



FCC PART 80

TEST AND MEASUREMENT REPORT

For

Samyung Eng Co., Ltd.

1123-17 Dongsam-Dong, Youngdo-Gu,
Busan, Korea

FCC ID: RN6SMR-3700

Report Type: Original Report	Product Type: Marine Communication Equipment
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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*” (Rev-12)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1210053-80	Original Report	2013-07-31

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of Samyung Eng Co., Ltd., and their product, FCC ID: RN6SMR-3700, model: SMR-3700 which will henceforth be referred to as the EUT "Equipment under Test". The EUT is a Marine Communication Equipment which operates on 9410 $\pm$ 30 MHz

Specifications	
Pulse width Types	0.1 microsecond/2100 Hz 0.3 microsecond/1650 Hz 0.5 microsecond/1200Hz 0.9 microsecond/600 Hz

1.2 Mechanical Description of EUT

The EUT Approximate measurement is:

For Antenna: 60 cm (D) x 27.4 cm (H). Weight: 9.0 kg.
SMR-3700: 33.2 cm (L) x 14 cm (H) x 30.7 cm (W). Weight: 4.7 kg.

The test data gathered are from typical production sample, serial number: 1210053-2, assigned by BACL.

1.3 Objective

This type approval report is prepared on behalf of *Samyung Eng Co., Ltd.*, accordance with FCC Part 80.

1.4 Related Submittal(s)/Grant(s)

No Related Submittals

1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, as well as the following individual parts:

Part 80 – Stations in the Maritime Services

Applicable Standards: TIA603-C

All emissions measurement was performed by Bay Area Compliance Laboratories 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 ± 2.0 dB for Conducted Emissions tests and ± 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 Luminaires 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=8430d44f1f47cf2996124343c704b367816b>

2 System Test Configuration

2.1 Justification

The EUT 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.

2.2 EUT Exercise Software

N/A

2.3 Equipment Modifications

No modification was made to the EUT

2.4 Special Equipment

No special equipment was used during testing

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Samyung ENC	Power Supply	SP-5AD	2520282
MRCtech	Wave Guide	PE9804	VA165QB402402B

2.6 EUT Internal Configuration Details

Antenna

Manufacturer	Description	Model	Serial Number
Samyung ENC	Power Supply	P003101-D1	PRSU3700 120501
Samyung ENC	Control Board	P003137	SMR-3700 120501
Samyung ENC	RF Board	P003126-E2	PRSU3700 120503

Display Unit

Manufacturer	Description	Model	Serial Number
Samyung ENC	Power Supply	P003730-D1	PSMR3700 120507
-	LCD	W2640-5	12B09487
Samyung ENC	Display Board	P003720	PSMR3700 120613
Samyung ENC	Control Board	P003750-C1	PSMR3700 120430
Samyung ENC	Mini PCB	P003936-A0	-

2.7 External I/O Cabling List and Details

Cable Descriptions	Length (m)	From	To
Power Cable	3	Power Supply	Display Unit
Scanner cable	15	Display Unit	Scanner

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1046, §80.215	RF Output Power	Compliant
§2.1047, §80.213(g)	Modulation Characteristics	N/A
§2.1049, §80.211(f)	Occupied Bandwidth and Emission Mask	Compliant
§2.1051, §80.211(f)	Spurious Emissions at Antenna Terminals	Compliant
§2.1053, §80.211(f)	Field Strength of Spurious Radiation	Compliant
§2.1055, §80.209	Frequency Stability	Compliant
§80.217	Suppression of the interference Aboard Ships	Compliant

4 FCC §2.1046 & §80.215 – RF Output Power

4.1 Applicable Standards

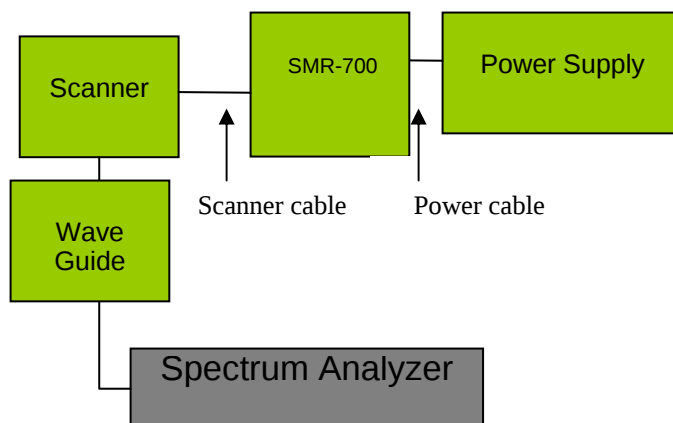
FCC §2.1046 and §80.215

4.2 Test Procedure

Conducted:

The RF output of the transmitter was connected to the signal generator and the spectrum analyzer through sufficient attenuation.

4.3 Test Setup Block Diagram



4.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10	1 year

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

4.5 Test Environmental Conditions

Temperature:	22-24 °C
Relative Humidity:	50-55 %
ATM Pressure:	101-102 kPa

The testing was performed by Wei Sun on 2012-12-03 on RF Site.

4.6 Test Results

Frequency (MHz)	Pulse Type	Peak Output Power (dBm)	Peak Output Power (watt)
9413	0.1 microsecond/2100 Hz	66.29	4255.98
9413	0.3 microsecond/1650 Hz	66.29	4255.98
9413	0.5 microsecond/1200Hz	65.88	3872.58
9413	0.9 microsecond/600 Hz	65.74	3749.73

5 FCC §2.1049 & §80.211 (f) – EMISSION BANDWIDTH & MASK

5.1 Applicable Standard

§2.1049 & §80.211(f)

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

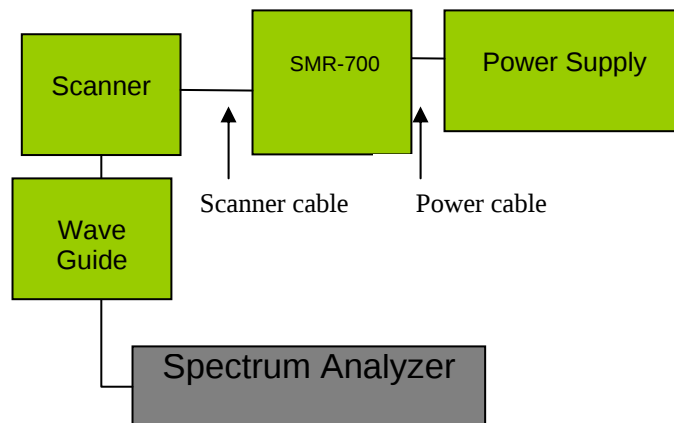
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

5.2 Test Procedure

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

According to the FCC 2-11-04/EAB/RF, Input and output signals were compared to verify that there was no any degradation to the signal due to amplification and conversion from the repeater using an RBW of 300 Hz or 1% of the emission bandwidth. Then the 20 dB & 99% bandwidth was recorded.

