FCC PART 90

TEST AND MEASUREMENT REPORT

For

Teledesign Systems, Inc.

1729 South Main Street,

Milpitas, CA 95035, USA

FCC ID: JWFTS4000GH
Model: TS4000-05G15

Report Type:	**Product Type:**
Original Report	VHF Radio Modem

Test Engineer: Lionel Lara

Report Number: R1209046-90GH

Report Date: 2012-10-29

Reviewed By: Victor Zhang, RF/EMC Lead

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1209046-90GH	Original Report	2012-10-29

1. General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Teledesign Systems, Inc.* and their product, FCC ID: JWFTS4000GH, model: TS4000-05G15, which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a VHF radio modem.

The EUTs are VHF radio modems that operate under FCC Part 90

Specifications	
Frequency Band	148-174 MHz
Modulation Type	GMSK
Emission Designator	F1D
RF Output Power	Low: 1 Watt High: 5 Watts
Channel Spacing	12.5 kHz
Power Supply	13.8 VDC

1.2 Mechanical Description

The EUT measures approximately 17cm (L) x 8 cm (W) x 4.5 cm (H) and weighs approximately 780g.

The test data gathered are from production sample, serial number: 41472, provided by the manufacturer.

1.3 Objective

This type approval report is prepared on behalf of *Teledesign Systems, Inc.* in accordance Part 90 of the Federal Communication Commissions rules.

The objective was to determine the RF output power; Occupied Bandwidth, Spurious Emissions, Frequency Stability and Transient Frequency Behavior are in compliance with the FCC rules.

1.4 Related Submittal(s)/Grant(s)

Part 95 report under FCC ID: JWFTS4000GH, No.: R1209046-95.

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, Sub-part J as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards:TIA603-C and ANSI 63.4-2003, American National Standard for Method of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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 CISPR16-4-2:2003, 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

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 C63.4-2003, 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

The software used was TS4000 Configuration Program provided by the client.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Internal Configuration

Manufacturers	Descriptions	Model	Serial Numbers
Teledesign Systems, Inc.	Modem Board	TS4000	036121
CalAmp	Radio Board	140-3433	-

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Dell	Laptop	PP37L	15324358501

2.6 Local Support Equipment Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
Topward	DC Power Supply	3303D	719031

2.7 External I/O Cabling List and Details

Cable Description	Length (m)	From	To
USB to RS232 cable	1.0	Laptop USB	EUT Serial Port
Coax cable	1.5	EUT	Antenna
Power supply cable	1.0	Power Supply	EUT

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1091	RF Exposure	Compliant
§2.1046, §90.205	RF Output Power	Compliant
§2.1047	Modulation Characteristics, Audio Frequency Response and Audio Filter Response	N/A[1]
§2.1049, §90.209	Occupied Bandwidth and Emission Mask	Compliant
§2.1051, §90.210	Spurious Emissions at Antenna Terminals	Compliant
§2.1055, §90.213	Frequency Stability	Compliant
§2.1053, §90.210	Field Strength of Spurious Radiation	Compliant
§90.214	Transient Frequency Behavior	Compliant

Note 1: Modulation characteristic is not required for digital modulaton.

4 FCC §2.1091 - RF Exposure Information

4.1 Applicable Standards

FCC §2.1091, (a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

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

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	842/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	30

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

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

Maximum rated peak output power at antenna input terminal (dBm):	36.99
Maximum peak output power at antenna input terminal (mW):	5000
Prediction distance (cm):	180
Prediction frequency (MHz):	148.945
Maximum Antenna Gain, typical (dBi):	12.1
Maximum Antenna Gain (numeric):	16.218
Power density of prediction frequency at 180 cm (mW/cm^2):	0.15
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.2

Conclusion

The device complies with the MPE requirements by providing a safe separation distance of at least 6 ft. (180) cm between the antenna with maximum 10 dBd (12.1 dBi) gain, including any radiating structure, and any persons when normally operated. RF exposure has been specified in the user manual.

5 FCC §2.1046 & §90.205 – RF Output Power

5.1 Applicable Standard

According to FCC §2.1046, and §90.205, (d) 150–174 MHz. (1) The maximum allowable station ERP is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 1. Applicants requesting an ERP in excess of that listed in table 1 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

Table 1—150–174 MHz—Maximum ERP/Reference HAAT for a Specific Service Area Radius

	Service area radius (km)									
	3	8	13	16	24	32	40	48[4]	64[4]	80[4]
Maximum ERP (w)[1]	1	28	178	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]	500[2]
Up to reference HAAT (m)[3]	15	15	15	15	33	65	110	160	380	670

1 Maximum ERP indicated provides for a 37 dBu signal strength at the edge of the service area per FCC Report R–6602, Fig. 19 (See §73.699, Fig. 10).

2 Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 37 dBu.

3 When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: ERPallow=ERPmax× (HAATref/HAATactual)2.

4 Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 37 dBu.

5.2 Test Procedure

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

5.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-08-11	1 Year

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 °C
RelativeHumidit:	48 %
ATM Pressure:	101.6 kPa

The testing was performed by Lionel Lara on 2012-08-27 in the RF Site.

5.5 Test Results

Test Mode: Transmitting GMSK with BT = 0.3 (Channel Baud Rate = 12600 bps for 12.5 kHz)

Channel Spacing (kHz)	Frequency (MHz)	Output Power (Low)		Output Power (High)	
		(dBm)	(Watt)	(dBm)	(Watt)
12.5 kHz	148.945	30.55	1.14	36.85	4.84

Test Mode: Transmitting GMSK with BT = 0.3 (Channel Baud Rate = 4000 bps for 12.5 kHz)

Channel Spacing (kHz)	Frequency (MHz)	Output Power (Low)		Output Power (High)	
		(dBm)	(Watt)	(dBm)	(Watt)
12.5 kHz	148.945	30.63	1.16	36.84	4.83

Test Mode: Transmitting GMSK with BT = 0.5 (Channel Baud Rate = 8400 bps for 12.5 kHz)

