

A

June 15, 2000

re: ea97821

To Whom It May Concern:

SUBJECT:

The 'final report' submitted on 14 June 2000 contained minor editorial errors and a missing Trademark. Please find attached a revised final report.

Sincerely,

Robert F. Martin  
Sr. Technical Manager  
Intertek Testing Services

70 CODMAN HILL RD  
BOXBOROUGH MA 01462  
USA

Emissions Testing  
Performed  
on the  
**Harmonix Corporation**  
**Communications Transceiver**  
**Model: EK6HOC3JH-SGM**

**To**

**FCC Part 15 Subpart C, 15.255**

Date of Test: May 24, 25 & 26, 2000

Page 1 of 44

Report Number: J20013614  
Revised 15 June 2000

Contact: Mr. Dana Wheeler

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### I – Introduction and Summary

TO: Mr. David Russell

FROM: Michael J. Peters, Senior Project Engineer

DATE: May 24, 25 & 26, 2000

JOB #: J20013614

RE: Emissions Testing Performed on the Communications Transceiver, Model: EK6HOC3JH-SGM

On May 24, 25 & 26, 2000 we tested the Communications Transceiver, Model: EK6HOC3JH-SGM to determine if it was in compliance with the FCC Part 15 , Subpart C, Section 15.255. A Production version of the sample was received on Wednesday, May 24, 2000 in good condition. We found that the unit met the Part 15 requirements when tested as received.

The following table presents the results of testing at typical frequencies. Details can be found in the referenced sections of this report.

| Test                                   | Frequency (MHz)         | Measurement                         | Requirement                     | Pass/Fail | Section of FCC Rules | Section of Test Report |
|----------------------------------------|-------------------------|-------------------------------------|---------------------------------|-----------|----------------------|------------------------|
| Fundamental Power Density              | 61,842.2                | 16.7pk/6.7ave<br>uW/cm <sup>2</sup> | 18pk/9ave<br>uW/cm <sup>2</sup> | P         | 15.255(b)(2)         | II                     |
| Rectricted Band Emissions              | 30-40000;<br>>40000     | Table 1-3<br>Section X              |                                 | P         | 15.209/15.205        | X                      |
| Line-conducted Emissions               | 0.45-30                 | Table 4 Section<br>X                |                                 | P         | 15.207               | X                      |
| Antenna Conducted Emissions – Receiver | No removable<br>antenna |                                     |                                 |           |                      |                        |
| Antenna Conducted Emissions – Transmit | No removable<br>antenna |                                     |                                 |           |                      |                        |
| Frequency Deviation Temperature        | 59,162,828,479          | +389,014Hz<br>- 476,541Hz           | 10 MHz                          | P         | 15.255(f)            | XII                    |
| Frequency Deviation Voltage            | 59,162,828,479          | +120,230Hz<br>-266,038Hz            | 10MHz                           | P         | 15.255(f)            | XII                    |

## **Modifications Required for Compliance**

The following modifications were installed during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by Harmonix Corporation prior to compliance testing):

- 1) A ferrite sleeve (Fair-Rite P/N: 0443164251) was placed around the power cord, internal to the device, in a straight through configuration.
- 2) 0.022 uF Y-capacitors were installed from each line to ground at the power input isolation block.
- 3) 0.1 uF X-capacitor was installed across each line at the power input isolation block.
- 4)

In summary, this report confirms that the Model: EK6HOC3JH-SGM is compliant with the FCC Part 15, Subpart C Section 15.255 requirements when production units conform to the initial sample. Please address all questions and comments concerning this report to Michael J. Peters, Senior Project Engineer.

## **II – Technical Requirements**

### **15.1 Scope**

The device is an intentional radiator intended to operate in accordance with 15.255 Operation in the band 59.05 to 64.0 GHz Of Part 15 of the FCC rules without a license.

### **15.15 General Technical Requirements**

There are no controls accessible to the user that would cause the device to operate in violation of the FCC rules.

### **15.27 Special Accessories**

No special accessories are necessary to meet compliance requirements.

### **15.37 Measurement Standards**

The measurement procedures specified by ANSI C63.4:1992 were used to setup and test the device. See Section IV of this test report for detailed description of the test procedure.

### **15.33 Frequency range of measurement**

The device was scanned for spurious and harmonic emissions from 30 MHz to 200 GHz.

### **15.35 Measurement detector functions and bandwidth**

The following table illustrates the detector functions and bandwidth used to test the device.

No deviations to the following were made.

| <b>Frequency Range</b> | <b>Measurement Detector</b> | <b>Measurement Bandwidth</b> |
|------------------------|-----------------------------|------------------------------|
| 450 kHz to 30 MHz      | Quasi-Peak                  | 9 kHz                        |
| 30 MHz to 1000 MHz     | Quasi-Peak                  | 120 kHz                      |
| 1000 MHz to 200 GHz    | Average                     | 1 MHz                        |

Note: The quasi-peak detector meets the requirements of CISPR 16.  
An averaging factor was not used for the device.

### **15.25 Transition Provisions**

Transition provisions were not applied to the device.  
A separate receiver is not being certified with the device.  
The device does not operate in the band 902-905 MHz.

### **15.201 Certification**

The device is required to be certified in accordance with Part 2 of the FCC rules, Subpart J.

### **15.203 Antenna Requirements**

The antenna is integral to the device and cannot be readily removed or replaced by the end-user.

### **15.204 External Radio Amplifier**

The device is not an amplifier.

### **15.205 Restricted bands of operation**

The emissions requirements below 40 GHz are the same as the general requirements of 15.209 which is the same as the requirement for emissions in restricted bands. Other than the fundamental emission, no other emissions were detected above 40 GHz.

Below 1000 MHz a quasi-peak detector was employed to measure emissions  
Above 1000 MHz, peak measurements were performed and compared to the average requirement.

### **15.207 Conducted Limits**

The device complies with the conducted emissions requirements when modified as described in the introduction.

### **15.209 Radiated emission limits; general requirements**

Below 40 GHz, the device is required to comply with the general emissions requirements. All measurements below 40 GHz were compared with the requirement.

#### **Detailed description of operation**

The transmitter was tested using worst-case OC3 and OC12 modulation. The modulation was present during radiated emissions testing. For frequency stability and output power test, the modulation signal was removed and the un-modulated carrier was measured.

#### **Justifications**

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in C63.4 (1992).

The worst case bit sequence was applied during test.

For maximizing emissions, the system was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the radiated emissions data contained in this report

Radiated emissions were tested in the range of 30 MHz to 2.0 GHz.

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For simplicity of testing, the unit was wired to transmit continuously.

## **15.255 Operation in the band 59.0 – 64.0 GHz**

### **Restrictions on Operations**

(a) Operation under the provisions of this section is not permitted for the following products:

(1) Equipment used on aircraft or satellites.

(2) Field disturbance sensors, including vehicle radar systems, unless the field disturbance sensors are employed for fixed operation. For the purposes of this section, the reference to fixed operation includes field disturbance sensors installed in fixed equipment, even if the sensor itself moves within the equipment.

The device is a low power communication device. It does not fall under either category 1) or 2) above.

(d) Only spurious emissions and transmissions related to a publicly-accessible coordination channel, whose purpose is to coordinate operation between diverse transmitters with a view towards reducing the probability of interference throughout the 59-64 GHz band, are permitted in the 59.0-59.05 GHz band.

The device does not operate in the 50.0 to 59.05 band. The lowest carrier frequency is 59.16 GHz.

*Note: The 59.0-59.05 GHz is reserved exclusively for a publicly-accessible coordination channel. The development of standards for this channel shall be performed pursuant to authorizations issued under Part 5 of this chapter.*

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### Field Strength

The following table summarized the field strength requirements for the devices operating in this band:

| Type of Transmitter                             | Power Density                       |                                   | Test Distance (meters) |
|-------------------------------------------------|-------------------------------------|-----------------------------------|------------------------|
|                                                 | Average(3)<br>(mW/cm <sup>2</sup> ) | Peak (2)<br>(mW/cm <sup>2</sup> ) |                        |
| NOT Field Disturbance Sensors                   | 9                                   | 18                                | 3                      |
| Fixed Field Disturbance Sensors (BW < 500 MHz)  |                                     |                                   |                        |
| Frequency Range - 61.0 to 61.5 GHz              | 9                                   | 18                                | 3                      |
| Frequency Range – 59.0 to 61.0 & 61.5 to 64 GHz | 0.009                               | 0.018                             | 3                      |
| Fixed Field Disturbance Sensors                 |                                     |                                   |                        |
| Not operating under Paragraph 15.255 (b)(2)     | 0.1 mW(1)                           | 9                                 | 3                      |

- 1) Output Power measurement (distance not applicable)
- 2) Peak power density shall be measured with an RF detector that has a detection bandwidth that encompasses the 59-64 GHz band and has a video bandwidth of at least 10 MHz, or using an equivalent measurement method.
- 3) The average emission limits shall be calculated, based on the measured peak levels, over the actual time period during which transmission occurs.