5.3 Test Setup Block Diagram



5.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10	1 year

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

5.5 Test Environmental Conditions

Temperature:	22-24 °C
Relative Humidity:	50-55 %
ATM Pressure:	101-102 kPa

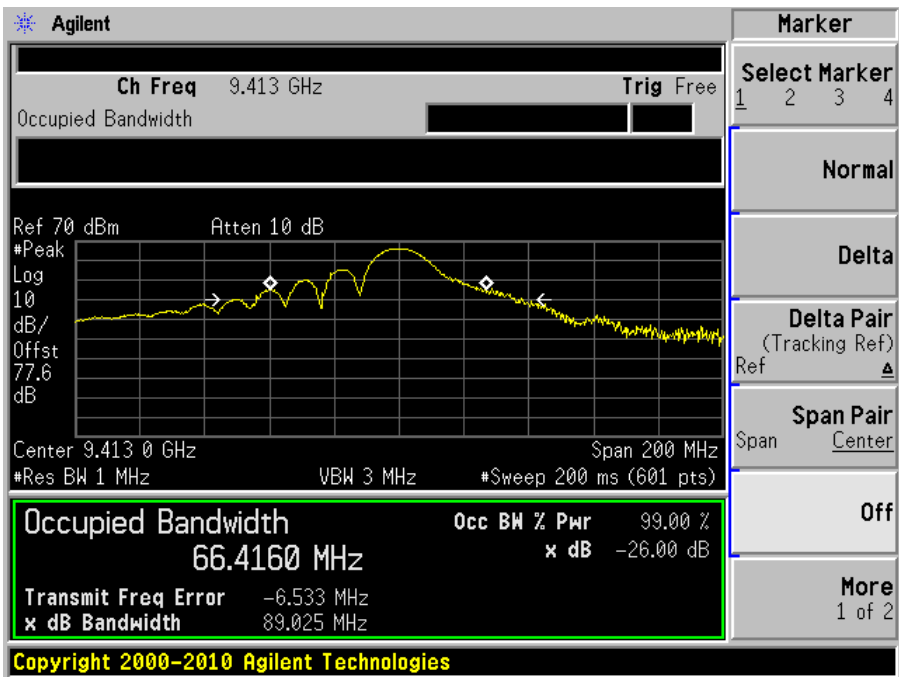
The testing was performed by Wei Sun on 2012-12-06 on RF Site.

5.6 Test Results

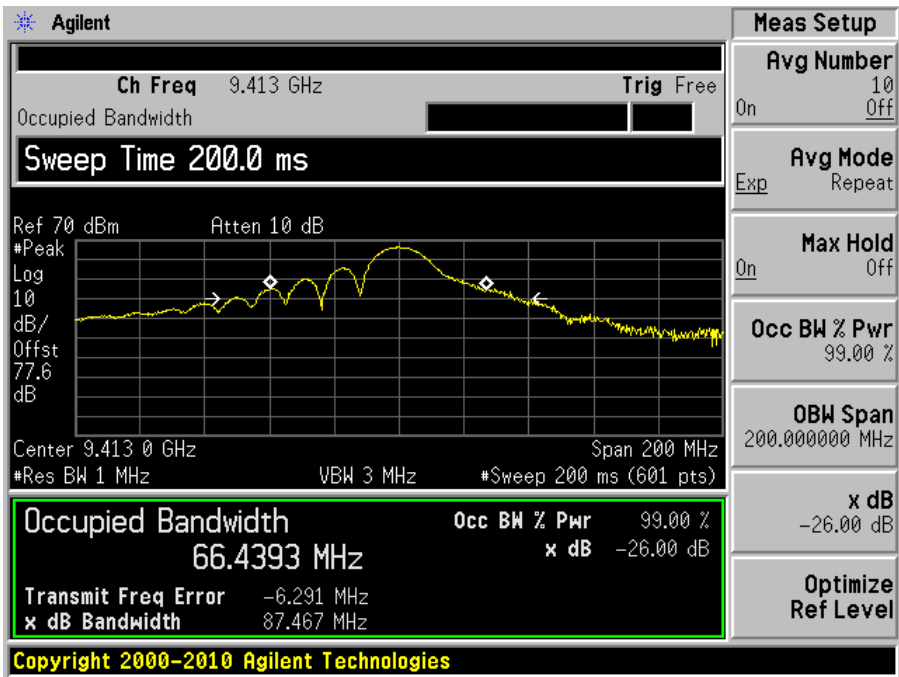
Frequency (MHz)	Pulse Type	Emission Bandwidth (MHz)
9413	0.1 microsecond/2100 Hz	66.4160
9413	0.3 microsecond/1650 Hz	66.4393
9413	0.5 microsecond/1200Hz	66.4009
9413	0.9 microsecond/600 Hz	66.7205

Please refer to the following plots:

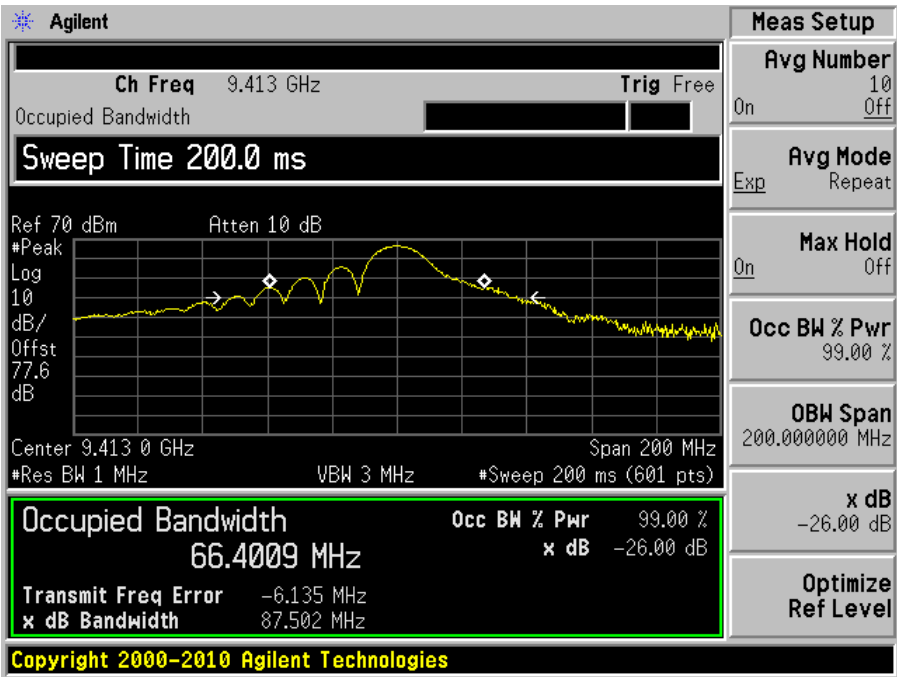
Pulse type: 0.1 microsecond/2100 Hz



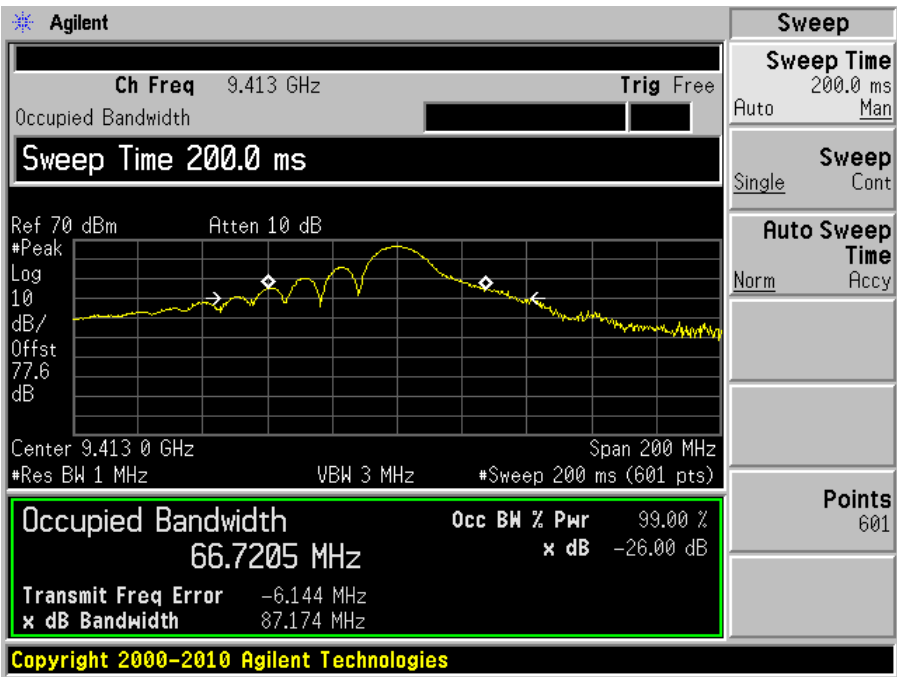
Pulse type: 0.3 microsecond/1650 Hz



Pulse type: 0.5 microsecond/1200Hz

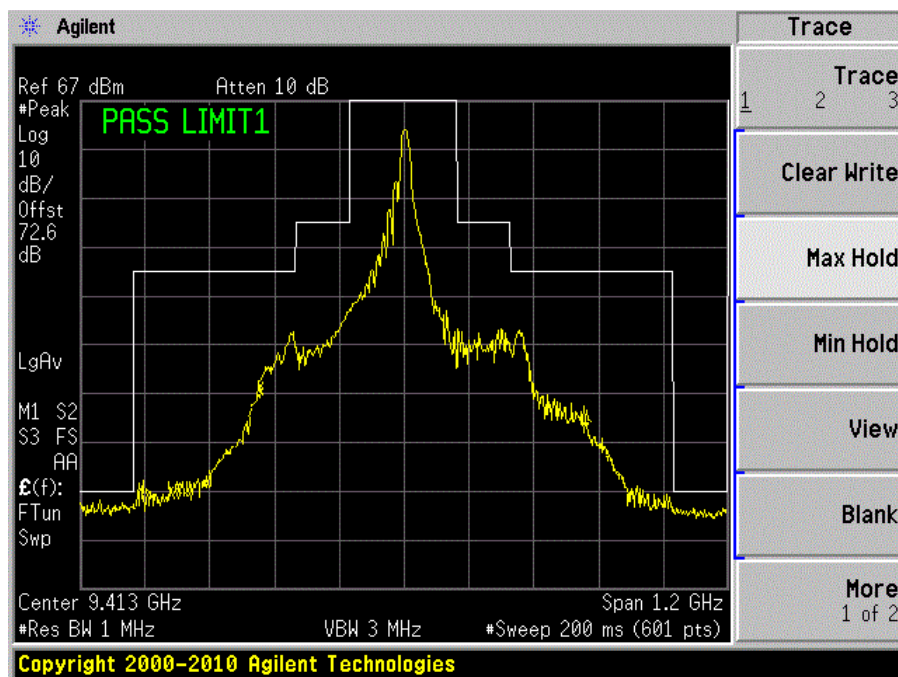


Pulse type: 0.9 microsecond/600 Hz

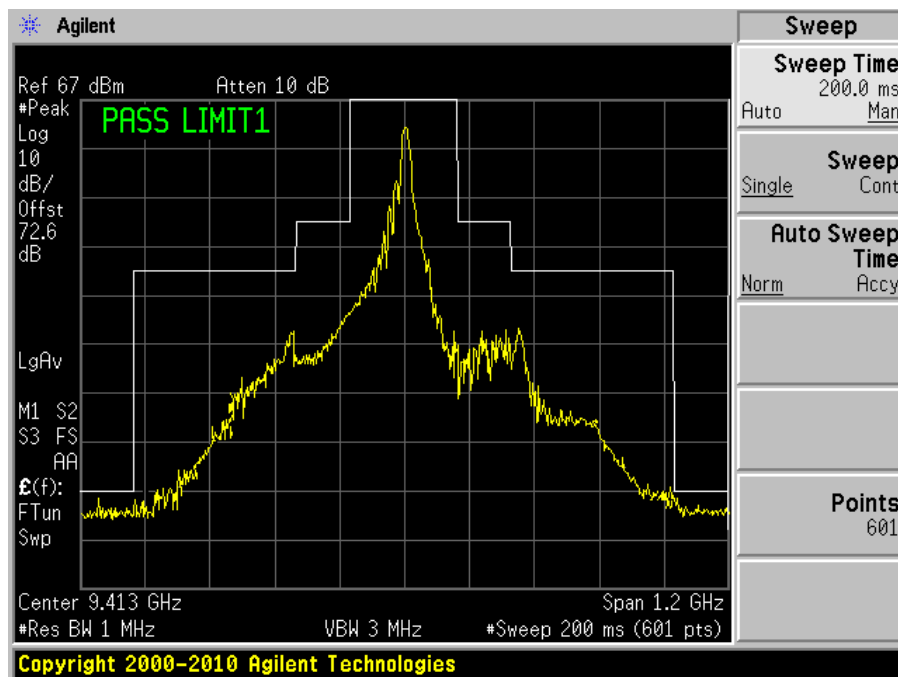


Emission Mask

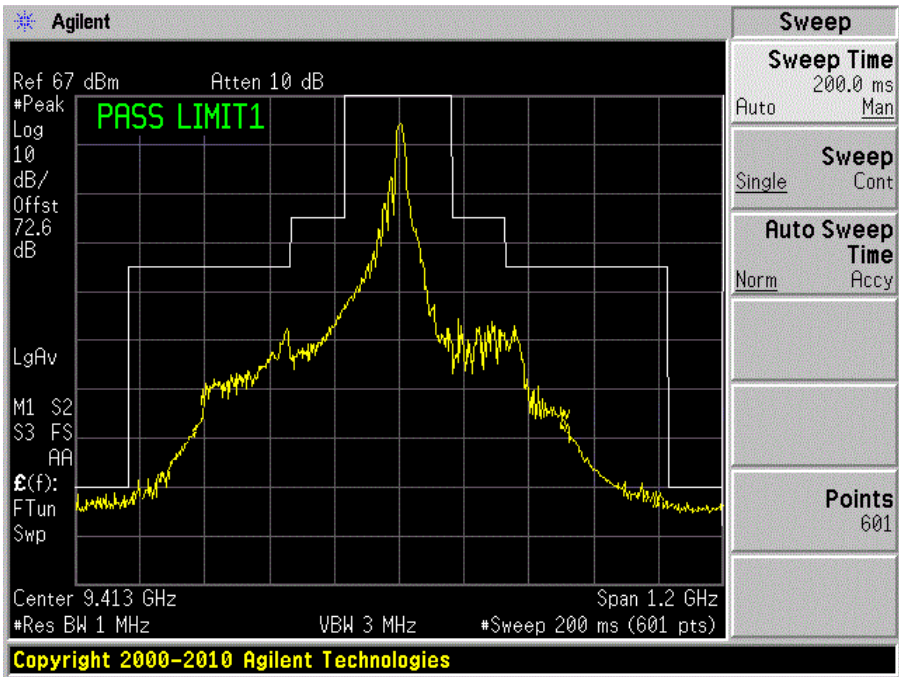
Pulse type: 0.1 microsecond/2100 Hz



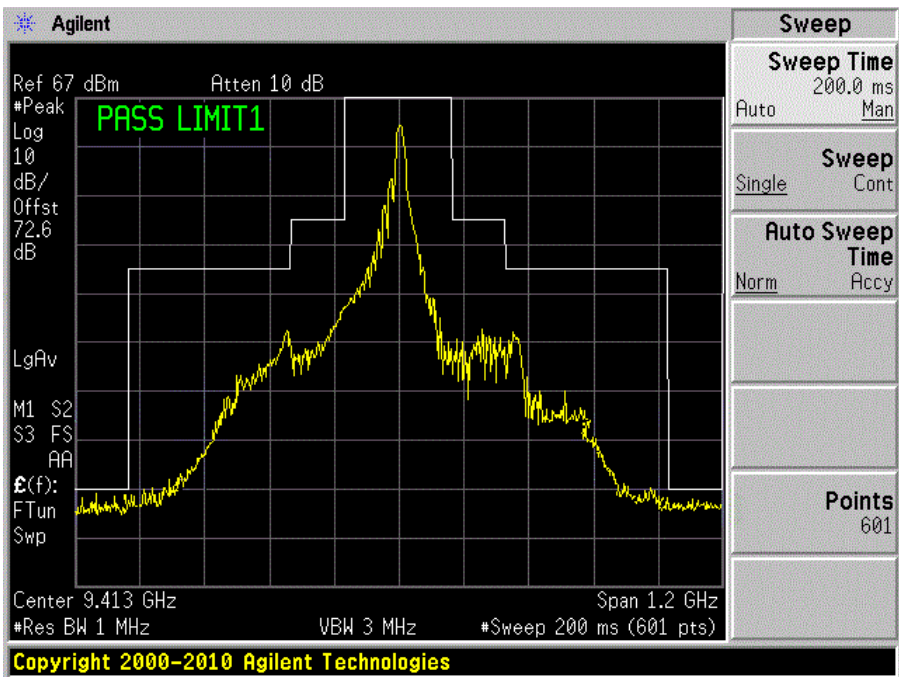
Pulse type: 0.3 microsecond/1650 Hz



Pulse type: 0.5 microsecond/1200Hz



Pulse type: 0.9 microsecond/600 Hz



