

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **GNC Guardian Mobility Corporation**

MODEL: **GM-SG01**

FCC ID: **RZTGMSG01**

DATE: **March 31, 2004**

This report concerns (check one): Original grant X
Class II change _____

Equipment type: **Transceiver**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes _____ No X

If yes, defer until: _____
date

N.A. agrees to notify the Commission by N.A.
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

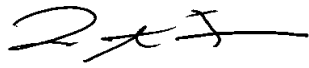
United States Technologies, Inc.
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508



I certify that I am authorized to sign for the manufacturer and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

UNITED STATES TECHNOLOGIES, INC. (AGENT RESPONSIBLE FOR TEST):

By: 

Name: Louis A Feudi

Title: Operations Manager

Date: March 31, 2004

GMC Guardian Mobility Corporation
116-15 Capella Court
Ottawa, ON K2E 7X1 Canada

By: _____

Name: _____

Title: _____

Date: _____

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ii.

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SECTION 1

GENERAL INFORMATION

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GENERAL INFORMATION

1.1 Product Description

The Equipment Under Test is the GMC Guardian Mobility Corporation GM-SG01. The EUT is a location-enabled, mobile “user to satellite” transmitter platform built around the Axonn, L.L.C. Model G-SENS STU satellite module. The unit operates at the following 4 transmit frequencies: 1611.25 MHz, 1613.75 MHz, 1616.26 MHz, & 1618.75 MHz. The GM-SG01 provides a modem functionality to transmit bursts of data containing user information, including GPS location, to a satellite constellation. The satellites operate as linear transponders and the signal is redirected to a ground station where the user information is extracted and distributed.

For the purpose of this test the EUT was placed into a high power (+22 dBm) constant TX mode of operation.

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1.2 Related Submittal(s)/Grant(s)

The EUT is subject to the following authorizations:

- a) Certification as a transmitter as specified by Part 25.

The information contained in this report is presented for the Part 25 Certification authorization(s) for the EUT.

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SECTION 2

TEST AND MEASUREMENTS

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TEST AND MEASUREMENTS

2.1 Configuration of Tested System

Prepared in accordance with the requirements of the FCC Rules and Regulations Part 2 & 25. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious emissions are shown in Figure 2.

2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered by the FCC under Registration Number 91037. Additionally, this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file IC2982.

2.3 Test Equipment

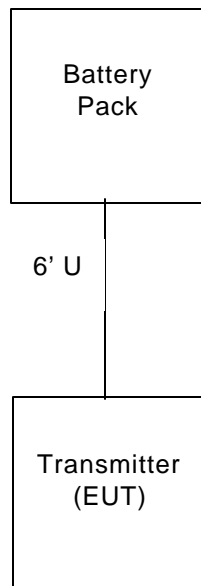
Table 2 describes test equipment used to evaluate this product.

2.4 Modifications

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 25 limits for the transmitter portion of the EUT.

FIGURE 1

TEST CONFIGURATION



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TABLE 1**EUT and Peripherals**

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Transmitter GMC Guardian Mobility Corporation (EUT)	GM-SG01	None	None	6' U
Battery Pack	None	None	N/A	None

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TABLE 2
TEST INSTRUMENTS

EQUIPMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8558B	HEWLETT-PACKARD	2332A10055	02/19/04
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	12/30/03
RF PREAMP	8447D	HEWLETT-PACKARD	2944A07436	05/10/03
RF PREAMP	8449B	HEWLETT-PACKARD	3008A00480	06/19/03
LOG PERIODIC ANTENNA	3146	EMCO	3236	07/21/03
LISN (x 2) 8028-50-TS24-BNC	8028	SOLAR ELE.	910494 & 910495	01/20/04
HORN ANTENNA	3115	HEWLETT-PACKARD	9107-3723	07/11/03
CALCULATION PROGRAM	N/A	N/A	Ver. 5.2	N/A

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2.5 Antenna Description

The EUT will incorporate a Satellite transmit antenna: 25 mm ceramic patch, Model PA25-1615-025SA, Spectrum Controls Inc. MMCX connector, +4 dBi gain.

GPS receive antenna: 25 mm ceramic patch, Model PA25-1575-008SA, Spectrum Controls, Inc., MMCX connector, passive.

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2.6 RF Power Output (FCC Section 2.1046)

In bands shared coequally with terrestrial radio communications services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station operating in frequency bands between 1 and 15 GHz, shall not exceed the limits below.

For angles of elevation of the horizon greater than 5 degrees there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.

FCC Minimum Standard (FCC Section 25.204 &)

$EIRP < +40 \text{ dBW}$ in any 4 kHz band for $\theta=0$ degrees

The manufacturer has stated that the EUT has a maximum output power of +22 dBm.

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TABLE 3
RF POWER OUTPUT

Frequency of Fundamental (MHz)	Measurement (dBm)	Cable Loss (dBm)	Adjusted Measurement (dBm)	Measurement (Watt)
1611.14	20.47	2.44	22.91	0.195
1618.88	20.67	2.44	23.11	0.205

Note: Given the output power and antenna gain of +4 dBi, even the direct lobe of radiation meets the FCC's EIRP Requirement for $\theta = 0$ (+40 dBW)

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Tester

Signature: 

Name: David Blethen

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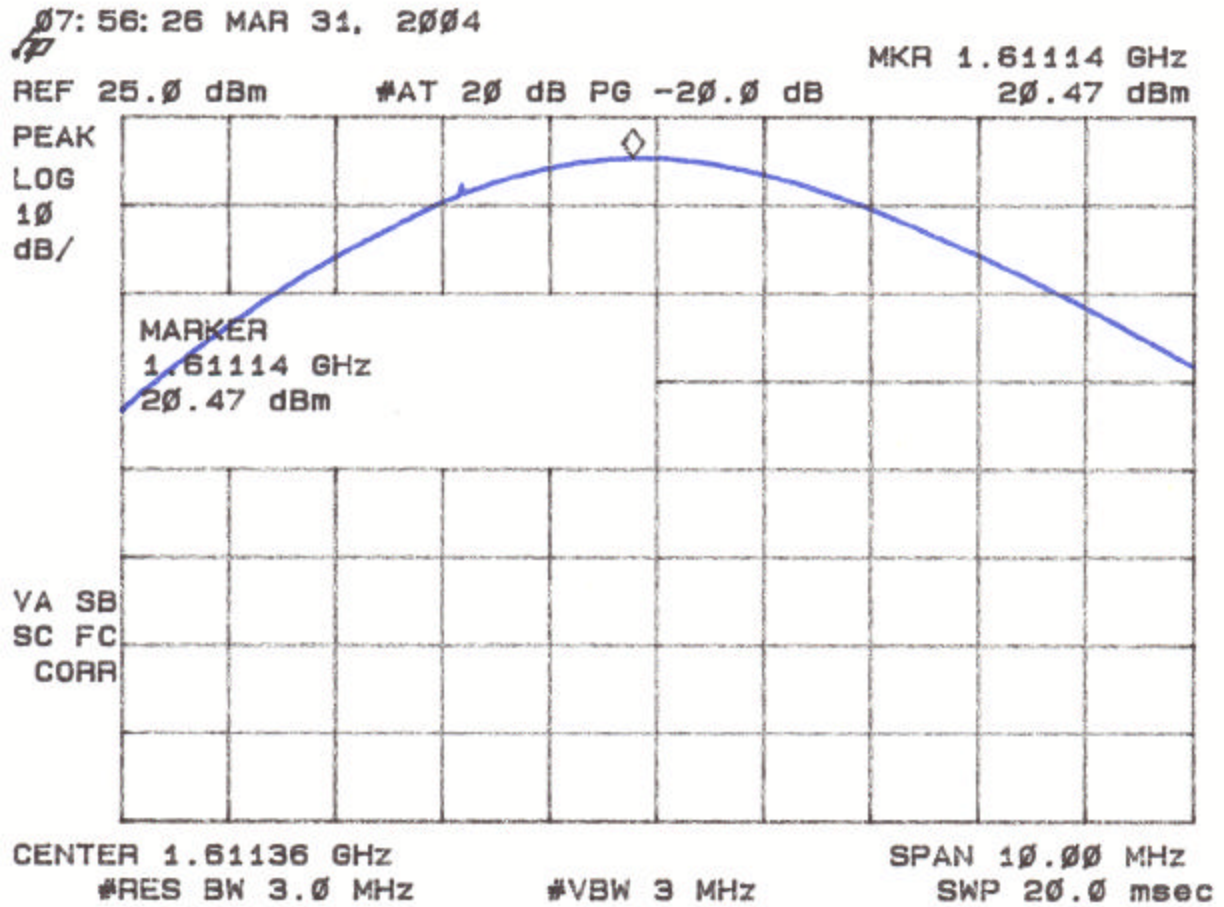
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Figure 3a.
RF Power Output



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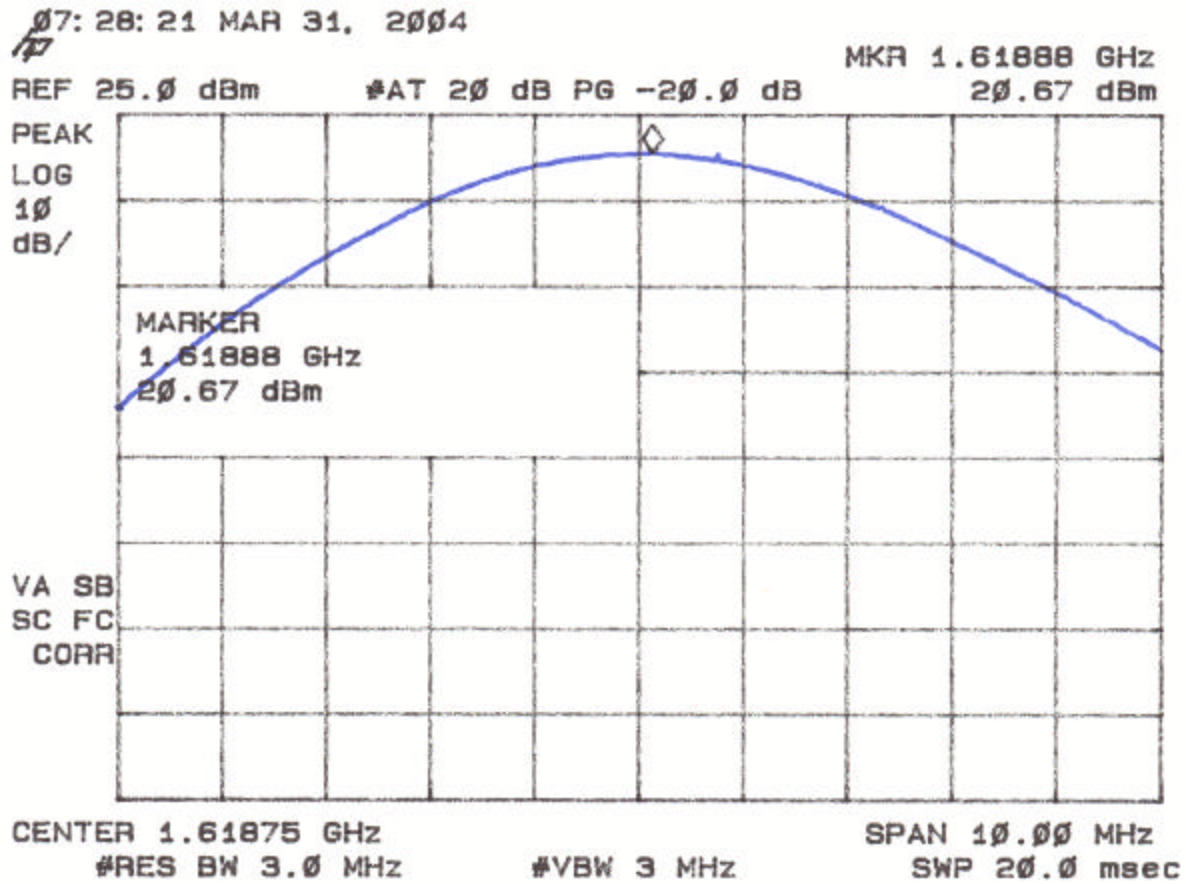
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Figure 3b.
RF Power Output



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2.7 Modulation Characteristics (FCC Section 2.1047)

Since the device incorporates digital modulation techniques, this information is not necessary.

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Figure 4.
Modulation Characteristics

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

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2.8 Occupied Bandwidth (FCC Section 2.1049)

EUT was modulated by its own internal sources. Low and High Channels were tested. The bandwidth of the fundamental was measured using a spectrum. The results are shown in Figure 5a through Figure 5d. Long sweep times were applied near to the fundamental to ensure a good signal was obtained.

FCC Minimum Standard (FCC Section 25.202(f))

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency by more than 50% up to and including 100% of the authorized bandwidth (2.5 MHz), at least 25 dB.

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency by more than 100% up to and including 250% of the authorized bandwidth (2.5 MHz), at least 35 dB.

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment by more than 250% of the authorized bandwidth (2.5 MHz), at least $43 + 10 \log (P_{\text{Watts}})$ attenuation below the mean power of the transmitter.