The following Table summarize the results of field strength testing:

| Antenna  | Fundamental Frequency (MHz) | Measurement (mW/cm <sup>2</sup> ) |     | Limit (mW/cm <sup>2</sup> ) |     | Pass/Fail | Table # | Test Distance (m) |
|----------|-----------------------------|-----------------------------------|-----|-----------------------------|-----|-----------|---------|-------------------|
|          |                             | Peak                              | Avg | Peak                        | Avg |           |         |                   |
| Patch    | 59,162.0                    | 2.3                               | 1.1 | 18                          | 9   | Pass      | 1       | 3                 |
| Patch    | 61,380.0                    | 3.6                               | 1.4 | 18                          | 9   | Pass      | 1       | 3                 |
| Patch    | 63,597.0                    | 3.0                               | 1.0 | 18                          | 9   | Pass      | 1       | 3                 |
| Parabola | 59,845.7                    | 16.0                              | 6.1 | 18                          | 9   | Pass      | 2       | 3                 |
| Parabola | 61,842.2                    | 16.7                              | 6.7 | 18                          | 9   | Pass      | 2       | 3                 |



**Spurious Emissions**

(b) Limits on spurious emissions:

(1) The power density of any emissions outside the 59.0-64.0 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in Section 15.209 of this part.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm<sup>2</sup> at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Spurious Emissions are summarized on Tables 1 through 3 in Section X of this report.

No emissions exceed the limits after modifications.

No emissions other than the fundamental were found >40GHz

**Peak Output Power**

(e) Except as specified below, the total peak transmitter output power shall not exceed 500 mW.

(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

(2) Peak transmitter output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 59-64 GHz band and that has a video bandwidth of at least 10 MHz, or using an equivalent measurement method.

(3) For purposes of demonstrating compliance with this paragraph, corrections to the transmitter output power may be made due to the antenna and circuit loss.

The output power of the transmitter is calculated based on the peak field strength readings from the previous section:

Antenna gain is calculated as:

$$G = 4\pi A_e / \lambda^2$$

Where,

G – Numeric gain,  $A_e$  – effective antenna area,  $\lambda$  - wavelength in meters

Using the actual area yields worst-case results (3"x5" = 0.0097 meters)

$$G = 4\pi * (0.0097) / (300/59,162)^2 = 4,740.5 \text{ (36.8 dB)}$$

The Power is derived from the field strength by the following formula:

$$P = (E \cdot r)^2 / 30 \cdot G$$

Where,

E – Field Strength in V/m, r – measurement distance in meters

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The field strength is related to power density (s) by  $s = E^2 / 377$

$$\begin{aligned} P &= ((377*s)^{1/2} * r)^2 / 30 * G \\ &= ((377*2.3)^{1/2} * 3)^2 / 30 * 4,740.5 = 0.0549 \text{ watts or } 54.9 \text{ mW} \end{aligned}$$

**Frequency Stability**

(f) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

Since there is not specific frequency deviation tolerance other than the emission must stay in the band, the maximum frequency deviation is determined as follows using the transmitters side-band frequency:

$$\begin{aligned}\text{Maximum Frequency Deviation} &= \text{Side-band Frequency} - \text{Band Start Frequency} \\ &= 59010.0 - 59.0 = \pm 10 \text{ MHz}\end{aligned}$$

For the highest frequency, the separation from the band edge to the side-band frequency is greater so the 10 MHz will be used there as well.

|                                                                   |
|-------------------------------------------------------------------|
| Measurement results are found in Section XII of this test report. |
|-------------------------------------------------------------------|

**Human Exposure to RF Fields**

(g) Regardless of the power density levels permitted under this section, devices operating under the provisions of this section are subject to the radio frequency radiation exposure requirements specified in § 1.1307(b), § 2.1091 and § 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

|                                                                                 |
|---------------------------------------------------------------------------------|
| Statement of compliance can be found in the attached document "Part 15MPE.doc". |
|---------------------------------------------------------------------------------|

**Prohibition on external Phase-Locking Inputs**

(h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other

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transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

|                                                                |
|----------------------------------------------------------------|
| No provisions exist for external phase locking of this device. |
|----------------------------------------------------------------|

**Transmitter Identification Requirement**

(i) Within any one second interval of signal transmission, each transmitter with a peak output power equal to or greater than 0.1 mW or a peak power density equal to or greater than 3 nW/cm<sup>2</sup>, as measured 3 meters from the radiating structure, must transmit a transmitter identification at least once. Each application for equipment authorization must declare that the equipment contains the required transmitter identification feature and must specify a method whereby interested parties can obtain sufficient information, at no cost, to enable them to fully detect and decode this transmitter identification information. Upon the completion of decoding, the transmitter identification data block must provide the following fields.

1. FCC Identifier, which shall be programmed at the factory.
2. Manufacturer's serial number, which shall be programmed at the factory.
3. Provision for at least 24 bytes of data relevant to the specific device, which shall be field programmable. The grantee must implement a method that makes it possible for users to specify and update this data. The recommended content of this field is information to assist in contacting the operator.

|                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------|
| Discussion of the transmitter identification feature is described in the attached documents "FCC Identifier.doc" and "FCC Letter.pdf". |
|----------------------------------------------------------------------------------------------------------------------------------------|

## **Part 2**

### **2.201 Emission Modulation and transmission characteristics**

The emission designator is determined as follows

Bandwidth is measured to be:

The main carrier modulation is pulse modulation using a sequence of un-modulated pulses. Therefore the first symbol is '5'.

The modulating signal is a single channel of digital information without the use of a modulating sub-carrier. Therefore the second symbol is '2'.

The type of information transmitted is a combination of all information types described in FCC section 2.201. Therefore the third symbol is 'W'

The emissions designator is:

**'52W'**

### **2.1041 Measurement Procedures**

Only the measurement procedures of Part 15 are required for this device. The device was not evaluated to the requirements of 2.1046 through 2.1057.

### **2.1091 Radiofrequency radiation exposure evaluation: Mobile Devices**

A Maximum Radiated Exposure evaluation statement, with supporting calculations is contained in the attachment "Part 15 MPE.doc".

### **2.1093 Radiofrequency radiation exposure evaluation: Portable Devices**

The device does not meet the definition of a portable device (That is it is not intended to operate within 20 cm of a persons body, it is used in a furnace and is magnetically activated inside the furnace) and is

therefore exempt from the requirements of this section.

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**III - Attestation**

**LABORATORY MEASUREMENTS**

**Pursuant To  
Part 15, Subpart C  
For  
Intentional Radiators**

**Company Name:** Harmonix Corporation  
**Address:** 1755 Osgood Street  
Andover, MA 01845

**Model:** EK6HOC3JH-SGM

**Date of Test(s):** May 24, 25 & 26, 2000

**Test Site Location:** INTERTEK TESTING SERVICES NA INC.  
70 Codman Hill Road  
Boxborough, MA 01719

**Site:** 3C

We attest to the accuracy of this report:



\_\_\_\_\_  
Signature

\_\_\_\_\_  
Michael J. Peters

\_\_\_\_\_  
Testing Performed By:

\_\_\_\_\_  
Senior Project Engineer

\_\_\_\_\_  
Title

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Robert F. Martin

\_\_\_\_\_  
Reviewer

\_\_\_\_\_  
Chief EMC Engineer

\_\_\_\_\_  
Title

## **IV - Site Description**

### **Introduction**

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C, General Requirements.

A. **Test Set-Up:** The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 (1992).

1. The test site is a Plastic/Fiberglass structure with a groundplane. The site has attenuation characteristics which meet the requirements of ANSI C63.4 (1992). Information on the site has been filed with the FCC as required by Rule 2.948. The address of the site is 70 Codman Hill Road, Boxborough, MA 01719.
2. Power to the site is nominal line voltage of 117 V<sub>AC</sub> and 230 V<sub>AC</sub>, 60 Hz.
3. The equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the groundplane. During the radiated emissions test, the turntable is rotated 360 degrees and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the search for maximum signal levels. The height of the antenna is varied from one meter to four meters. Body-worn, hand-held and small portable devices are mounted on a non-conductive box and emissions are investigated on three orthogonal axis.
4. Detector function for radiated emissions is in peak or quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings according to the following formula:

$$\text{Averaging Factor in dB} = 20 \text{ LOG (duty cycle)}$$

The time period over which the duty cycle is measured is 100 msec. The worst-case (highest percentage on) duty cycle is used and described specifically in the data section. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix 465 Oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

5. Antennas used below 1000 MHz were EMCO Model 3142 Biconolog Antennas and Compliance Designe Inc. Model A100 tuned Dipole Antennas. For measurements between 1000 MHz and 18000 MHz above 1 GHz, an EMCO Model: 3115 Horn Antenna is used. The Antennas used are listed in the Test Equipment Summary.
6. The field strength measuring equipment used included:

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### V - Measurement Equipment