6 FCC §2.1051 & §80.211 (f) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

6.1 Applicable Standard

§2.1051 & §80.211 (f)

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

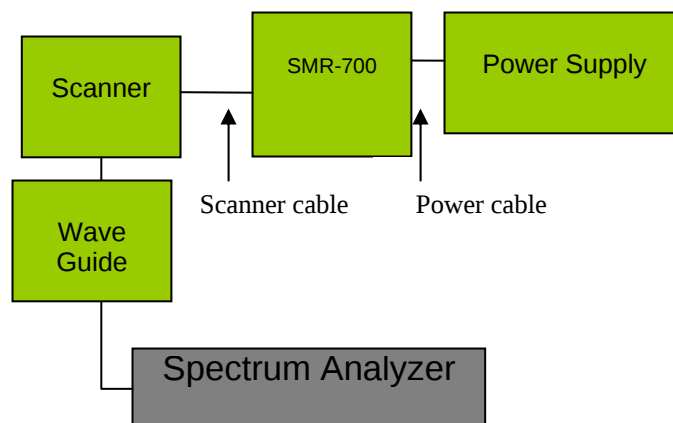
(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

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

6.3 Test Setup Block Diagram



6.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

6.5 Test Environmental Conditions

Temperature:	22-24 °C
Relative Humidity:	50-55 %
ATM Pressure:	101-102 kPa

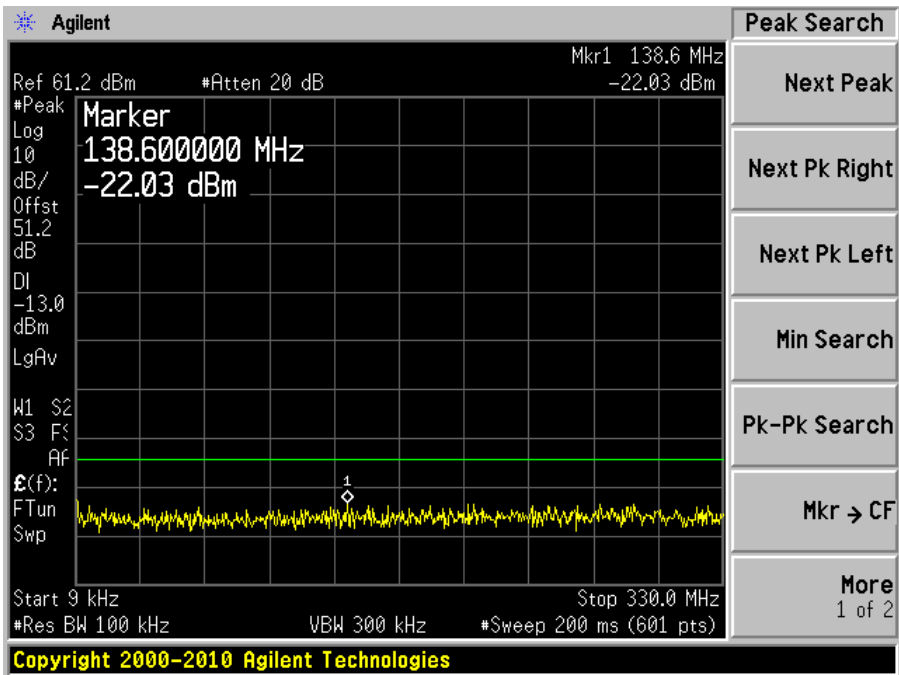
The testing was performed by Wei Sun on 2012-12-03 on RF Site.

