

**VitalCom, Inc.**  
**FCC Part 15, Class II Permissive Change Application**  
**Model DR-10000**

**November 2, 2000**

## MEASUREMENT/TECHNICAL REPORT

**COMPANY NAME:** VitalCom, Inc.  
**MODEL:** DR-10000  
**FCC ID:** BQI00DR-10000  
**DATE:** November 2, 2000

This report concerns (check one): Original grant\_\_\_\_  
Class II change \_\_X\_\_

Equipment type: **Low Power Transmitter (for Biomedical Applications)**

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:

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# SECTION 1

## GENERAL INFORMATION

## **GENERAL INFORMATION**

### **Product Description**

The Equipment Under Test (EUT) is a VitalCom, Inc., DR-10000. The DR-10000 is a wireless Access Point (AP) designed for use in medical monitoring applications. The DR-10000 receives patient monitoring data from similar radios (FCC ID: BQI00DT-4500) attached to the patients in that hospital. The DR-10000 is linked to other DR-10000's through a 10Base-T Ethernet backbone. This backbone allows the AP's to pass patient data back to the end user of the system - a nurses monitoring station. The DR-10000 is composed of two 608-614 MHz wireless transceivers and Ethernet conversion circuitry that passes data from these transceivers to the Ethernet backbone.

The DR-10000 may operate with two different types of antennas: a 0 dBi monopole to provide omni-directional coverage and a +2 dBi patch antenna to provide unidirectional coverage. The unit requires external DC power but has its own internal voltage regulation. The DR-10000 is self contained in a plastic package and is designed to be installed on the ceiling of a hospital hallway.

The EUT has been previously approved under FCC ID: BQI00DR-10000 by the FCC on 9/8/00. The transmitter modules have been modified since this application as follows:

- 1) The SAW RF bandpass filter (reference designator F5 in the transmit chain has been replaced by a third order, top capacitively coupled LC filter. This change will result in increased yield.
- 2) The power amplifier transistor, HBFP450 (reference designator Q3) in the transmit chain has been replaced by transistor BFP450. The replacement transistor is the functional and performance equivalent of the original transistor. The change is in place to allow alternate supply to facilitate planning.

These changes will be incorporated into all future units.

### **Related Submittal(s)/Grant(s)**

The EUT has been previously approved under FCC ID: BQI00DR-10000 on 9/8/00.

Additionally, the EUT will be used with other transceivers (already submitted and approved under FCC ID: BQI00DT-4500).

## SECTION 2

### TESTS AND MEASUREMENTS

## TESTS AND MEASUREMENTS

### Configuration of Tested System

The sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (1992). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. 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 and fundamental emissions are shown in Figure 2.

Since the EUT has been previously tested and approved, only the specific tests that would be affected by the changes to the EUT (as given in the product description) are given in this report.

### Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

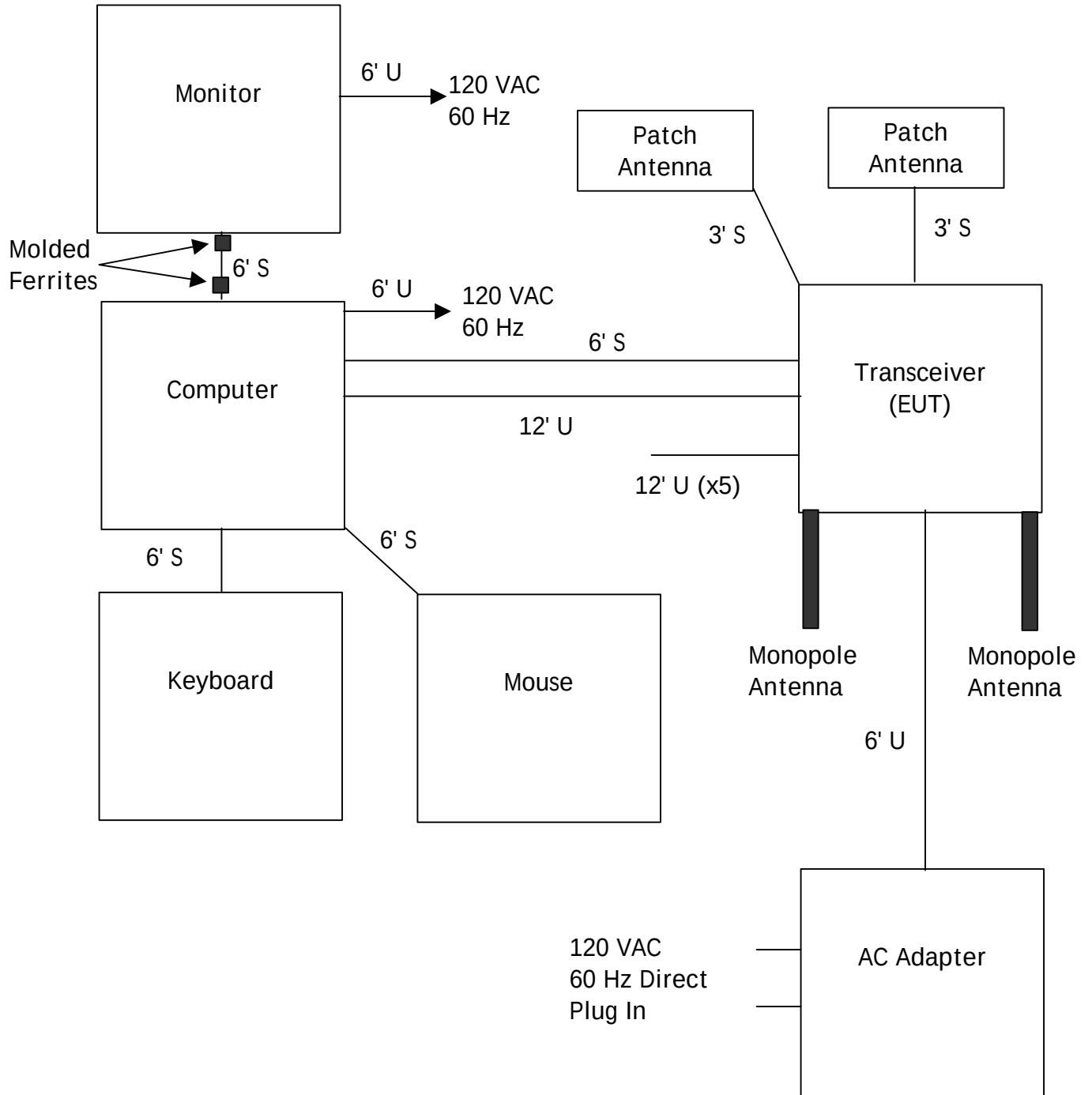
### Modifications

No modifications were made by US Tech, to bring the EUT into compliance with FCC Part 15 limits for the transmitter portion of the EUT or the Class A Digital Device Requirements.

### Test Equipment

Table 2 describes test equipment used to evaluate this product.