The following equipment was used to make measurements for emissions testing:

| Description       | Manufacturer      | Model              | Serial #   | Cal Due    |
|-------------------|-------------------|--------------------|------------|------------|
| ANTENNA           | EMCO              | 3142               | 9711-1223  | 10/12/2000 |
| RECEIVER          | HEWLETT PACKARD   | 8542E              | 3625A00188 | 01/19/2001 |
| RF FILTER         | HEWLETT PACKARD   | 85420E             | 3427A00177 | 01/19/2001 |
| PREAMPLIFIER      | MITEQ             |                    |            |            |
| MIXER, 140-220GHZ | MILLITECH         | MSH-05-8FDCSN 8807 | 017        |            |
| MIXER, 50-75GHZ   | MILLITECH         | MHB-15-R00W0 8203  | 019        |            |
| MIXER, 33-50GHZ   | MILLITECH         | MHB-22-R00W0 8203  | 013        |            |
| MIXER, 110-170GHZ | MILLITECH         | MHB-06-R00WN 8807  | 022        |            |
| MIXER, 75-110GHZ  | MILLITECH         | MHB-10-R00W0 8203  | 015        |            |
| LISN              | SOLAR ELECTRONICS | 8012-50-R-24-BNC   | 865575     | 04/20/2001 |
| HORN ANTENNA      | EMCO              | 3115               | 9602-4675  | 11/04/2000 |

7. The frequency range to be scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency, or 40 GHz, whichever is lower. For line-conducted emissions, the range scanned is 450 kHz to 30 MHz.
8. The EUT is warmed up for 15 minutes prior to the test. AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new battery is used.
9. Conducted measurements were made as described in ANSI C63.4 (1992). An IF bandwidth of 9 kHz is used, and peak or quasi-peak detection is employed.
10. The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application No. 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report. Above 1000 MHz, a bandwidth of 1 MHz is generally used.
11. Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz (where no preamplifier is used), signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

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12. For measurements made in the 9 kHz to 30 MHz range, a distance of 30 meters was used unless a good signal-to-noise ratio could not be obtained. In that case, a closer distance was used and that distance is so marked in the data table.

### VI – Summary of Equipment Under Test

|    |                                                              |                         |
|----|--------------------------------------------------------------|-------------------------|
| 1  | <b>Manufacturer:</b>                                         | Harmonix Corporation    |
| 2  | <b>Grantee:</b>                                              | Harmonix Corporation    |
| 3  | <b>Model No.:</b>                                            | EK6HOC3JH-SGM           |
| 4  | <b>Trade Name:</b>                                           | GigaLINK™               |
| 5  | <b>Serial No.:</b>                                           |                         |
| 6  | <b>Date of Test:</b>                                         | May 24, 25 & 26, 2000   |
| 7  | <b>Frequencies to which device can be tuned</b>              | 59.16 to 63.60 GHz      |
| 8  | <b>Can customer tune device?</b>                             | NO                      |
| 9  | <b>Detailed description of operation pursuant to 15.209:</b> | See Section II - 15.209 |
| 10 | <b>Applicable emissions limits:</b>                          | 15.255, 15.209          |
| 11 | <b>Additional Comments:</b>                                  |                         |

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### VII - Configuration Information

**Equipment Under Test:** Communications Transceiver

**Model:** EK6HOC3JH-SGM

**Serial No.:**

**FCC Identifier:**

### Support Equipment:

COMMS Analyzer

\* Remotely Located \*

Manufacturer: Hewlett Packard  
Model: 37717C  
Serial Number: GB00000407

OC3port Plus

\* Remotely Located \*

Manufacturer: Fluke  
Model: OC3P2S  
Serial Number: 7468001

ITE Power Supply

\* Remotely Located \*

Manufacturer: Ault Inc  
Model: SW 108  
Serial Number: Not Labeled

Power Supply

Manufacturer: Harmonix  
Model: Not Labeled  
Serial Number: Not Labeled

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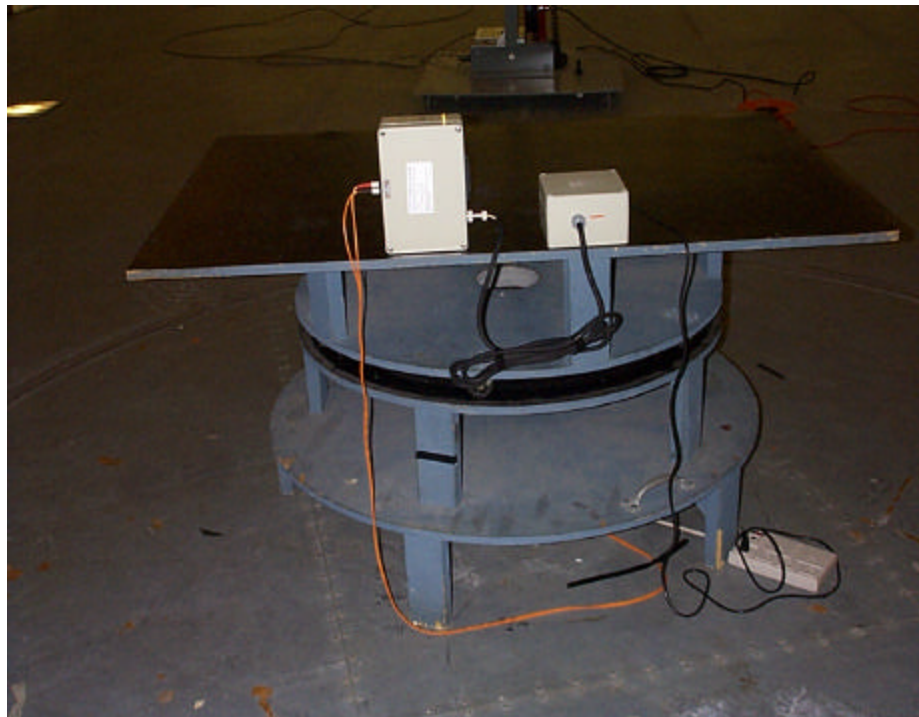
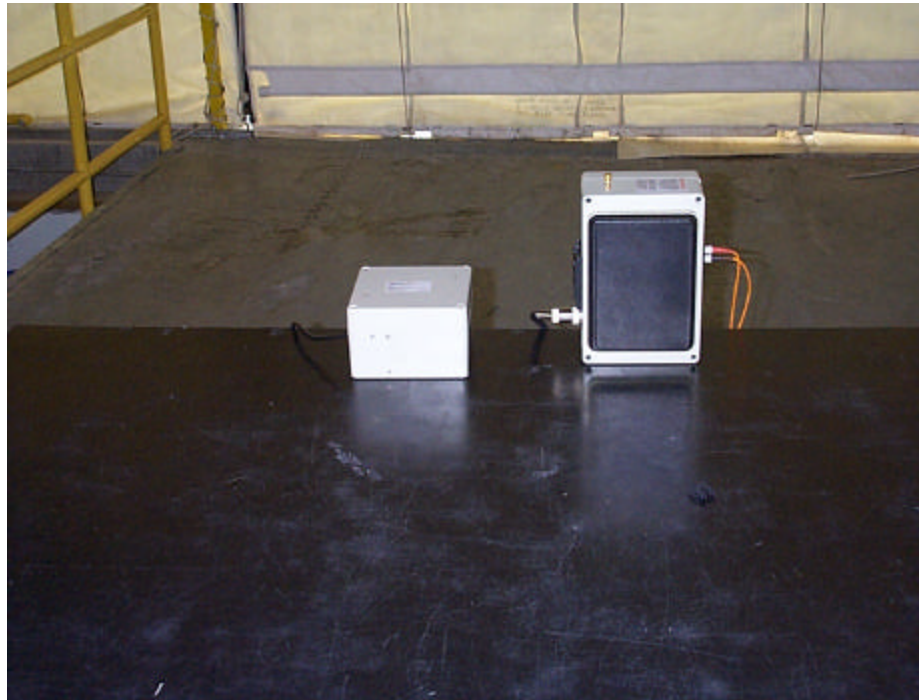
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**Cables:**

| <b>QTY</b> | <b>Description</b> | <b>Shield Description</b> | <b>Hood Description</b> | <b>Length<br/>(m)</b> |
|------------|--------------------|---------------------------|-------------------------|-----------------------|
| 2          | Fiber-optic        | Unshielded                | Plastic                 | 5                     |
| 1          | Power Cord         | Unshielded                | Plastic                 | 2                     |