Channel Spacing (kHz)	Frequency (MHz)	Output Power (Low)		Output Power (High)	
		(dBm)	(Watt)	(dBm)	(Watt)
12.5 kHz	148.945	30.56	1.14	36.83	4.82

Test Mode: Transmitting GMSK with BT = 0.5 (Channel Baud Rate = 4000 bps for 12.5 kHz)

Channel Spacing (kHz)	Frequency (MHz)	Output Power (Low)		Output Power (High)	
		(dBm)	(Watt)	(dBm)	(Watt)
12.5 kHz	148.945	30.57	1.14	36.83	4.82

Test Mode: Transmitting GMSK with BT = 0.3 (Channel Baud Rate = 12600 bps for 12.5 kHz)

Channel Spacing (kHz)	Frequency (MHz)	Output Power (Low)		Output Power (High)	
		(dBm)	(Watt)	(dBm)	(Watt)
12.5 kHz	162.06	30.27	1.06	36.29	4.26

Test Mode: Transmitting GMSK with BT = 0.3 (Channel Baud Rate = 4000 bps for 12.5 kHz)

Channel Spacing (kHz)	Frequency (MHz)	Output Power (Low)		Output Power (High)	
		(dBm)	(Watt)	(dBm)	(Watt)
12.5 kHz	162.06	30.22	1.05	36.30	4.27

Test Mode: Transmitting GMSK with BT = 0.5 (Channel Baud Rate = 8400 bps for 12.5 kHz)

Channel Spacing (kHz)	Frequency (MHz)	Output Power (Low)		Output Power (High)	
		(dBm)	(Watt)	(dBm)	(Watt)
12.5 kHz	162.06	30.13	1.03	36.30	4.27

Test Mode: Transmitting GMSK with BT = 0.5 (Channel Baud Rate = 4000 bps for 12.5 kHz)

Channel Spacing (kHz)	Frequency (MHz)	Output Power (Low)		Output Power (High)	
		(dBm)	(Watt)	(dBm)	(Watt)
12.5 kHz	162.06	30.05	1.01	36.30	4.27

6 FCC §2.1047 & §90.207 – Modulation Characteristic

6.1 Applicable Standard

FCC §2.1047 & §90.207:

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

6.2 Test Result

N/A, modulation characteristic is not required for digital modulaton.

7 FCC §2.1049 & §90.210 – Occupied Bandwidth & Emission Mask

7.1 Applicable Standard

According to FCC §90.210: *Emission Mask D—12.5 kHz channel bandwidth equipment.* For transmitters 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:
(1) On any frequency from the center of the authorized bandwidth $f_0$to 5.625 kHz removed from f_0: Zero dB.
(2) 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.
(3) 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 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

7.2 Test Procedure

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

The resolution bandwidth of the spectrum analyzer was set at 100 Hz and the spectrum was recorded in the frequency band ±50 KHz from the carrier frequency.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-08-11	1 Year

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

7.4 Test Environmental Conditions

Temperature:	22 °C
RelativeHumidit:	48 %
ATM Pressure:	101.6 kPa

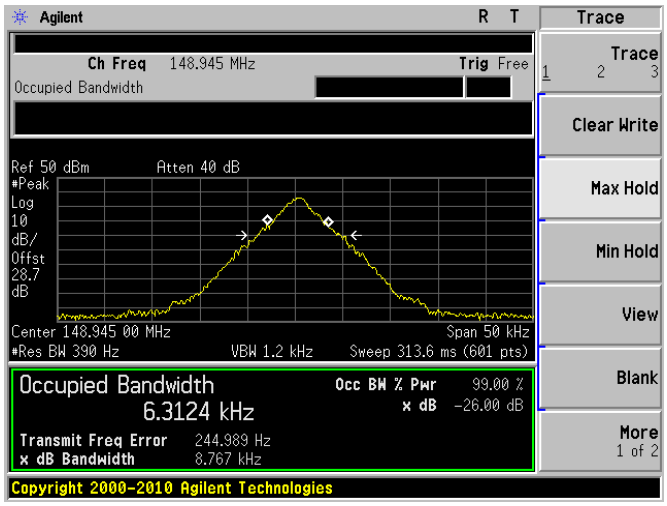
The testing was performed by Lionel Lara on 2012-08-27 in the RF Site.

7.5 Test Results

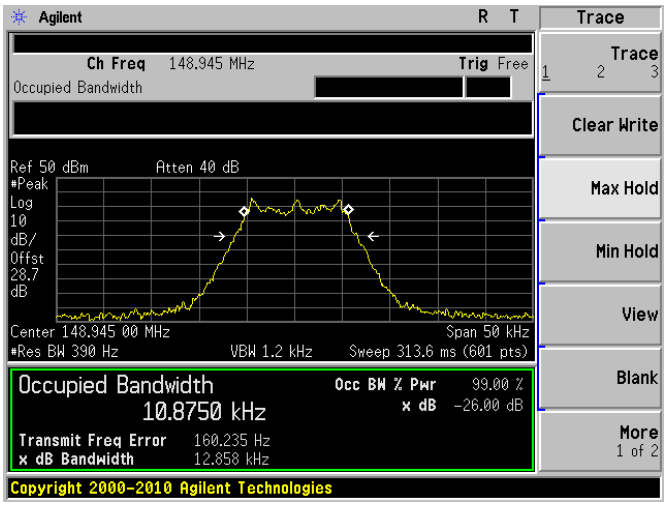
Please refer to the hereinafter plots.