For Lowest Channel = $43 + 10 \log (0.195) = 35.9 \text{ dB}$

For Highest Channel = $43 + 10 \log (0.205) = 36.12 \text{ dB}$

The following plots show that all emissions were at least 25.01 dB below the fundamental.

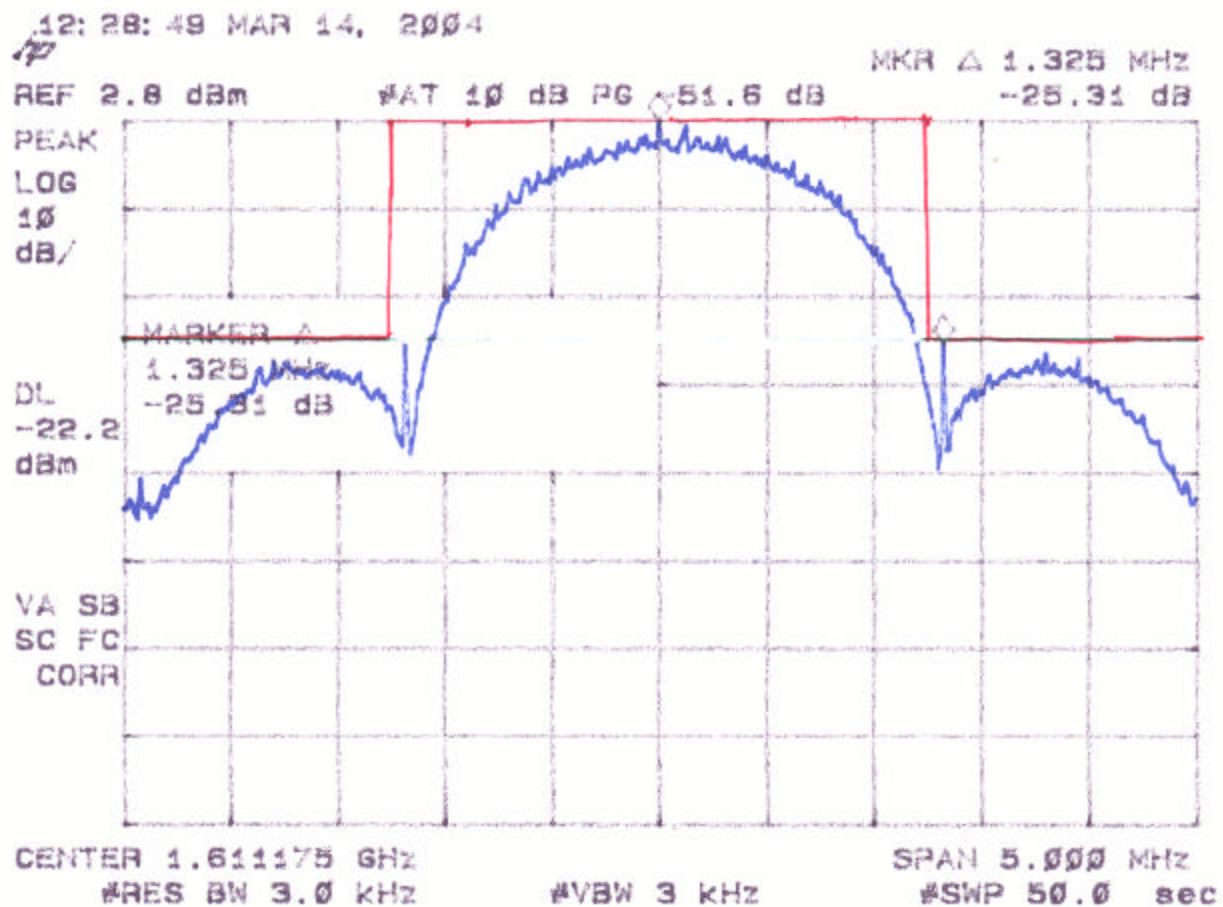
Note:

A 3 kHz RBW was used instead. This was deemed to be comparable to 4 kHz RBW.

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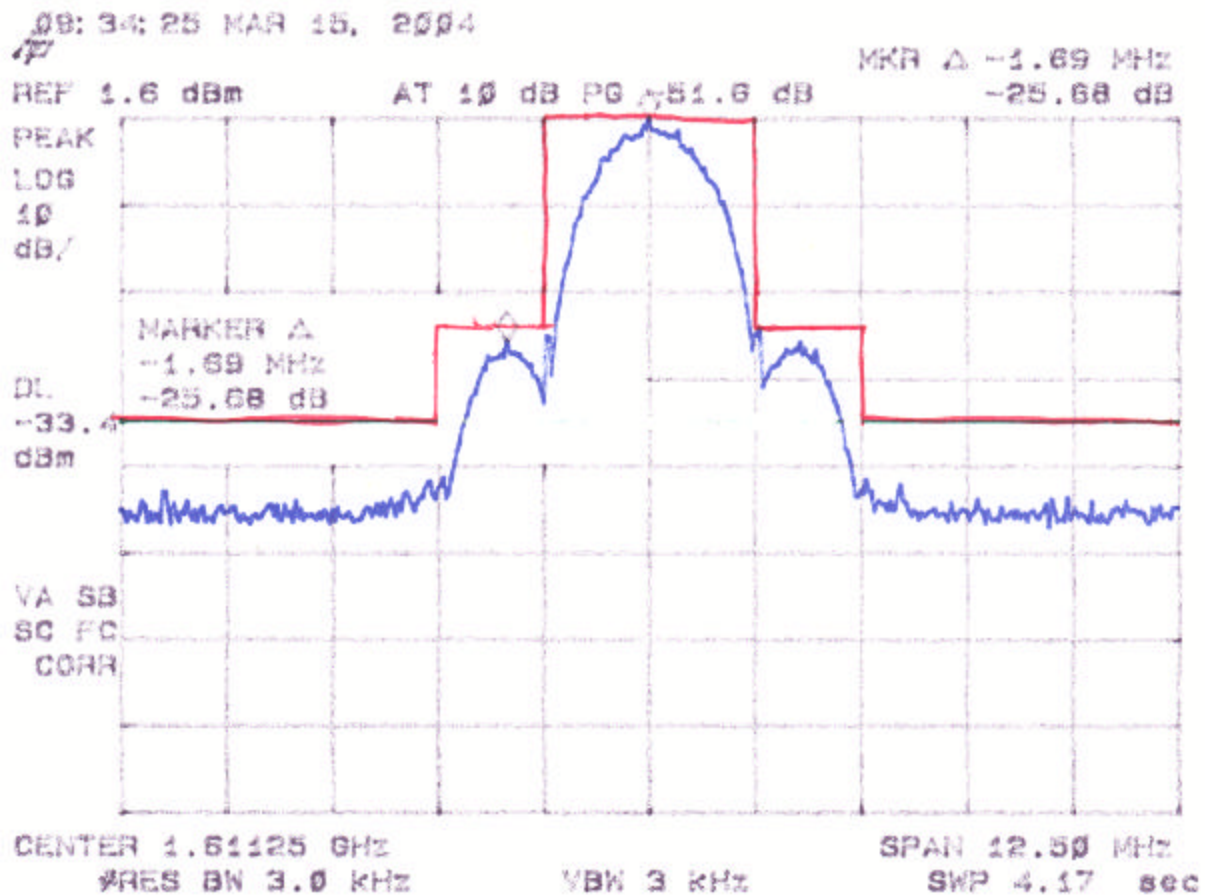
Figure 5a.
Occupied Bandwidth 50 - 100% From Edge of Authorized Bandwidth – Low



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Figure 5b.
Occupied Bandwidth > 100% From Edge of Authorized Bandwidth – Low



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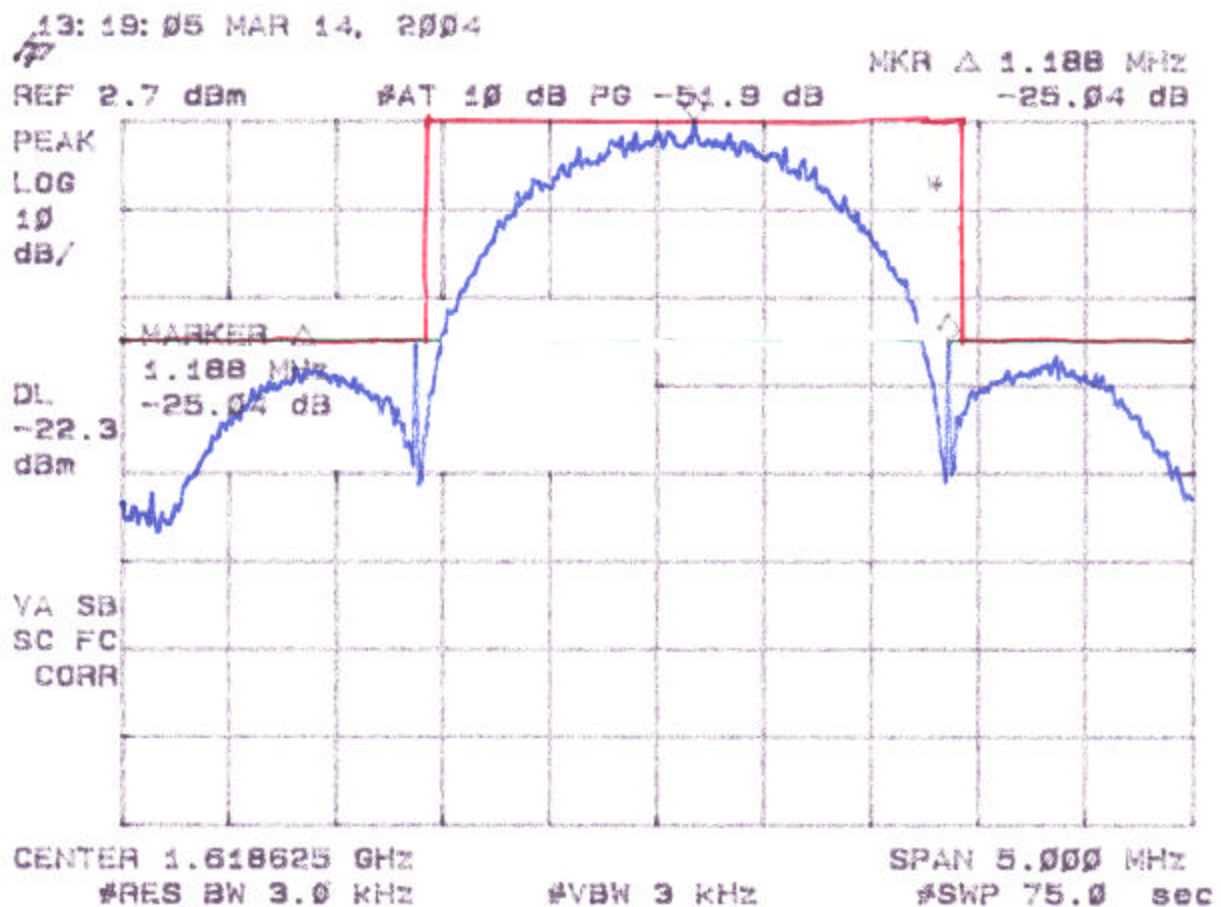
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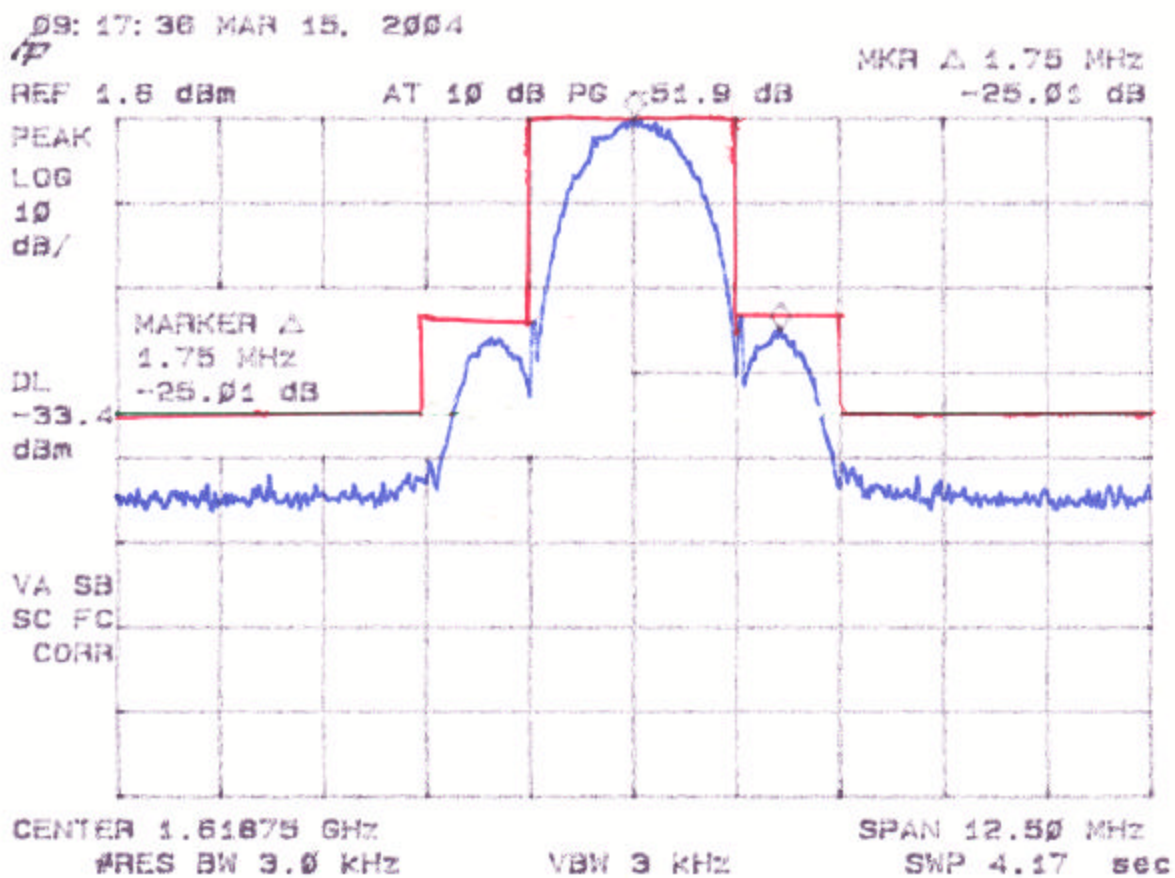
Figure 5c.
Occupied Bandwidth 50 - 100% From Edge of Authorized Bandwidth – High



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Figure 5d.
Occupied Bandwidth > 100% From Edge of Authorized Bandwidth – High



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2.9 Spurious Emissions at Antenna Terminals (FCC Section 2.1051)

Spurious emissions appearing at the antenna terminals were measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer. Results are shown in Figures 6a – 6n.

