-56.77	5.354	0.61	-52.026	-13	-39.026
1320.03	54.99	73	100	H	1320.03	-57.31	5.354	0.61	-52.566	-13	-39.566

8 FCC §2.1049, §90.209 & §90.210 – Occupied Bandwidth and Emission Mask

8.1 Applicable Standards

According to FCC §90.209, operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25 kHz channel bandwidth will be authorized a 6 kHz bandwidth. All stations must operate on channels with a bandwidth of 12.5 kHz or less beginning January 1, 2013, unless the operations meet the efficiency standard of §90.203 (j) (3).

According to FCC §90.210 (b), for transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

- On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: at least 25 dB.

- On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: at least 35 dB.

- On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: at least 43 +10 log (P) dB.

According to FCC §90.210 (d), for transmitter designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: zero dB.

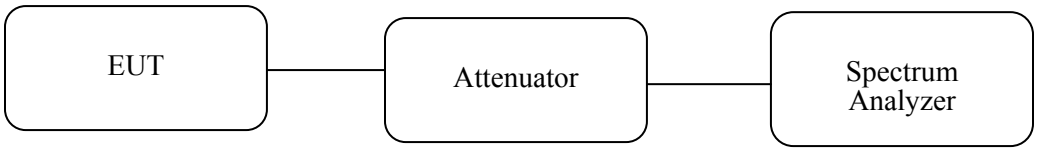
- On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: at least 7.27(f_d-2.88 kHz) dB.

- On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: at least 50 +log (P) dB or 70 dB, whichever is the lesser attenuation.

- The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settling do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

8.2 Test Procedure

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



8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2013-11-07	1 year
BK Precision	Source, DC	1740	26502000233	-	-

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

8.4 Test Environmental Conditions

Temperature:	22-25 °C
Relative Humidity:	41-47 %
ATM Pressure:	101.6-101.7 kPa

The testing was performed by Simon Ma from 2014-06-24 to 2014-06-25 at RF Site.

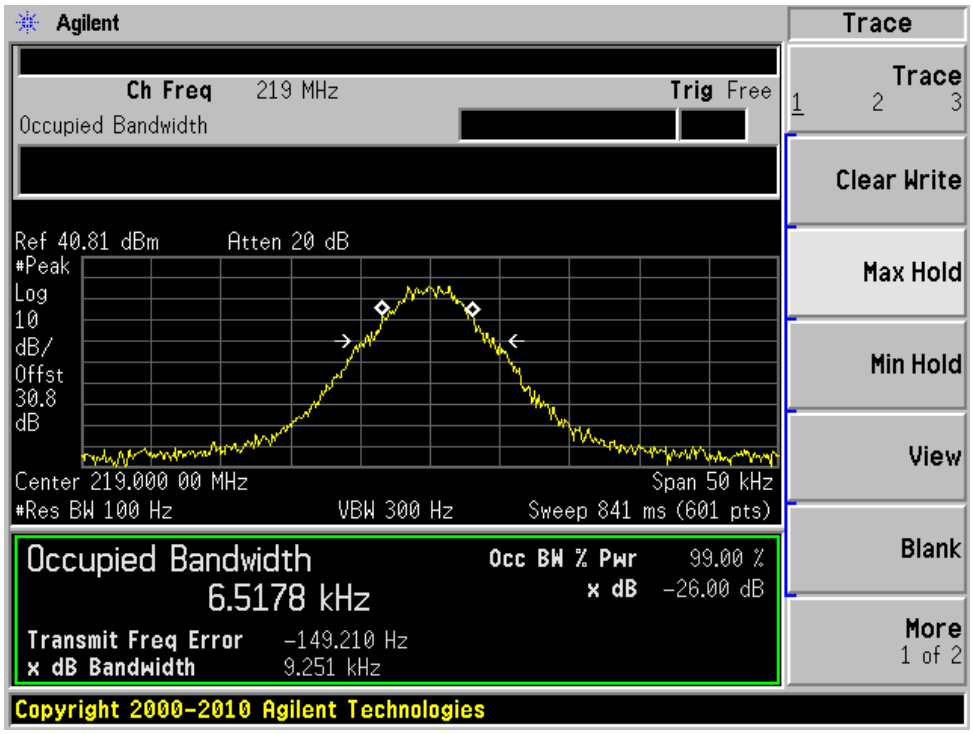
8.5 Test Results

Channel Spacing	Bit Rate (bps)	Channel Frequency (MHz)	99% OBW (kHz)	26 dB OBW (kHz)	Limits (kHz)
12.5 kHz	9600	219	6.5178	9.251	11.25
	4800	219	5.4522	9.442	11.25
25 kHz	19200	219	8.0727	10.631	20
	9600	219	7.9433	10.598	20