Occupied Bandwidth (High Power Level)

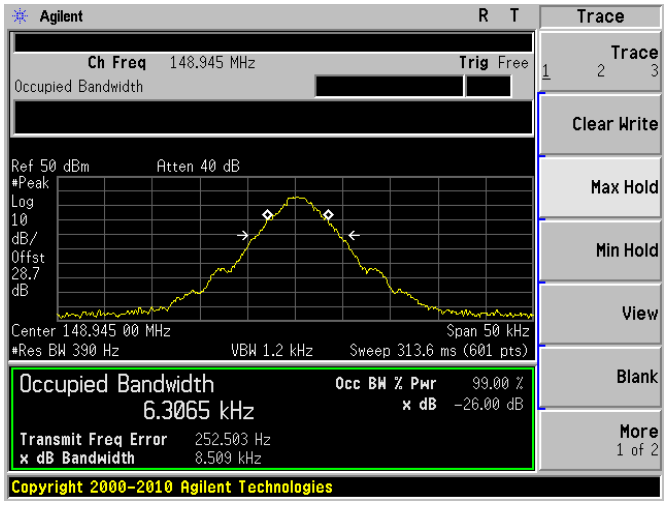
148.945 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 12600 bps, 12.5 kHz



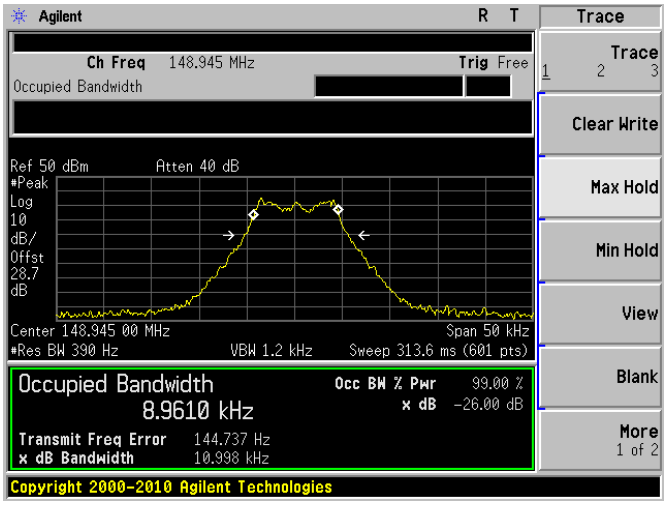
148.945 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 4000 bps, 12.5 kHz



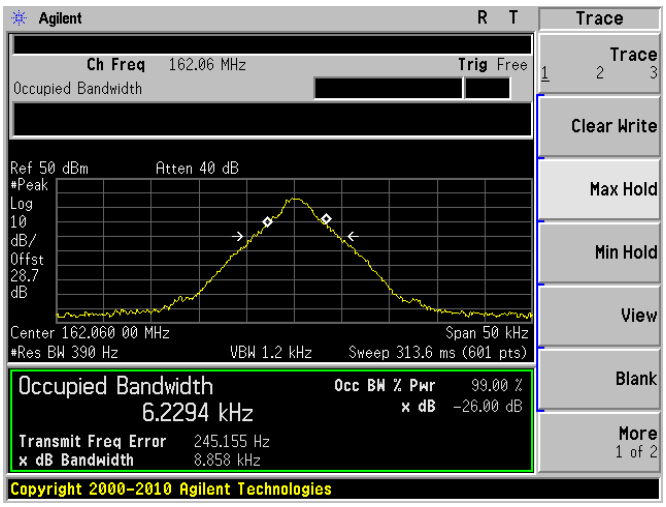
148.945 MHz, Modulation: GMSK with BT = 0.5, Channel Baud Rate: 8400 bps, 12.5 kHz



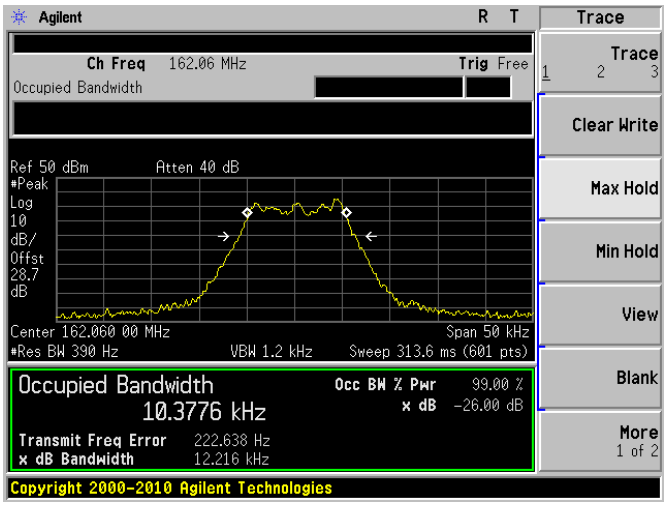
148.945 MHz, Modulation: GMSK with BT = 0.5, Channel Baud Rate: 4000 bps, 12.5 kHz



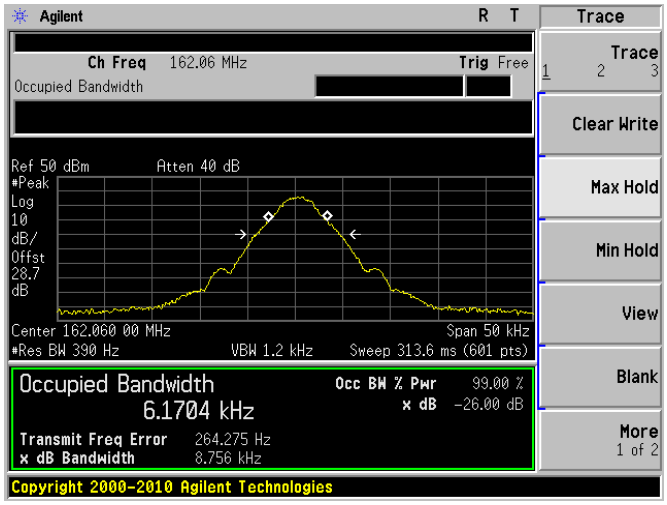
162.06 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 12600 bps, 12.5 kHz



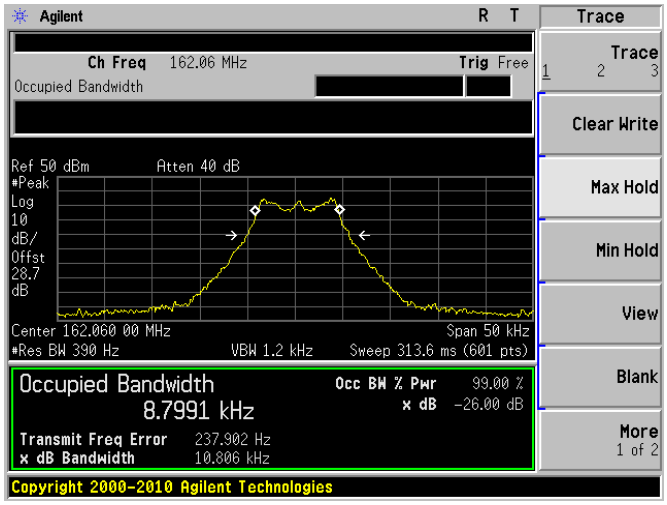
162.06 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 4000 bps, 12.5 kHz



