SMITH ELECTRONICS, INC.
ELECTROMAGNETIC COMPATIBILITY LABORATORIES

RADIO-FREQUENCY EMISSIONS TEST REPORT

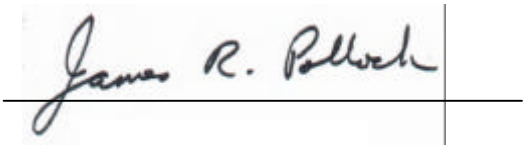
FOR

HEXAGRAM, INC.

DATA COLLECTOR UNIT (DCU)
RECEIVER
Model 5373A
FCC ID: LLB5373A

March 10, 2004

Prepared by:



Prepared for:

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TEST REPORT

OBJECTIVE

Measurements were performed on December 11 & 12, 2003, to determine if the Hexagram Model 5373A DCU was in compliance with the FCC emissions requirements of 15.109 and 15.111 for a digital device and a receiver.

SUMMARY

The Hexagram Model 5373A DCU was found to be in compliance with the radiated radio frequency emissions requirement of the FCC for a digital device and a receiver when installed in its weatherproof metal enclosure.

The DCU would be considered a Class A digital device but was found to meet the more stringent Class B requirements which are the same requirements as for the receiver.

GENERAL INFORMATION

MANUFACTURER	Hexagram, Inc. 23905 Mercantile Road Cleveland, OH 44122
TEST DATES	December 11 & 12, 2003
EQUIPMENT UNDER TEST	Hexagram Model 5373A Data Collection Unit (DCU) Receiver
TEST SPECIFICATION	FCC Part 15 15.109(a)(b), 15.111(a)

MEASUREMENT EQUIPMENT

Spectrum Analyzer	Hewlett Packard Type 8568B with 85680A RF Spectrum Analyzer section SN: 2216A02120 85662A display section SN: 2152A03683 Calibrated: 6/03
Quasi-Peak Adapter	Hewlett Packard Model: 85650A SN: 2043A00350 Calibrated: 6/03
Spectrum Analyzer	Hewlett-Packard Type 8593EM SN: 3536A00147 Calibrated: 1/04
Preamplifier	Hewlett Packard Type 8447D SN: 1937A03103 Gain: 26 dB
Vector Plotter	Hewlett Packard Type 7407A SN: 2308A39494
LISN's	50 uH LISN's per ANSI C63.4-1992
Biconical Antenna	EMCO Model: 3104 Frequency Range: 30-200 MHz
Log Periodic Antenna	EMCO Model: 3146 Frequency Range: 200-1000 MHz
Ridged Wave-Guide Antenna	EMCO Model 3115 Frequency Range: 1 – 18 GHZ
Coaxial Cable	Type RG-214/U 1 m length 2 m length

INTRODUCTION

The Hexagram Data Collector Unit (DCU) receiver is a battery powered receiving system intended to be centrally located within an area with a distribution of Hexagram Meter Transmitting Units (MTU's). The MTU's periodically transmit untility meter data which is received and stored by the DCU. At predetermined intervals, the DCU transmits the data to a central location using a cellular telephone installed within the DCU enclosure. The DCU is installed within a plastic housing, which is, in turn, mounted in a steel, weather-proof, enclosure. The receiving antenna, the cell phone antenna, and a solar panel are mounted externally to the steel enclosure.

The DCU also contains the digital hardware necessary for operation and data storage, and is thus a Class A digital device as well as a receiver.

The receiver is to tune within the 450 MHz – 470 MHz band and is a super-heterodyne receiver with an IF frequency of 85.86 MHz. The local oscillator (LO) of the system operates 85.86 MHz above the tuned frequency. The receiver input contains a band-pass filter that reduces any extraneous input signal and also contains the LO frequency and its harmonics within the system.

This report describes the tests performed on the receiver in support of an application for certification.

MEASUREMENTS PERFORMED

. The receiver and microprocessor portions of the DCU was examined for radiated emissions per Part 15, and has been determined to comply with the appropriate sections of that part (15.109 & 15.111). The data used for determining compliance is presented in this report.

ANTENNA POWER CONDUCTION EMISSIONS

Emissions from the antenna port of a receiver are required to be 2 nW or less. Two nanowatts is equivalent to –57 dBm. The antenna port of the DCU was attached to the spectrum analyzer input port with a 1 meter length of RG-214/U. The loss in this length of cable ranges from less than 0.1 dB at 100 MHz to less than 1 dB at 5 GHz. The emissions over the frequency range of 0 to 5 GHz was measured in two analyzer scans, 0 – 2.921 GHZ and 2.679 – 5 GHz. The –57 dB level was shown on each scan. The measured values were not closer than 10 dB below the limit level.

A sample of the emissions without the input filter installed is shown in Fig. 1. On these scans, the LO signals are clearly visible and do approach the –57 dB level. For these scans the receiver was tuned to 460.1 MHz, near mid-band.

Figures 2 – 4 show the antenna terminal emissions with the appropriate filter installed for each frequency. The tuned frequencies shown are: Fig. 2, 450.0 MHz, Fig. 3, 460.1 MHz, and Fig. 4, 470.0 MHz. With the filter installed, no significant emissions are visible from the antenna port except for a small peak at about 2.7 GHz in Fig. 2. A minimum of 15 dB clearance to the –57 dB limit is maintained.

The emissions from the antenna port of the DCU are well below the limit of 2 nW.

RADIATED EMISSIONS

The radiated emissions from the DCU system were examined in the shielded room. The measurements were made at a distance of 1 meter, with the receiver and cell-phone antennas installed as can be seen in Pictorial 1.

The receiver portion of the DCU was investigated from 200 MHz to 5 GHz. The digital portion of the DCU was scanned between 30 MHz and 1000 MHz.

Figure 5 shows the scans made between 30 MHz & 1000 MHz with the enclosure closed as for normal operation. The information shown is basically the ambient level inside the shielded room. These plots cover the range required for the digital device and would be well below the Class B limit which is shown on the plots. As no emissions could be detected in the room at one meter, it was determined not necessary to make open field measurements at three meters.

Because no receiver emissions were detected with the steel enclosure properly closed, a set of measurements was taken with the enclosure door open. These measurements are found in Figs. 6 & 7. Figure 6 covers 200 MHz – 1000 MHz while Fig. 7 covers 1 – 5 GHz. These plots provide an indication of the emissions from the system without the use of the shielded enclosure.