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

FCC Minimum Standard (FCC Section 25.202(f))

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment by more than 250% of the authorized bandwidth (2.5 MHz), at least

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

For Lowest Channel = $43 + 10 \log (0.195) = 35.9 \text{ dB}$

For Highest Channel = $43 + 10 \log (0.205) = 36.12 \text{ dB}$

The following plots show that all emissions were at least 25.01 dB below the fundamental.

Note:

A 10 kHz RBW was used instead. This was deemed to be comparable to 4 kHz RBW.

Additional requirement for 1574.397 - 157.443 MHz (FCC Section 25.213(b))

- 80 dBW (- 50 dBm)

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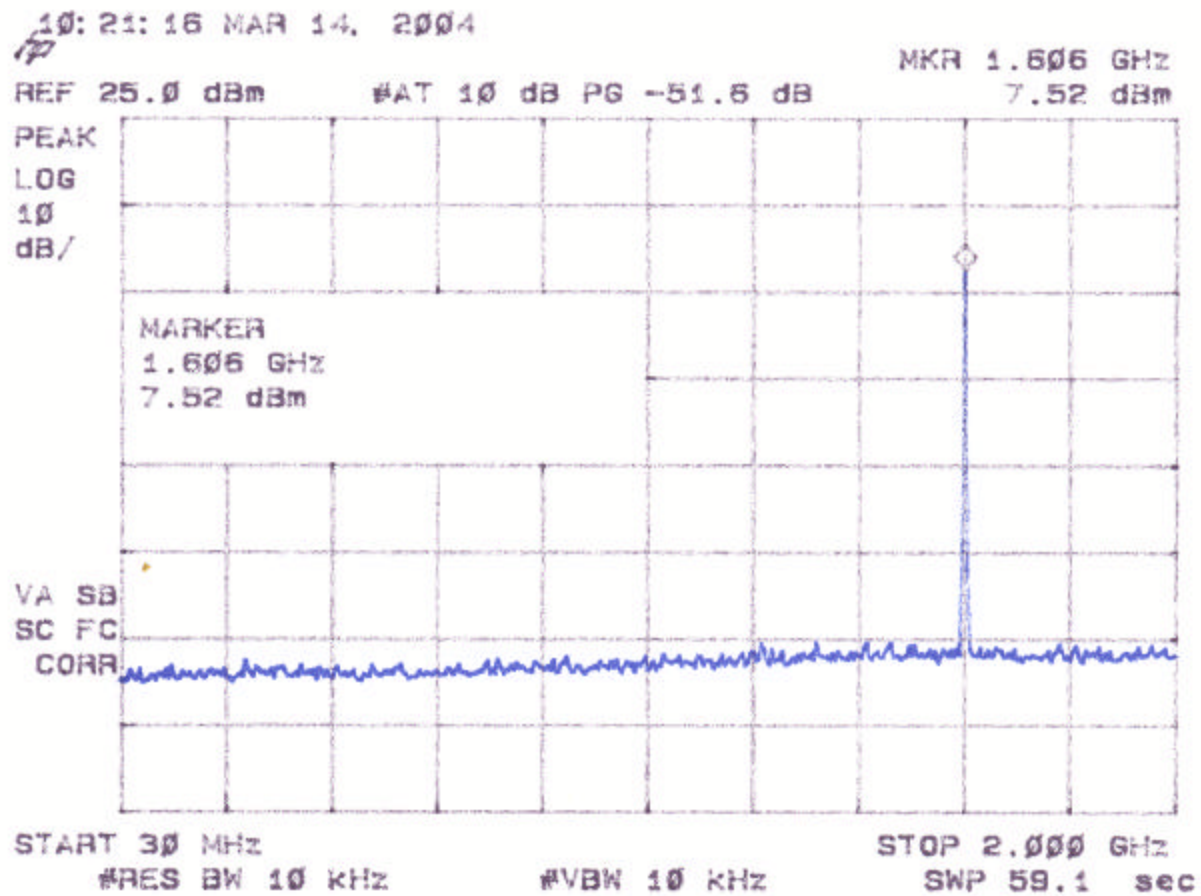
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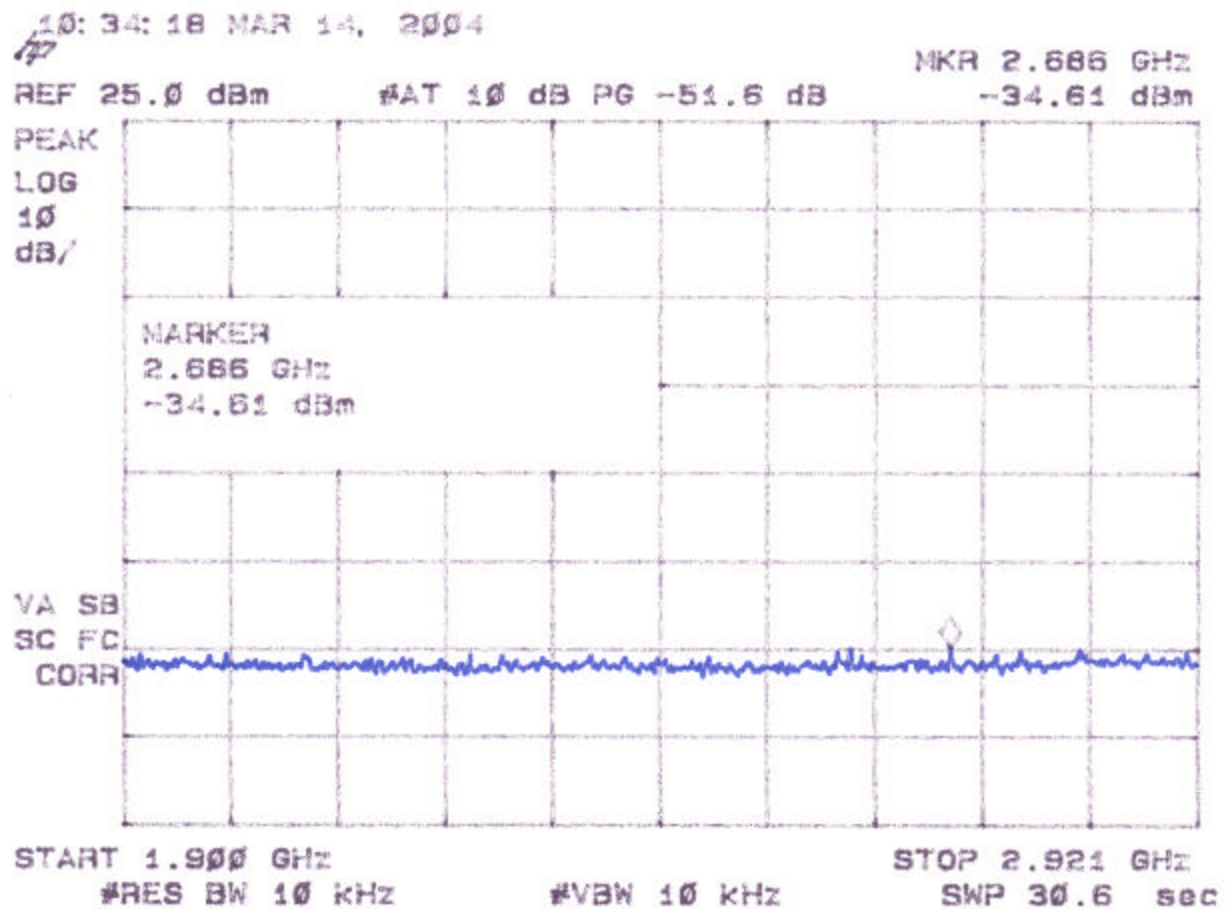
Figure 6a.
Spurious Emissions at Antenna Terminals – Low Channel



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Figure 6b.
Spurious Emissions at Antenna Terminals – Low Channel



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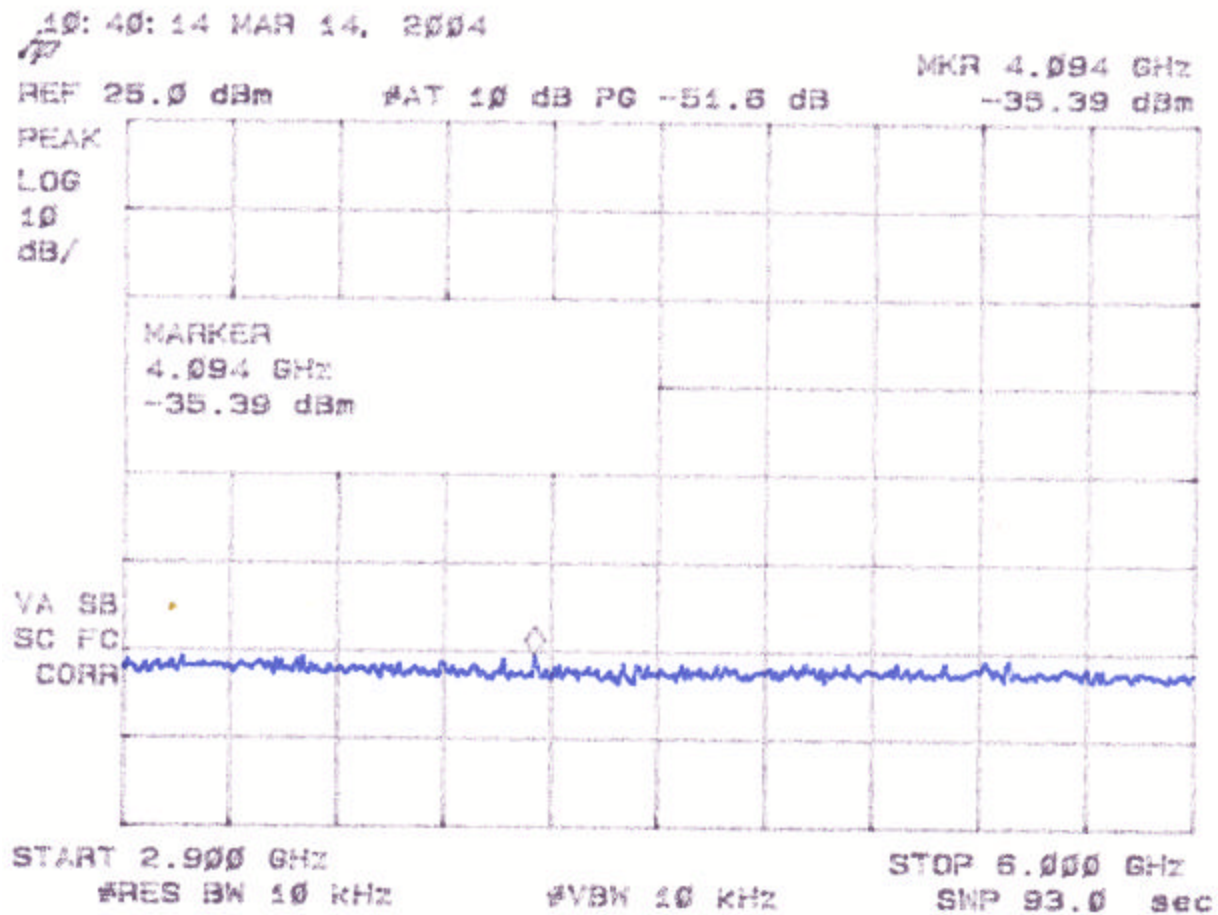
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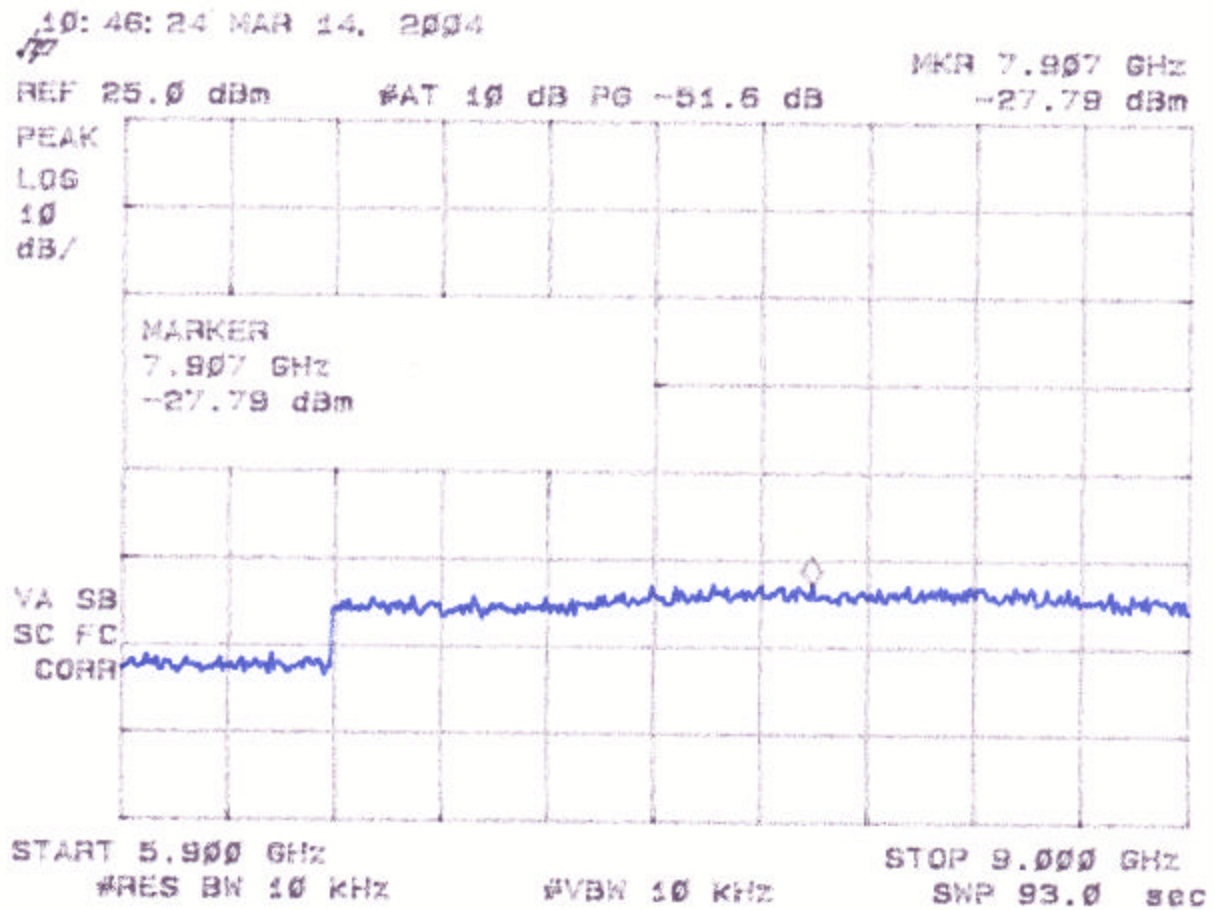
Figure 6c.
Spurious Emissions at Antenna Terminals – Low Channel