162.06 MHz, Modulation: GMSK with BT = 0.5, Channel Baud Rate: 8400 bps, 12.5 kHz

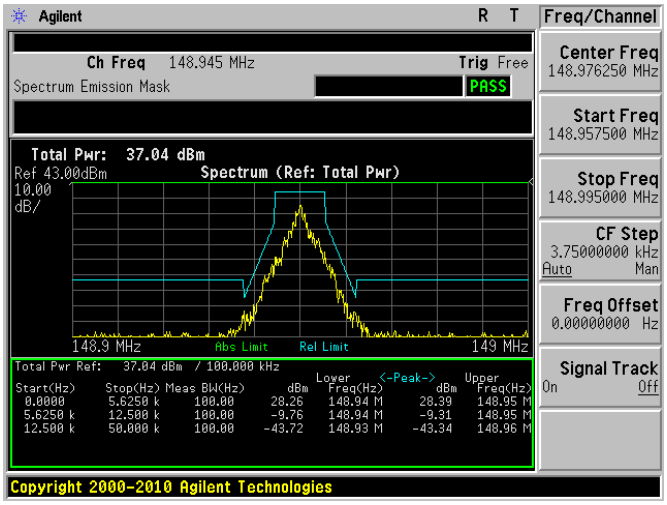


162.06 MHz, Modulation: GMSK with BT = 0.5, Channel Baud Rate: 4000 bps, 12.5 kHz

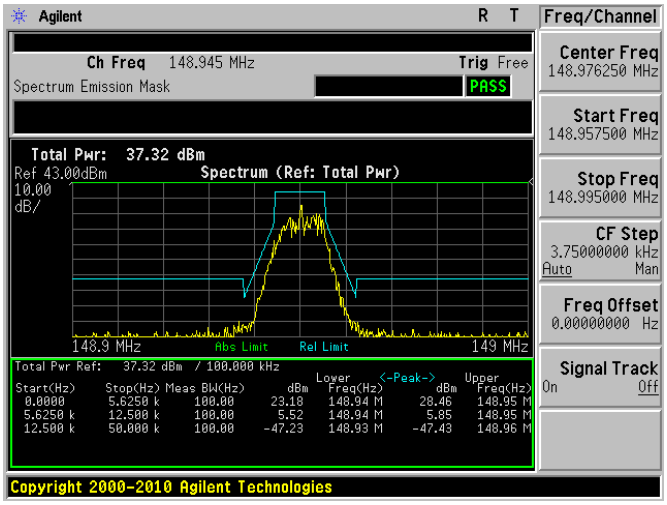


Emission Mask (High Power Level)

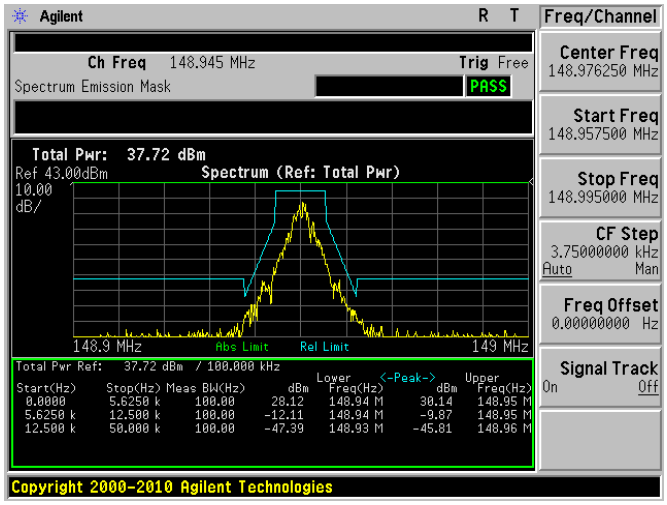
148.945 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 12600 bps, 12.5 kHz



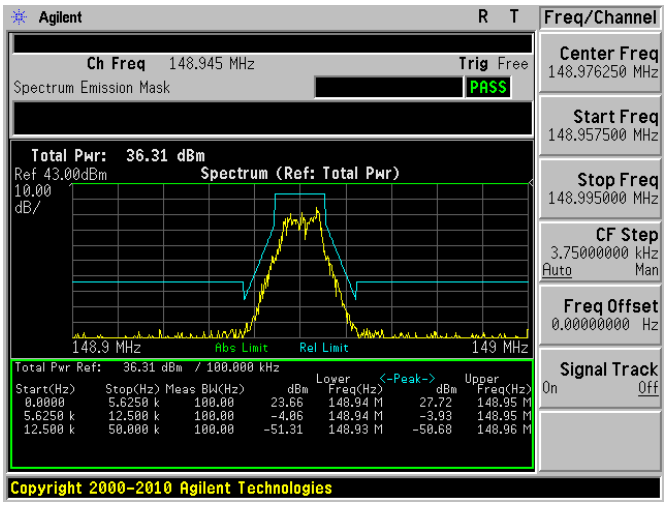
148.945 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 4000 bps, 12.5 kHz