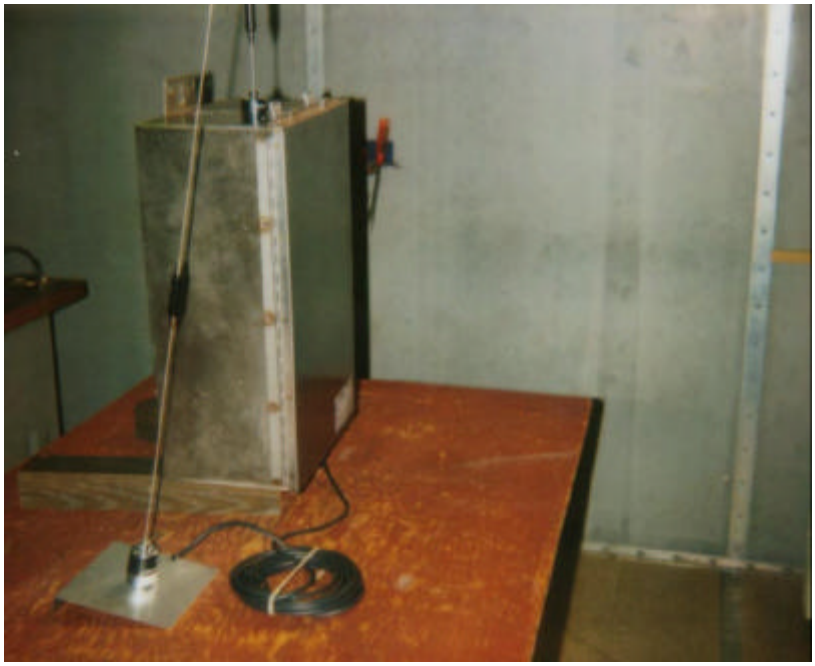
The following figures, 9 – 17, show the plots made with the enclosure door closed and the system powered. No emissions are observed during these measurements. The

only non-ambient signal seen in the plots is a “transmitter” signal from a signal generator set to the tuned frequency of the receiver. Again, as no emissions were observed at the one meter distance, it was determined not necessary to make the open field measurements at three meters.

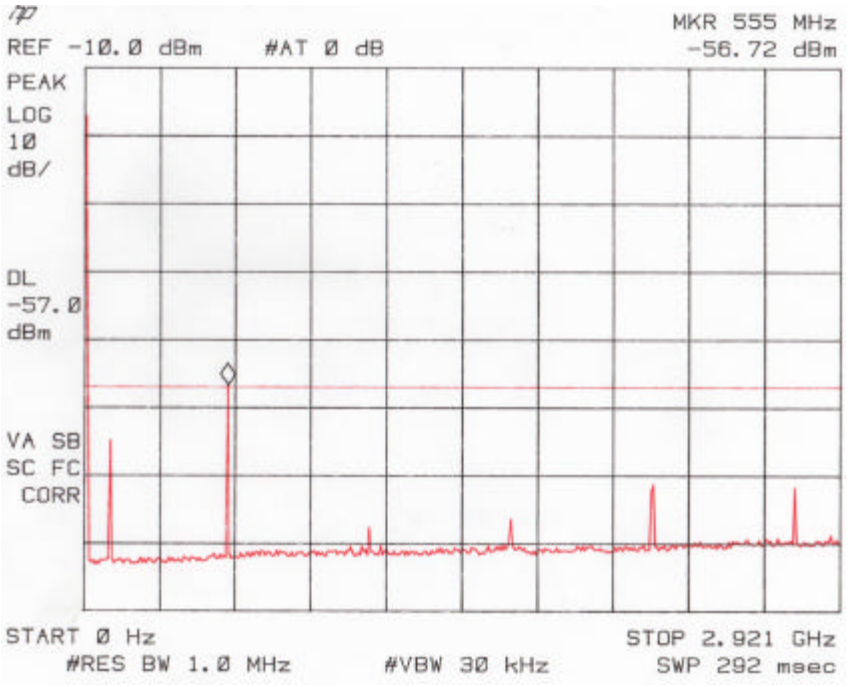
Figure 18 shows ambient plots of the 30 – 1000 MHz range for comparison to the previous plots of that range.

CONCLUSION

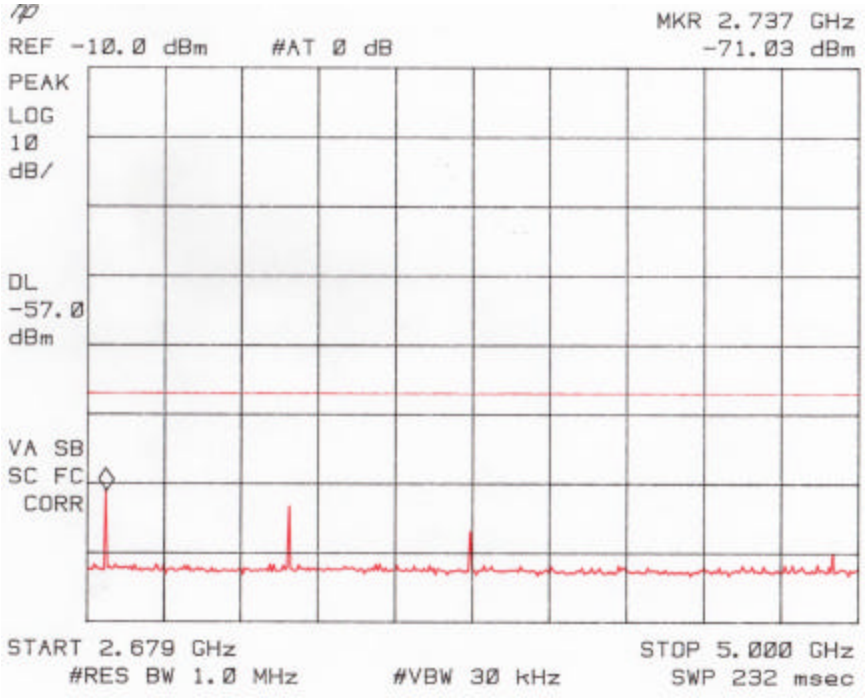
As no radiated emissions could be detected at close range in a shielded room when the system was enclosed as required, it is determined that the DCU receiver is in compliance with the requirements of 15.109 for receiver and digital device emissions. Also, no emissions within 15 dB of the antenna conducted power limit were observed so that the DCU is in compliance with the requirements of 15.111 for receiver antenna port emissions. Therefore, it is determined that the Model 5373A DCU by Hexagram does meet the requirements of Part 15, and is qualified for Certification.