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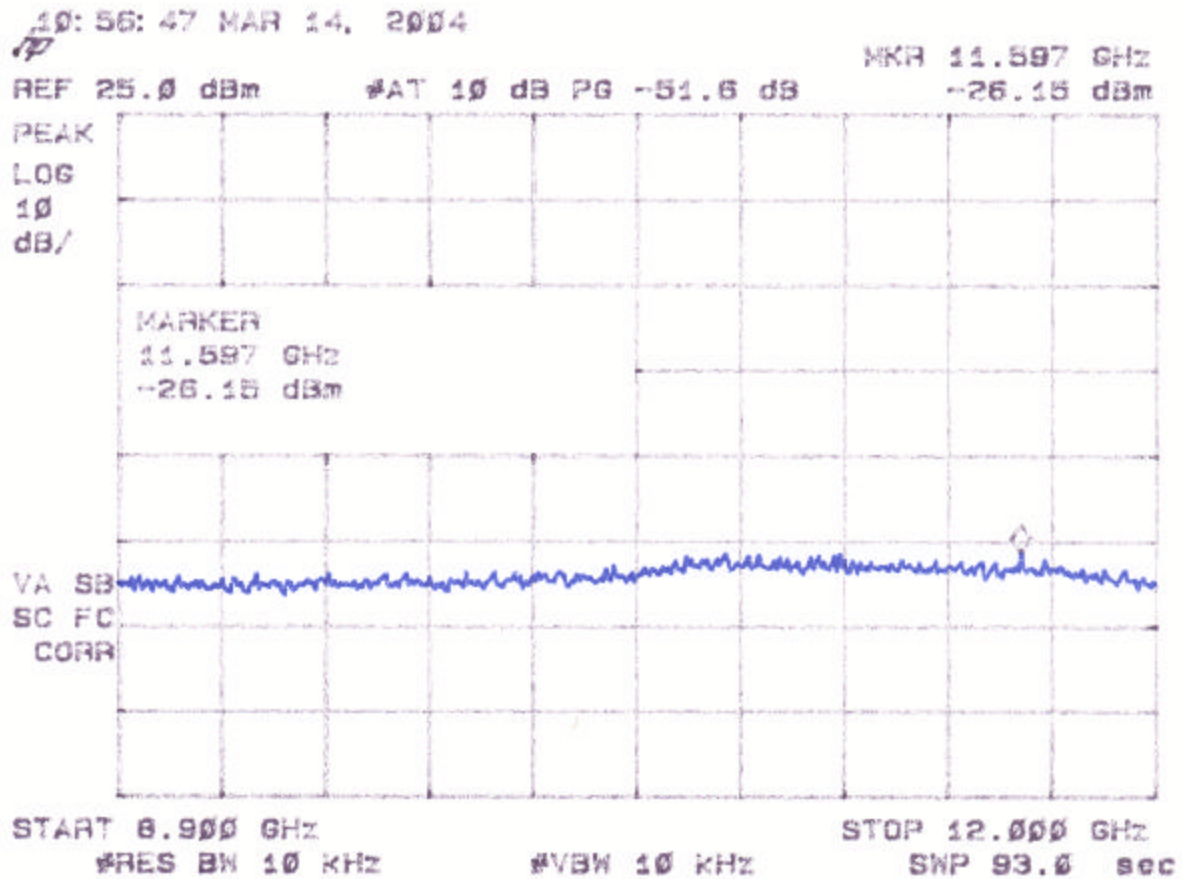
Figure 6d.
Spurious Emissions at Antenna Terminals – Low Channel



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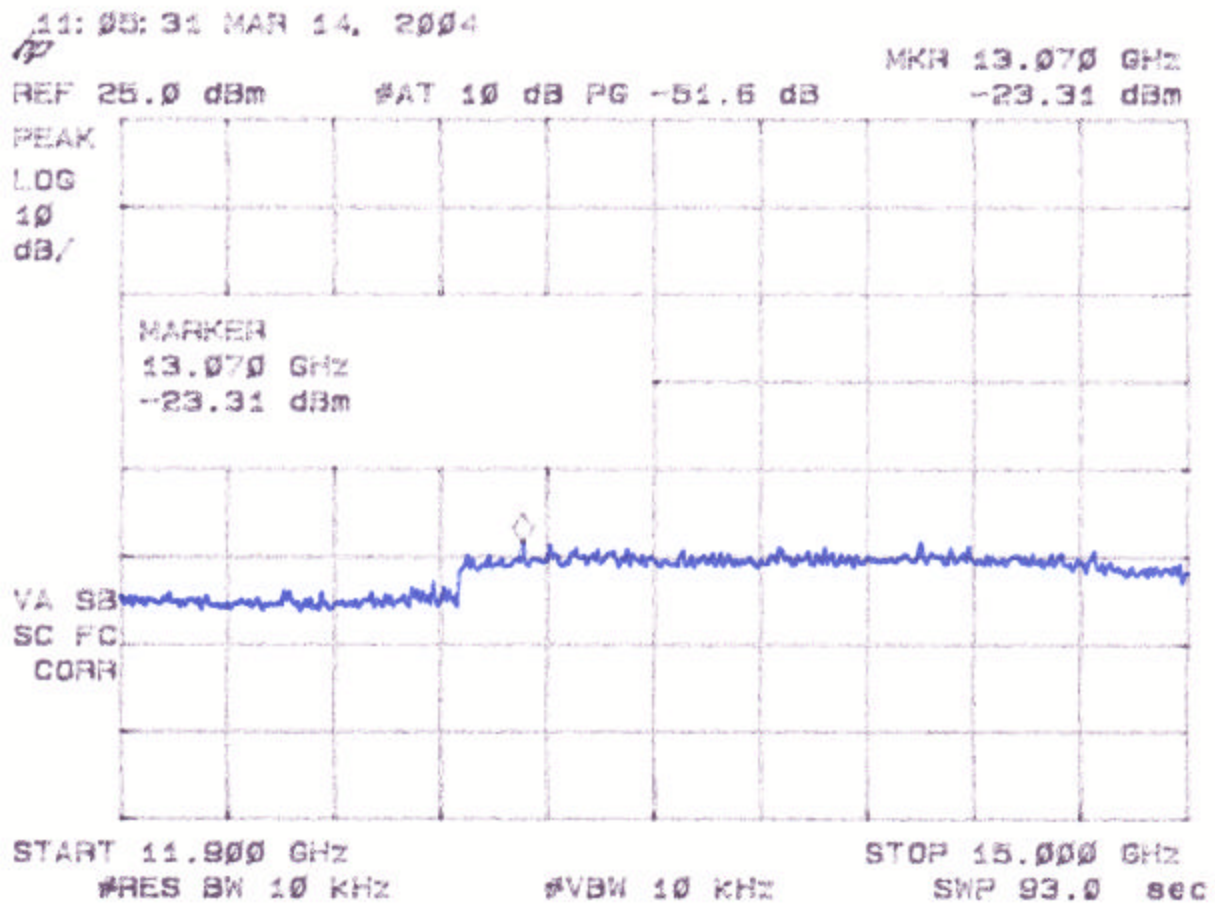
Figure 6e.
Spurious Emissions at Antenna Terminals – Low Channel



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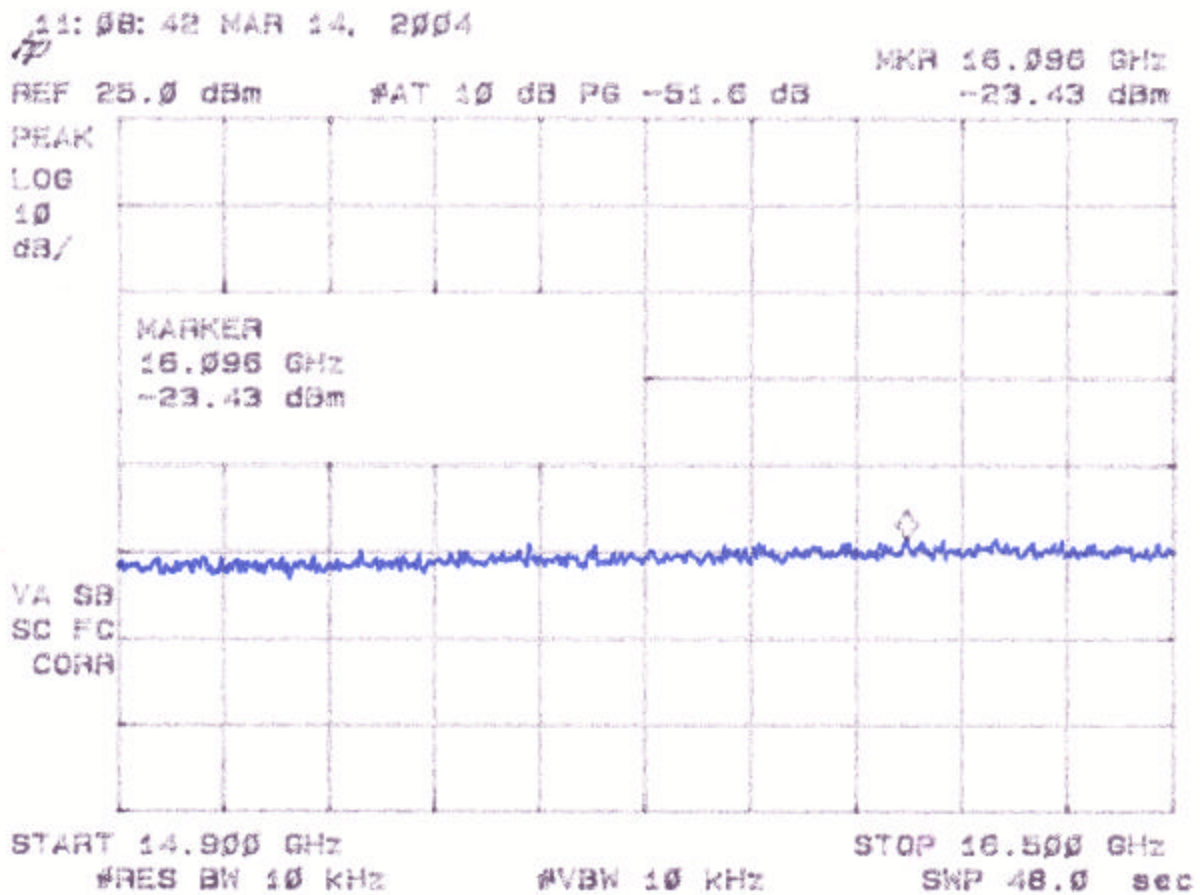
Figure 6f.
Spurious Emissions at Antenna Terminals – Low Channel