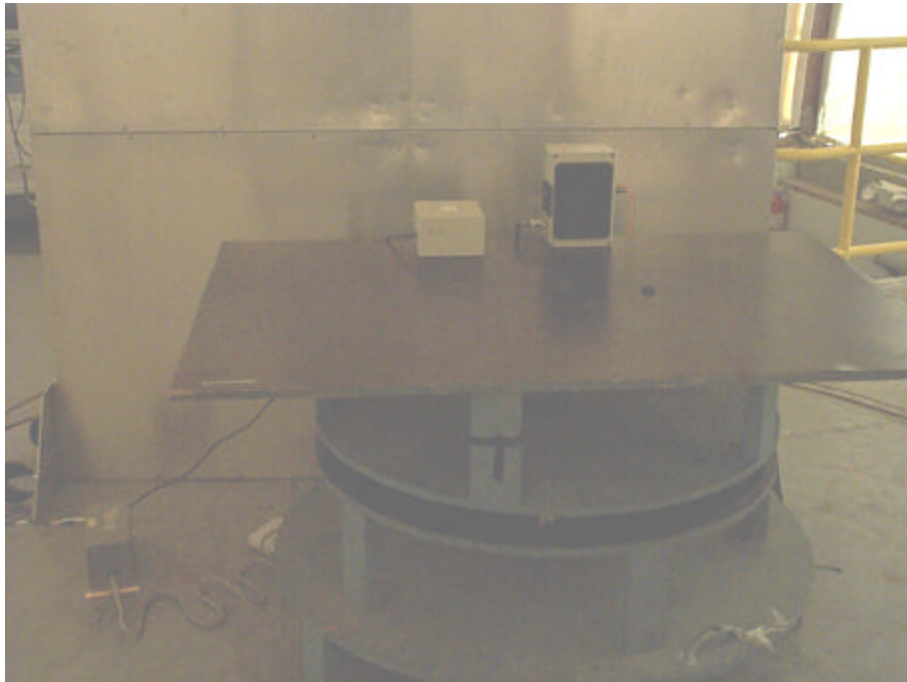
**VIII - Configuration Photographs**

**Worst-Case Radiated Emissions**

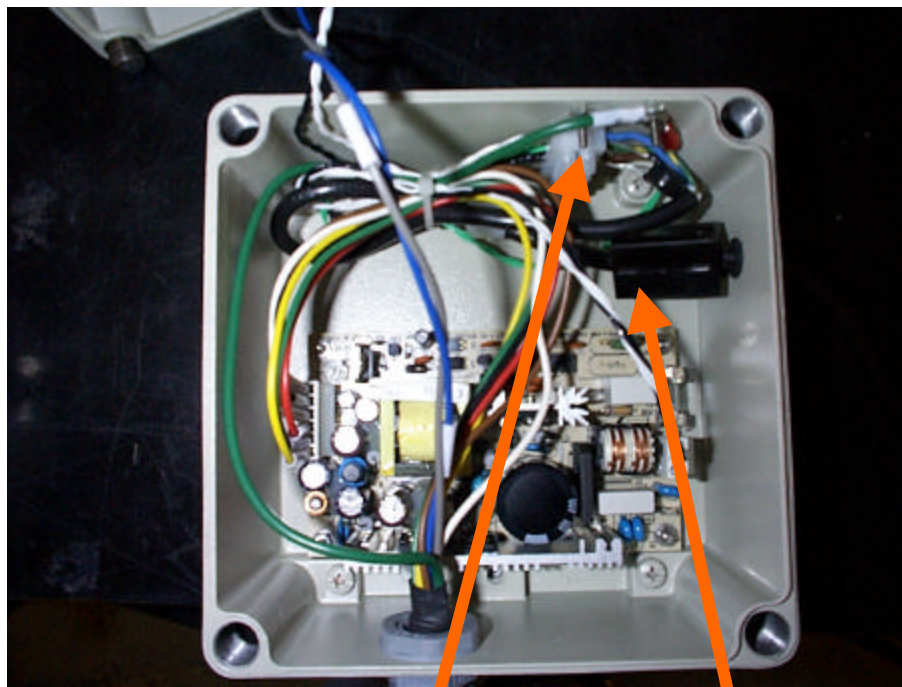




**Worst-Case Line-Conducted Emissions**



Photograph of Ferrite Sleeve Modification:



Power Block where  
Capacitors are installed

Ferrite  
Sleeve

## **IX - Sample Calculation**

The following is how net field strength readings were determined:

$$NF = RF + AF + CF + PF + DF$$

Where,

NF = Net Reading in dBμV/m

RF = Reading from receiver in dBμV/m

AF = Antenna Correction Factor in dB

CF = Cable Correction Factor in dB

PF = Preamplifier Correction Factor in dB

DF = Distance Factor in dB (using 20 dB/decade), from 3 to 1 meters 10.5 dB was added for measurements performed at 1 meter

To convert from dBμV/m to μV/m or mV/m the following was used:

$$UF = 10^{(NF / 20)}$$

Where,

UF = Net Reading in μV/m

$$MF = UF / 1000$$

Where,

MF = Net Reading in mV/m

### **Example:**

For the fundamental field strength measurement at [Frequency] (distance = [d] meters) see table [x].

$$NF = RF + AF + CF + PF + DF$$

$$UF = xx^{(xx.x \text{ dB}\mu\text{V} / 20)} = yyy,yyy \mu\text{V/m}$$

$$MF = yyy,yyy \mu\text{V} / 1000 = zz.z \text{ mV/m}$$

# Intertek Testing Services NA, Inc.

## X - Data Tables

### Radiated Emissions / Interference

Table: 1

Company: **Harmonix**

Model: **Patch Antenna - SGM**

Job No.: **J20013614**

Date: 05/24/00

Standard: FCC Part 15, 15.255

Class: None      Group: None

Notes: RBW=1MHz, VBW=7MHz

Tested by: Michael Peters

Location: Site 3C

Detector: TEK 2784

Antenna: Mixer + Horn (33-200)

PreAmp: None

Cable(s): 1.5 m High Frequency

Distance: **3.000** meters

|          | Ant.<br>Pol.<br>(V/H)         | Frequency<br>MHz | Reading<br>dBm | Antenna<br>Factor<br>dB(1/m) | Cable<br>Loss<br>dB | Mixer<br>Factor<br>dB | Net<br>dB(uV/m) | Net<br>(uW/cm <sup>2</sup> ) | Limit<br>(uW/cm <sup>2</sup> ) | Pass/<br>Fail |
|----------|-------------------------------|------------------|----------------|------------------------------|---------------------|-----------------------|-----------------|------------------------------|--------------------------------|---------------|
|          | <b>MID Channel</b>            |                  |                |                              |                     |                       |                 |                              |                                |               |
| av<br>pk | h                             | 61380.090        | 61.4           | 40.945                       | 0.8                 | 23.0                  | 126.1           | 1.092                        | 9.0                            | Pass          |
|          |                               | 61380.090        | 64.7           | 40.9                         | 0.8                 | 23.0                  | 129.4           | 2.334                        | 18.0                           | Pass          |
|          | h                             | 61224.530        | 34.6           | 40.9                         | 0.8                 | 23.0                  | 99.3            | 0.002                        | 9.0                            | Pass          |
|          | h                             | 61069.160        | 34.2           | 40.9                         | 0.8                 | 23.0                  | 98.9            | 0.002                        | 9.0                            | Pass          |
|          | h                             | 61516.500        | FALSE          | 41.0                         | 0.8                 | 23.0                  |                 |                              |                                |               |
|          | h                             | 61540.000        | 37.6           | 41.0                         | 0.8                 | 23.0                  | 102.4           | 0.005                        | 9.0                            | Pass          |
|          | h                             | 60913.450        | 26.0           | 40.9                         | 0.8                 | 23.0                  | 90.7            | 0.000                        | 9.0                            | Pass          |
|          | <b>Low Channel</b>            |                  |                |                              |                     |                       |                 |                              |                                |               |
| av<br>pk | h                             | 59162.060        | 63.7           | 40.6                         | 0.8                 | 22.0                  | 127.1           | 1.368                        | 9.0                            | Pass          |
|          | h                             | 59162.060        | 67.9           | 40.6                         | 0.8                 | 22.0                  | 131.3           | 3.599                        | 18.0                           | Pass          |
|          | h                             | 59010.000        | 34.8           | 40.6                         | 0.8                 | 22.0                  | 98.2            | 0.002                        | 9.0                            | Pass          |
|          | h                             | 59321.000        | 35.6           | 40.6                         | 0.8                 | 22.0                  | 99.0            | 0.002                        | 9.0                            | Pass          |
|          | <b>High Channel</b>           |                  |                |                              |                     |                       |                 |                              |                                |               |
| av<br>pk | h                             | 63597.860        | 59.7           | 41.3                         | 0.8                 | 24.0                  | 125.8           | 0.998                        | 9.0                            | Pass          |
|          | h                             | 63597.860        | 64.5           | 41.3                         | 0.8                 | 24.0                  | 130.6           | 3.013                        | 18.0                           | Pass          |
|          | h                             | 63573.140        | 32.3           | 41.2                         | 0.8                 | 24.0                  | 98.3            | 0.002                        | 9.0                            | Pass          |
|          | h                             | 63442.300        | 33.4           | 41.2                         | 0.8                 | 24.0                  | 99.4            | 0.002                        | 9.0                            | Pass          |
|          | Parabola Antenna May 25, 2000 |                  |                |                              |                     |                       |                 |                              |                                |               |

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## Intertek Testing Services NA, Inc.