Pictorial 1
Hexagram 5373A DCU
Test Set-Up

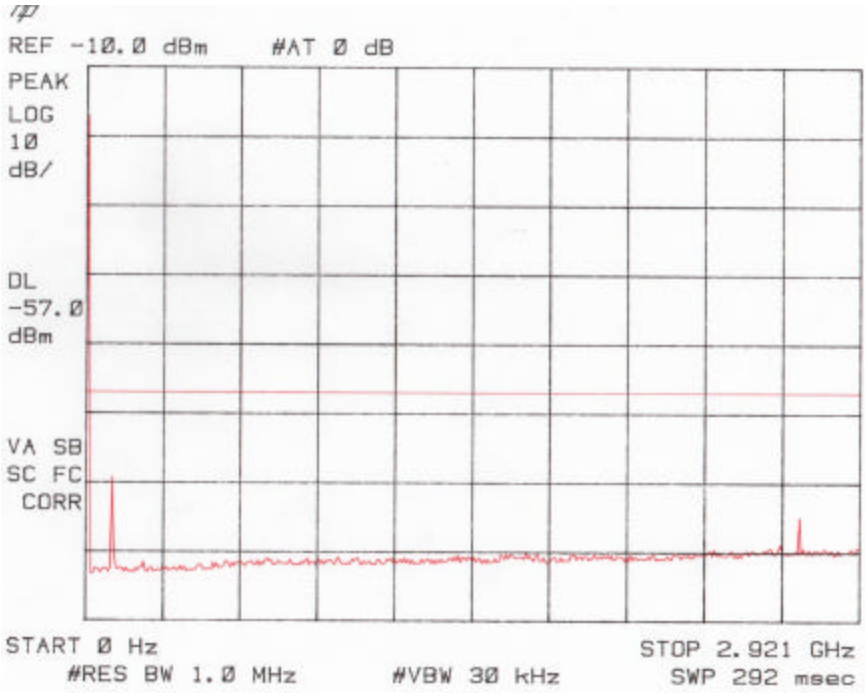


2 nW

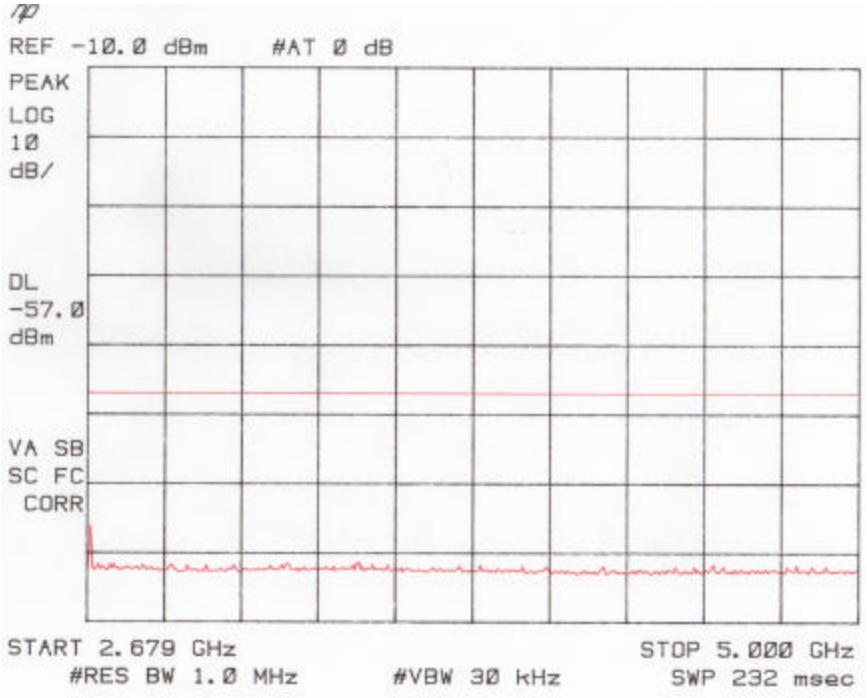


2 nW

Fig. 1
Antenna Terminal Power
No Input Filter

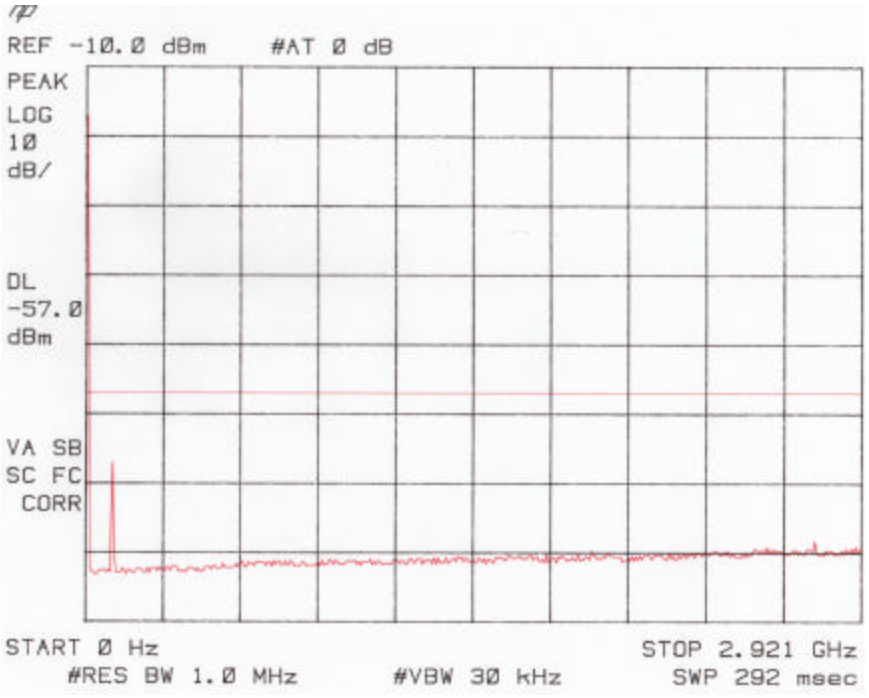


2 nW

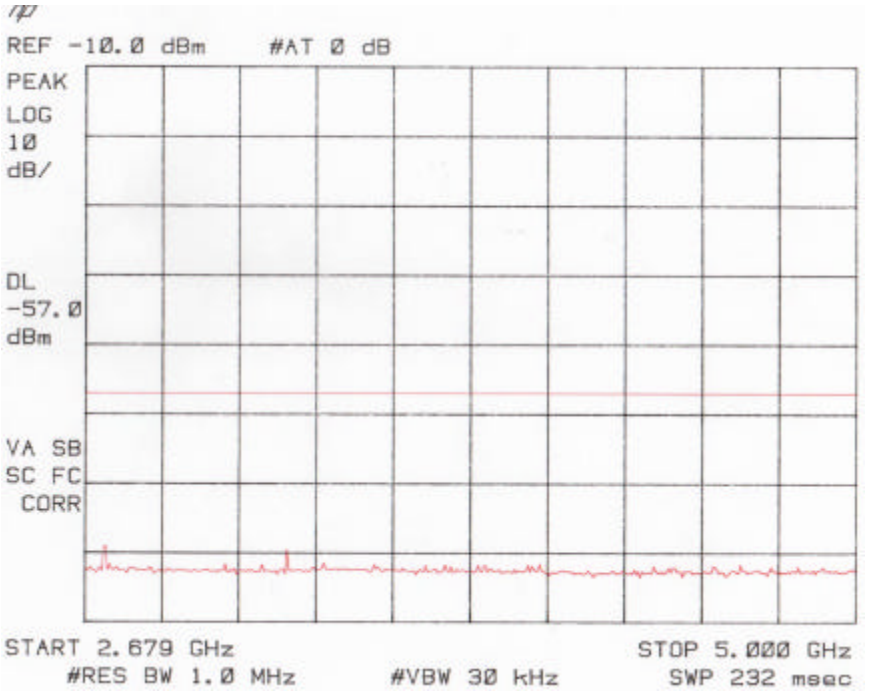


2 nW