**FIGURE 1**  
**TEST CONFIGURATION**



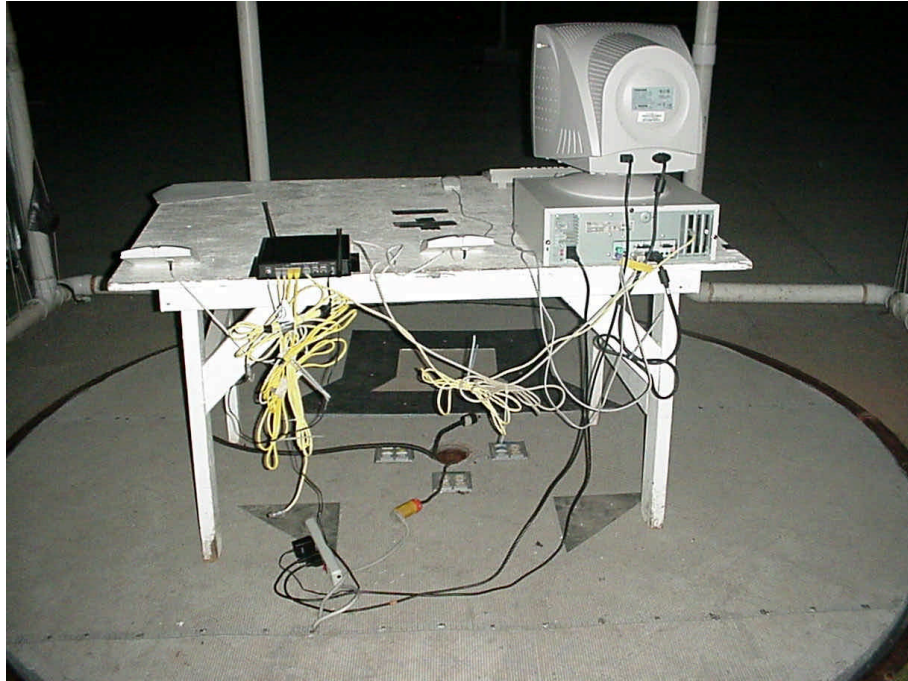
**FIGURE 2a**

**Photograph(s) for Fundamental, Spurious and Digital Devices Emissions**



**FIGURE 2b**

**Photograph(s) for Fundamental, Spurious and Digital Devices Emissions**



**FIGURE 2c**

**Photograph(s) for Conducted Emissions**



**TABLE 1****EUT and Peripherals**

| <b>PERIPHERAL<br/>MANUFACTURER</b>     | <b>MODEL<br/>NUMBER</b>       | <b>SERIAL<br/>NUMBER</b> | <b>FCC ID:</b>                            | <b>CABLES<br/>P/D</b>         |
|----------------------------------------|-------------------------------|--------------------------|-------------------------------------------|-------------------------------|
| Transmitter<br>VitalCom, Inc.<br>(EUT) | DR-10000                      | None                     | BQI00DR-10000<br>(Previously<br>approved) | 6' S<br>12' U<br>5 @ 12' U    |
| Antenna (x2)<br>Cushcraft              | SL6081<br>(Patch, +2 dBi)     | None                     | None                                      | 3' S each                     |
| Antenna (x2)<br>Nearson, Inc.          | P-24A48G<br>(Monopole, 0 dBi) | None                     | None                                      | None                          |
| AC Adapter<br>Volgen                   | SPU10R-2                      | 00172142                 | N/A                                       | 6' U                          |
| Computer<br>Hewlett Packard            | Vectra VE17DT                 | US92702722               | DoC Approved                              | 6' U<br>Power<br>Cord         |
| Monitor<br>Toshiba                     | TekBright 510V                | 89035633                 | EWBOC15DB06                               | 6' S<br>6' U<br>Power<br>Cord |
| Keyboard<br>Hewlett Packard            | SK-2502C                      | C990608784               | DoC Approved                              | 6' S                          |
| Mouse<br>Hewlett Packard               | M-S34                         | LZE92123016              | DZL211029                                 | 6' S                          |

**TABLE 2****TEST INSTRUMENTS**

| <b>TYPE</b>          | <b>MANUFACTURER</b> | <b>MODEL</b> | <b>SN.</b>         |
|----------------------|---------------------|--------------|--------------------|
| SPECTRUM ANALYZER    | HEWLETT-PACKARD     | 8593E        | 3205A00124         |
| SPECTRUM ANALYZER    | HEWLETT-PACKARD     | 8558B        | 2332A09900         |
| S A DISPLAY          | HEWLETT-PACKARD     | 853A         | 2404A02387         |
| COMB GENERATOR       | HEWLETT-PACKARD     | 8406A        | 1632A01519         |
| RF PREAMP            | HEWLETT-PACKARD     | 8447D        | 1937A03355         |
| RF PREAMP            | HEWLETT-PACKARD     | 8449B        | 3008A00480         |
| HORN ANTENNA         | EMCO                | 3115         | 3723               |
| BICONICAL ANTENNA    | EMCO                | 3110         | 9307-1431          |
| LOG PERIODIC ANTENNA | EMCO                | 3146         | 9110-3600          |
| LISN                 | SOLAR ELE.          | 8028         | 910495 &<br>910494 |
| THERMOMETER          | FLUKE               | 52           | 5215250            |
| MULTIMETER           | FLUKE               | 85           | 53710469           |
| PLOTTER              | HEWLETT-PACKARD     | 7475A        | 2325A65394         |

**Frequency Range of Fundamental(s) (47 CFR 15.242(b))**

Under all conditions of operation, the fundamental emissions shall be contained within a single television broadcast channel and lie wholly within the frequency range of 174-216 MHz and 470-668 MHz.