6.6 Test Results

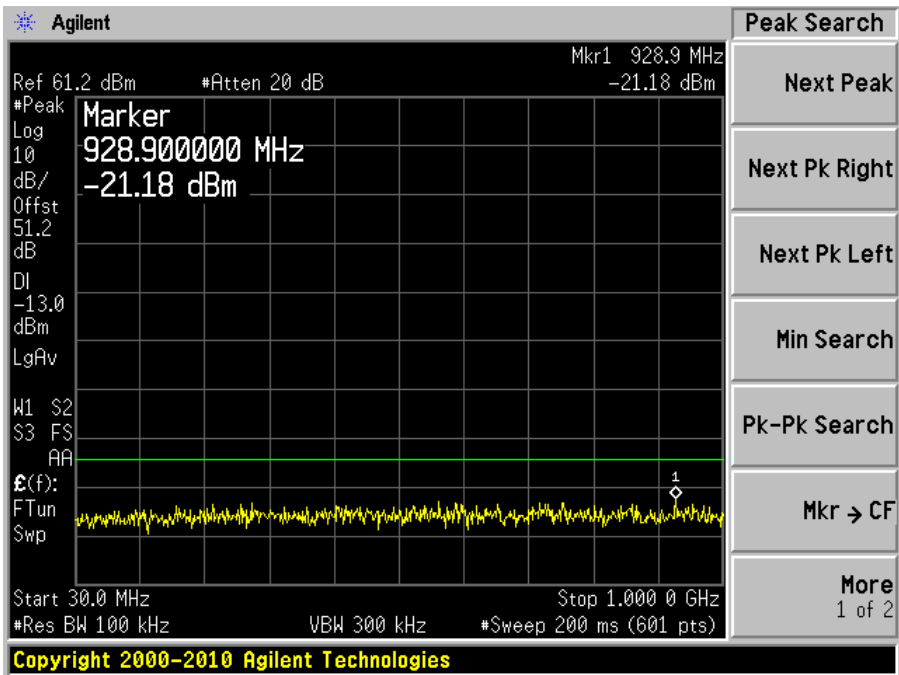
Please refer to the plot hereinafter.

Worst Case: Pulse type: 0.1 microsecond/2100 Hz

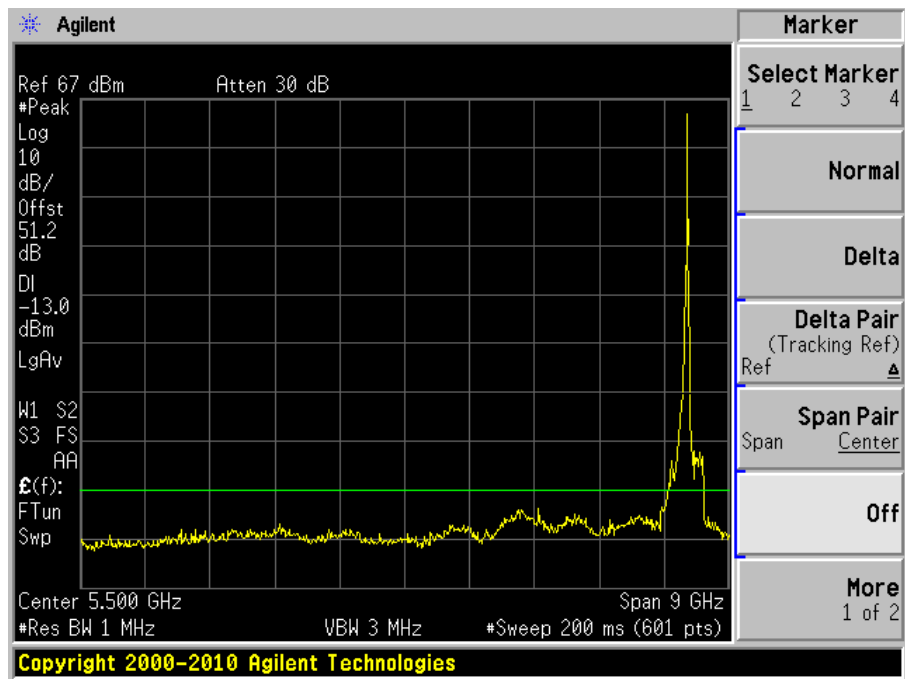
Plot 1: 9 kHz to 30 MHz



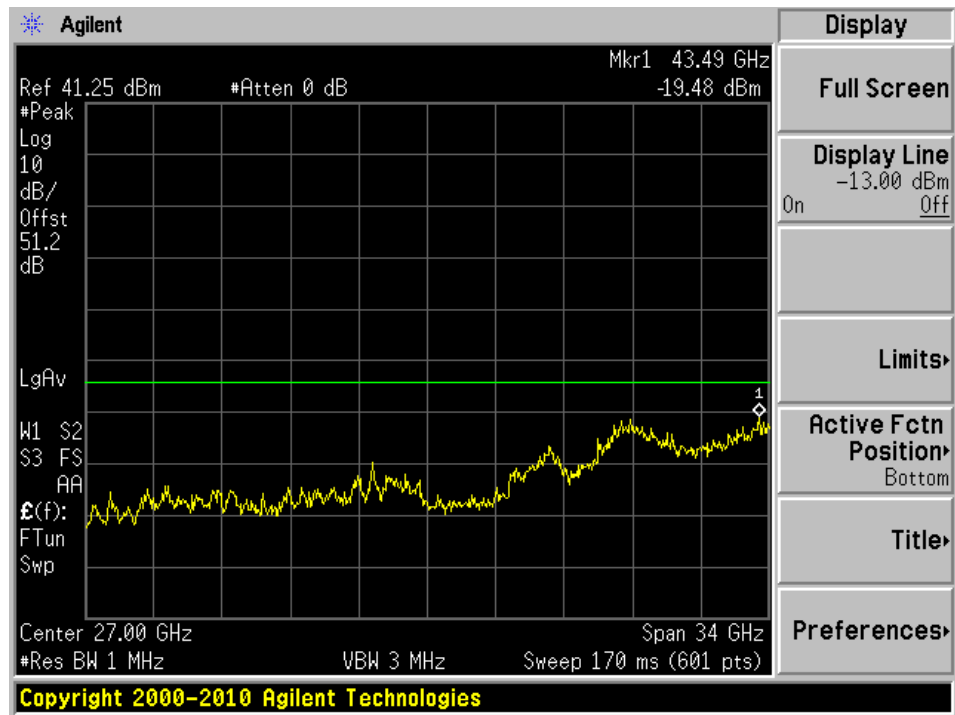
Plot 2: 30 MHz to 1GHz



Plot 2: 1 GHz to 10 GHz



Plot 4: 10 GHz to 44 GHz



7 FCC §2.1053 & §80.211 (f) – FIELD STRENGTH OF SPURIOUS RADIATIONS

7.1 Applicable Standard

§2.1053 & §80.211 (f)