Fig. 2
Antenna Terminal Power
450 MHz w/Input Filter

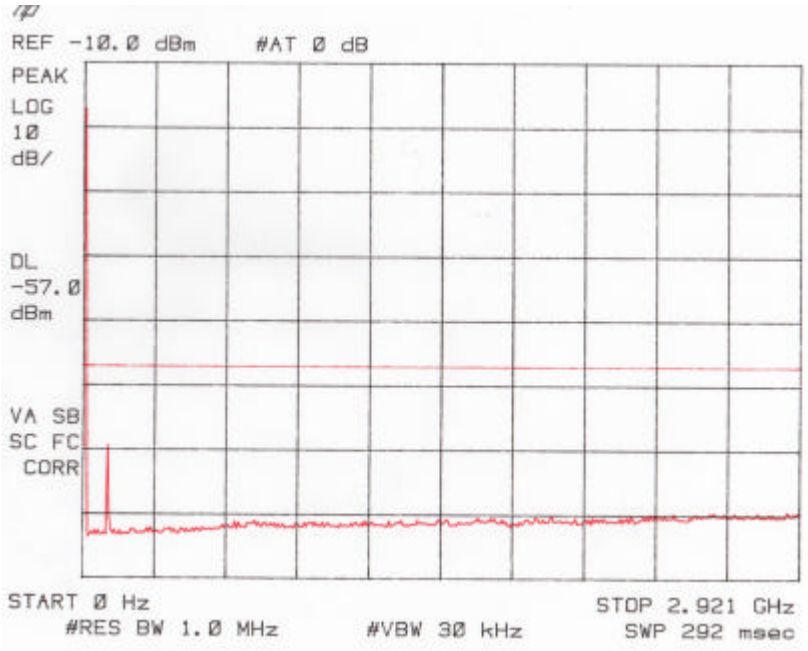


2 nW

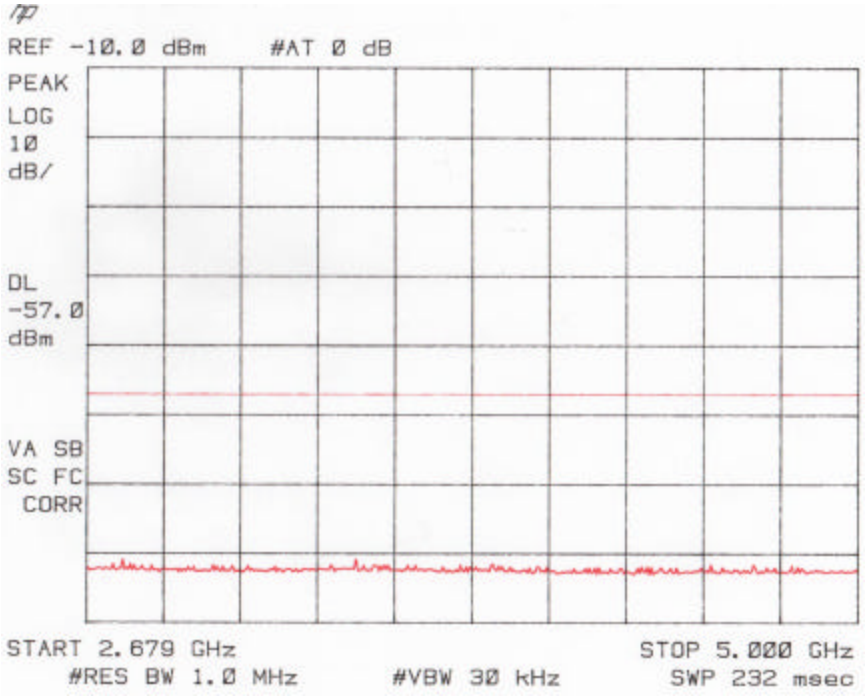


2 nW

Fig. 3
Antenna Terminal Power
460.1 MHz w/Input Filter

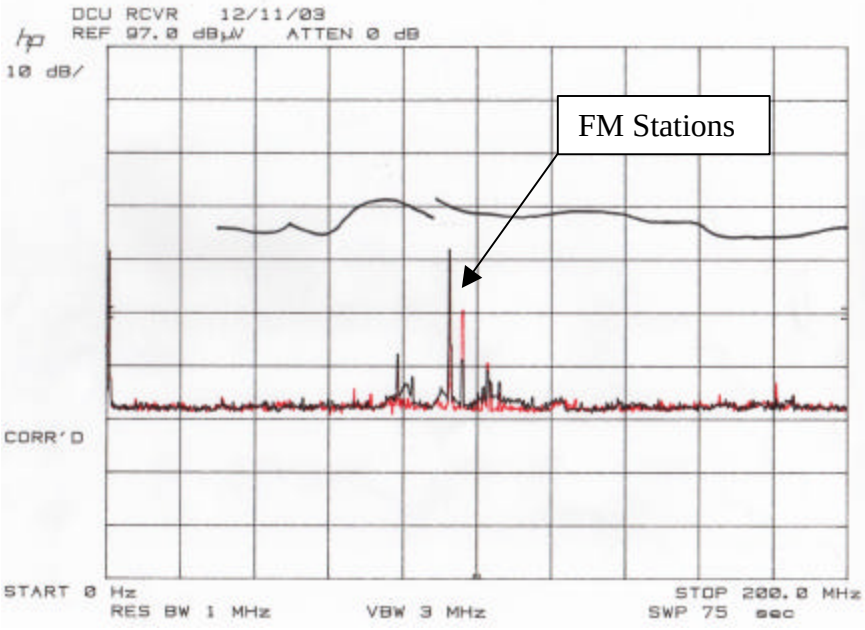


2 nW

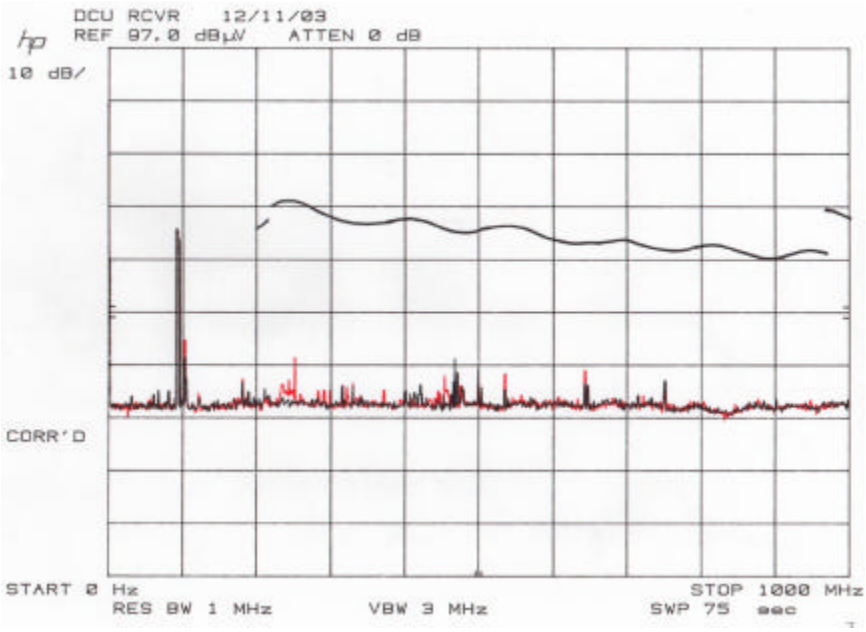