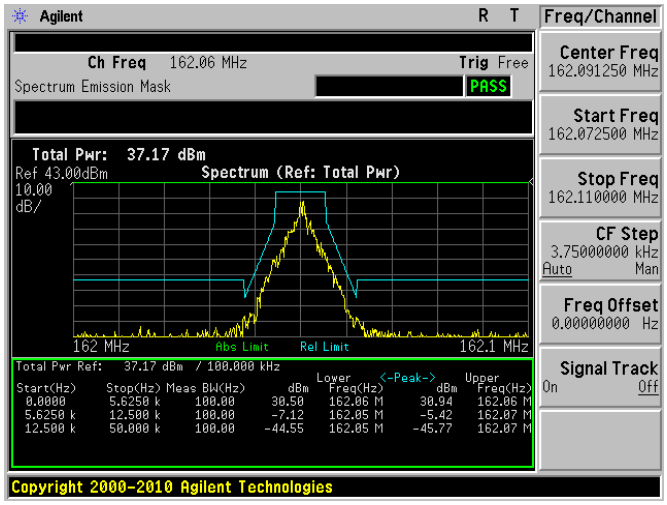
148.945 MHz, Modulation: GMSK with BT = 0.5, Channel Baud Rate: 8400 bps, 12.5 kHz



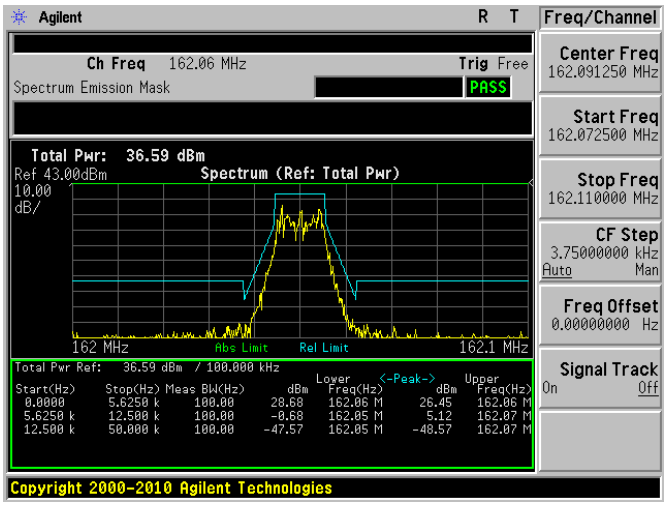
148.945 MHz, Modulation: GMSK with BT = 0.5, Channel Baud Rate: 4000 bps, 12.5 kHz



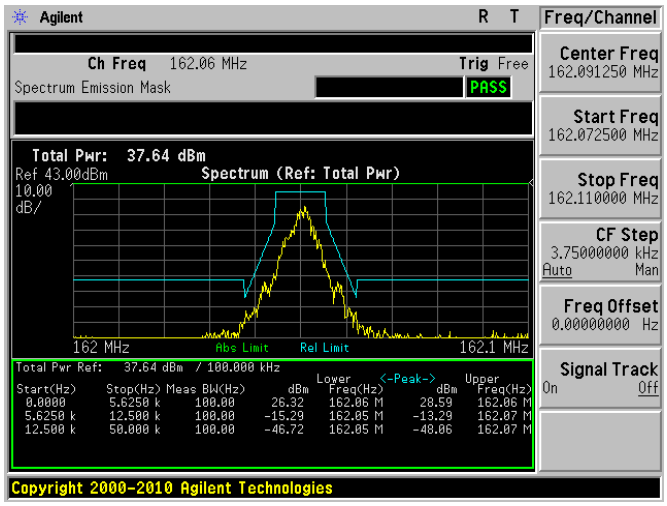
162.06 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 12600 bps, 12.5 kHz



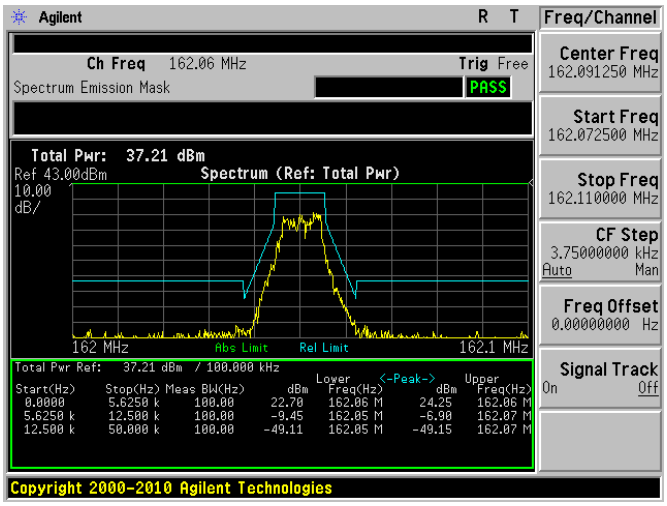
162.06 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 4000 bps, 12.5 kHz



162.06 MHz, Modulation: GMSK with BT = 0.5, Channel Baud Rate: 8400 bps, 12.5 kHz



162.06 MHz, Modulation: GMSK with BT = 0.5, Channel Baud Rate: 4000 bps, 12.5 kHz



8 FCC §2.1051 & §90.210 - Spurious Emissions at Antenna Terminals

8.1 Applicable Standard

According to FCC §90.210: 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 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

8.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-08-11	1 Year

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 °C
RelativeHumidit:	48 %
ATM Pressure:	101.6 kPa

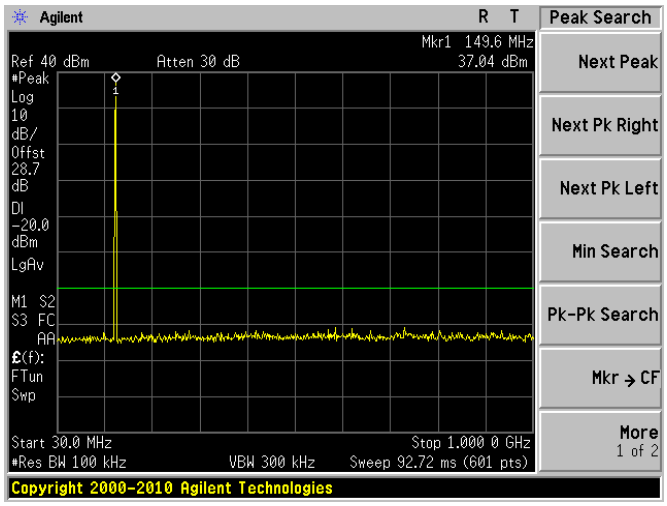
The testing was performed by Lionel Lara on 2012-08-27 in the RF Site.