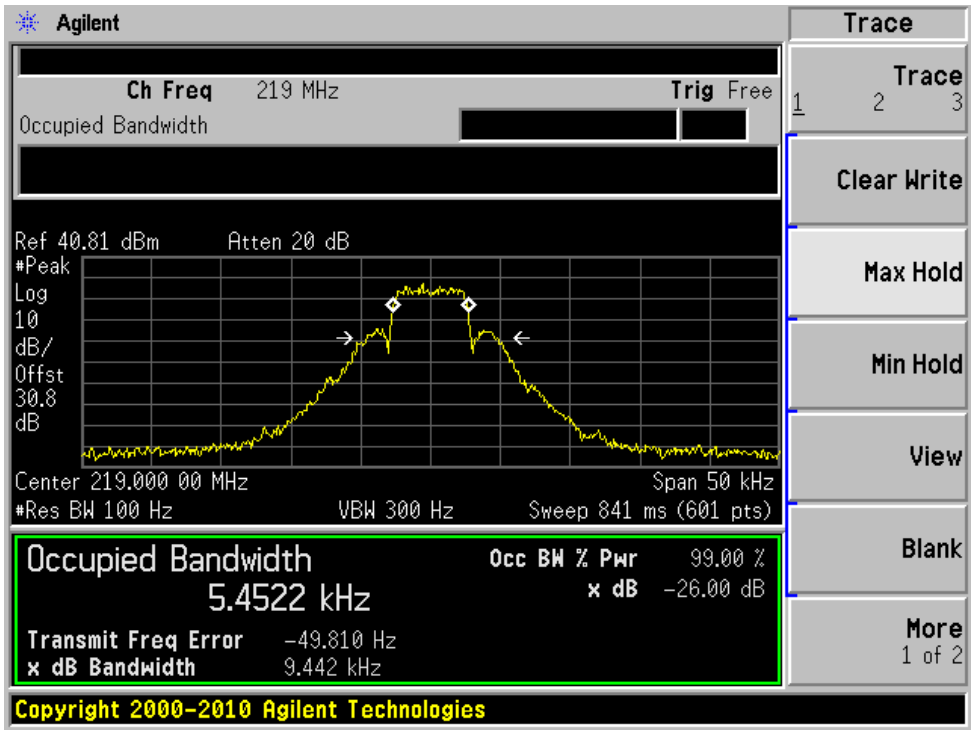
Please refer to the following plots.