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

7.2 Test Procedure

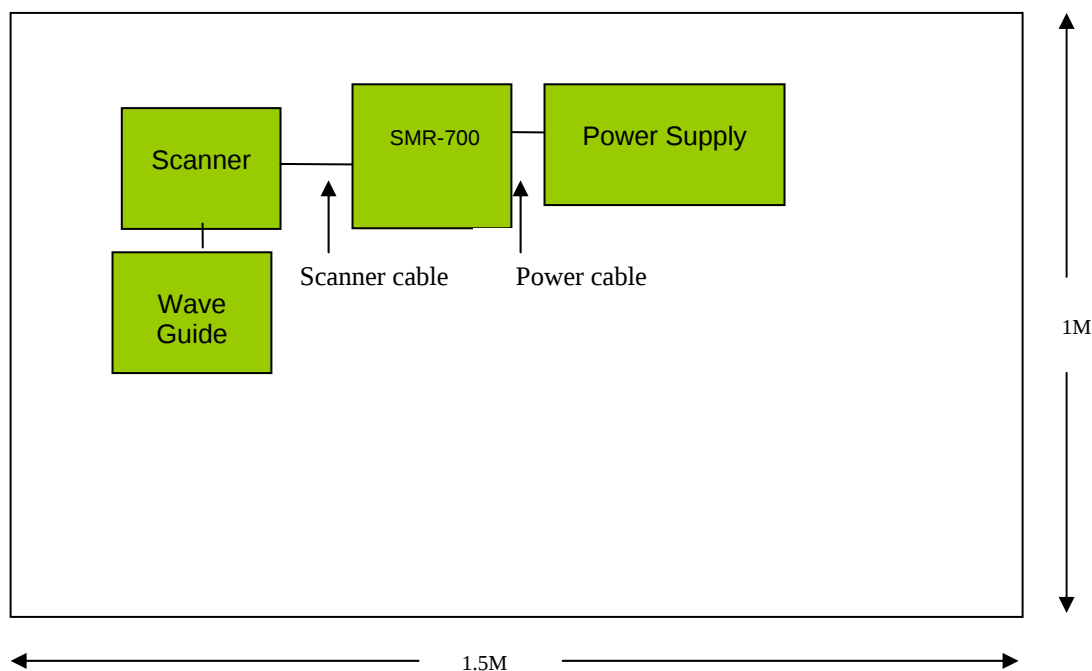
The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

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

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

7.3 Test Setup Block Diagram



7.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2012-06-18	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2012-03-08	1 year
Com-Power	Dipole antenna	AD-100	2229	2012-07-23	2 years
Eaton	Horn antenna	96001	Mar-07	2011-10-03	1 year
A.H. Systems	Horn antenna	SAS-200/571	261	2012-01-18	1 year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 year
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10	1 year

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

7.5 Test Environmental Conditions

Temperature:	22-24 °C
Relative Humidity:	50-55 %
ATM Pressure:	101-102 kPa

The testing was performed by Wei Sun on 2012-12-04 in 5 Meters Chamber #2.

7.6 Test Results

Worst Case: Pulse type: 0.1 microsecond/2100 Hz

Indicated		Table Azimuth (Degree)	Test Antenna		Substituted		Antenna Gain Cord. (dB)	Path Loss (dB)	Absolute Level (dBm)	FCC Part 80	
Frequency (MHz)	Reading (dBuV/m)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)				Limit (dBm)	Margin (dB)
1734	77.78	59	165	V	1734	-21.37	9.46	2.21	-14.12	-13	-1.12
1734	74.69	284	205	H	1734	-24.35	9.46	2.21	-17.1	-13	-4.1
18827	68.91	122	171	V	18827	-16.24	8.83	12.17	-19.58	-13	-6.58
18827	68.79	300	165	H	18827	-16.32	8.83	12.17	-19.66	-13	-6.66
207.13	84.32	271	168	V	207.13	-22.99	0	0.59	-23.58	-13	-10.58
207.13	80.9	115	206	H	207.13	-26.3	0	0.59	-26.89	-13	-13.89

8 FCC §2.1055 & §80.209 (g) – Frequency Stability

8.1 Applicable Standard

§2.1055 & §80.209 (b)

(b) When pulse modulation is used in land and ship radar stations operating in the bands above 2.4 GHz the frequency at which maximum emission occurs must be within the authorized bandwidth and must not be closer than $1.5/T$ MHz to the upper and lower limits of the authorized bandwidth where “T” is the pulse duration in microseconds. In the band 14.00-14.05 GHz the center frequency must not vary more than 10 MHz from 14.025 GHz.

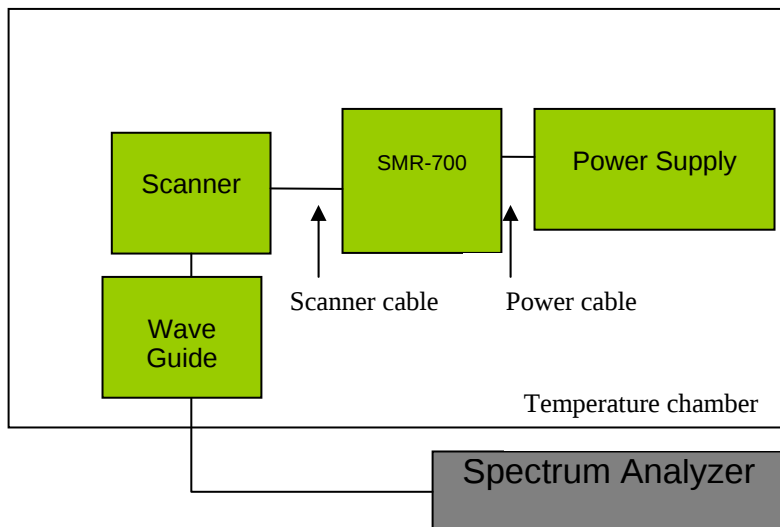
8.2 Measurement Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to the Spectrum Analyzer 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 Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable DC power supply Source. The voltage was set to 115% and 85% of the nominal value. The output frequency was recorded for each voltage.

8.3 Test Setup Block Diagram



8.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10	1 year
Espec	Temperature Chamber	ESL-4CA	18010	2012-02-10	1 year

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

8.5 Test Environmental Conditions

Temperature:	24 °C
Relative Humidity:	49 %
ATM Pressure:	101.97 kPa

The testing was performed by Wei Sun on 2012-12-03 at RF Site.

8.6 Test Results

0.1 microsecond/2100 Hz

Test Condition		Tested Frequency (MHz)	Limit (MHz)
Voltage (Vac)	Temperature (°C)		
102	20 °C	9413.056	9315 - 9485
138		9413.077	9315 - 9485
120	55 °C	9413.047	9315 - 9485
120	45 °C	9413.051	9315 - 9485
120	35 °C	9413.068	9315 - 9485
120	25 °C	9413.070	9315 - 9485
120	15 °C	9413.049	9315 - 9485
120	-5 °C	9413.089	9315 - 9485
120	-15 °C*	9413.092	9315 - 9485

0.3 microsecond/1650 Hz

Test Condition		Tested Frequency (MHz)	Limit (MHz)
Voltage (Vac)	Temperature (°C)		
102	20 °C	9413.0947	9315 - 9485
138		9413.0251	9315 - 9485
120	55 °C	9413.0607	9315 - 9485
120	45 °C	9143.0637	9315 - 9485
120	35 °C	9413.0339	9315 - 9485
120	25 °C	9413.0491	9315 - 9485
120	15 °C	9143.0506	9315 - 9485
120	-5 °C	9413.0642	9315 - 9485
120	-15 °C*	9413.0573	9315 - 9485

0.5 microsecond/1200Hz

Test Condition		Tested Frequency (MHz)	Limit (MHz)
Voltage (Vac)	Temperature (°C)		
102	20 °C	9413.0094	9315 - 9485
138		9413.2860	9315 - 9485
120	55 °C	9413.0867	9315 - 9485
120	45 °C	9143.0727	9315 - 9485
120	35 °C	9413.0540	9315 - 9485
120	25 °C	9413.0466	9315 - 9485
120	15 °C	9413.0667	9315 - 9485
120	-5 °C	9413.0874	9315 - 9485
120	-15 °C*	9413.0328	9315 - 9485

0.9 microsecond/600 Hz

Test Condition		Tested Frequency (MHz)	Limit (MHz)
Voltage (Vac)	Temperature (°C)		
102	20 °C	9413.0267	9315 - 9485
138		9413.0272	9315 - 9485
120	55 °C	9413.0281	9315 - 9485
120	45 °C	9413.0219	9315 - 9485
120	35 °C	9413.0239	9315 - 9485
120	25 °C	9413.0314	9315 - 9485
120	15 °C	9413.0405	9315 - 9485
120	-5 °C	9413.0431	9315 - 9485
120	-15 °C*	9413.0278	9315 - 9485

* Note: lowest functional temperature is -15 °C.