8.5 Test Results

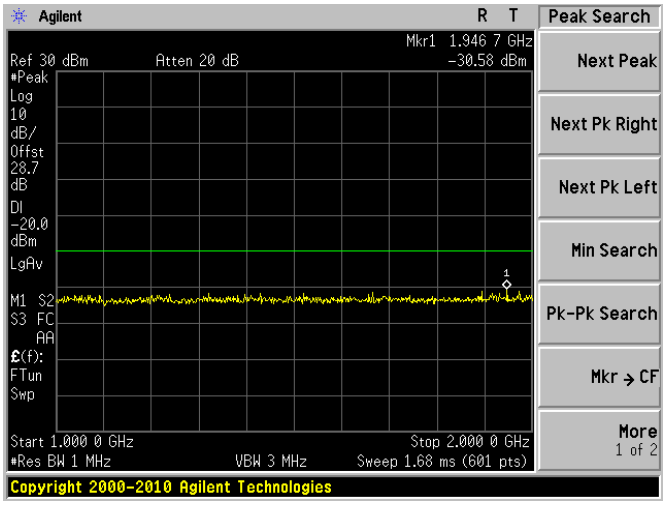
Please refer to the hereinafter plots.

High Power

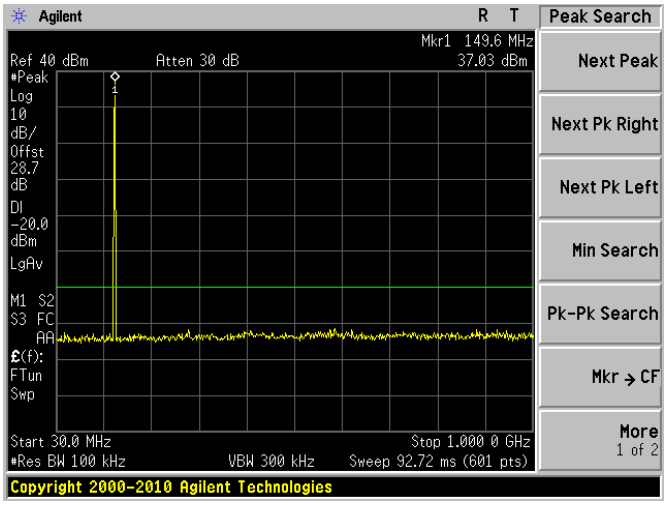
148.945 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 12600 bps, 12.5 kHz
30 MHz to 1 GHz



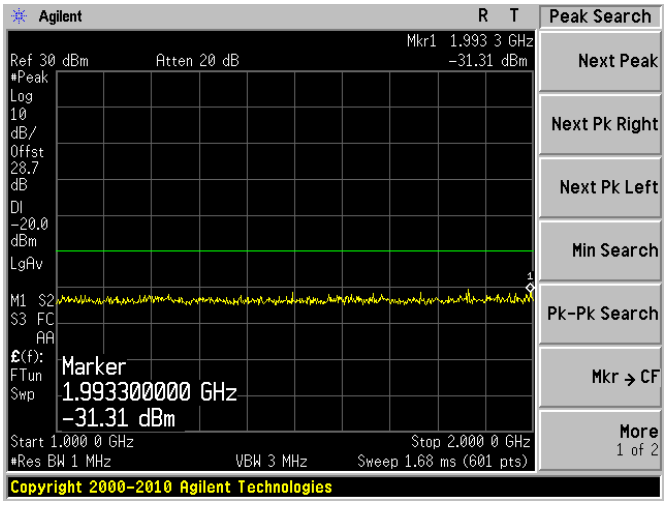
148.945 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 12600 bps, 12.5 kHz
1GHz to 2 GHz



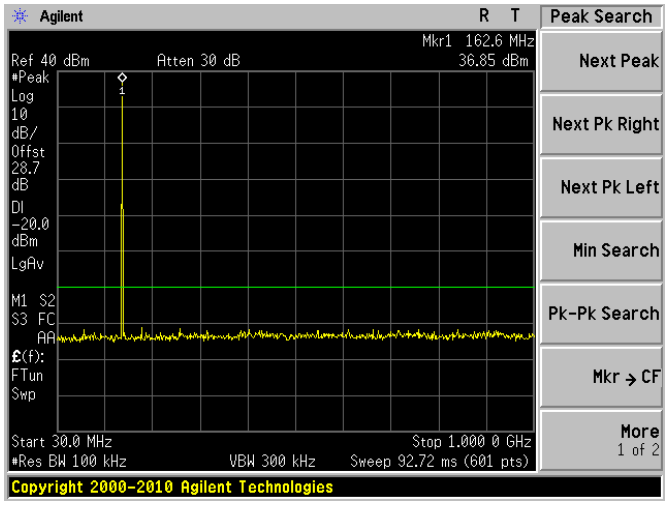
148.945 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 4000 bps, 12.5 kHz
30 MHz to 1 GHz



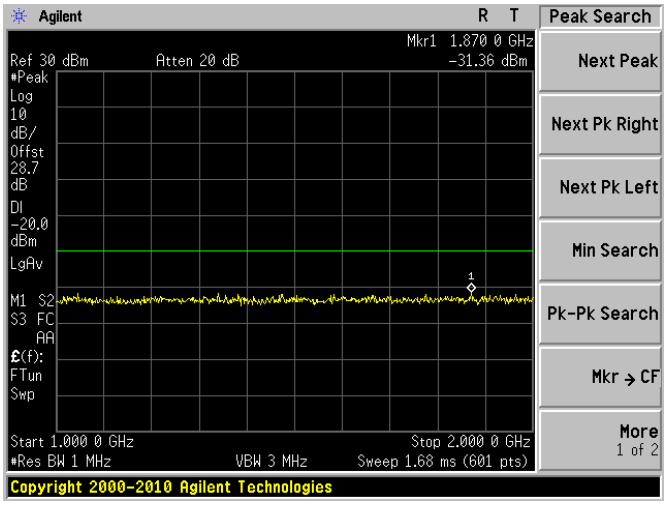
148.945 MHz, Modulation: GMSK with BT = 0.3, Channel Baud Rate: 4000 bps, 12.5 kHz
1GHz to 2 GHz