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Figure 6g.
Spurious Emissions at Antenna Terminals – Low Channel



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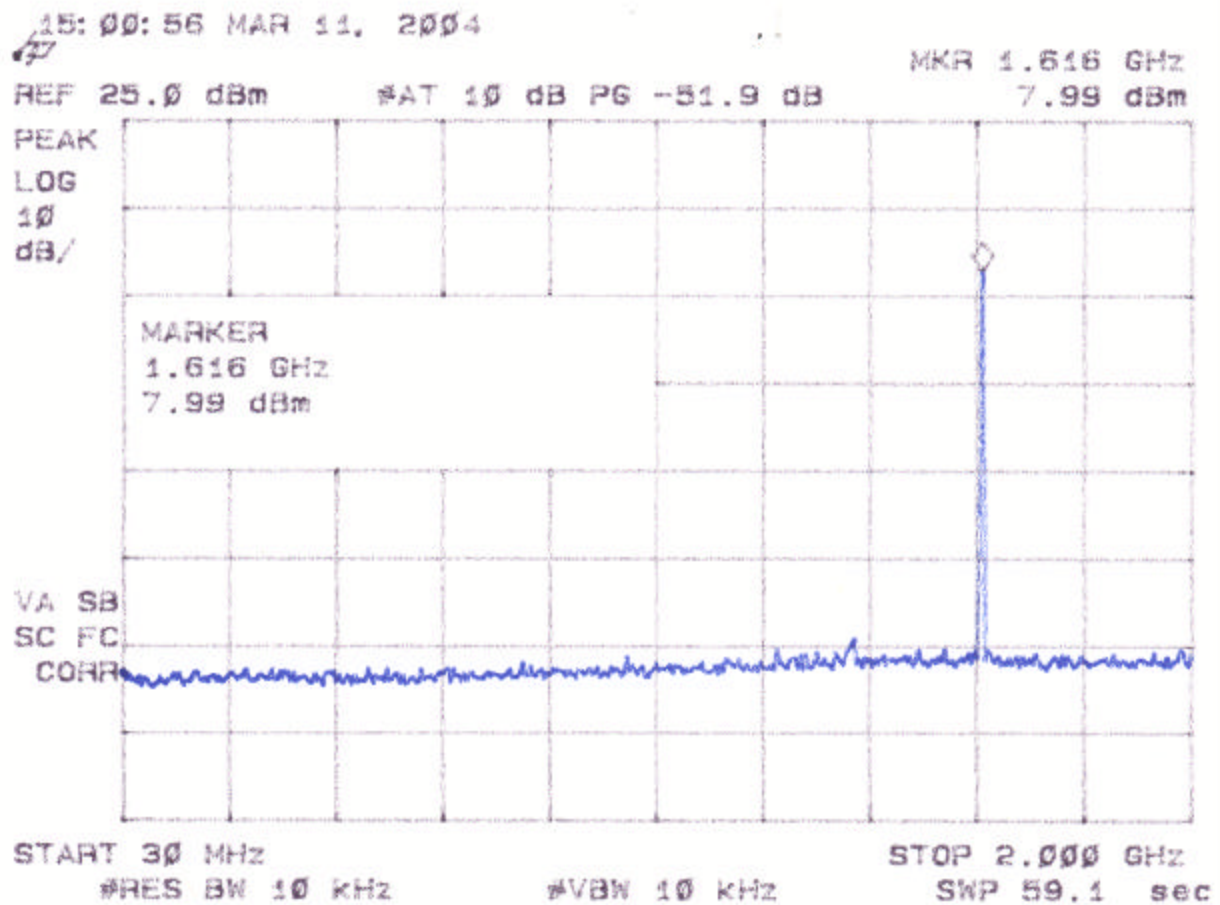
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Figure 6h.
Spurious Emissions at Antenna Terminals - High Channel

Limit = -80 dBW = -50 dBm

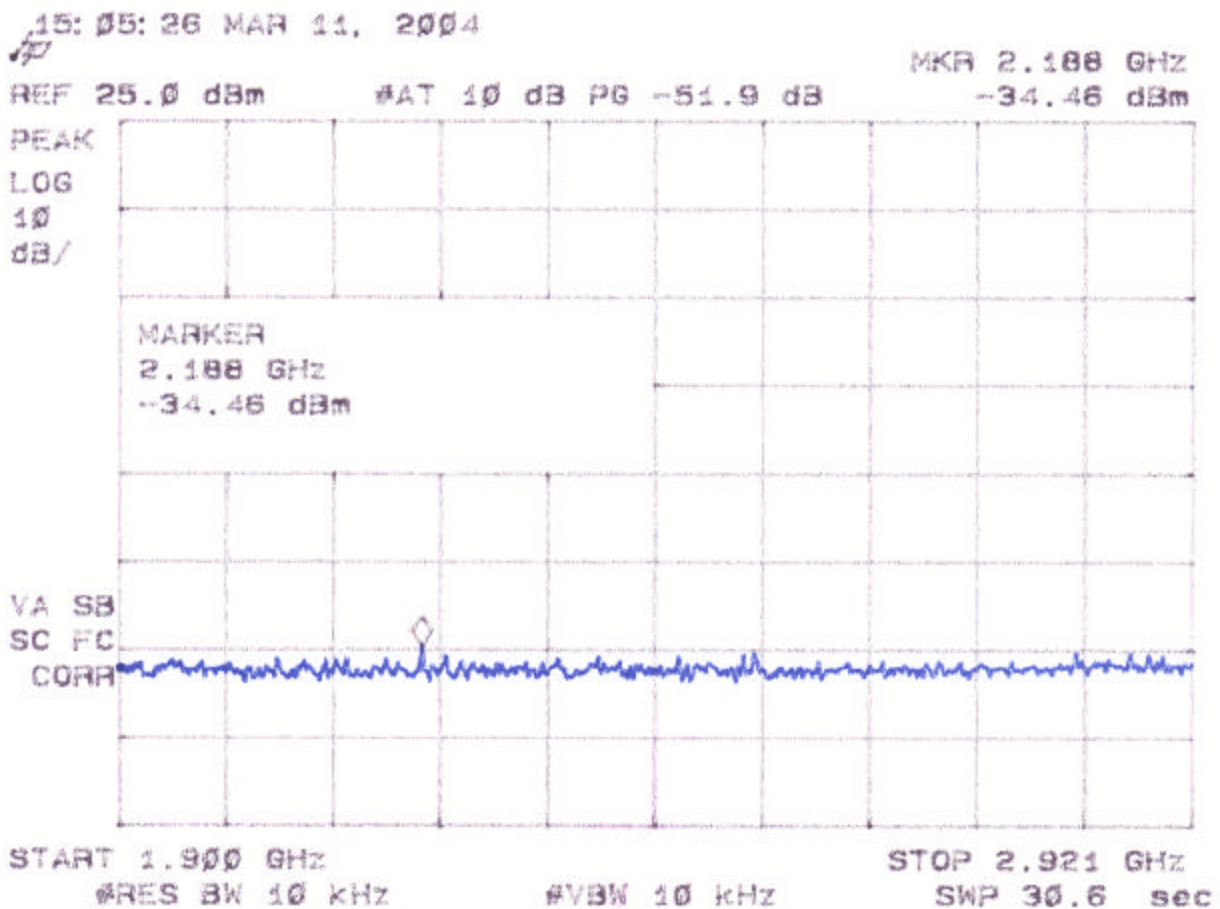


NOTE: Marker shows Fundamental Frequency

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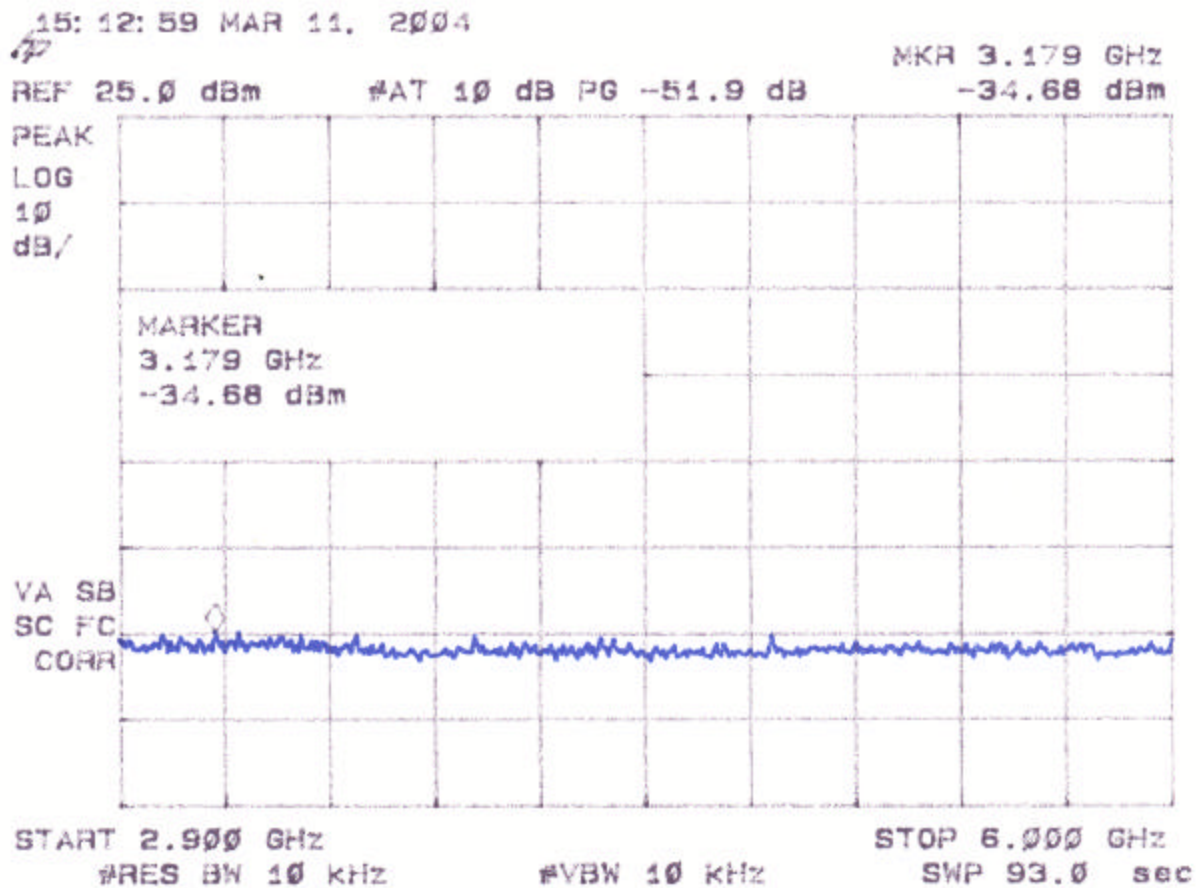
Figure 6i.
Spurious Emissions at Antenna Terminals