2 nW

Fig. 4
Antenna Terminal Power
470 MHz w/Input Filter



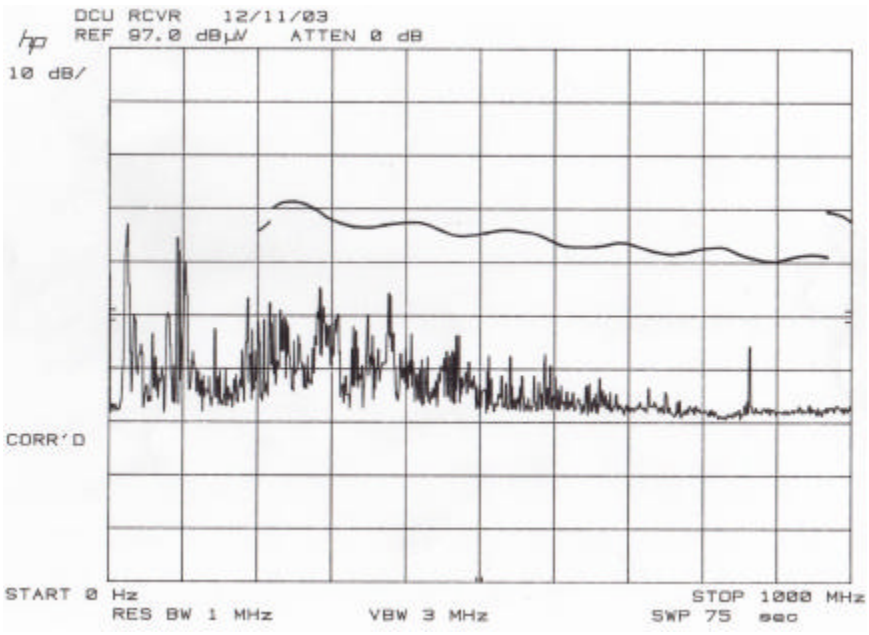
Class B Limit



Class B Limit

Red = Vertical
Black = Horizontal

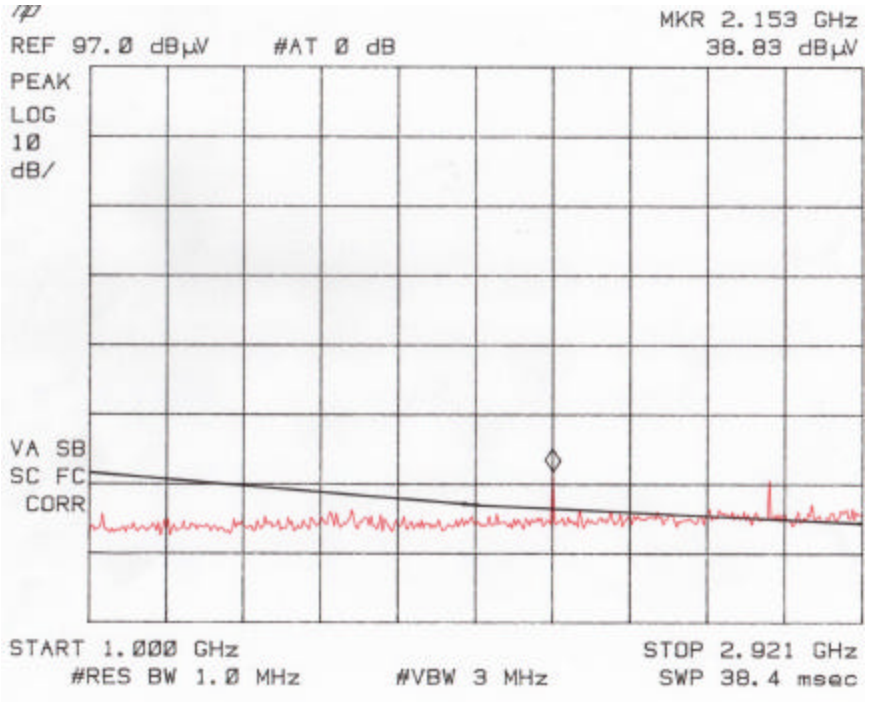
Fig. 5
Spurious Emissions
Cabinet Closed
20 – 1000 MHz