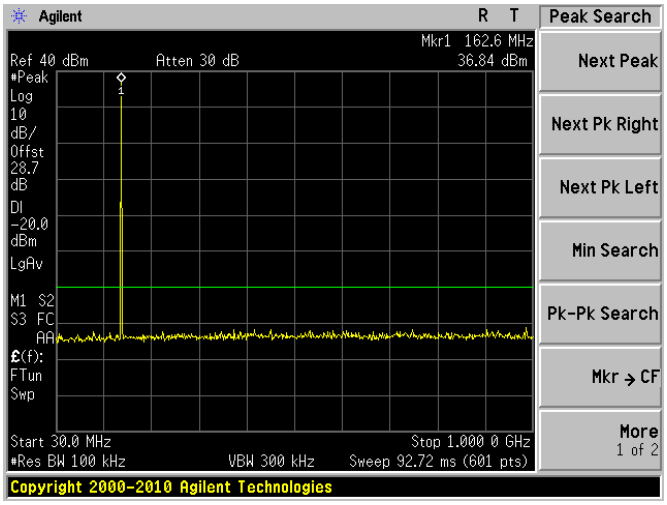
162.06 MHz, Modulation: GMSK with BT = 0.3,
Channel Baud Rate: 12600 bps, 12.5 kHz
30 MHz to 1 GHz



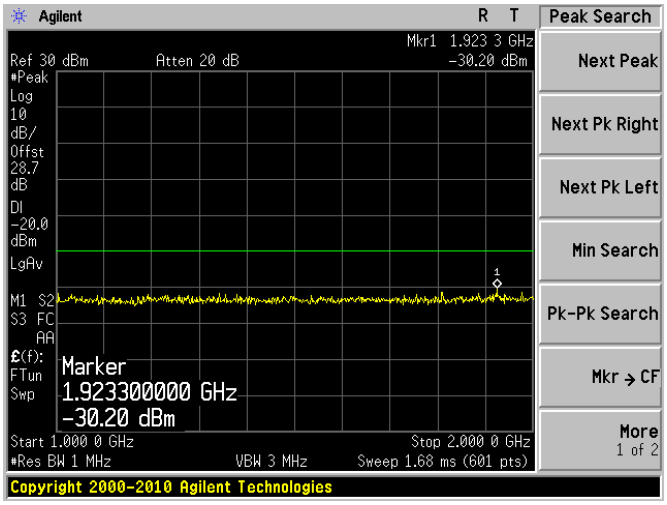
162.06 MHz, Modulation: GMSK with BT = 0.3,
Channel Baud Rate: 12600 bps, 12.5 kHz
1GHz to 2 GHz



162.06 MHz, Modulation: GMSK with BT = 0.3,
Channel Baud Rate: 4000 bps, 12.5 kHz
30 MHz to 1 GHz



162.06 MHz, Modulation: GMSK with BT = 0.3,
Channel Baud Rate: 4000 bps, 12.5 kHz
1GHz to 2 GHz



9 FCC §2.1055 (d) & §90.213 - Frequency Stability

9.1 Applicable Standard

FCC §2.1055, §90.213

Minimum Frequency Stability

[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1,2,3]100	100	200
25–50	20	20	50
72–76	5		50
150–174	[5,11]5	[6]5	[4,6]50
216–220	1.0		1.0
220–222[12]	0.1	1.5	1.5
421–512	[7,11,14]2.5	[8]5	[8]5
806–809	[14]1.0	1.5	1.5
809–824	[14]1.5	2.5	2.5
851–854	1.0	1.5	1.5
854–869	1.5	2.5	2.5
896–901	[14]0.1	1.5	1.5
902–928	2.5	2.5	2.5
902–928[13]	2.5	2.5	2.5
929–930	1.5		
935–940	0.1	1.5	1.5
1427–1435	[9]300	300	300
Above 2450[10]			

6 In the 150–174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.

9.2 Test Procedure

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

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-08-11	1 Year
ESPEC	Humidity 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.*

9.4 Test Environmental Conditions

Temperature:	21 °C
RelativeHumidit:	51 %
ATM Pressure:	101.4 kPa

The testing was performed by Lionel Lara on 2012-08-29 in the RF Site.

9.5 Test Results

CW, 162.06 MHz

Test Condition		Reference Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (PPM)	Limit (PPM)
Voltage (Vdc)	Temperature (^{o}C)				
Frequency vs. Temperature					
13.8	60	162.06	162.060043	0.265334	± 5
13.8	50	162.06	162.060067	0.413427	± 5
13.8	40	162.06	162.060025	0.154264	± 5
13.8	30	162.06	162.060003	0.018512	± 5
13.8	20	162.06	162.060028	0.172776	± 5
13.8	10	162.06	162.060082	0.505985	± 5
13.8	0	162.06	162.060092	0.567691	± 5
13.8	-10	162.06	162.060073	0.45045	± 5
13.8	-20	162.06	162.060067	0.413427	± 5
13.8	-30	162.06	162.060062	0.382574	± 5
Frequency vs. Voltage					
24.0	20	162.06	162.060027	0.166605	± 5
11.7	20	162.06	162.06002	0.123411	± 5

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

10.1 Applicable Standard

According to FCC §90.210: 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 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

10.2 Test Procedure

The transmitter was placed on Styrofoam on the turntable, and it was normal transmitting with 50ohm termination 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 frequency range up to tenth harmonic of the fundamental frequency was investigated.

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

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001) – the absolute level

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-08-11	1 Year
Sunol Science Corp	System Controller	SC99V	113005-1	N/R	NA
Sunol Science Corp	Combination Antenna	JB1	A013105-3	2012-07-24	1 Year
EMCO	Horn antenna	3115	9511-4627	2011-10-03	1 Year
Hewlett Packard	Pre amplifier	8447D	2944A06639	2012-06-09	1 Year
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2012-05-09	1 Year

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

10.4 Test Environmental Conditions

Temperature:	22 °C
RelativeHumidit:	52 %
ATM Pressure:	101.1 kPa

The testing was performed by Lionel Lara on 2012-08-30 in 5 meter chamber 3.