9 FCC §80.217 – Suppression of Interference aboard Ships

9.1 Applicable Standard

For 80.217

- (a) A voluntarily equipped ship station receiver must not cause harmful interference to any receiver required by statute or treaty.
- (b) The electromagnetic field from receivers required by statute or treaty must not exceed the following value at a distance over sea water of one nautical mile from the receiver:

Frequency of Interfering Emissions (MHz)	Field Intensity in Microvolts per Meter
Below 30 MHz	0.1
30 MHz – 100 MHz	0.3
100 MHz – 300 MHz	1.0
Over 300 MHz	3.0

Or

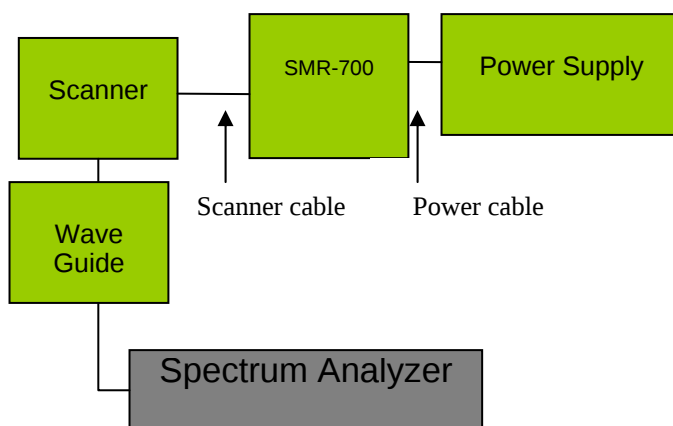
Deliver not more than the following amounts of power, to an artificial antenna having electrical characteristics equivalent to those of the average receiving antenna(s) use on shipboard:

Frequency of Interfering Emissions (MHz)	Power to Artificial Antenna in Microwatts
Below 30 MHz	400
30 MHz – 100 MHz	4000
100 MHz – 300 MHz	40000
Over 300 MHz	400000

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

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10	1 year

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

9.5 Test Environmental Conditions

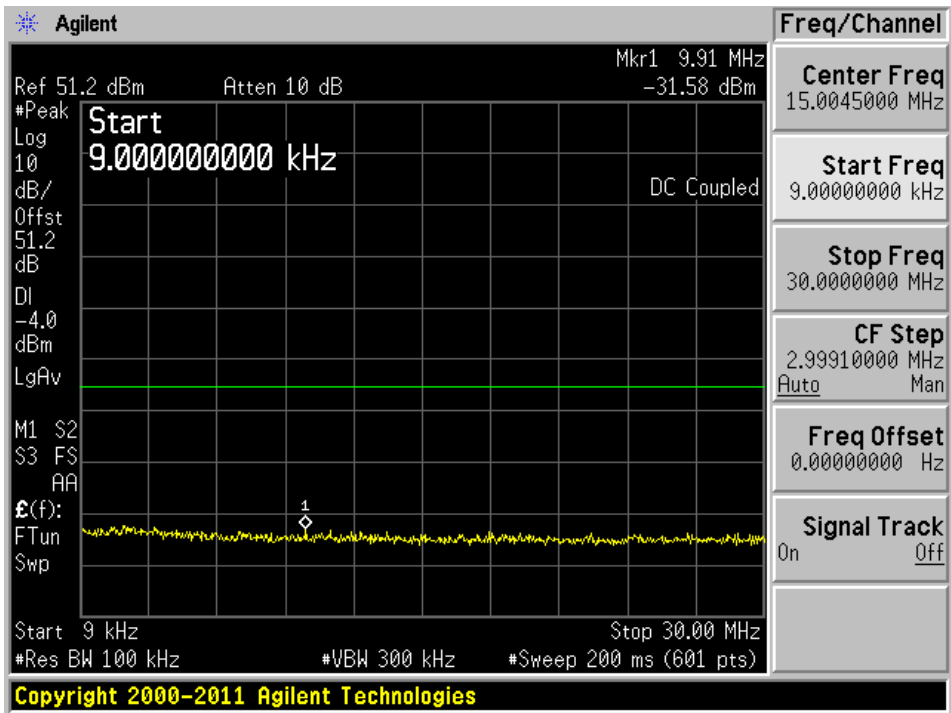
Temperature:	24 °C
Relative Humidity:	49 %
ATM Pressure:	101.97 kPa

The testing was performed by Wei Sun on 2012-12-07 at RF Site.

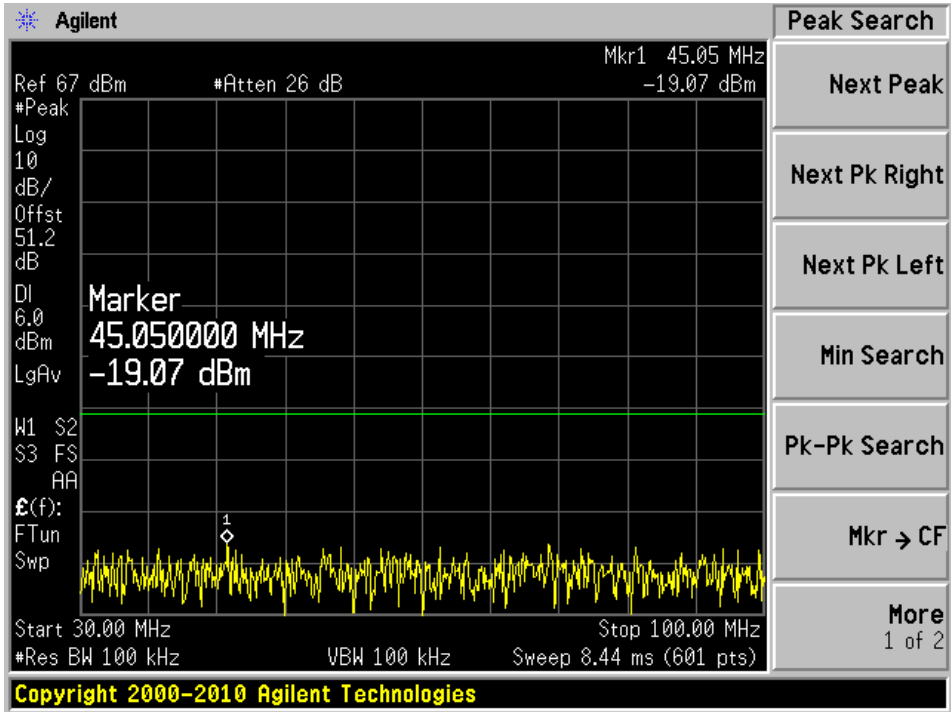
9.6 Test Results

Please refer to the following plots.