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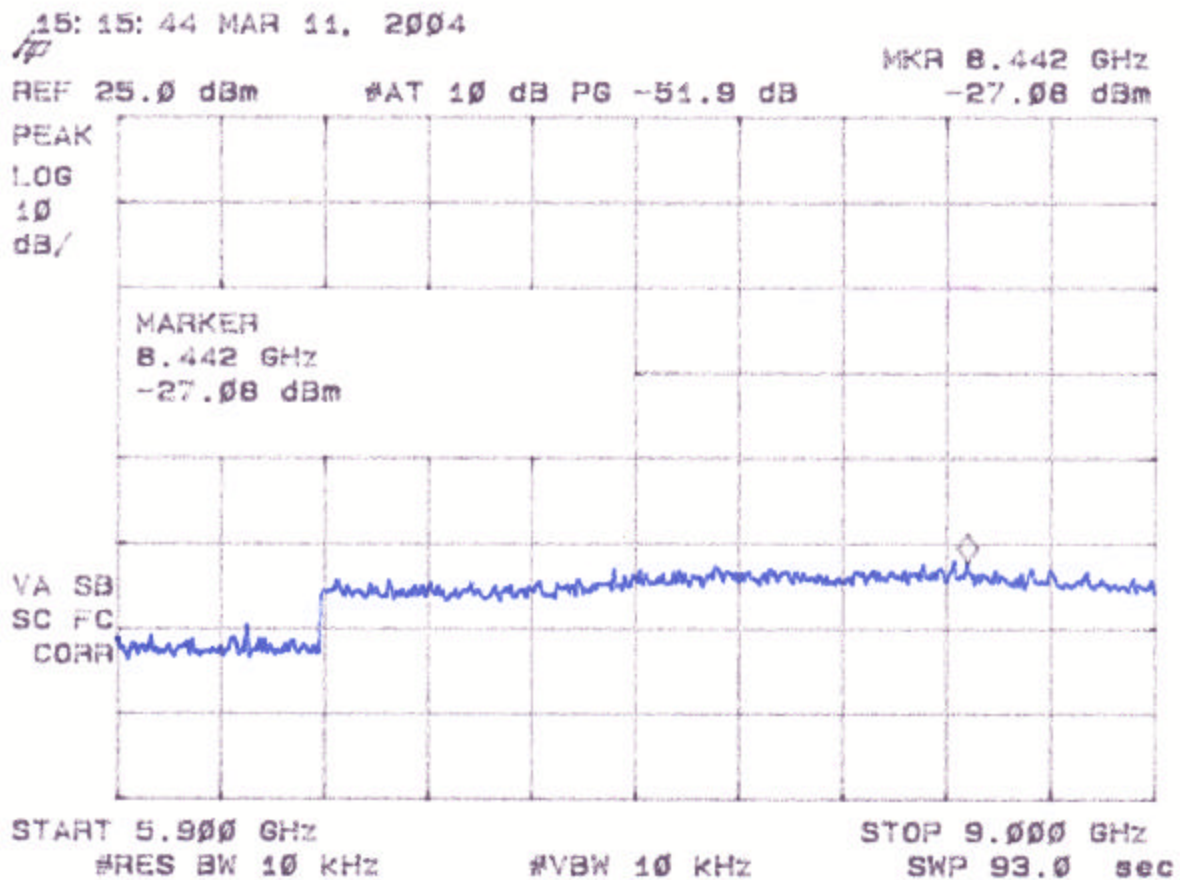
Figure 6j.
Spurious Emissions at Antenna Terminals – High Channel



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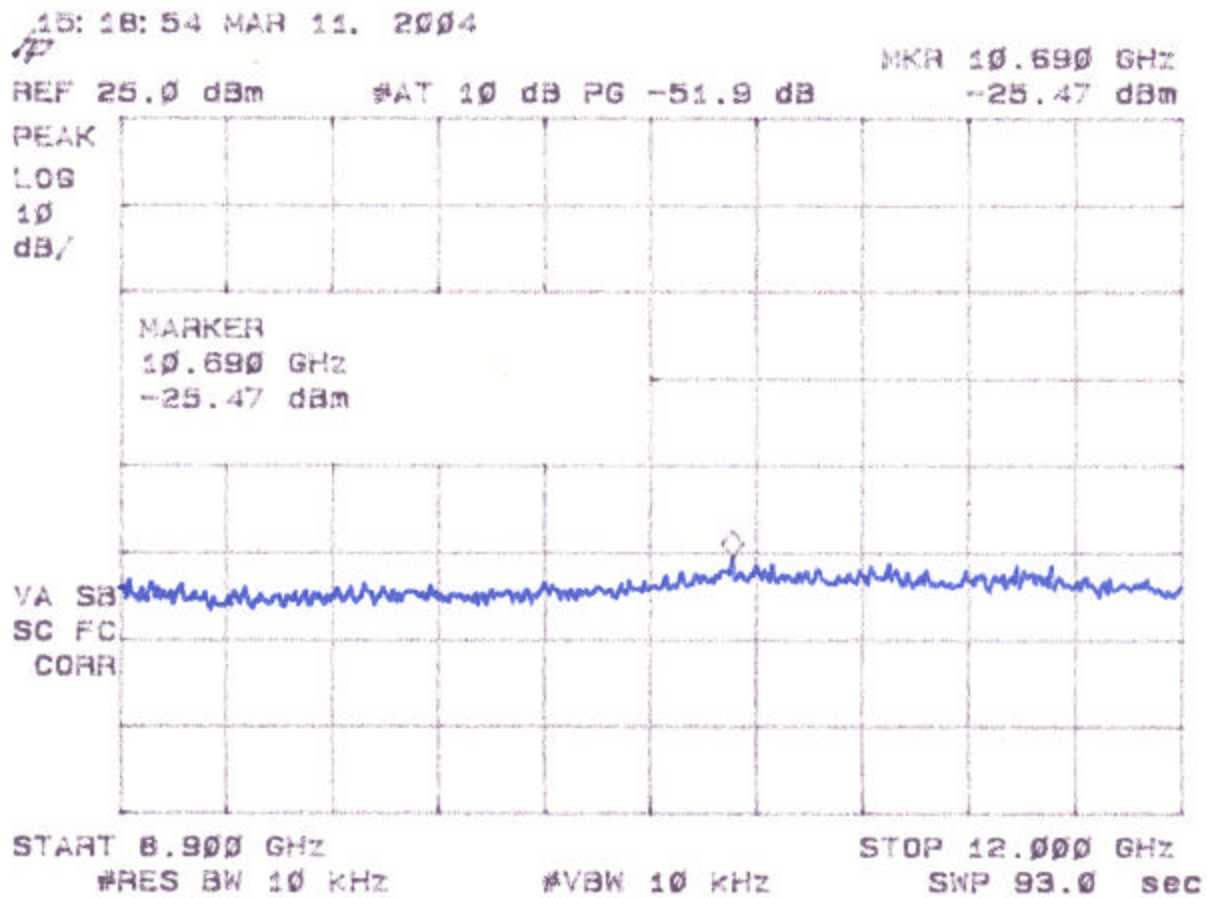
Figure 6k.
Spurious Emissions at Antenna Terminals – High Channel



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Figure 6I.
Spurious Emissions at Antenna Terminals – High Channel



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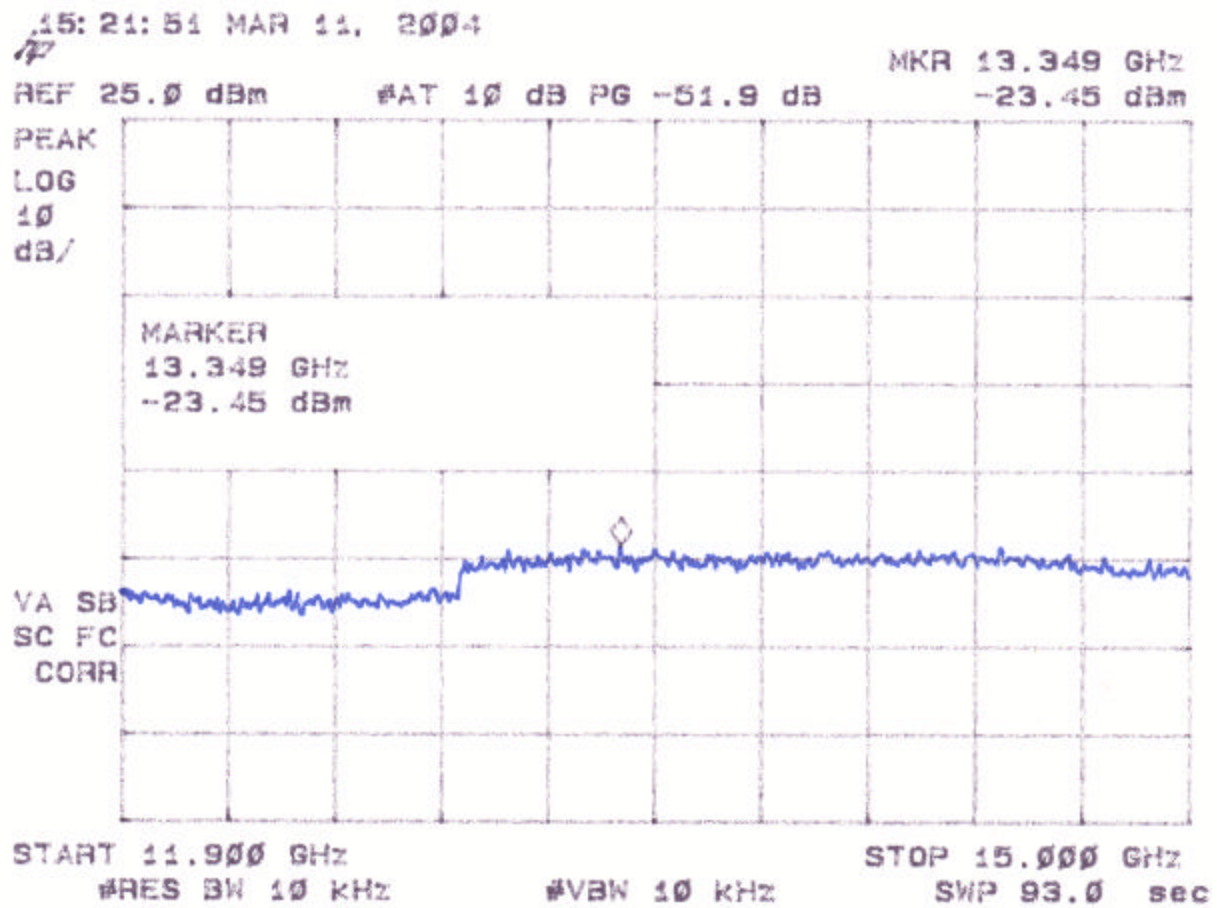
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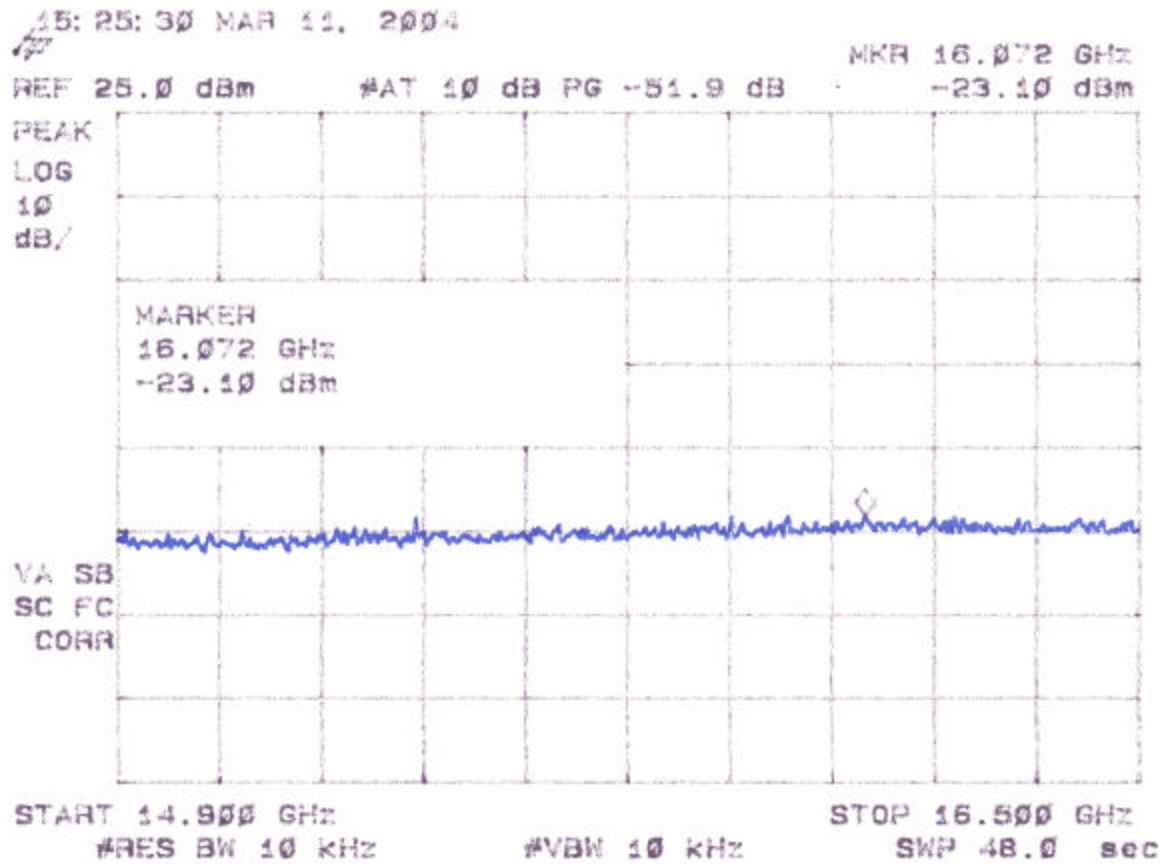
Figure 6m.
Spurious Emissions at Antenna Terminals – High Channel



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Figure 6n.
Spurious Emissions at Antenna Terminals – High Channel



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2.10 Field Strength of Spurious Radiation (FCC Section 2.1053)

Spurious emissions were evaluated from 30 MHz to 16.2 GHz at an EUT to antenna distance of 1 or 3 meters. The EUT was tested with an external power source and modulated by its own internal sources. Both the low and high channel was tested. The EUT was placed on an open area test site and the spurious emissions tested as stipulated by EIT/TIA-603: 1992 section 2.2.12. Measurements for 30 to 1000 MHz were made with the analyzer's bandwidth set to 120 kHz. Measurements above 1 GHz were made with the analyzer's bandwidth set to 1 MHz. The worse case results are shown in Table 4. Measurements were taken to the 10th harmonic.