The EUT is designed to operate within TV channel 37 on the following frequency list:

|            |
|------------|
| 608.6656   |
| 608.802133 |
| 608.938667 |
| 609.0752   |
| 609.211733 |
| 609.348267 |
| 609.4848   |
| 609.621333 |
| 609.757867 |
| 609.8944   |
| 610.030933 |
| 610.167467 |
| 610.304    |
| 610.440533 |
| 610.577067 |
| 610.7136   |
| 610.850133 |
| 610.986667 |
| 611.1232   |
| 611.259733 |
| 611.396267 |
| 611.5328   |
| 611.669333 |
| 611.805867 |
| 611.9424   |
| 612.078933 |
| 612.215467 |
| 612.352    |
| 612.488533 |
| 612.625067 |
| 612.7616   |
| 612.898133 |

### **Field Strength of Fundamental Emission (47 CFR 15.242(c))**

Measurements were made using a QP detector. Field strength taken of the fundamental emission is shown in Tables 3a through 3c. Both Radios were checked (one radio with patch antennas and the other with monopoles). Only the worse case results are shown for each low, middle, and high transmit channel.

TABLE 3a

## FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: October 16, 2000  
 UST Project: 00-0465  
 Customer: VitalCom, Inc.  
 Model: DR-10000

QP Measurement (Low Channel)  
 Highest Emission measured from Radio A

| FREQ.<br>(MHz) | TEST DATA<br>(Dbm)<br>@ 3m | ANTENNA FACTOR<br>+<br>CABLE ATTENUATION | RESULTS<br>(uV/m)<br>@ 3m | QP<br>FCC LIMITS<br>(uV/m)<br>@ 3m |
|----------------|----------------------------|------------------------------------------|---------------------------|------------------------------------|
| 608.695        | -34.0*                     | 25.1                                     | 80,352.6                  | 200,000                            |

\* - Quasi-Peak Measurement

## SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog  $((-34.0 + 25.1 + 107)/20)$  = 80,352.6  
 CONVERSION FROM dBm TO dBuV = 107 dB

Test Results

Reviewed By: \_\_\_\_\_

Name: Tim R. Johnson

TABLE 3b

## FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: October 16, 2000  
 UST Project: 00-0465  
 Customer: VitalCom, Inc.  
 Model: DR-10000

QP Measurement (Middle Channel)  
 Highest Emission measured from Radio A

| FREQ.<br>(MHz) | TEST DATA<br>(dBm)<br>@ 3m* | ANTENNA FACTOR<br>+<br>CABLE ATTENUATION | RESULTS<br>(uV/m)<br>@ 3m | QP<br>FCC LIMITS<br>(uV/m)<br>@ 3m |
|----------------|-----------------------------|------------------------------------------|---------------------------|------------------------------------|
| 610.745        | -34.0*                      | 25.1                                     | 80,352.6                  | 200,000                            |

\* - Quasi-Peak Measurement

## SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog  $((-34.0 + 25.1 + 107)/20)$  = 80,352.6

CONVERSION FROM dBm TO dBuV = 107 dB

Test Results

Reviewed By: \_\_\_\_\_

Name: Tim R. Johnson

TABLE 3c

## FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: October 16, 2000  
 UST Project: 00-0465  
 Customer: VitalCom, Inc.  
 Model: DR-10000

QP Measurement (High Channel)  
 Highest Emission measured from Radio A

| FREQ.<br>(MHz) | TEST DATA<br>(dBm)<br>@ 3m* | ANTENNA FACTOR<br>+<br>CABLE ATTENUATION | RESULTS<br>(uV/m)<br>@ 3m | QP<br>FCC LIMITS<br>(uV/m)<br>@ 3m |
|----------------|-----------------------------|------------------------------------------|---------------------------|------------------------------------|
| 612.805        | -34.0*                      | 25.2                                     | 81,283.1                  | 200,000                            |

\* - Quasi-Peak Measurement

## SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog  $((-34.0 + 25.2 + 107)/20)$  = 81,283.1

CONVERSION FROM dBm TO dBuV = 107 dB

Test Results

Reviewed By: \_\_\_\_\_

Name: Tim R. Johnson

**Field Strength Of Spurious Emissions (47 CFR 15.242(c))**

Measurements were made using a peak detector. Field strength of Spurious Emissions are shown in Table 4 and Figures 3a through 3b. For comparison to the average limits, duty cycle corrections were made as shown below. Any emission less than 1000 MHz and falling within the restricted bands of 15.205 were not adjusted for averaging and the limits of 15.209 were applied.

Both Radios were checked (one radio with patch antennas and the other with monopoles). The results from each radio were similar, but preliminary data showed that the Radio with the monopole antennas to be worse case. Therefore all results shown are for the radio configured with the monopole antennas.