10.5 Test Results

Worst Margin: **-39.81 dB** at **486.18 MHz** in the **Horizontal** polarization.

Please see following table for detailed results.

High Power, CW, 162.06 MHz

Indicated		Turntable Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
324.12	36.44	70	183	H	324.12	-66.18	0	0.4	-66.58	-20	-46.58
324.12	41.53	140	102	V	324.12	-61.09	0	0.4	-61.49	-20	-41.49
486.18	44.38	331	279	H	486.18	-59.21	0	0.6	-59.81	-20	-39.81
486.18	40.73	335	144	V	486.18	-62.86	0	0.6	-63.46	-20	-43.46

11 FCC §90.214 - Transient Frequency Behavior

11.1 Applicable Standard

FCC §90.214: Transmitters designed to operate in the 150–174 MHz and 421–512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals[1,2]	Maximum frequency difference[3]	All equipment
		150 to 174 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels		
t_1[4]	± 25.0 kHz	5.0 ms
t_2	± 12.5 kHz	20.0 ms
t_3[4]	± 25.0 kHz	5.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels		
t_1[4]	± 12.5 kHz	5.0 ms
t_2	± 6.25 kHz	20.0 ms
t_3[4]	± 12.5 kHz	5.0 ms

[1] $_{on}$is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

$t_1$is the time period immediately following t_{on}.

$t_2$is the time period immediately following t_1.

$t_3$is the time period from the instant when the transmitter is turned off until t_{off}.

$t_{off}$is the instant when the 1 kHz test signal starts to rise.

[2]During the time from the end of $t_2$to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.

[3]Difference between the actual transmitter frequency and the assigned transmitter frequency.

[4]If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

11.2 Test Procedure

TIA/EIA-603-C 2.2.19

11.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Tektronix	Digital Phosphor Oscilloscope	TDS7104	B020557	2012-06-12	1 Year
Agilent	Generator, Signal	E4438C	MY45091309	2012-05-03	1 Year
HP	Modulation Analyzer	8901A	2026A00847	2012-08-08	1 Year

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

11.4 Test Environmental Conditions

Temperature:	20 °C
RelativeHumidit:	50 %
ATM Pressure:	101.2 kPa

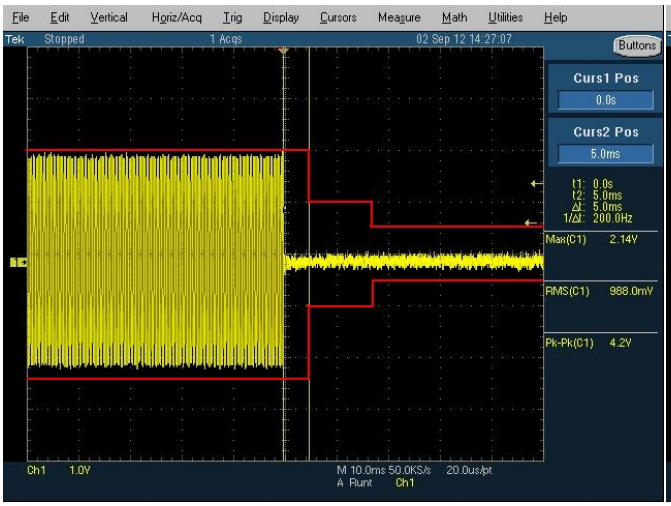
The testing was performed by Lionel Lara on 2012-09-04 in the RF Site.

11.5 Test Results

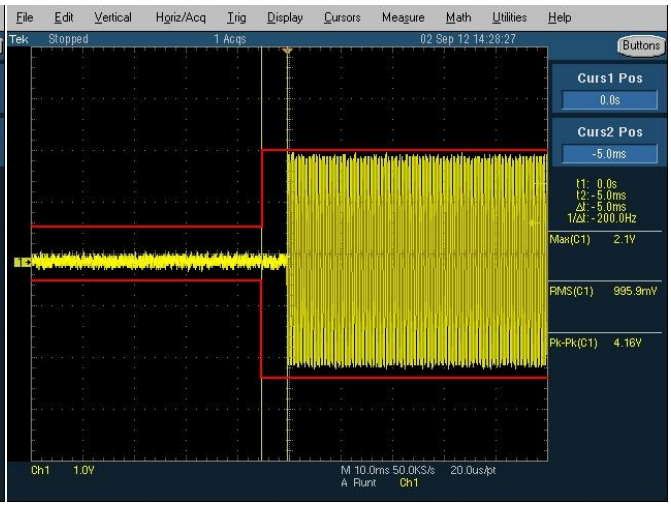
Please refer to the hereinafter plots.

Modualtion: GMSK 0.3, 12.5 kHz

Powering Up

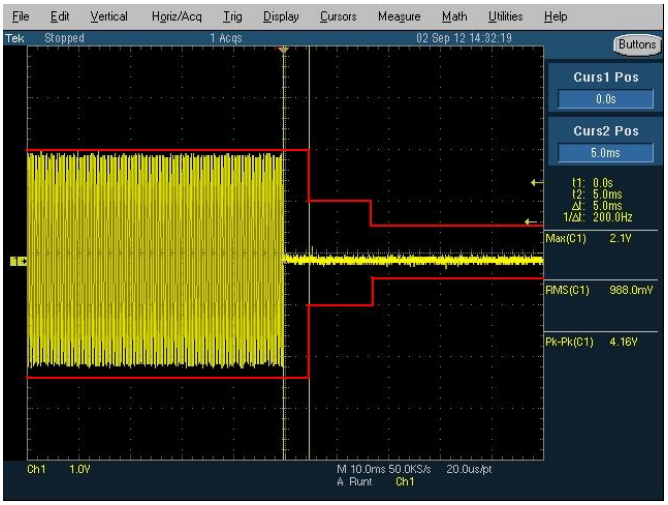


Powering Down



Modualtion: GMSK 0.5, 12.5 kHz

Powering Up



Powering Down