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### Radiated Emissions / Interference

Table: 2

Company: **Harmonix**

Model: **Parabolic Antenna - SGM**

Job No.: **J20013614**

Date: 05/25/00

Standard: FCC Part 15, 15.255

Class: None      Group: None

Notes: RBW=1MHz, VBW=7MHz

Tested by: Michael Peters

Location: Site 3C

Detector: TEK 2784

Antenna: Mixer + Horn (33-200)

PreAmp: None

Cable(s): 1.5 m High Frequency

Distance: **3.000** meters

|          | Ant.<br>Pol.<br>(V/H) | Frequency<br>MHz | Reading<br>dBm | Antenna<br>Factor<br>dB(1/m) | Cable<br>Loss<br>dB | Mixer<br>Factor<br>dB | Net<br>dB(uV/m) | Net<br>(uW/cm <sup>2</sup> ) | Limit<br>(uW/cm <sup>2</sup> ) | Pass/<br>Fail |
|----------|-----------------------|------------------|----------------|------------------------------|---------------------|-----------------------|-----------------|------------------------------|--------------------------------|---------------|
|          | <b>HIGH Channel</b>   |                  |                |                              |                     |                       |                 |                              |                                |               |
| av<br>pk | V                     | 62024.000        | FALSE          | 41.0                         | 0.8                 | 23.0                  |                 |                              |                                |               |
|          | V                     | 61842.220        | 68.8           | 41.0                         | 0.8                 | 23.0                  | 133.6           | 6.090                        | 9.0                            | Pass          |
|          | V                     | 61842.220        | 73.0           | 41.0                         | 0.8                 | 23.0                  | 137.8           | 16.019                       | 18.0                           | Pass          |
|          | V                     | 62464.100        | 45.0           | 41.1                         | 0.8                 | 23.0                  | 109.9           | 0.026                        | 9.0                            | Pass          |
|          | V                     | 61220.100        | 45.4           | 40.9                         | 0.8                 | 23.0                  | 110.1           | 0.027                        | 9.0                            | Pass          |
|          | <b>LOW Channel</b>    |                  |                |                              |                     |                       |                 |                              |                                |               |
| av<br>pk | V                     | 59845.700        | 70.5           | 40.7                         | 0.8                 | 22.0                  | 134.0           | 6.701                        | 9.0                            | Pass          |
|          | V                     | 59845.700        | 74.5           | 40.7                         | 0.8                 | 22.0                  | 138.0           | 16.736                       | 18.0                           | Pass          |
|          | V                     | 60467.560        | 50.0           | 40.8                         | 0.8                 | 22.0                  | 113.6           | 0.061                        | 9.0                            | Pass          |
|          | V                     | 59223.350        | 48.8           | 40.6                         | 0.8                 | 22.0                  | 112.2           | 0.044                        | 9.0                            | Pass          |

# Intertek Testing Services NA, Inc.

## Radiated Emissions / Interference

Table: 3

Company: **Harmonix**

Model: **Patch Antenna - SGM**

Job No.: **J20013614**

Date: 05/24/00

Standard: FCC15

Class: B

Group: None

Notes: Radiated Emissions from 30 MHz to 40 GHz

Tested by: Michael Peters

Location: Site 3C

Detector: HP 8542E

Antenna: LOG1 7-2-99 H10

PreAmp: None

Cable(s): 3C-3m 3-1-00

Distance: **3** meters

RBW 120 kHz < 1 GHz, 1MHz > 1GHz

|    | Ant.<br>Pol.<br>(V/H)                                                     | Frequency<br>MHz | Reading<br>dB(uV) | Antenna<br>Factor<br>dB(1/m) | Cable<br>Loss<br>dB | Pre-amp<br>Factor<br>dB | Distance<br>Factor<br>dB | Net<br>dB(uV/m) | Limit<br>dB(uV/m) | Margin<br>dB |   |
|----|---------------------------------------------------------------------------|------------------|-------------------|------------------------------|---------------------|-------------------------|--------------------------|-----------------|-------------------|--------------|---|
| bb | V                                                                         | 35.570           | 25.4              | 15.1                         | 0.3                 | 0.0                     | 0.0                      | 40.8            | 40.0              | +0.8         | * |
|    | V                                                                         | 39.750           | 20.4              | 12.7                         | 0.3                 | 0.0                     | 0.0                      | 33.4            | 40.0              | -6.6         |   |
|    | Installed a 1/4" ferrite on the power (to AC mains) internal to the unit. |                  |                   |                              |                     |                         |                          |                 |                   |              |   |
| bb | V                                                                         | 35.500           | 21.5              | 15.1                         | 0.3                 | 0.0                     | 0.0                      | 36.9            | 40.0              | -3.1         |   |
| bb | V                                                                         | 56.350           | 19.6              | 7.8                          | 0.5                 | 0.0                     | 0.0                      | 27.9            | 40.0              | -12.1        |   |
| bb | V                                                                         | 74.300           | 14.7              | 6.5                          | 0.1                 | 0.0                     | 0.0                      | 21.3            | 40.0              | -18.7        |   |
|    | V                                                                         | 155.710          | 20.7              | 8.7                          | 0.5                 | 0.0                     | 0.0                      | 29.9            | 43.5              | -13.6        |   |
|    | V                                                                         | 155.250          | 21.5              | 8.7                          | 0.5                 | 0.0                     | 0.0                      | 30.7            | 43.5              | -12.8        |   |
|    | V                                                                         | 137.600          | 14.4              | 7.4                          | 0.4                 | 0.0                     | 0.0                      | 22.1            | 43.5              | -21.4        |   |
|    | V                                                                         | 200.550          | 13.9              | 9.9                          | 1.0                 | 0.0                     | 0.0                      | 24.8            | 43.5              | -18.7        |   |
|    | V                                                                         | 181.250          | 16.9              | 9.9                          | 0.8                 | 0.0                     | 0.0                      | 27.6            | 43.5              | -15.9        |   |
|    | V                                                                         | 234.000          | 13.5              | 11.7                         | 1.2                 | 0.0                     | 0.0                      | 26.4            | 46.0              | -19.6        |   |
|    | V                                                                         | 267.380          | 13.7              | 12.7                         | 1.3                 | 0.0                     | 0.0                      | 27.7            | 46.0              | -18.3        |   |
|    | V                                                                         | 401.640          | 8.1               | 16.3                         | 1.7                 | 0.0                     | 0.0                      | 26.1            | 46.0              | -19.9        |   |
| bb | V                                                                         | 3860.000         | 41.9              | 33.5                         | 1.9                 | 22.1                    | 9.5                      | 45.7            | 54.0              | -8.3         |   |
|    | V                                                                         | 28500.000        | 38.6              | 47.0                         | 4.1                 | 34.9                    | 9.5                      | 45.3            | 54.0              | -8.7         |   |

**Conducted Emissions / Interference**

Table: 4

Company: Harmonix

Model: Patch Antenna - SGM

Job No.: J20013614

Date: 05/25/00

Standard: FCC15

Class: B

Group: None

Notes:

Tested by: Michael Peters

Location: Site 3C

Detector: HP 8542E

Cable(s): 3C-3m 3-1-00

Limiter: yes

System Loss: Includes the Cable and LISN loss.

**INITIAL**

| Frequency<br>MHz | Reading<br>Side A<br>dB | Reading<br>Side B<br>dB | Attenuator<br>Factor<br>dB | System<br>Loss<br>dB | Quasi-Peak    |                 |              |
|------------------|-------------------------|-------------------------|----------------------------|----------------------|---------------|-----------------|--------------|
|                  |                         |                         |                            |                      | Net<br>dB(uV) | Limit<br>dB(uV) | Margin<br>dB |
| 0.483            | 31.1                    |                         | 20.0                       | 0.9                  | 52.0          | 48.0            | +4.0 *       |
| 0.690            | 25.3                    |                         | 20.0                       | 0.9                  | 46.2          | 48.0            | -1.8         |
| 0.897            | 29.8                    |                         | 20.0                       | 0.9                  | 50.7          | 48.0            | +2.7 *       |
| 2.829            | 29.6                    |                         | 20.0                       | 0.9                  | 50.5          | 48.0            | +2.5 *       |
| 6.008            | 31.2                    |                         | 20.0                       | 0.7                  | 51.9          | 48.0            | +3.9 *       |
| 26.660           | 32.8                    |                         | 20.0                       | 0.1                  | 52.9          | 48.0            | +4.9 *       |
| 26.150           | 34.1                    |                         | 20.0                       | 0.1                  | 54.2          | 48.0            | +6.2         |

**FINAL**

New Power Supply with 22,000 pF Y caps (and ferrite as installed yesterday)

| Frequency<br>MHz | Reading<br>Side A<br>dB | Reading<br>Side B<br>dB | Attenuator<br>Factor<br>dB | System<br>Loss<br>dB | Quasi-Peak    |                 |              |
|------------------|-------------------------|-------------------------|----------------------------|----------------------|---------------|-----------------|--------------|
|                  |                         |                         |                            |                      | Net<br>dB(uV) | Limit<br>dB(uV) | Margin<br>dB |
| 15.200           | 23.3                    | 21.7                    | 20.0                       | 0.4                  | 43.7          | 48.0            | -4.3         |
| 15.320           | 22.2                    | 22.3                    | 20.0                       | 0.4                  | 42.7          | 48.0            | -5.3         |
| 14.412           | 17.9                    | 21.3                    | 20.0                       | 0.4                  | 41.7          | 48.0            | -6.3         |
| 15.917           | 22.3                    | 23.6                    | 20.0                       | 0.4                  | 44.0          | 48.0            | -4.0         |
| 15.148           | 22.5                    | 19.5                    | 20.0                       | 0.4                  | 42.9          | 48.0            | -5.1         |
| 8.925            | 14.4                    | 20.2                    | 20.0                       | 0.7                  | 40.9          | 48.0            | -7.1         |
| 11.978           | 12.5                    | 14.0                    | 20.0                       | 0.4                  | 34.4          | 48.0            | -13.6        |
| 14.575           | 21.4                    | 20.3                    | 20.0                       | 0.4                  | 41.8          | 48.0            | -6.2         |

## XII - Bandwidth

The following plot(s) show bandwidth measurements made.