**Duty Cycle Correction During 100 msec:**

The system is designed that the system hops at 35 msec per channel. The system will only be on one channel in any 100 msec period of time. During this 35 msec per channel, each transmitter is allotted only a small duration of this period (5 msec max).

Therefore the worse case duty cycle is:

$$\text{Duty Cycle Correction} = 20 \log (0.05) = -26.0 \text{ dB}$$

TABLE 4a

## FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: October 3, 2000  
 UST Project: 00-0465  
 Customer: VitalCom, Inc.  
 Model: DR-10000

## Peak Measurements (Low Channel)

| FREQ.<br>(MHz.) | TEST DATA<br>(dBm)<br>@ 1m | ANTENNA FACTOR<br>+<br>CABLE ATTENUATION | RESULTS<br>(uV/m)<br>@ 3m | PEAK<br>FCC LIMITS<br>(uV/m)<br>@ 3m |
|-----------------|----------------------------|------------------------------------------|---------------------------|--------------------------------------|
| 1.215           | -69.6                      | 28.7                                     | 672.9                     | 5000                                 |

## Peak Measurements (High Channel)

| FREQ.<br>(MHz.) | TEST DATA<br>(dBm)<br>@ 1m | ANTENNA FACTOR<br>+<br>CABLE ATTENUATION | RESULTS<br>(uV/m)<br>@ 3m | PEAK<br>FCC LIMITS<br>(uV/m)<br>@ 3m |
|-----------------|----------------------------|------------------------------------------|---------------------------|--------------------------------------|
| 1.226           | -70.2                      | 28.7                                     | 628.1                     | 5000                                 |

\* - To achieve better dynamic range, all measurements were made a 1 meter

## SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog  $((-69.6 - 9.54 + 28.7 + 107)/20)$  = 672.9

CONVERSION FROM dBm TO dBuV = 107 dB

CONVERSION FROM 1m TO 3m =  $20 \log (1/3)$  = -9.54 dB

Test Results

Reviewed By: \_\_\_\_\_

Name: Tim R. Johnson

TABLE 4b

## FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Date: October 3, 2000  
 UST Project: 00-0465  
 Customer: VitalCom, Inc.  
 Model: DR-10000

## Average Measurements (Low Channel)

| FREQ.<br>(MHz.) | TEST DATA<br>(dBm)<br>@ 1m | ANTENNA FACTOR<br>+<br>CABLE ATTENUATION | RESULTS<br>(uV/m)<br>@ 3m | AVERAGE<br>FCC LIMITS<br>(uV/m)<br>@ 3m |
|-----------------|----------------------------|------------------------------------------|---------------------------|-----------------------------------------|
| 1.215           | -95.6                      | 28.7                                     | 33.7                      | 500                                     |

## Average Measurements (High Channel)

| FREQ.<br>(MHz.) | TEST DATA<br>(dBm)<br>@ 1m | ANTENNA FACTOR<br>+<br>CABLE ATTENUATION | RESULTS<br>(uV/m)<br>@ 3m | AVERAGE<br>FCC LIMITS<br>(uV/m)<br>@ 3m |
|-----------------|----------------------------|------------------------------------------|---------------------------|-----------------------------------------|
| 1.226           | -96.2                      | 28.7                                     | 31.5                      | 500                                     |