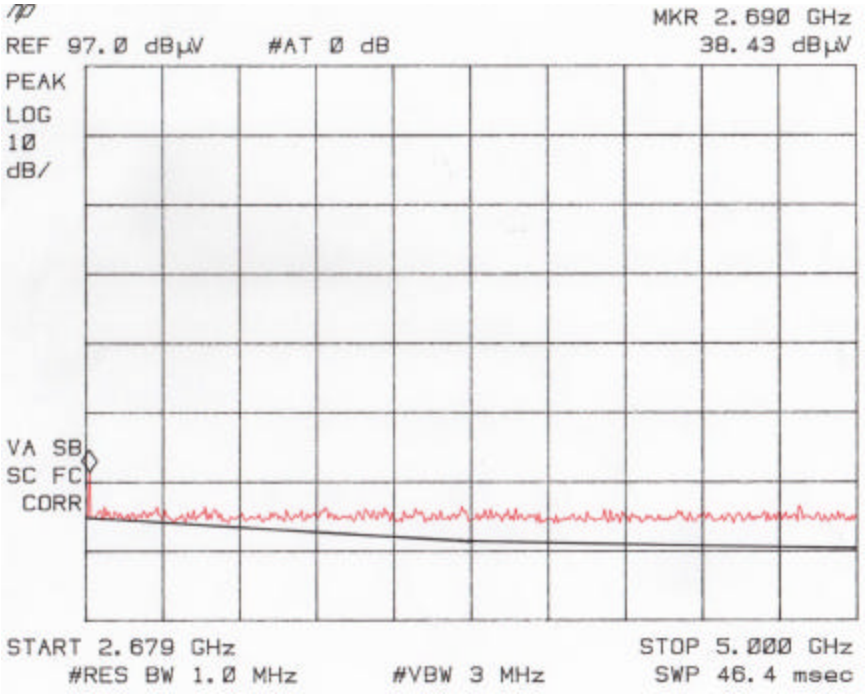
Class B Limit

Vertical

Fig. 6
Spurious Emissions
Cabinet Open
200 – 1000 MHz

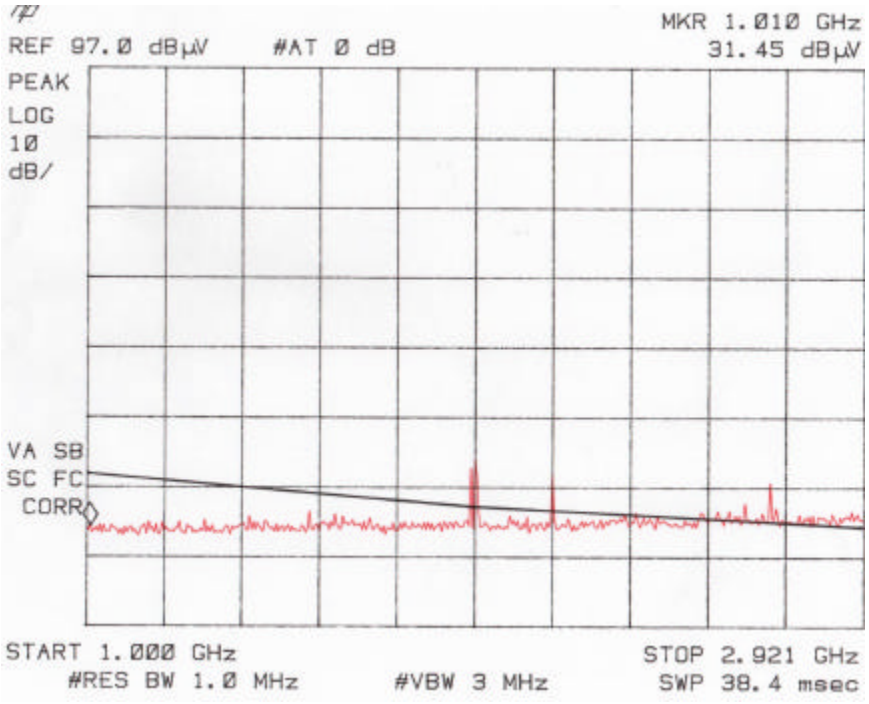


Class B Limit

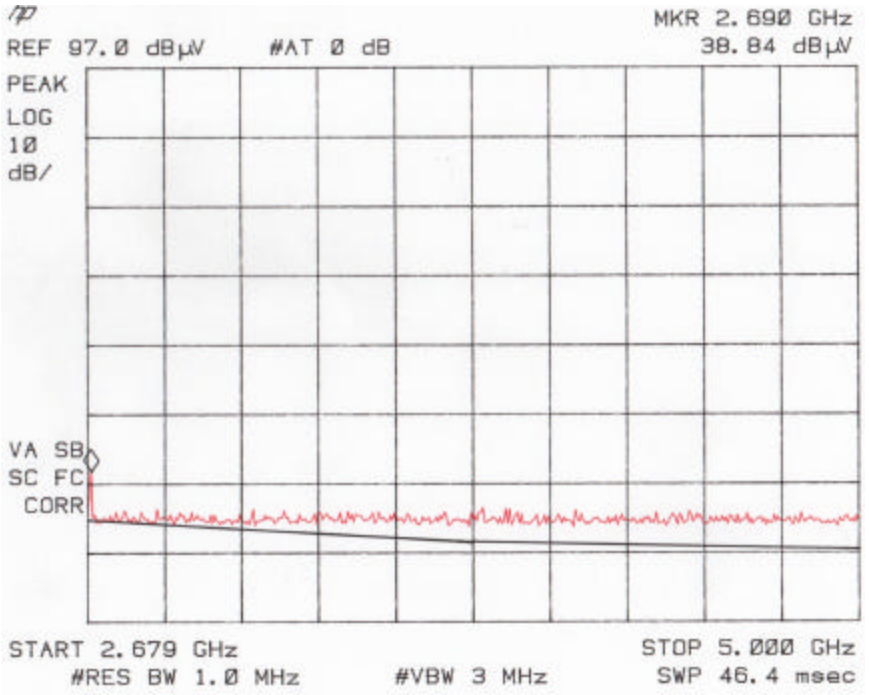


Class B Limit

Fig. 7
Spurious Emissions
Cabinet Open
1 – 5 GHz Vertical

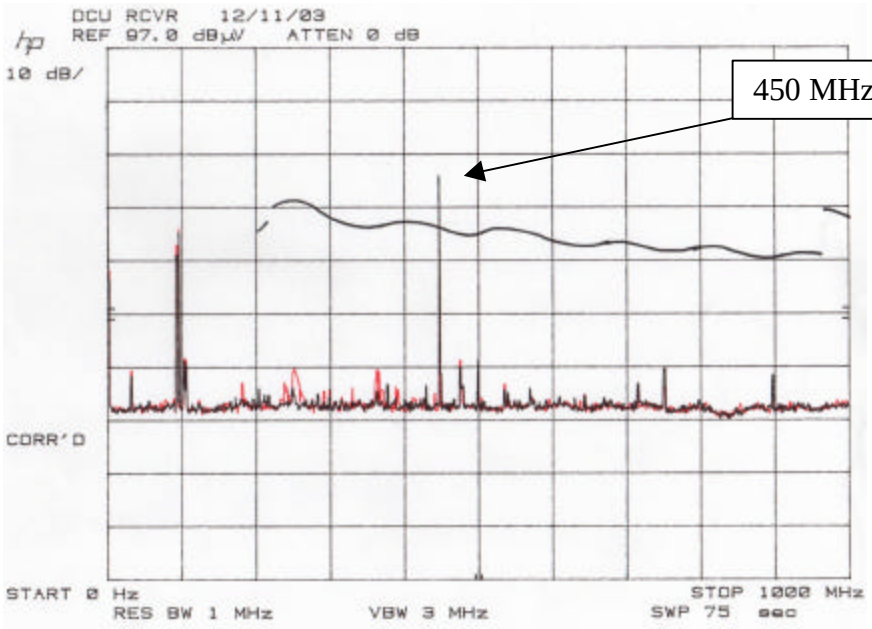


Class B Limit



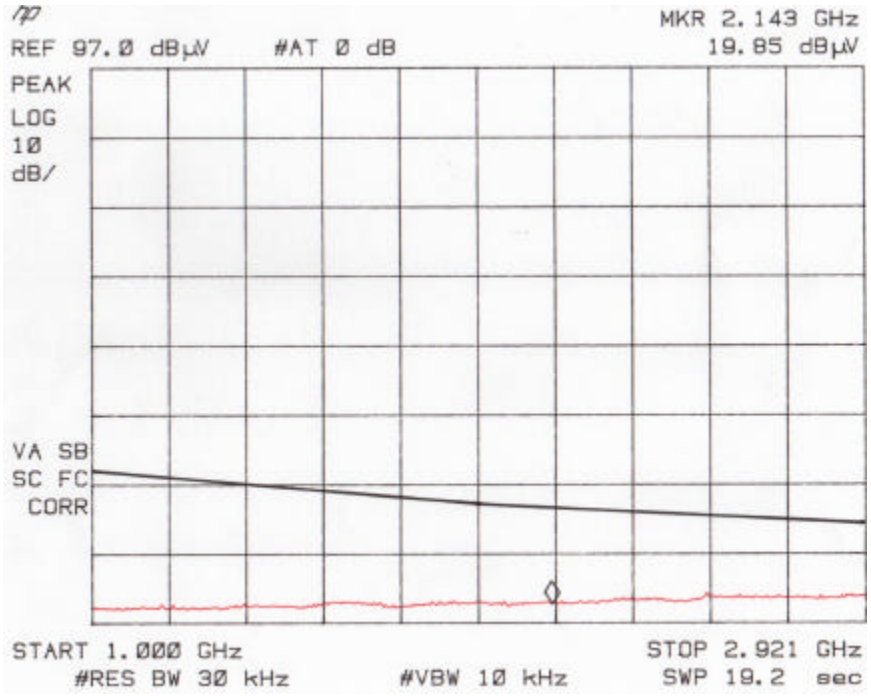