Occupied Bandwidth

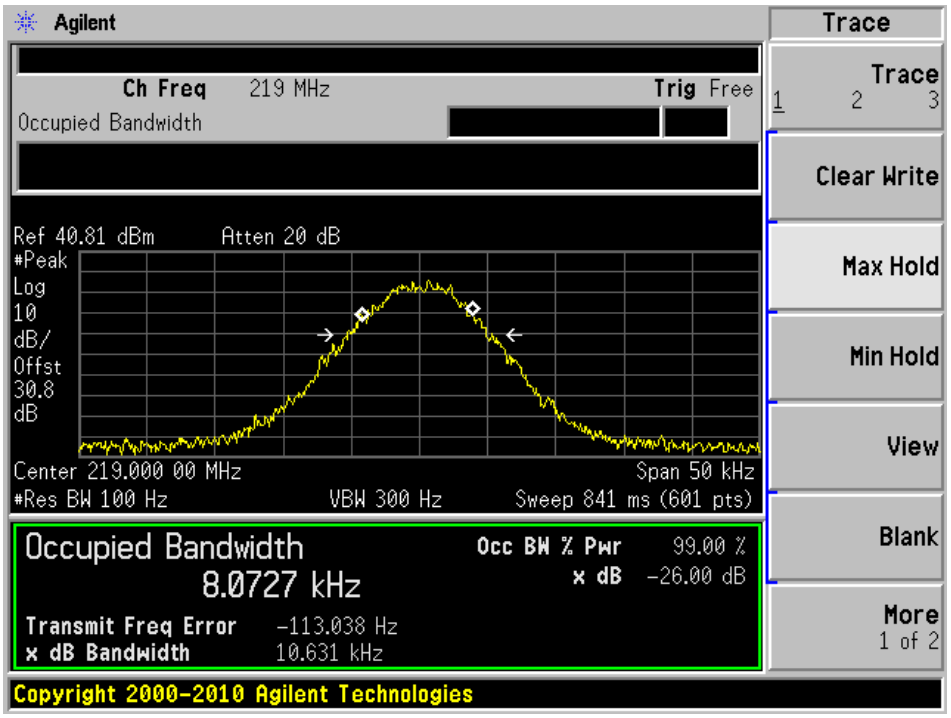
12.5 kHz, 9600 bps, Middle Channel



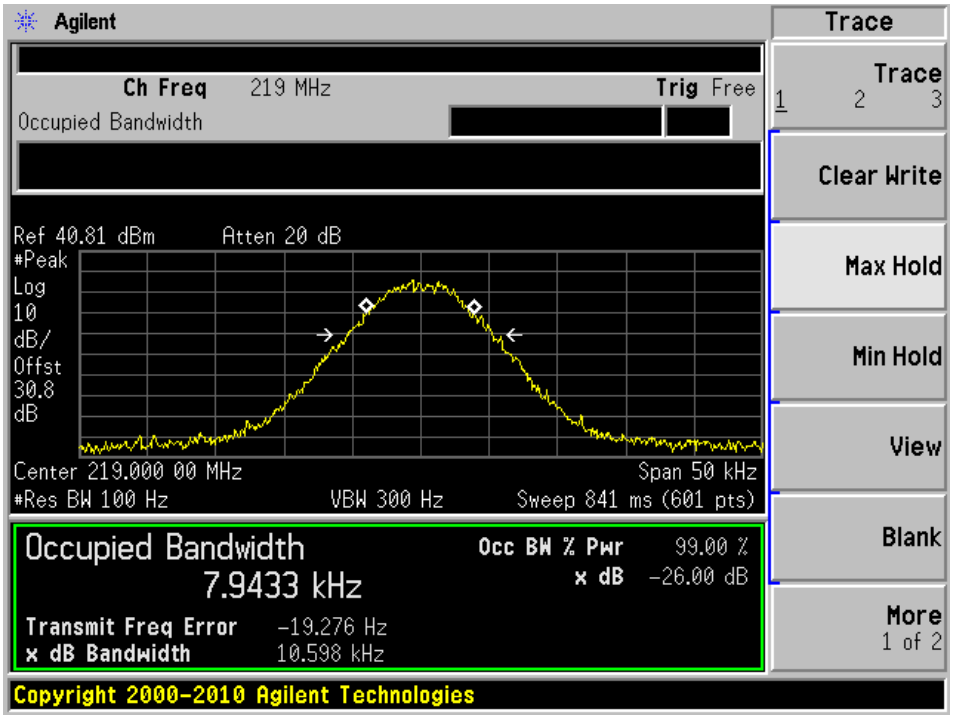
12.5 kHz, 4800 bps, Middle Channel



25 kHz, 19200 bps, Middle Channel

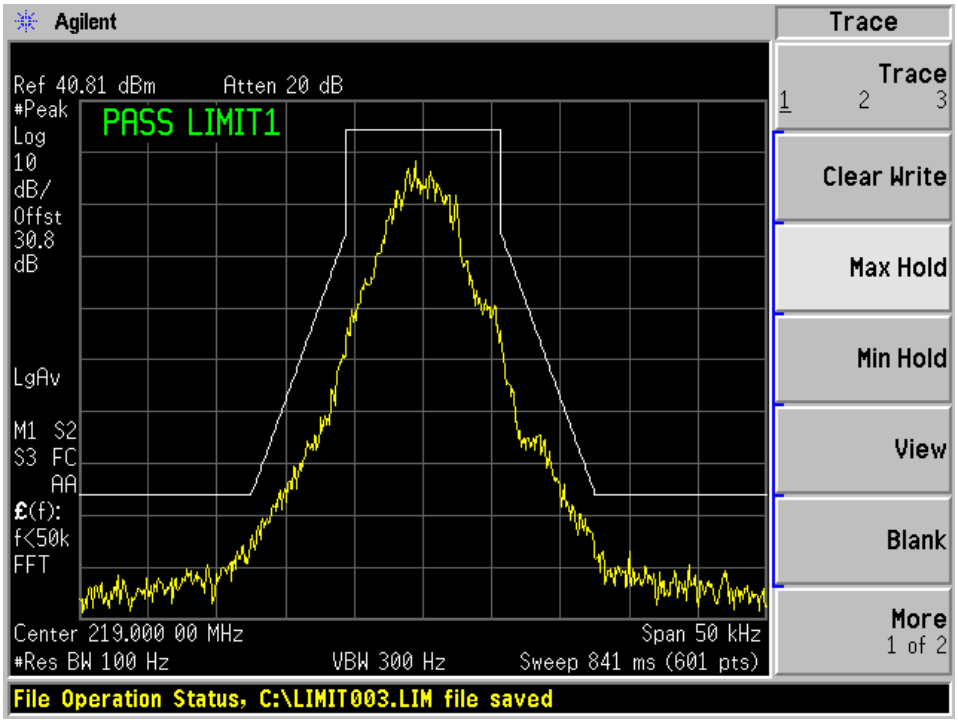


25 kHz, 9600 bps, Middle Channel

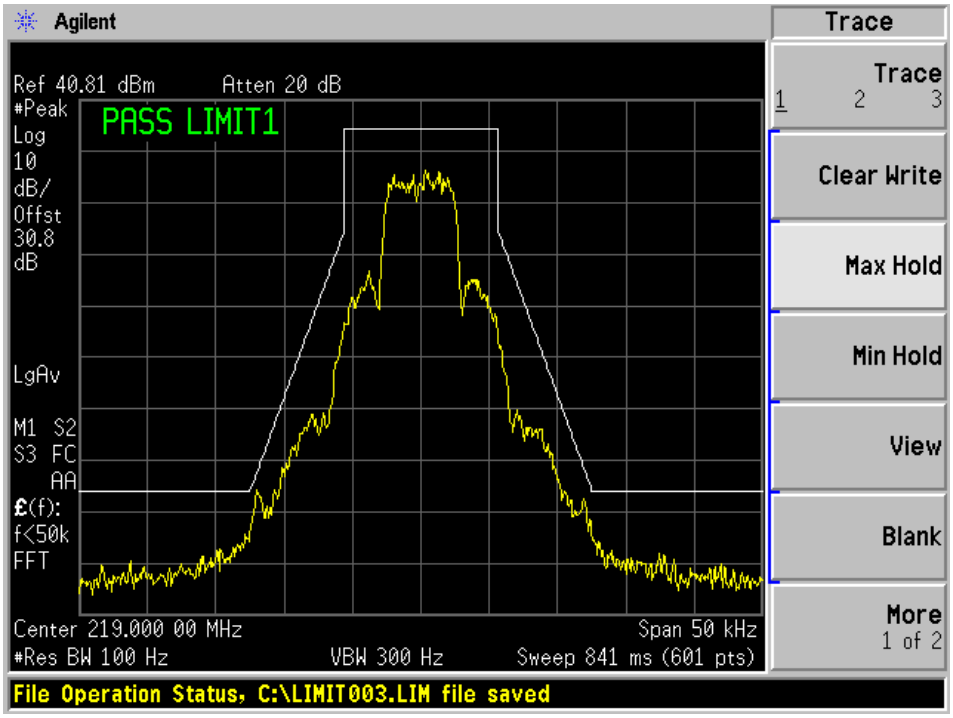


Emission Mask

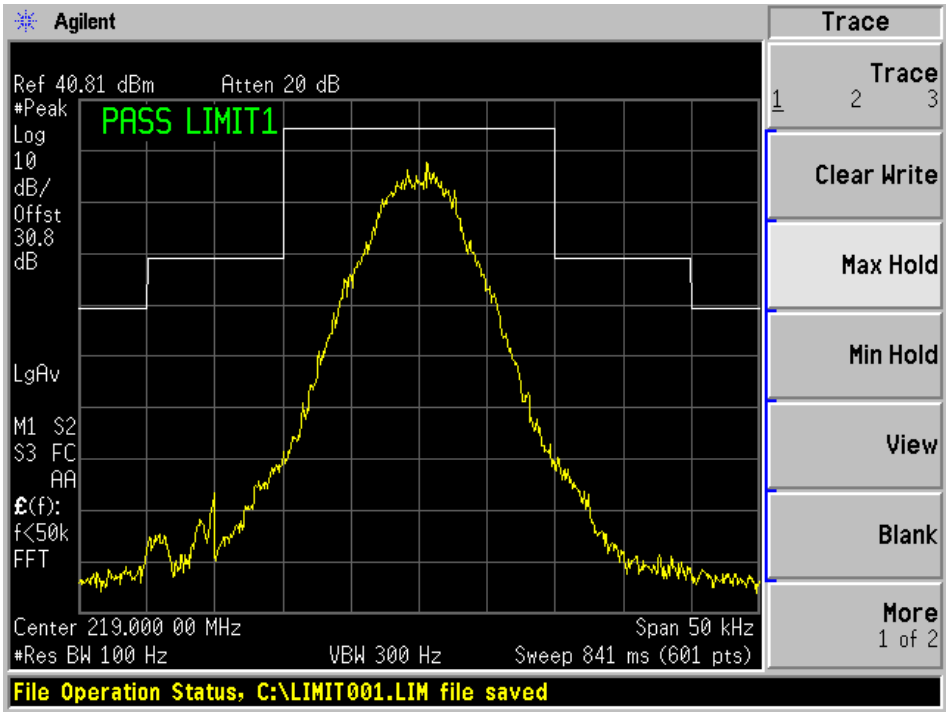
12.5 kHz, 9600 bps, Middle Channel



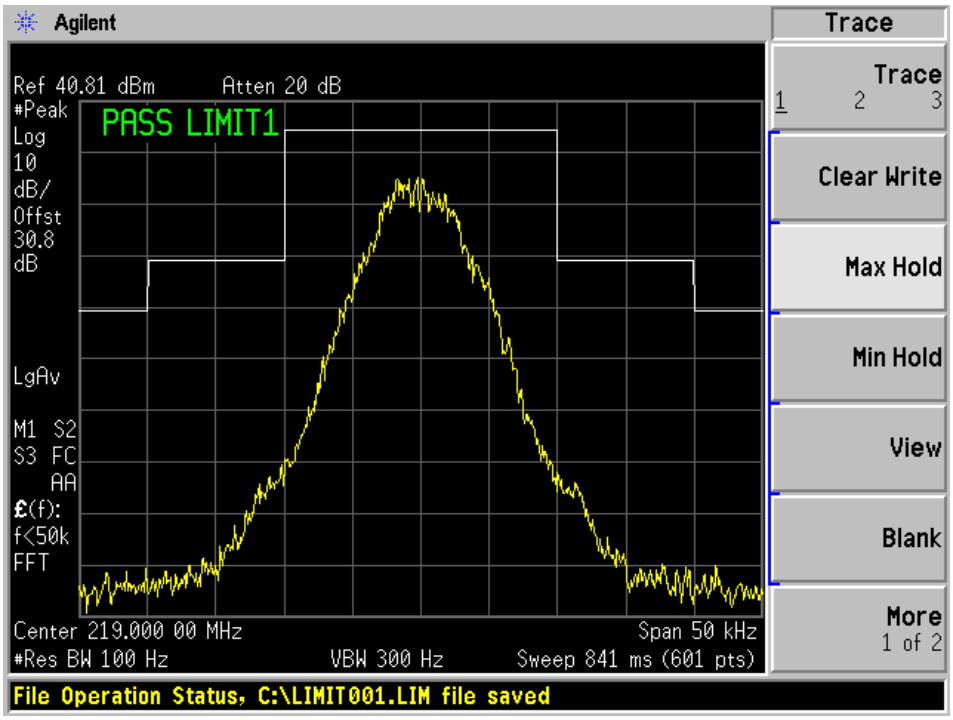
12.5 kHz, 4800 bps, Middle Channel



25 kHz, 19200 bps, Middle Channel



25 kHz, 9600 bps, Middle Channel



9 FCC §2.1091 &§1.1310 – Exposure of Human to RF Fields

9.1 Applicable Standards

Before equipment certification is granted, the procedure of RSS-102 must be followed concerning the exposure of humans to RF fields.

According to FCC 1.1310, RF limits used for general public will be applied to the EUT.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (min)
0.3–1.34	614	1.63	100	30
1.34–30	824/f	2.19/f	$900/f^2$	30
30–300	27.5	0.073	0.2	30
300–1 500	-	-	f/1500	30
1 500–100 000	-	-	1.0	30

F = frequency in MHz * = Plane-wave equivalent power density

9.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from 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

9.3 Test Results

Maximum peak output power at antenna input terminal (dBm):	35.1
Maximum peak output power at antenna input terminal (mW):	3235.93
Prediction distance (cm):	36
Prediction frequency (MHz):	220
Antenna Gain, typical (dBi):	0
Power density at predication frequency and distance (mW/cm^2):	0.19879
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	0.2

Maximum peak output power at antenna input terminal (dBm):	35.1
Maximum peak output power at antenna input terminal (mW):	3235.93
Prediction distance (cm):	100
Prediction frequency (MHz):	220
Antenna Gain, typical (dBi):	6
Power density at predication frequency and distance (mW/cm^2):	0.1026
MPE limit for uncontrolled exposure at predication frequency (mW/cm^2):	0.2