\* - To achieve better dynamic range, all measurements were made a 1 meter

\*\* - Readings adjusted by duty cycle =  $20 \log (0.05) = -26.0 \text{ dB}$

## SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m =  $\text{Antilog} ((-95.6 - 9.54 + 28.7 + 107)/20) = 33.7$

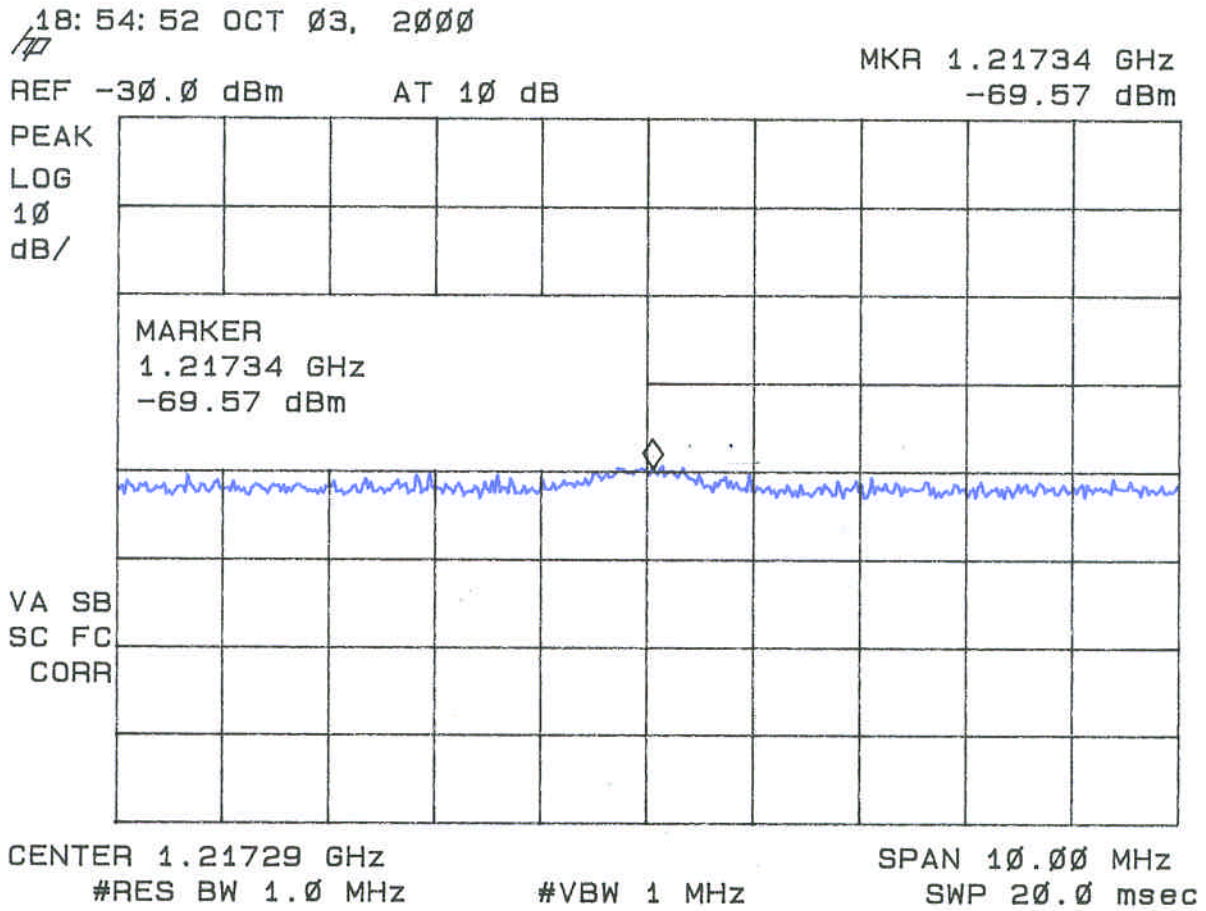
CONVERSION FROM dBm TO dBuV = 107 dB

Test Results

Reviewed By: \_\_\_\_\_ Name: Tim R. Johnson

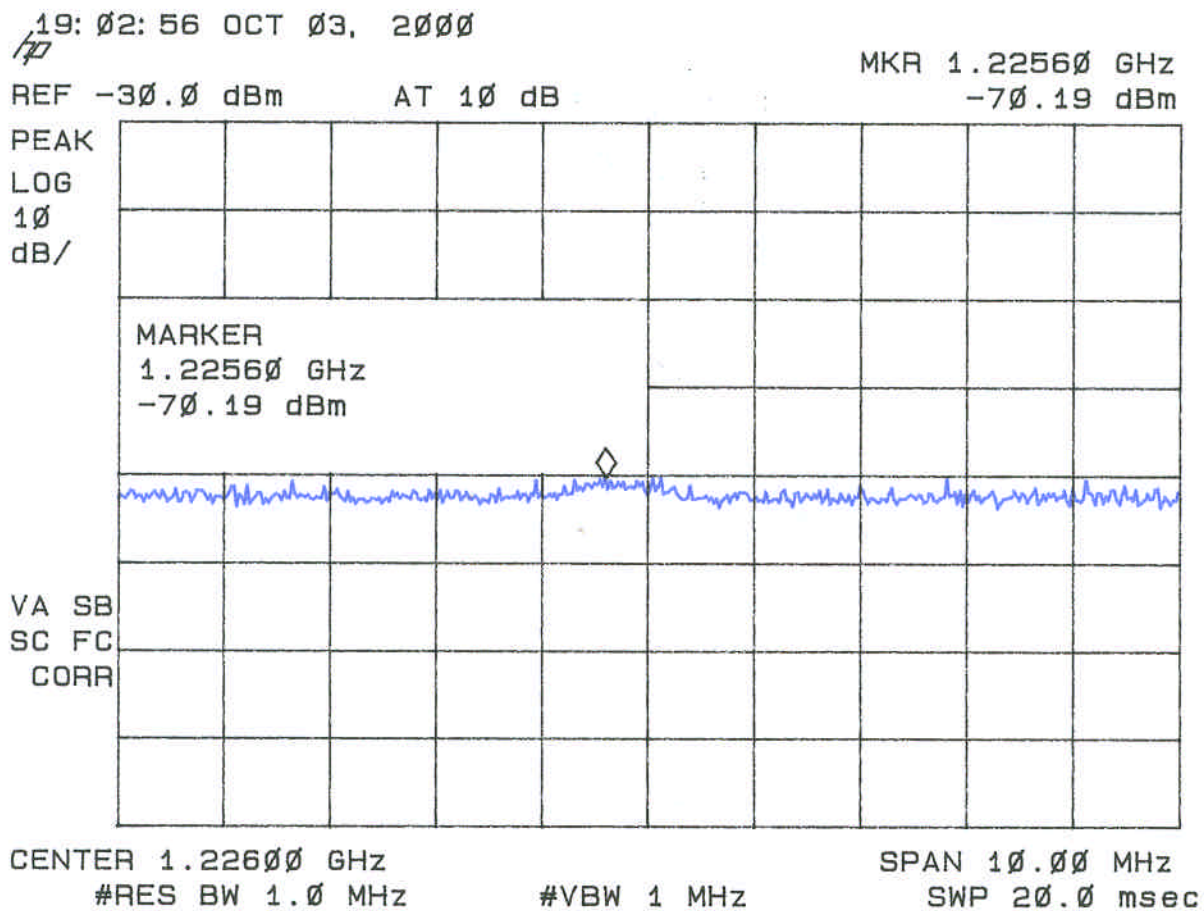
FIGURE 3a

## SPURIOUS EMISSIONS 15.242(c)



**FIGURE 3b**

## SPURIOUS EMISSIONS 15.242(c)



## **Radiated Digital Device Emissions (47 CFR 15.109a)**

Radiated emissions were evaluated from 30 MHz to 6.5 GHz with the EUT set to a receive mode of operation. Measurements were made with the analyzer's bandwidth set to 120 kHz for measurements below 1 GHz and 1 MHz for measurements above greater than or equal to 1 GHz. Results of these emissions are shown in Tables 5a and 5b.

TABLE 5a

**CLASS A  
RADIATED EMISSIONS**

Test Date: June 17, 2000  
 UST Project: 00-0465  
 Customer: VitalCom, Inc.  
 Model: DR-10000

Measurements 30 MHz – 1 GHz

| FREQ.<br>(MHz) | TEST DATA<br>(dBm)<br>@ 10m | ANTENNA<br>FACTOR<br>+<br>CABLE ATTEN. | RESULTS<br>(uV/m)<br>@ 10m | LIMITS<br>(uV/m) @<br>10m | MARGIN<br>BELOW<br>LIMIT<br>(dB) |
|----------------|-----------------------------|----------------------------------------|----------------------------|---------------------------|----------------------------------|
| 240.0          | -84.1                       | 14.7                                   | 76.0                       | 210.0                     | 8.8                              |
| 400.0          | -85.9*                      | 19.6                                   | 108.4                      | 210.0                     | 5.7                              |
| 420.0          | -85.9*                      | 20.3                                   | 117.8                      | 210.0                     | 5.0                              |
| 440.0          | -84.8*                      | 20.9                                   | 142.2                      | 210.0                     | 3.4                              |
| 450.0          | -89.3*                      | 21.1                                   | 87.1                       | 210.0                     | 7.6                              |
| 520.0          | -89.3*                      | 23.0                                   | 108.4                      | 210.0                     | 5.7                              |
| 540.0          | -88.4                       | 23.2                                   | 122.7                      | 210.0                     | 4.7                              |