Class B Limit

Fig. 8
Spurious Emissions
Cabinet Open
1 – 5 MHz Horizontal

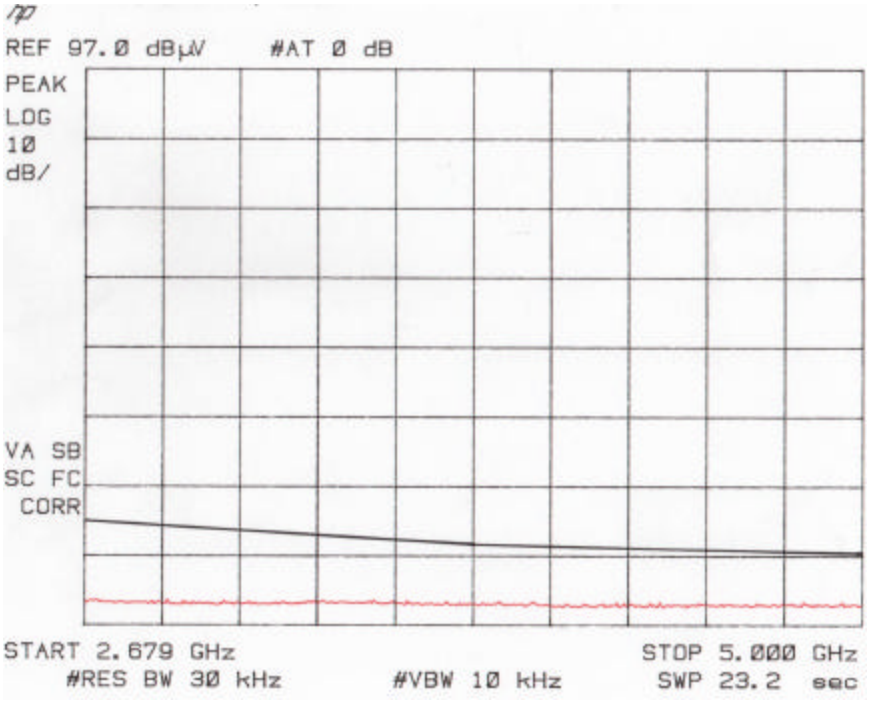


Red = Vertical
Black = Horizontal

Fig. 9
Spurious Emissions 450 MHz
Cabinet Closed
200 – 1000 MHz H / V

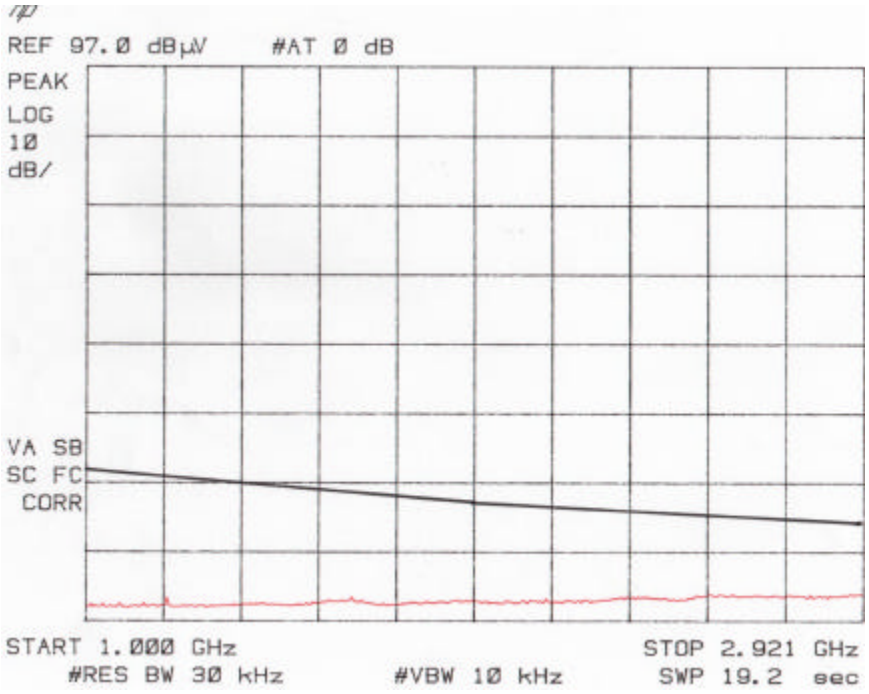


Class B Limit



Class B Limit

Fig. 10
Spurious Emissions 450 MHz
Cabinet Closed
1 – 5 GHz Vertical



