

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- 1) The SAW RF bandpass filter (reference designator F5 in the transmit chain has been replaced by a third order, top capacitively coupled LC filter.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- 2) The power amplifier transistor, HBFP450 (reference designator Q3) in the transmit chain has been replaced by transistor BFP450.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

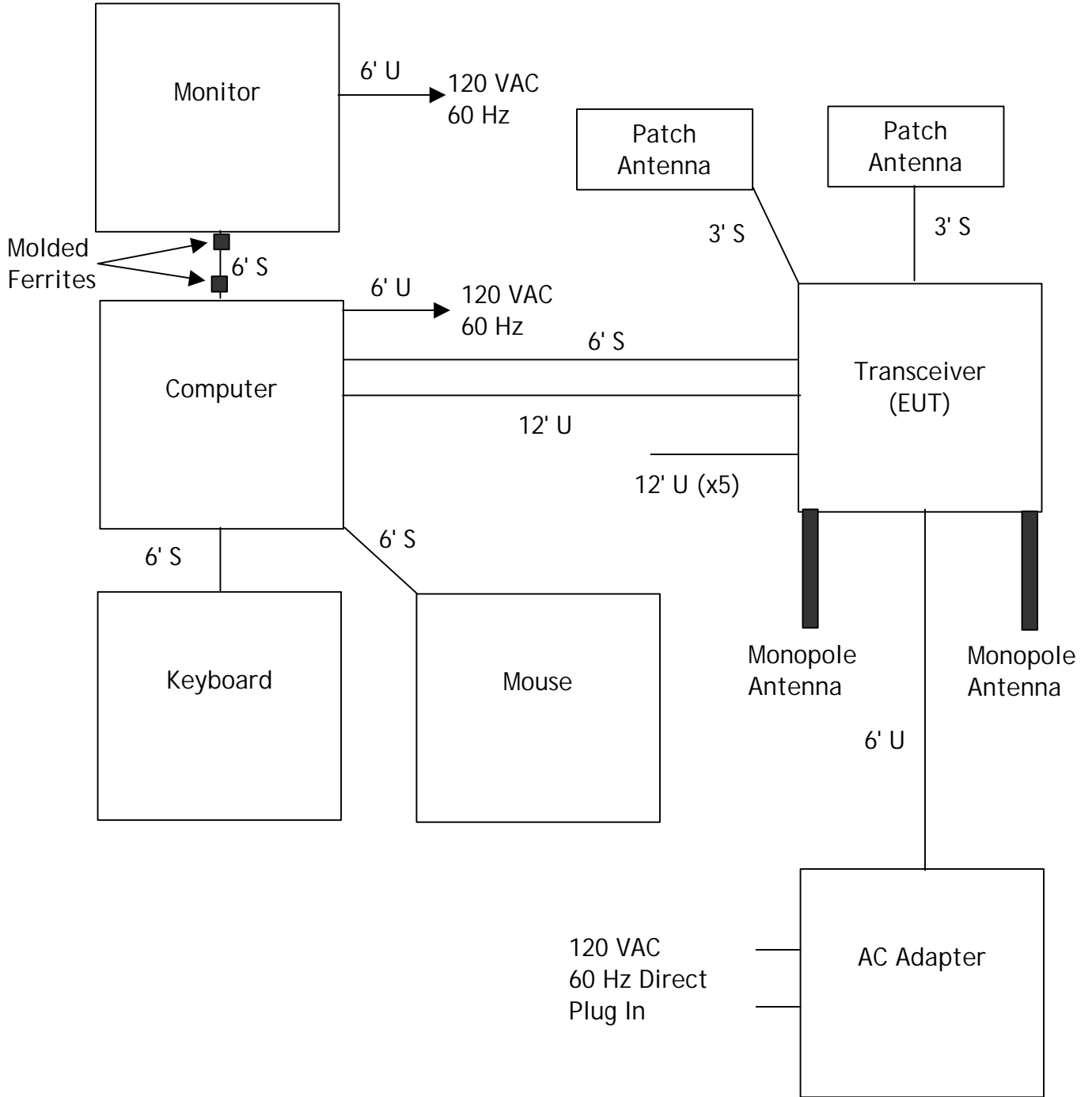


FIGURE 2a

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



FIGURE 2b

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

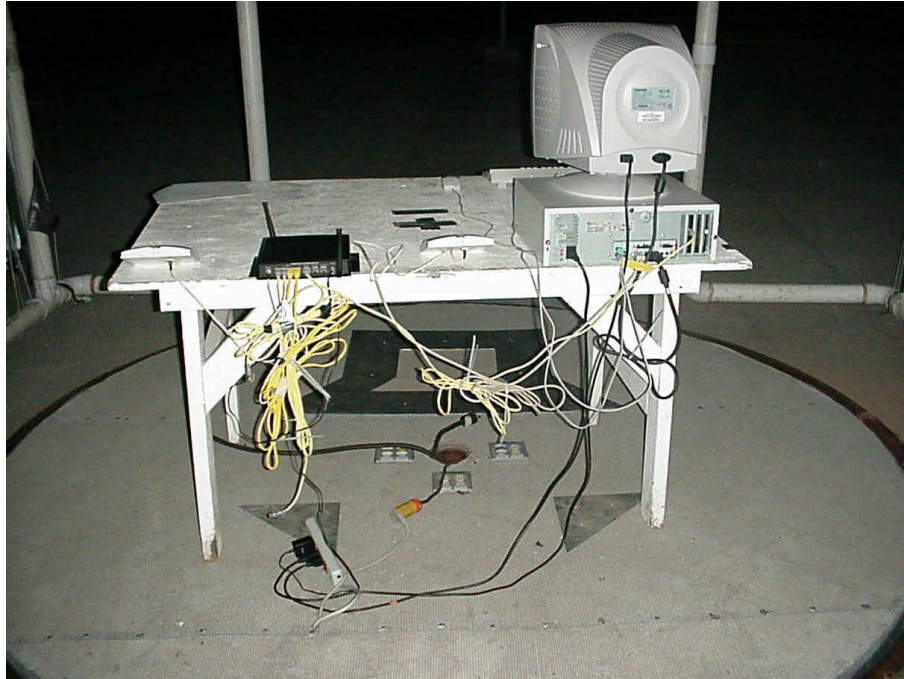


FIGURE 2c

Photograph(s) for Conducted Emissions



TABLE 1

EUT and Peripherals

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

TABLE 2

TEST INSTRUMENTS

TYPE	MANUFACTURER	MODEL	SN.
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 & 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. (MHz)	TEST DATA (Dbm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	QP FCC LIMITS (uV/m) @ 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. (MHz)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	QP FCC LIMITS (uV/m) @ 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. (MHz)	TEST DATA (dBm) @ 3m*	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	QP FCC LIMITS (uV/m) @ 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. (MHz.)	TEST DATA (dBm) @ 1m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
1.215	-69.6	28.7	672.9	5000

Peak Measurements (High Channel)

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

Average Measurements (High Channel)

FREQ. (MHz.)	TEST DATA (dBm) @ 1m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	AVERAGE FCC LIMITS (uV/m) @ 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 = $20 \log(0.05) = -26.0$ 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)