\* = Quasi-Peak Measurement

**SAMPLE CALCULATIONS:**

**RESULTS uV/m @ 10m =**

**Antilog  $((-84.1 + 14.7 + 107)/20) = 76.0$**

**CONVERSION FROM dBm TO dBuV = 107 dB**

**Test Results**

**Reviewed By: \_\_\_\_\_ Name: Tim R. Johnson**

**TABLE 5b****CLASS A  
RADIATED EMISSIONS**

**Test Date:** October 3, 2000  
**UST Project:** 00-0465  
**Customer:** VitalCom, Inc.  
**Model:** DR-10000

**Peak Measurements >1 GHz**

| FREQ.<br>(GHz) | TEST DATA<br>(dBm)<br>@ 3m | AMP<br>GAIN<br>(dB) | ANT.<br>FACTOR<br>(dB) | CABLE<br>LOSS<br>(dB) | RESULTS<br>(uV/m)<br>@ 10m | FCC LIMITS<br>(uV/m)<br>@ 10m | MARGIN<br>BELOW<br>LIMIT<br>(dB) |
|----------------|----------------------------|---------------------|------------------------|-----------------------|----------------------------|-------------------------------|----------------------------------|
| 1.000          | -47.8                      | 35.9                | 25.2                   | 2.3                   | 111.4                      | 300.0                         | 8.6                              |
| 1.064          | -55.8                      | 35.8                | 25.7                   | 2.4                   | 44.8                       | 300.0                         | 16.7                             |
| 1.620          | -53.7                      | 35.2                | 27.5                   | 3.1                   | 81.7                       | 300.0                         | 11.3                             |
| 3.248          | -55.9                      | 34.8                | 32.1                   | 4.7                   | 135.5                      | 300.0                         | 6.9                              |

**SAMPLE CALCULATIONS:**

**RESULTS uV/m @ 10m =**

**Antilog  $((-47.8 - 35.9 + 25.2 + 2.3 - 10.46 + 107)/20) = 111.4$**

**CONVERSION FROM dBm TO dBuV = 107 dB**

**CONVERSION FROM 3m to 10m = -10.46**

**Test Results**

**Reviewed By**

**Signature:** \_\_\_\_\_ **Name:** Tim R. Johnson

**Power Line Conducted Emissions for Digital Device, Transmitter, and Receiver  
FCC Section 15.107 & 15.207**

The conducted voltage measurements have been carried out in accordance with FCC Section 15.107, with a spectrum analyzer connected to a LISN and the EUT placed into an idle condition or a continuous mode of receive. The results are given in Table 6.

**TABLE 6**  
**CONDUCTED EMISSIONS DATA**  
**CLASS B**

Test Date: October 8, 2000  
 UST Project: 00-0465  
 Customer: VitalCom, Inc.  
 Model: DR-10000

| FREQ.<br>(MHz) | TEST DATA<br>(dBm) |         | RESULTS<br>(uV) |         | FCC<br>LIMITS<br>(uV) | MARGIN<br>BELOW<br>LIMIT<br>(dB)<br>PHASE | MARGIN<br>BELOW<br>LIMIT<br>(dB)<br>NEUTRAL |
|----------------|--------------------|---------|-----------------|---------|-----------------------|-------------------------------------------|---------------------------------------------|
|                | PHASE              | NEUTRAL | PHASE           | NEUTRAL |                       |                                           |                                             |
| 0.72           | -71.8              | -69.6   | 57.5            | 74.1    | 250.0                 | 12.8                                      | 10.6                                        |
| 4.1            | -67.1              | -70.8   | 98.9            | 64.6    | 250.0                 | 8.1                                       | 11.8                                        |
| 6.3            | -69.7              | -69.0   | 73.3            | 79.4    | 250.0                 | 10.7                                      | 10.0                                        |
| 15.6           | -67.6              | -71.4   | 93.3            | 60.3    | 250.0                 | 8.6                                       | 12.4                                        |
| 26.6           | -63.9              | -68.9   | 142.9           | 80.4    | 250.0                 | 4.9                                       | 9.9                                         |
| 26.8           | -65.0              | -68.4   | 125.9           | 85.1    | 250.0                 | 6.0                                       | 9.4                                         |

**SAMPLE CALCULATIONS:****RESULTS uV =****Antilog  $((-71.8 + 107)/20) = 57.5$** **CONVERSION FROM dBm TO dBuV = 107 dB****Tested Results****Reviewed By****Signature: \_\_\_\_\_ Name: Tim R. Johnson**