FCC Minimum Standard (FCC Section 25.202(f))

For out-of-band emissions for frequencies removed from the midpoint of the assigned frequency segment by more than 250% of the authorized bandwidth (2.5 MHz), at least

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

For Lowest Channel = $43 + 10 \log (0.195) = 35.9 \text{ dB}$

For Highest Channel = $43 + 10 \log (0.205) = 36.12 \text{ dB}$

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FIELD STRENGTH OF SPURIOUS RADIATION

Limit: $43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (0.195) = 35.9 \text{ dB}$

TABLE 4a

Worse Case Mode = Low Channel

Frequency (MHz)	Polarity (H or V)	Corrected Substitution Level Relative to Dipole (dBm)	Attenuated Level Below Carrier Power (dB)
3225.6	H	-33.8	55.9
4833.89	V	-52.2	75.10

Note: All other Harmonic frequencies were below 20dB of the FCC Limits.

SAMPLE CALCULATION:

Attenuated Level Below Carrier Power =
 $10 \log (\text{TX Power in mW}) - \text{Corrected Substitution Level (dBm)}$
 $10 \log (195.0) - -33.8 = 55.9$

Test Date: March 30, 2004

Tester
Signature:  **Name:** David Blethen

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Model: GM-SG01

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FIELD STRENGTH OF SPURIOUS RADIATION

Limit: $43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (0.205) = 36.2 \text{ dB}$

TABLE 4b

Worse Case Mode = High Channel

Frequency (MHz)	Polarity (H or V)	Corrected Substitution Level Relative to Dipole (dBm)	Attenuated Level Below Carrier Power (dB)
3237.51	V	-30.8	53.9
4856.17	H	-52.23	75.3

Note: All other Harmonic frequencies were below 20dB of the FCC Limits.

SAMPLE CALCULATION:

Attenuated Level Below Carrier Power =
 $10 \log (\text{TX Power in mW}) - \text{Corrected Substitution Level (dBm)}$
 $10 \log (205.0) - -30.8 = 53.9$

Test Date: March 30, 2004

Tester
Signature:  **Name:** David Blethen

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2.11 Frequency Stability (FCC Section 2.1055 and 25.202(d))

The frequency tolerance of the carrier signal was measured by while ambient temperature was varied from -30 to 50 degrees centigrade. The frequency tolerance was verified at 10 degree increments. Additionally, the supply voltage was varied from 85% to 115% of the nominal value (except for hand carried, battery powered equipment which was additionally measured at battery endpoint).

FCC Minimum Standard

None

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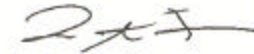
FCC ID: RZTGMSG01

FCC Verification

Guardian Mobility Model GM-SG01

Frequency Stability vs. Temperature (At Startup)

Test Results Reviewed By:



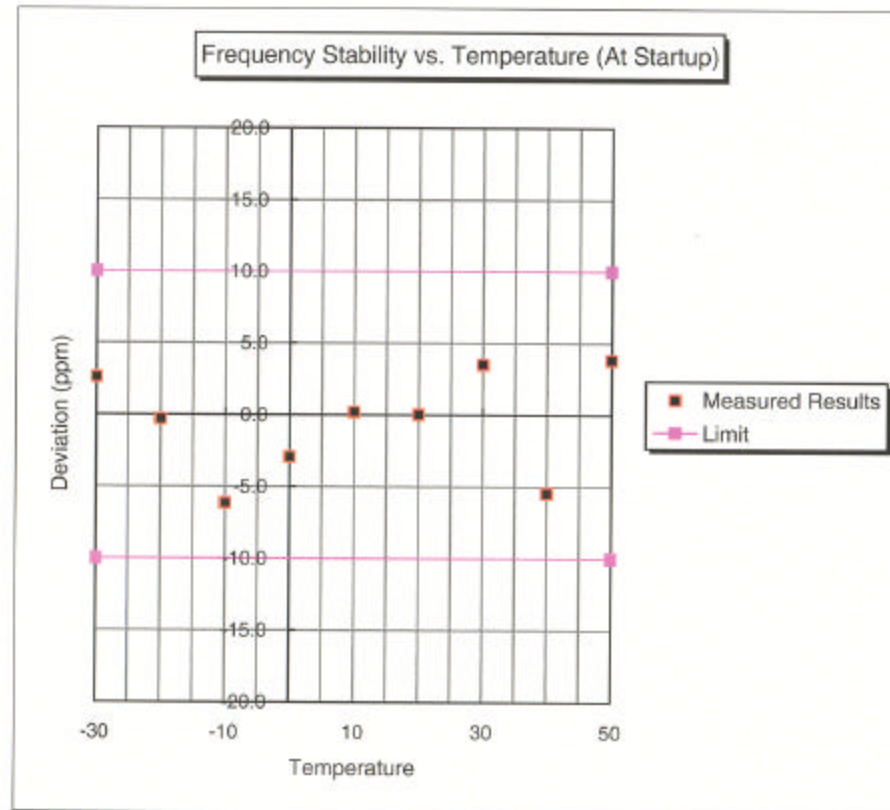
Louis A. Feudi

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	1611.406280	2.6
-20	1611.401560	-0.3
-10	1611.392140	-6.1
0	1611.397340	-2.9
10	1611.402380	0.2
20	1611.402090	0.0
30	1611.407740	3.5
40	1611.393260	-5.5
50	1611.408230	3.8

Actual TX Frequency was: 1611.250

Reference Point from 20 degrees C: 1611.402 MHz

Maximum Deviation = 0.001% or 10 ppm



Report Number: 04-0025

Issue Date: March 31, 2004

Customer: GMC Guardian Mobility Corporation

FCC ID: RZTGMSG01

Model: GM-SG01

FCC Verification

Guardian Mobility Model: GM-SG01

Frequency Stability vs. Temperature (2 minutes after startup)

Test Results Reviewed By:



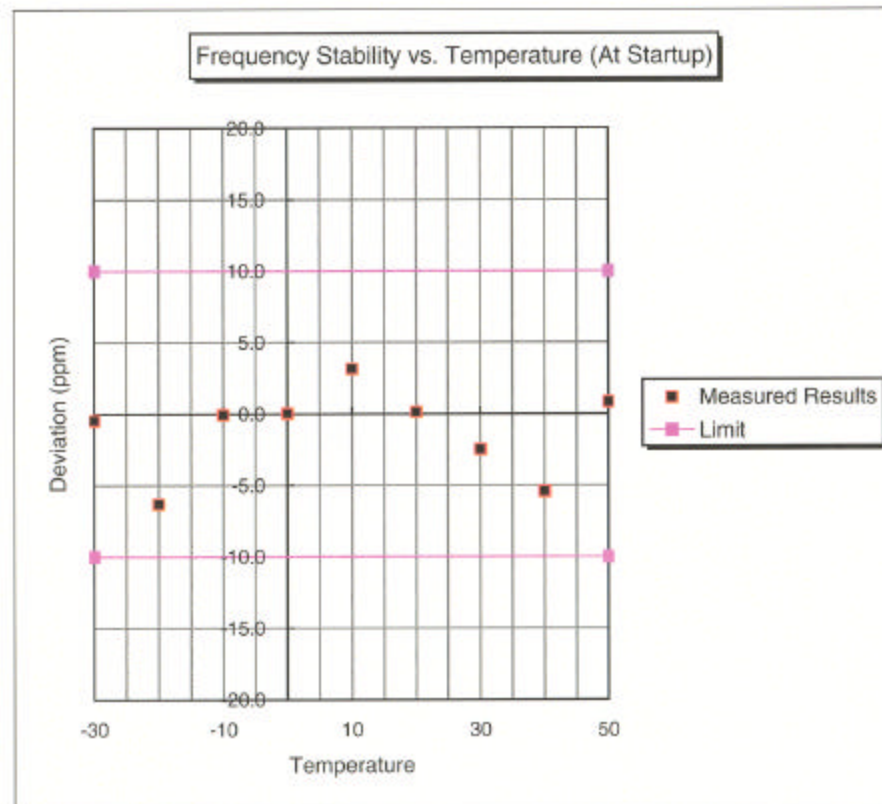
Louis A. Feudi

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	1611.401240	-0.5
-20	1611.391810	-6.3
-10	1611.401890	-0.1
0	1611.402050	0.0
10	1611.407090	3.2
20	1611.402200	0.1
30	1611.397990	-2.5
40	1611.393260	-5.4
50	1611.403350	0.8

Actual TX Frequency was: 1611.250

Reference Point from 20 degrees C: 1611.402 MHz

Maximum Deviation = 0.001% or 10 ppm



Report Number: 04-0025

Issue Date: March 31, 2004

Customer: GMC Guardian Mobility Corporation

Model: GM-SG01

FCC ID: RZTGMSG01

FCC Verification

Guardian Mobility Model GM-SG01

Frequency Stability vs. Temperature (5 minutes after startup)

Test Results Reviewed By:



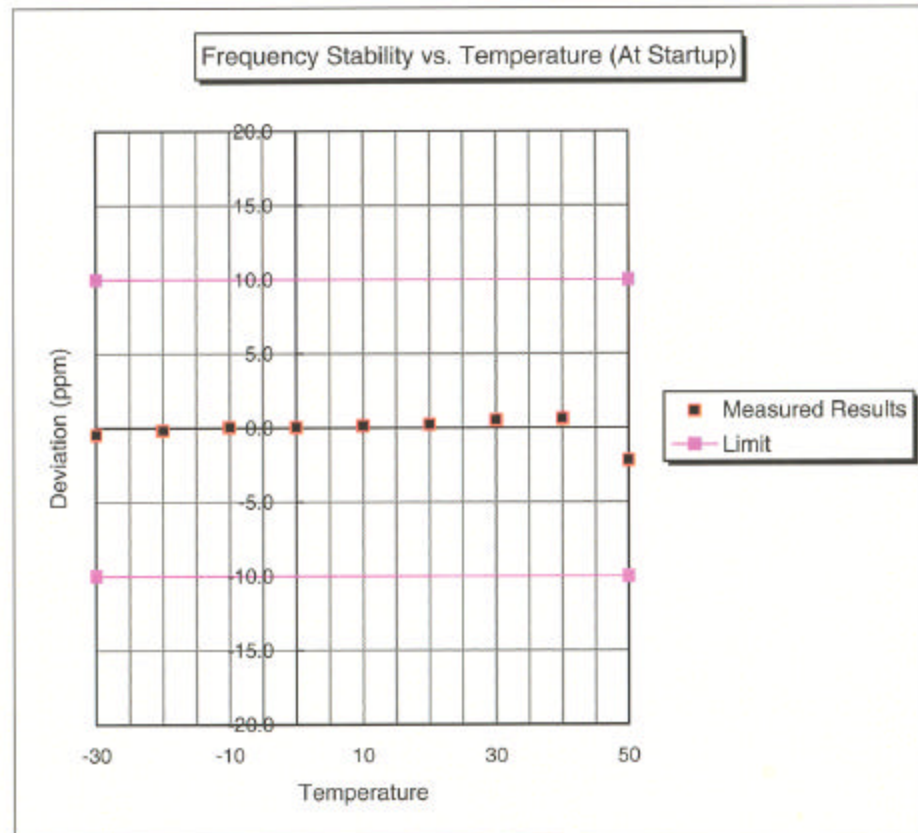
Louis A. Feudi

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	1611.401240	-0.5
-20	1611.401730	-0.2
-10	1611.402050	0.0
0	1611.402050	0.0
10	1611.402210	0.1
20	1611.402360	0.2
30	1611.402860	0.5
40	1611.403010	0.6
50	1611.398480	-2.2

Actual TX Frequency was: 1611.250

Reference Point from 20 degrees C: 1611.402 MHz

Maximum Deviation = 0.001% or 10 ppm



Report Number: 04-0025

Issue Date: March 31, 2004

Customer: GMC Guardian Mobility Corporation

Model: GM-SG01

FCC ID: RZTGMSG01

FCC Verification

Guardian Mobility Model GM-SG01

Frequency Stability vs. Temperature (10 minutes after startup)

Test Results Reviewed By:



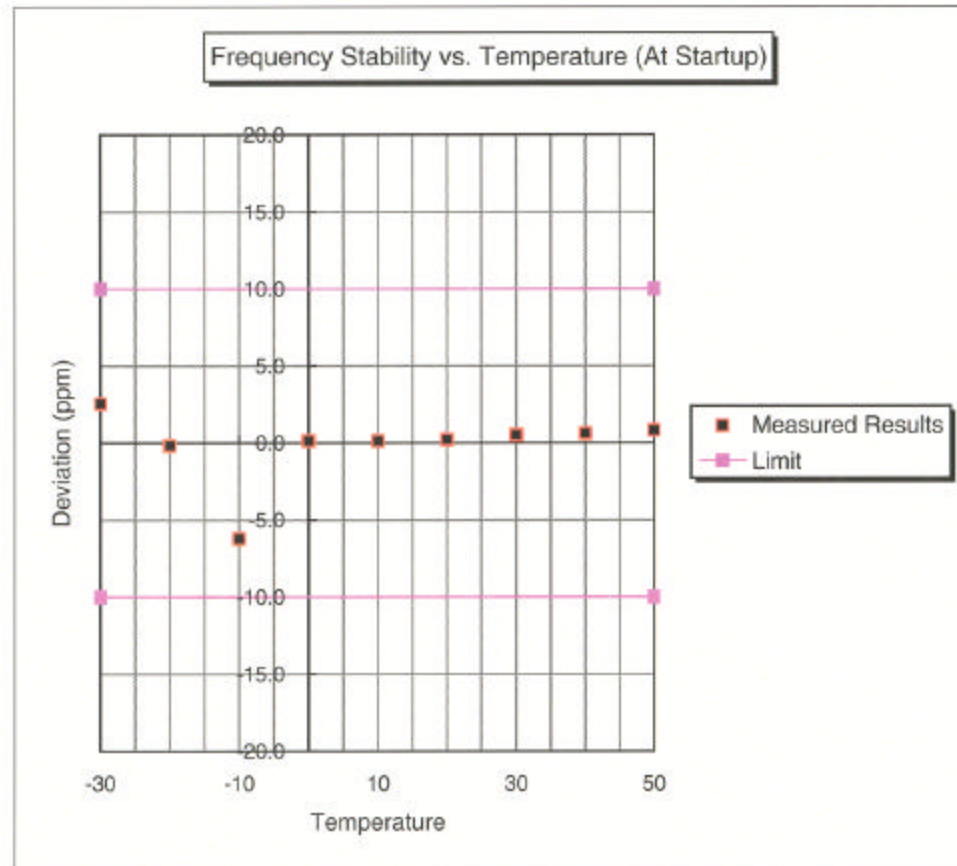
Louis A. Feudi

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	1611.406110	2.6
-20	1611.401730	-0.2
-10	1611.391980	-6.2
0	1611.402210	0.1
10	1611.402210	0.1
20	1611.402360	0.2
30	1611.402860	0.5
40	1611.403010	0.6
50	1611.403350	0.8

Actual TX Frequency was: 1611.250

Reference Point from 20 degrees C: 1611.402 MHz

Maximum Deviation = 0.001% or 10 ppm



Report Number: 04-0025

Issue Date: March 31, 2004

Customer: GMC Guardian Mobility Corporation

Model: GM-SG01

FCC ID: RZTGMSG01

FCC Verification

Guardian Mobility Model GM-SG01

Frequency Stability vs. Voltage

Test Results Reviewed By:

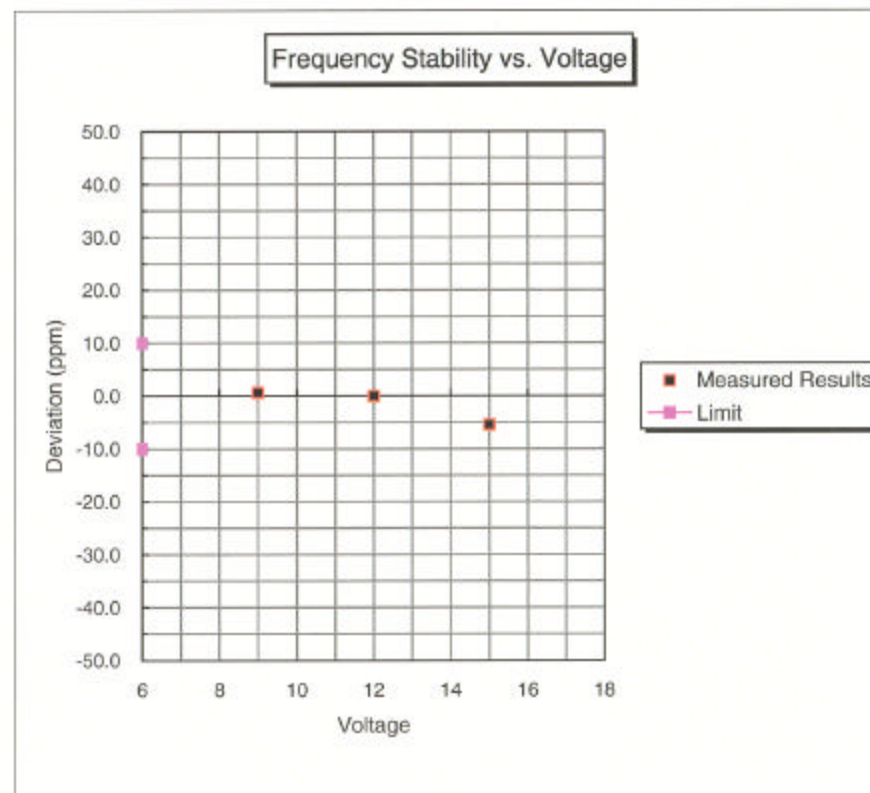


Louis A. Feudi

Voltage (V DC)	Measured Frequency (MHz)	Deviation (ppm)
15	1611.393260	-5.5
12	1611.402050	0.0
9	1611.403050	0.6

Actual TX Frequency was: 1611.250
Reference Point from 20 degrees C: 1611.402 MHz

Maximum Deviation = N/A



Report Number: 04-0025
Customer: GMC Guardian Mobility Corporation
Model: GM-SG01

Issue Date: March 31, 2004
FCC ID: RZTGMSG01

2.12 Emissions from Mobile Earth Stations for Protection of Aeronautical Radionavigation-Satellite Service. (FCC Section 25.216)

Emissions from the EUT were evaluated from 1559 MHz – 1605 MHz and did not exceed the limit at -70dBW/MHz, averaged over 20 milliseconds.

Emissions from the EUT were evaluated from 1605 MHz – 1610 MHz and did not exceed the limits ranging from -70 dBW/MHz at 1605 MHz to -10dBW/MHz at 1610 MHz, averaged over 20 milliseconds.

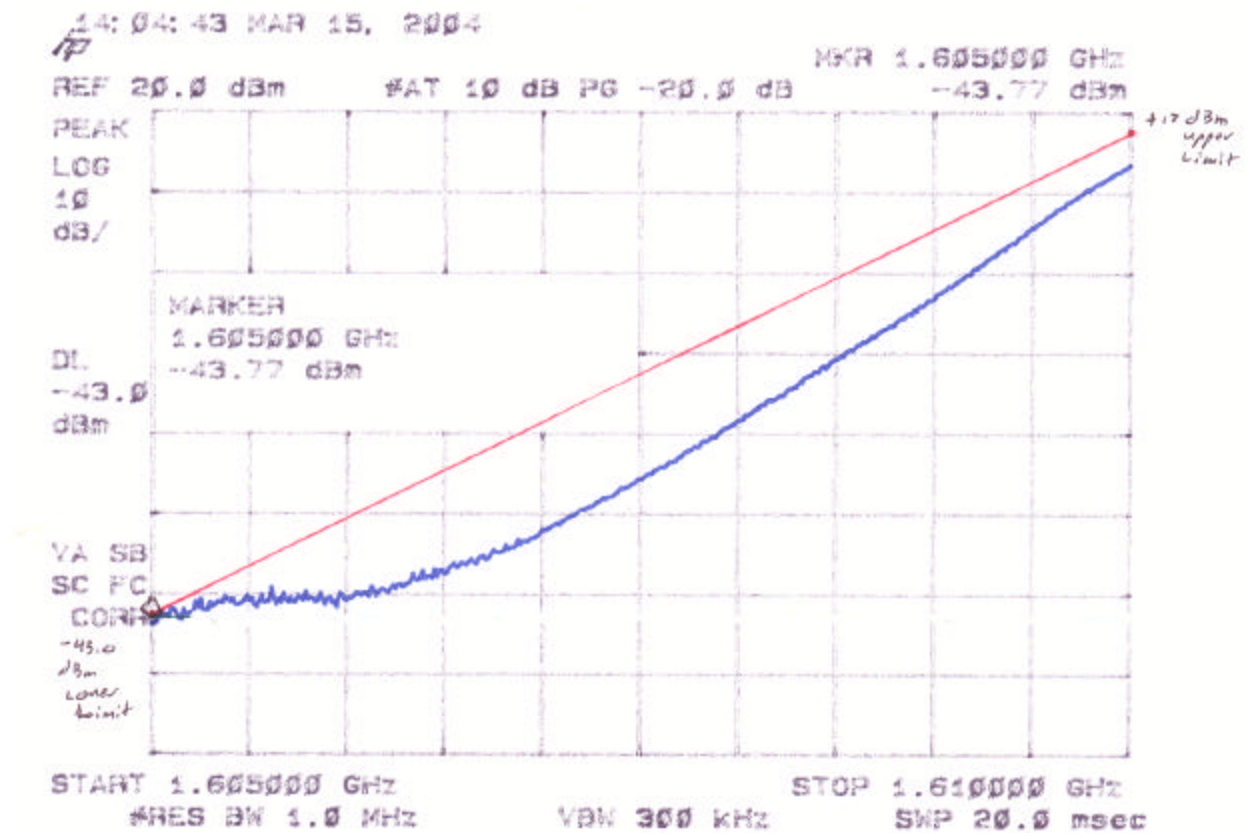
Emissions were measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminal with the Resolution Bandwidth set to 1 MHz. Results are shown on Figures 7a -7c.

Report Number: 04-0025
Customer: GMC Guardian Mobility Corporation
Model: GM-SG01

Issue Date: March 31, 2004
FCC ID: RZTGMSG01

Figure 7a.
Emissions from Mobile Earth Stations for Protection
of Aeronautical Radionavigation-Satellite Service

Limit = - 70 dBW/ MHz to -10 dBW/MHz + 4 dBi (-44 dBm to +16 dBm)

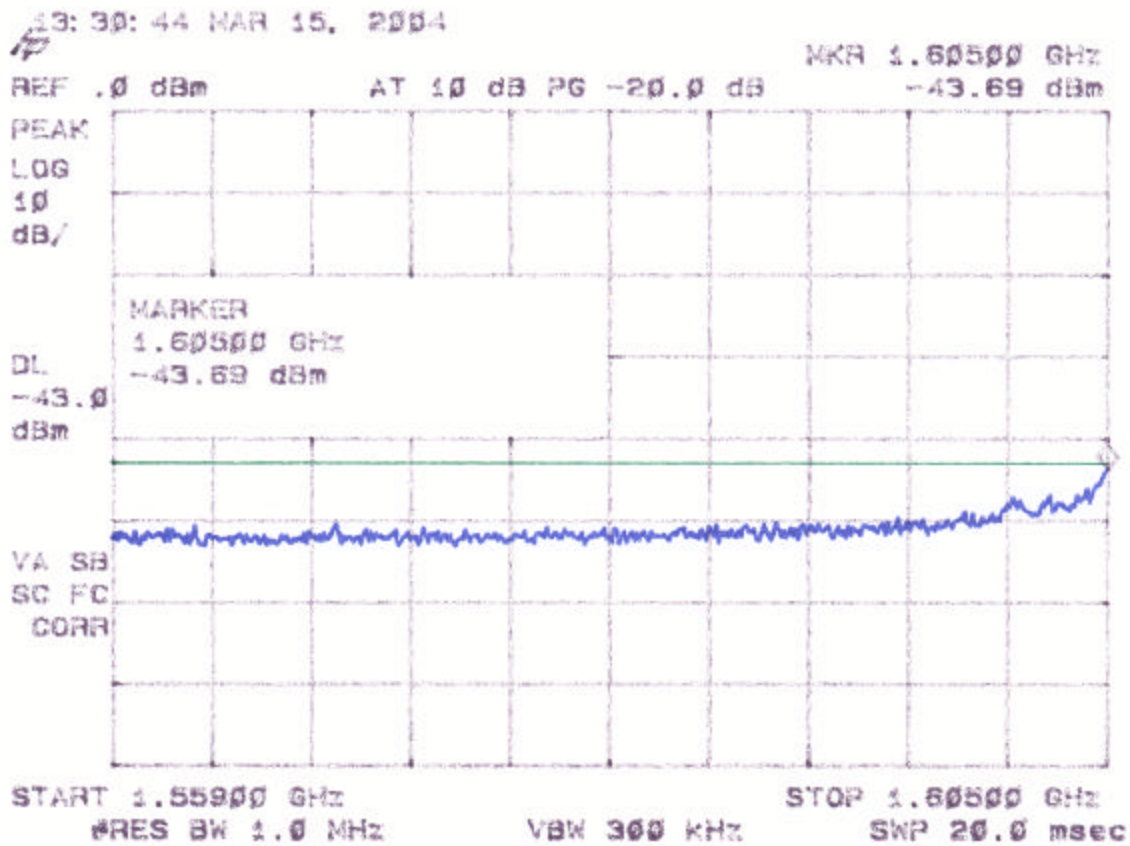


Report Number: 04-0025
Customer: GMC Guardian Mobility Corporation
Model: GM-SG01

Issue Date: March 31, 2004
FCC ID: RZTGMSG01

Figure 7b.
Emissions from Mobile Earth Stations for Protection
of Aeronautical Radionavigation-Satellite Service

Limit = - 70 dBW/MHz + 4 dBi (-44 dBm)



Report Number: 04-0025
Customer: GMC Guardian Mobility Corporation
Model: GM-SG01

Issue Date: March 31, 2004
FCC ID: RZTGMSG01

Figure 7c.
Emissions from Mobile Earth Stations for Protection
of Aeronautical Radionavigation-Satellite Service

Limit = -70 dBW/MHz to -10 dBW/MHz + 4 dBi (-44 dBm to +16dBm)