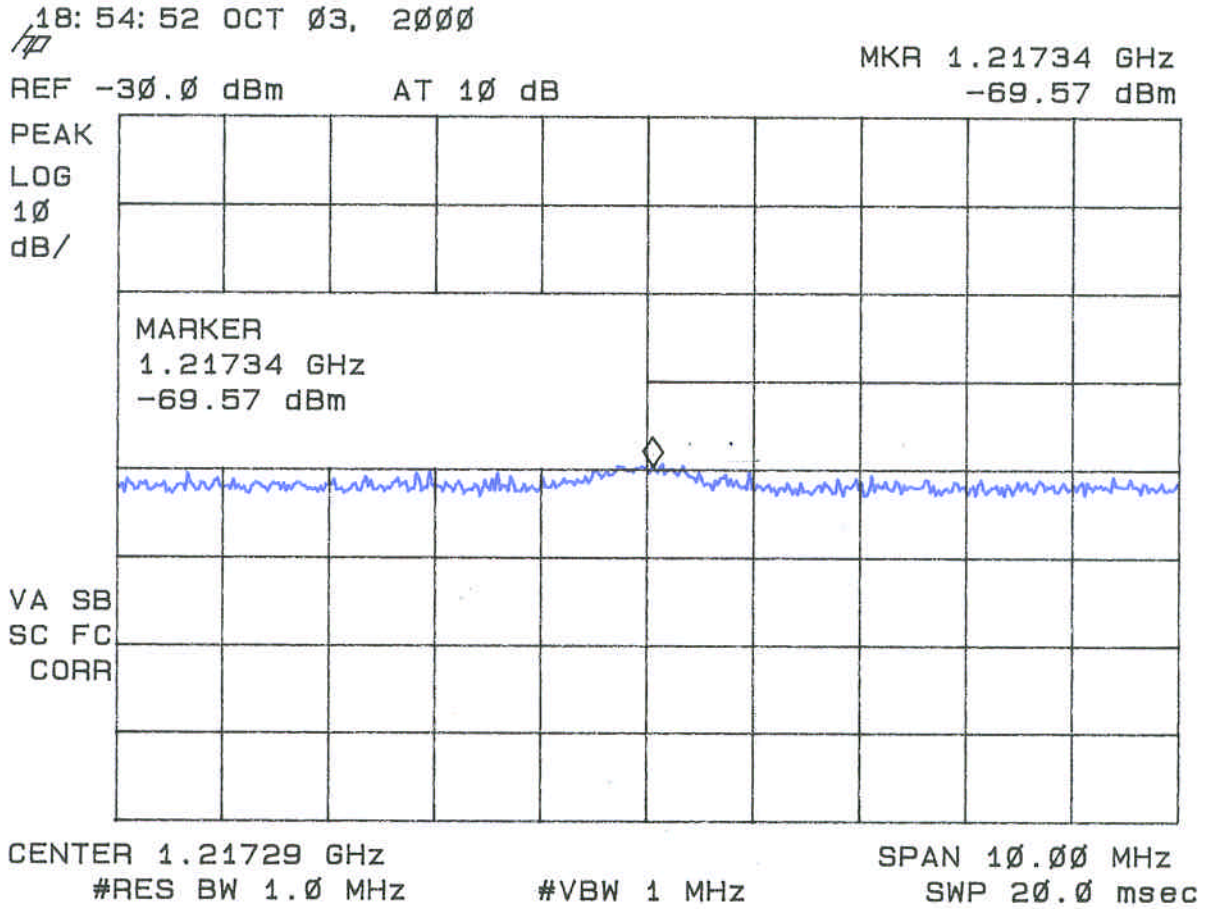
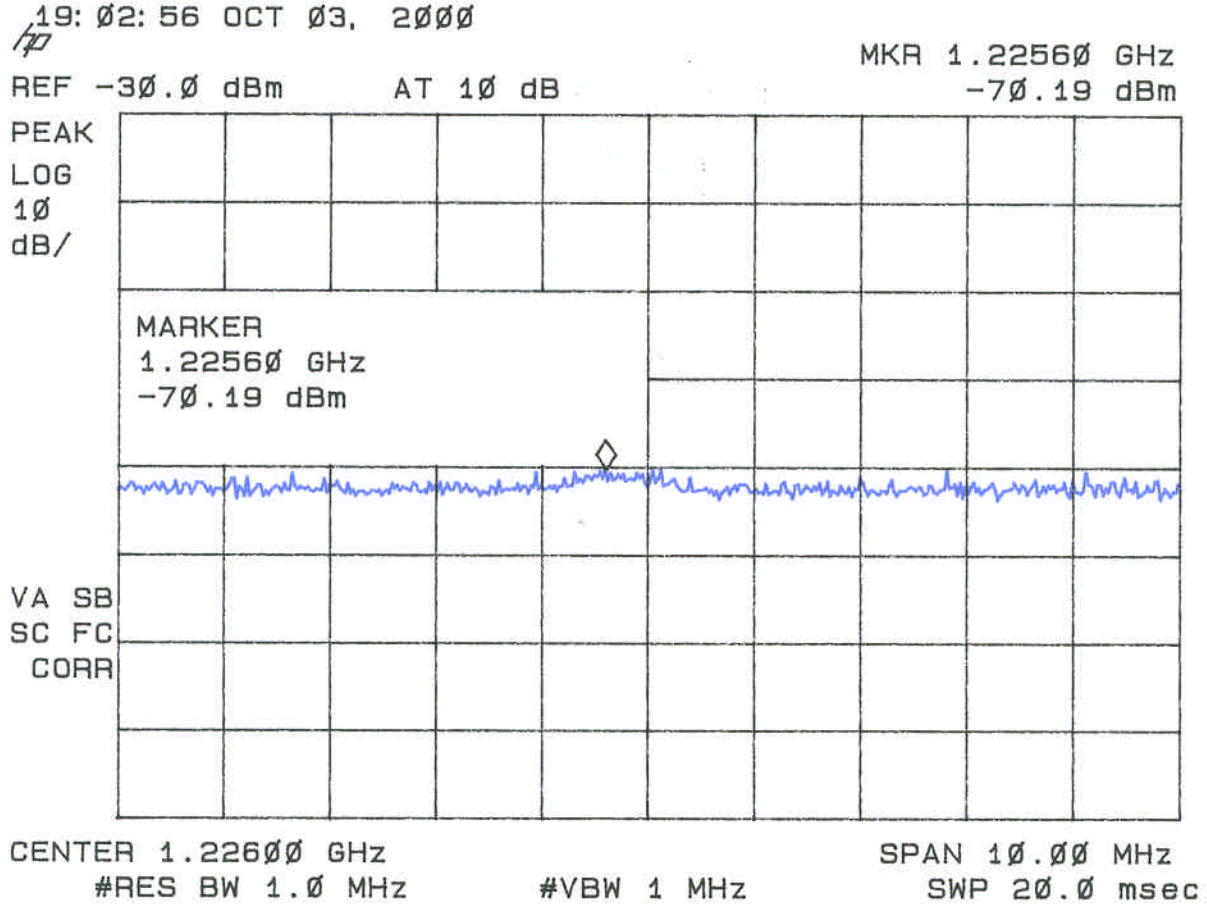


FIGURE 3b

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. (MHz)	TEST DATA (dBm) @ 10m	ANTENNA FACTOR + CABLE ATTEN.	RESULTS (uV/m) @ 10m	LIMITS (uV/m) @ 10m	MARGIN BELOW LIMIT (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. (GHz)	TEST DATA (dBm) @ 3m	AMP GAIN (dB)	ANT. FACTOR (dB)	CABLE LOSS (dB)	RESULTS (uV/m) @ 10m	FCC LIMITS (uV/m) @ 10m	MARGIN BELOW LIMIT (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. (MHz)	TEST DATA (dBm)		RESULTS (uV)		FCC LIMITS (uV)	MARGIN BELOW LIMIT (dB) PHASE	MARGIN BELOW LIMIT (dB) 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