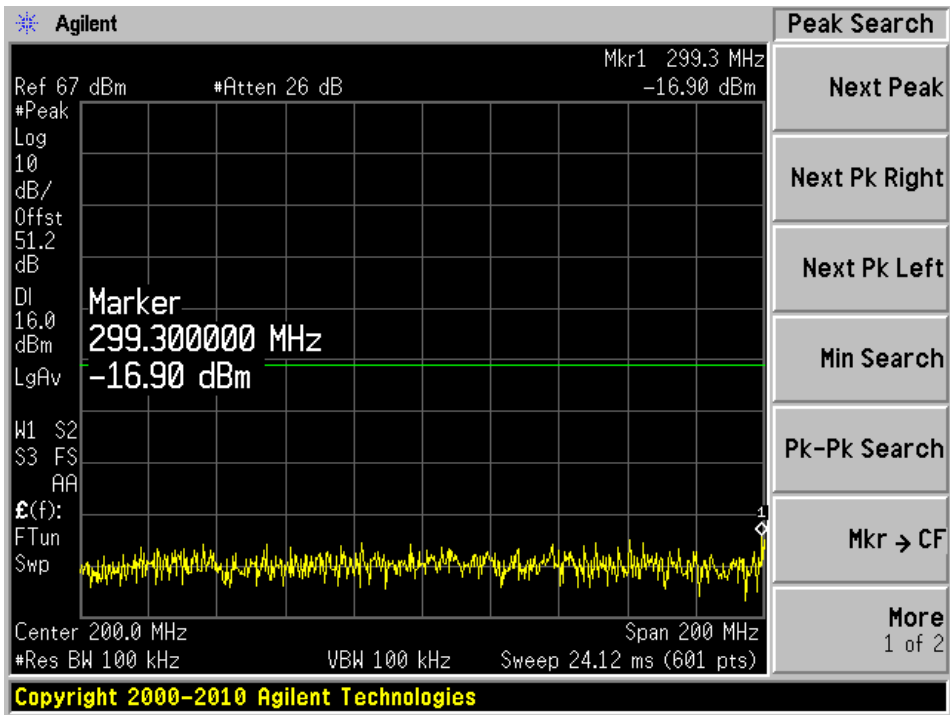
Below 30 MHz



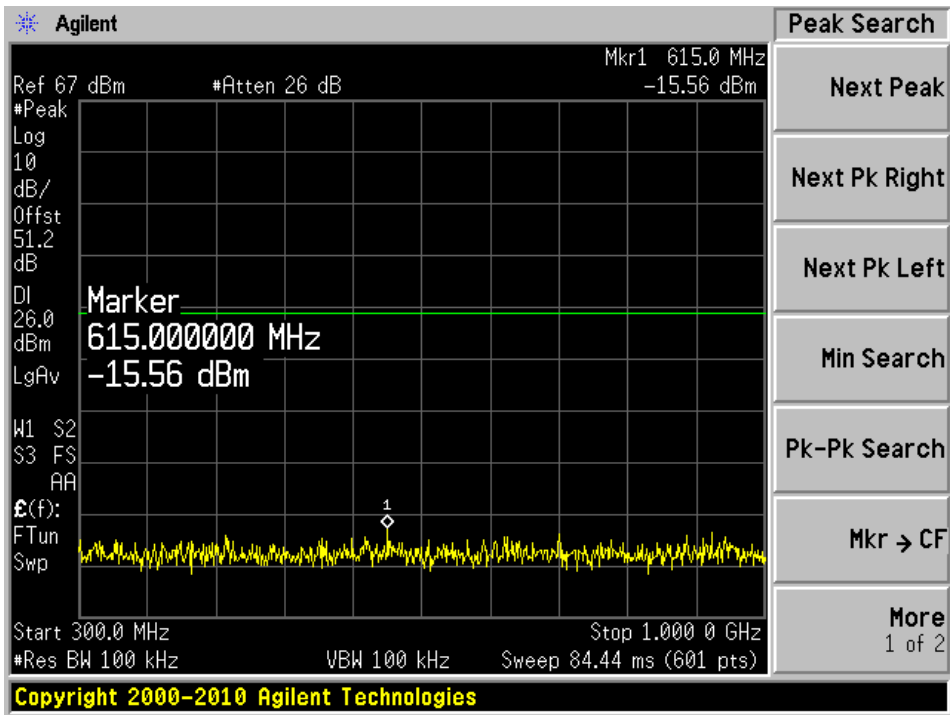
30 MHz to 100 MHz



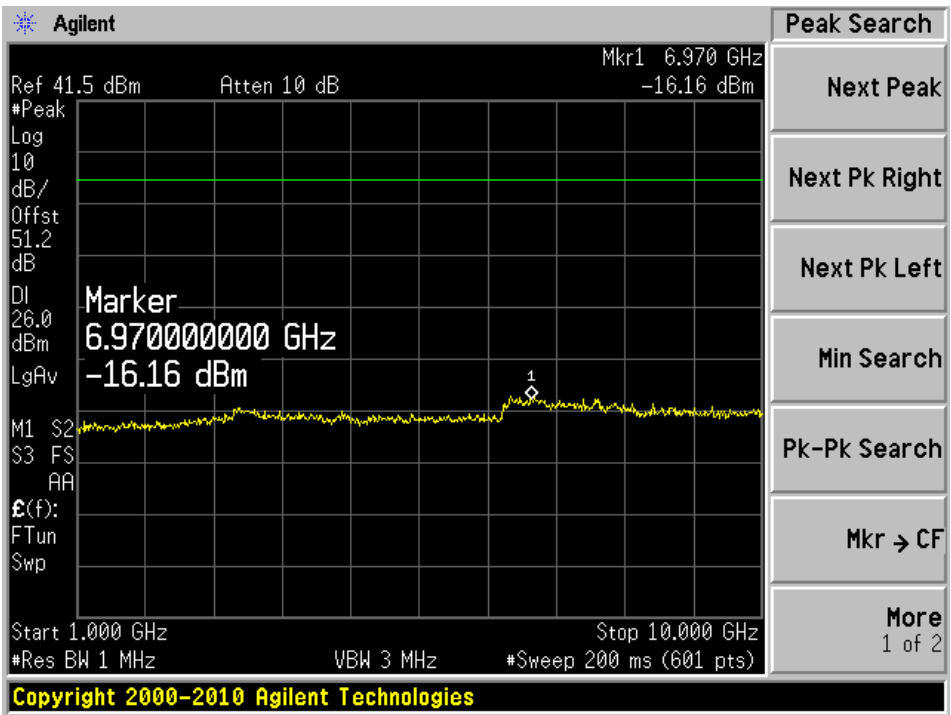
100 MHz to 300 MHz



300 MHz to 1000 MHz



1 GHz to 10 GHz



10 GHz to 44 GHz