### For the Patch Antenna Radio

#### Occupied Bandwidth - Low Channel

Center Frequency: 59166.5 MHz

Resolution Bandwidth: 1000 kHz

Video Bandwidth: 7000 kHz

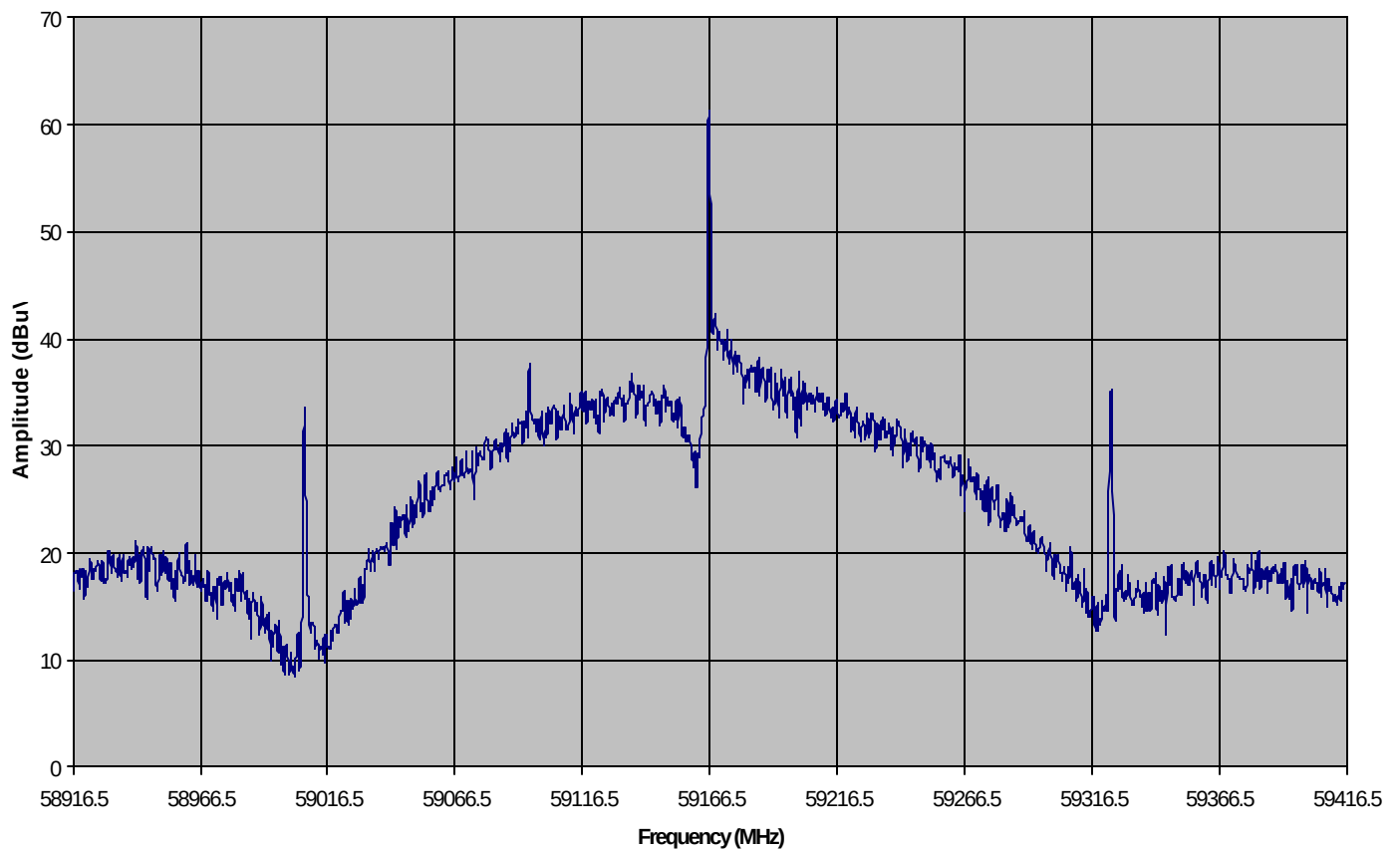
Reference Level: 87 dBuV

Attenuation: 0 dB

Span: 500 MHz

Occupied BW: 313 kHz

Date: May 25, 2000



Occupied Bandwidth - Mid Channel

Center Frequency: 61382 MHz

Resolution Bandwidth: 1000 kHz

Video Bandwidth: 7000 kHz

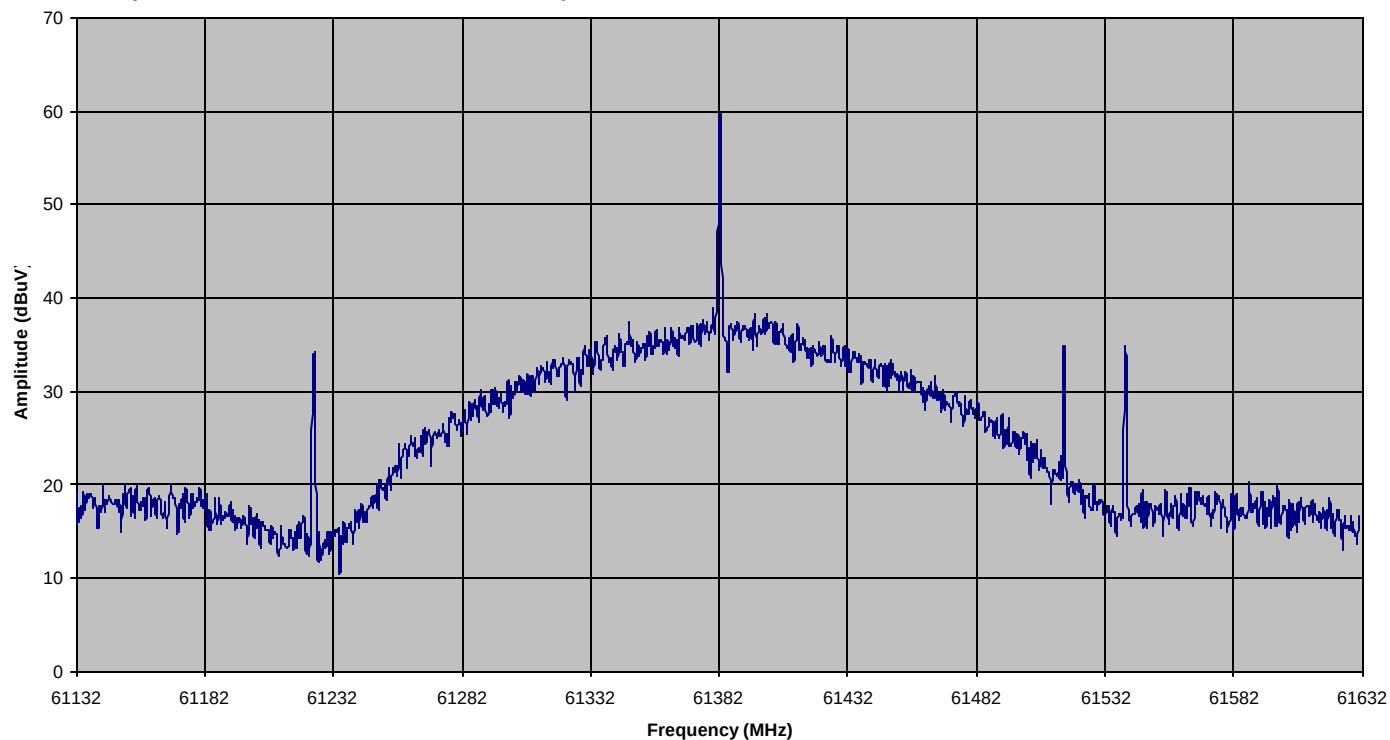
Reference Level: 87 dBuV

Attenuation: 0 dB

Span: 500 MHz

Occupied BW: 315 kHz

Date: May 25, 2000



Occupied Bandwidth - High Channel

Center Frequency: 63600 MHz

Resolution Bandwidth: 1000 kHz

Video Bandwidth: 7000 kHz

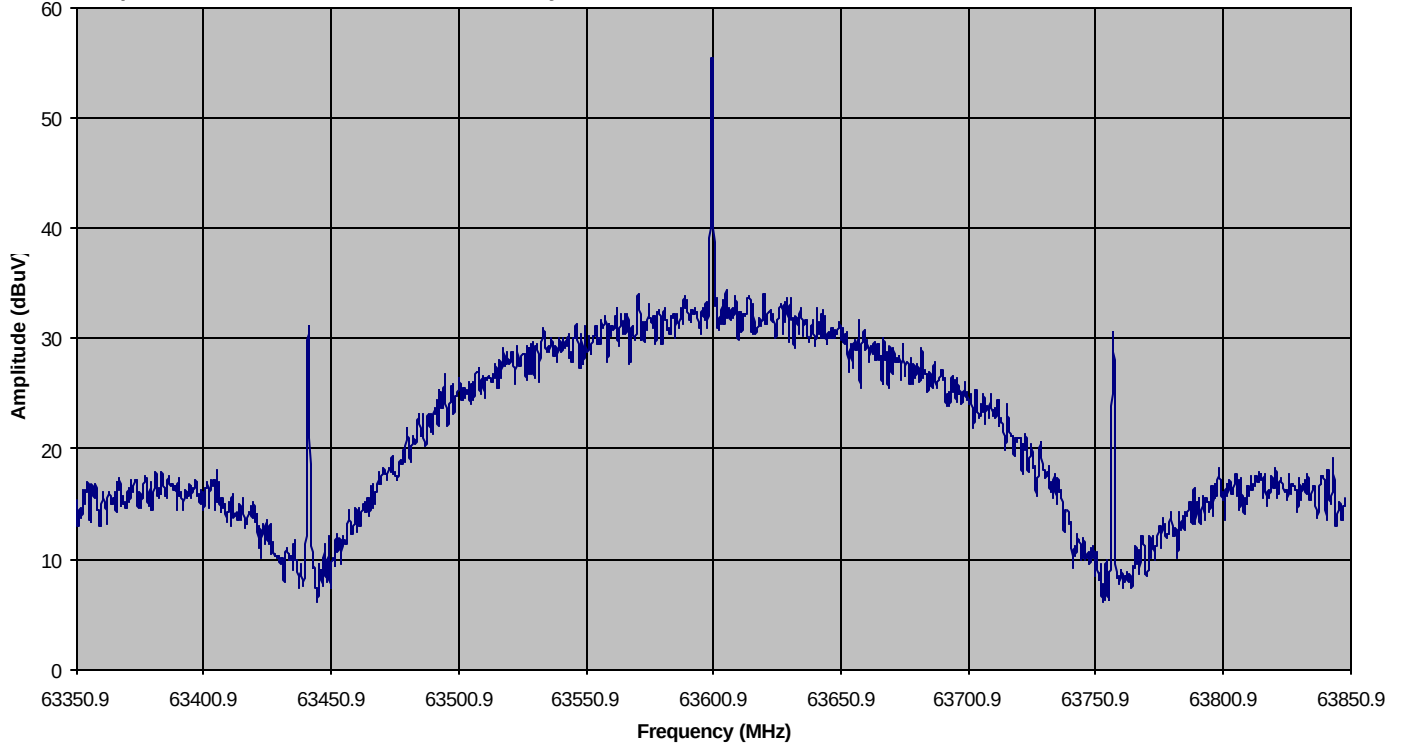
Reference Level: 87 dBuV

Attenuation: 0 dB

Span: 500 MHz

Occupied BW: 376 kHz

Date: May 25, 2000



Parabolic Antenna Radio

Occupied Bandwidth - Low Channel

Center Frequency: 59848 MHz

Resolution Bandwidth: 1000 kHz

Video Bandwidth: 7000 kHz

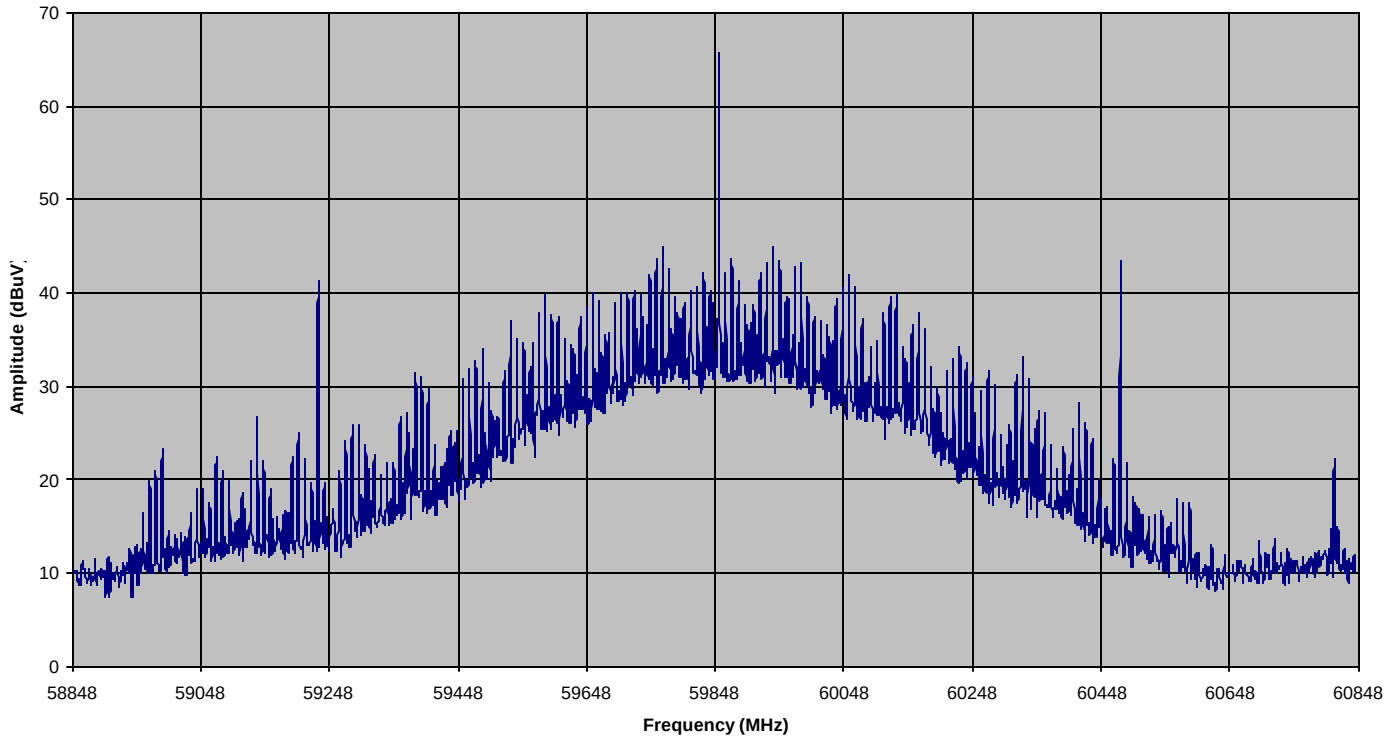
Reference Level: 95.9 dBuV

Attenuation: 0 dB

Span: 2 GHz

Occupied BW: 1148 kHz

Date: May 25, 2000



Occupied Bandwidth - Low Channel

Center Frequency: 61852 MHz

Resolution Bandwidth: 1000 kHz

Video Bandwidth: 7000 kHz

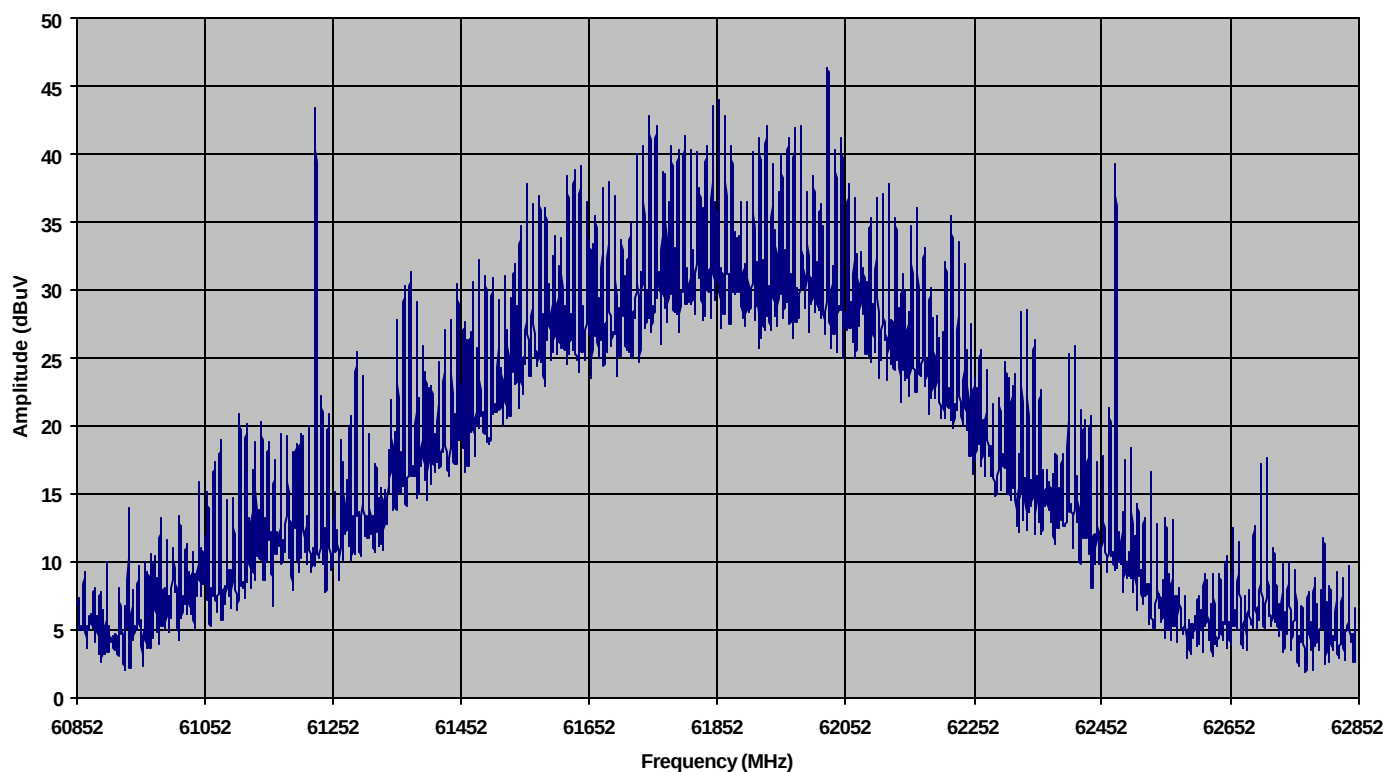
Reference Level: 87 dBuV

Attenuation: 0 dB

Span: 2 GHz

Occupied BW: 1256 kHz

Date: May 25, 2000



## Intertek Testing Services NA, Inc.

### XII - Frequency Deviation

|                     |                   |                             |                |      |
|---------------------|-------------------|-----------------------------|----------------|------|
| <b>Date of Test</b> | May 26 & 29, 2000 | <b>Test Engineer</b>        | Michael Peters |      |
| <b>Test Site</b>    | Safety Lab        | <b>Temperature/Humidity</b> | -20 to 50 °C   | 35 % |

#### Frequency Stability over Temperature

| Maximum Allowed Frequency Deviation: |          | 10 MHz                    |                          |                |            |
|--------------------------------------|----------|---------------------------|--------------------------|----------------|------------|
| Temperature (°C)                     |          | Reference Frequency (MHz) | Measured Frequency (MHz) | Deviation (Hz) | Pass/Fail? |
| -20                                  | @ 0 min  | 59,162,828,479            | 59,163,286,596           | -458,117       | Pass       |
| -20                                  | @ 2 min  | 59,162,828,479            | 59,163,287,351           | -458,872       | Pass       |
| -20                                  | @ 5 min  | 59,162,828,479            | 59,163,296,242           | -467,763       | Pass       |
| -20                                  | @ 10 min | 59,162,828,479            | 59,163,305,020           | -476,541       | Pass       |
| 20                                   |          | 59,162,828,479            |                          |                |            |
| +50                                  | @ 0 min  | 59,162,828,479            | 59,162,583,632           | 244,847        | Pass       |
| +50                                  | @ 2 min  | 59,162,828,479            | 59,162,523,962           | 304,517        | Pass       |
| +50                                  | @ 5 min  | 59,162,828,479            | 59,162,490,007           | 338,472        | Pass       |
| +50                                  | @ 10 min | 59,162,828,479            | 59,162,439,465           | 389,014        | Pass       |

#### Frequency Stability over Voltage

| Maximum Allowed Frequency Deviation: |          | 10 MHz                    |                          |                |            |
|--------------------------------------|----------|---------------------------|--------------------------|----------------|------------|
| Rated Input Voltage:                 |          | 120 VAC                   |                          |                |            |
| Voltage (VAC)                        |          | Reference Frequency (MHz) | Measured Frequency (MHz) | Deviation (Hz) | Pass/Fail? |
| 102                                  | @ 0 min  | 59,162,828,479            | 59,163,094,517           | -266,038       | Pass       |
| 102                                  | @ 2 min  | 59,162,828,479            | 59,163,076,843           | -248,264       | Pass       |
| 102                                  | @ 5 min  | 59,162,828,479            | 59,163,032,101           | -203,622       | Pass       |
| 102                                  | @ 10 min | 59,162,828,479            | 59,162,954,073           | -125,594       | Pass       |
| 120                                  |          | 59,162,828,479            |                          |                |            |
| 138                                  | @ 0 min  | 59,162,828,479            | 59,162,948,709           | -120,230       | Pass       |

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**Intertek Testing Services NA, Inc.**

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|     |          |                |                |         |      |
|-----|----------|----------------|----------------|---------|------|
| 138 | @ 2 min  | 59,162,828,479 | 59,162,901,701 | -73,222 | Pass |
| 138 | @ 5 min  | 59,162,828,479 | 59,162,881,431 | -52,952 | Pass |
| 138 | @ 10 min | 59,162,828,479 | 59,162,838,507 | -10,028 | Pass |

# Intertek Testing Services NA, Inc.

|                     |                   |                             |                |      |
|---------------------|-------------------|-----------------------------|----------------|------|
| <b>Date of Test</b> | May 26 & 29, 2000 | <b>Test Engineer</b>        | Michael Peters |      |
| <b>Test Site</b>    | Safety Lab        | <b>Temperature/Humidity</b> | -20 to 50 °C   | 35 % |

## Frequency Stability over Temperature

| Maximum Allowed Frequency Deviation: |          | 10 MHz                    |                          |                |            |
|--------------------------------------|----------|---------------------------|--------------------------|----------------|------------|
| Temperature (°C)                     |          | Reference Frequency (MHz) | Measured Frequency (MHz) | Deviation (Hz) | Pass/Fail? |
| -20                                  | @ 0 min  | 63,598,076,053            | 63,598,145,509           | -69,456        | Pass       |
| -20                                  | @ 2 min  | 63,598,076,053            | 63,598,142,113           | -66,060        | Pass       |
| -20                                  | @ 5 min  | 63,598,076,053            | 63,598,145,443           | -69,390        | Pass       |
| -20                                  | @ 10 min | 63,598,076,053            | 63,598,165,672           | -89,619        | Pass       |
| 20                                   |          | 63,598,076,053            |                          |                |            |
| +50                                  | @ 0 min  | 63,598,076,053            | 63,597,538,609           | 537,444        | Pass       |
| +50                                  | @ 2 min  | 63,598,076,053            | 63,597,488,206           | 587,847        | Pass       |
| +50                                  | @ 5 min  | 63,598,076,053            | 63,597,448,977           | 627,076        | Pass       |
| +50                                  | @ 10 min | 63,598,076,053            | 63,597,524,735           | 551,318        | Pass       |

## Frequency Stability over Voltage

| Maximum Allowed Frequency Deviation: |          | 10 MHz                    |                          |                |            |
|--------------------------------------|----------|---------------------------|--------------------------|----------------|------------|
| Rated Input Voltage:                 |          | 120 VAC                   |                          |                |            |
| Voltage (VAC)                        |          | Reference Frequency (MHz) | Measured Frequency (MHz) | Deviation (Hz) | Pass/Fail? |
| 102                                  | @ 0 min  | 63,598,076,053            | 63,598,041,400           | 34,653         | Pass       |
| 102                                  | @ 2 min  | 63,598,076,053            | 63,598,018,138           | 57,915         | Pass       |
| 102                                  | @ 5 min  | 63,598,076,053            | 63,597,983,159           | 92,894         | Pass       |
| 102                                  | @ 10 min | 63,598,076,053            | 63,597,919,044           | 157,009        | Pass       |
| 120                                  |          | 63,598,076,053            |                          |                |            |
| 138                                  | @ 0 min  | 63,598,076,053            | 63,597,901,206           | 174,847        | Pass       |
| 138                                  | @ 2 min  | 63,598,076,053            | 63,597,863,001           | 213,052        | Pass       |

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**Intertek Testing Services NA, Inc.**

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|     |          |                |                |         |      |
|-----|----------|----------------|----------------|---------|------|
| 138 | @ 5 min  | 63,598,076,053 | 63,597,848,409 | 227,644 | Pass |
| 138 | @ 10 min | 63,598,076,053 | 63,597,817,169 | 258,884 | Pass |