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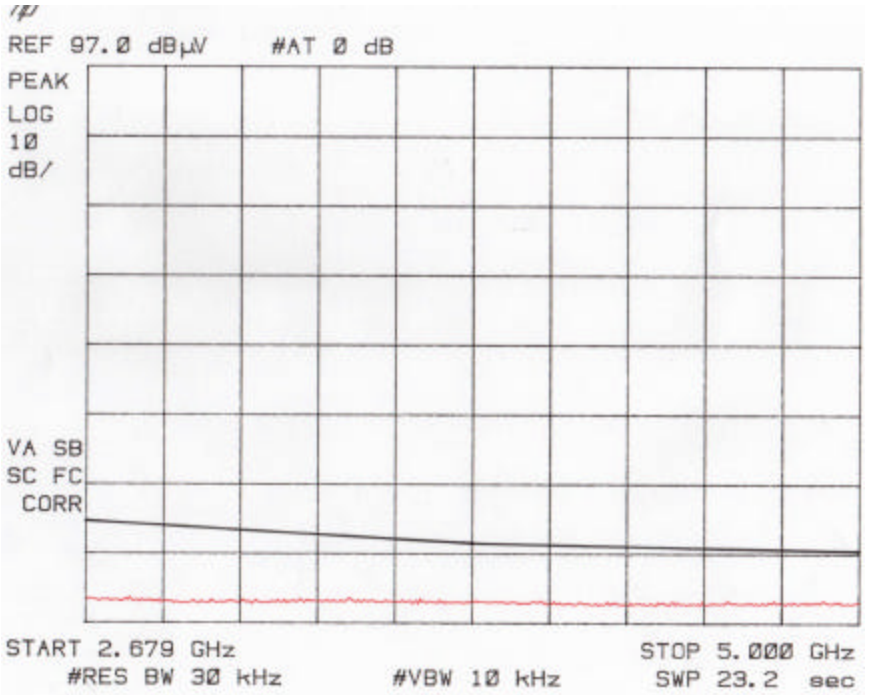
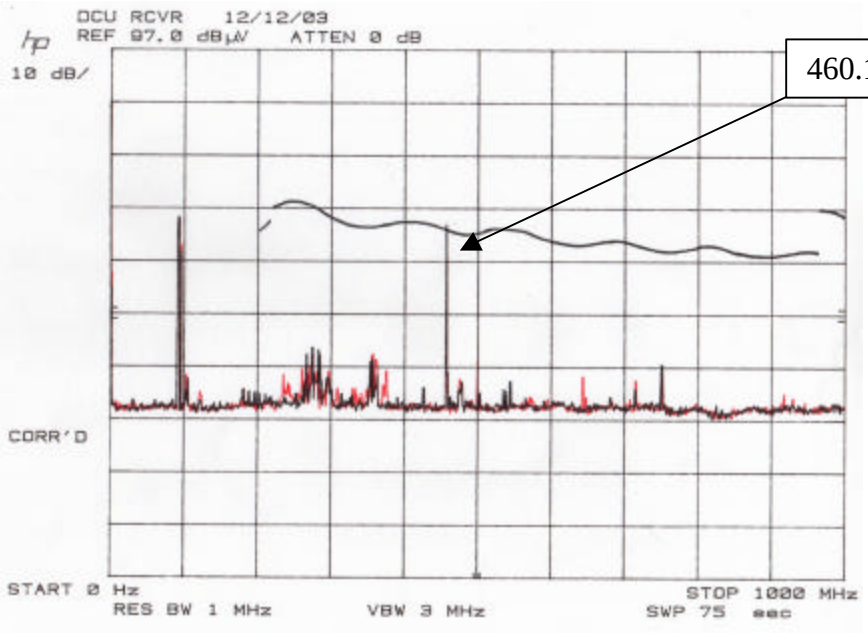


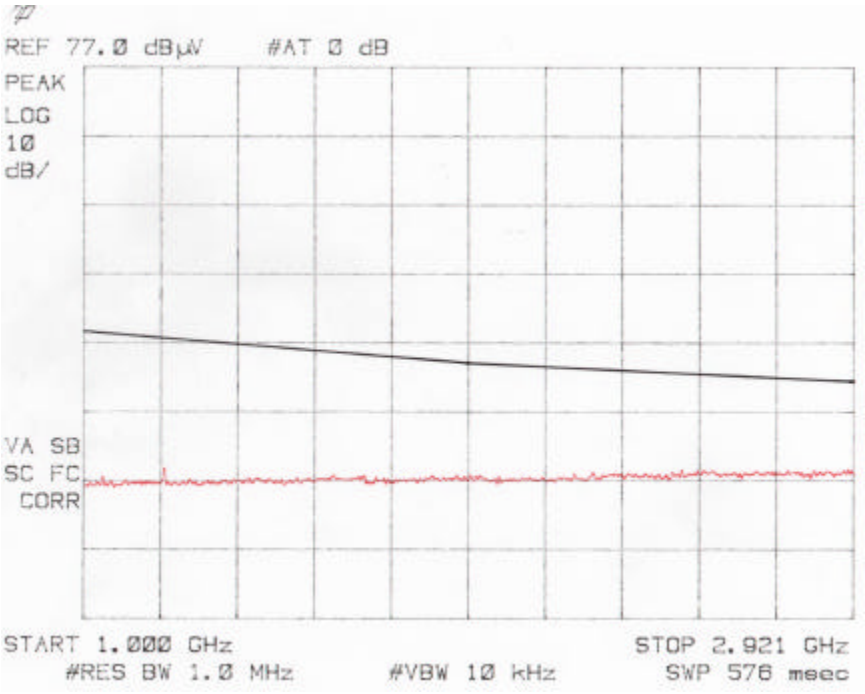
Class B Limit

Fig. 11
Spurious Emissions 450 MHz
Cabinet Closed
1 – 5 GHZ Horizontal



Red = Vertical
Black = Horizontal

Fig. 12
Spurious Emissions 460.1 MHz
Cabinet Closed
200 – 1000 MHz H / V



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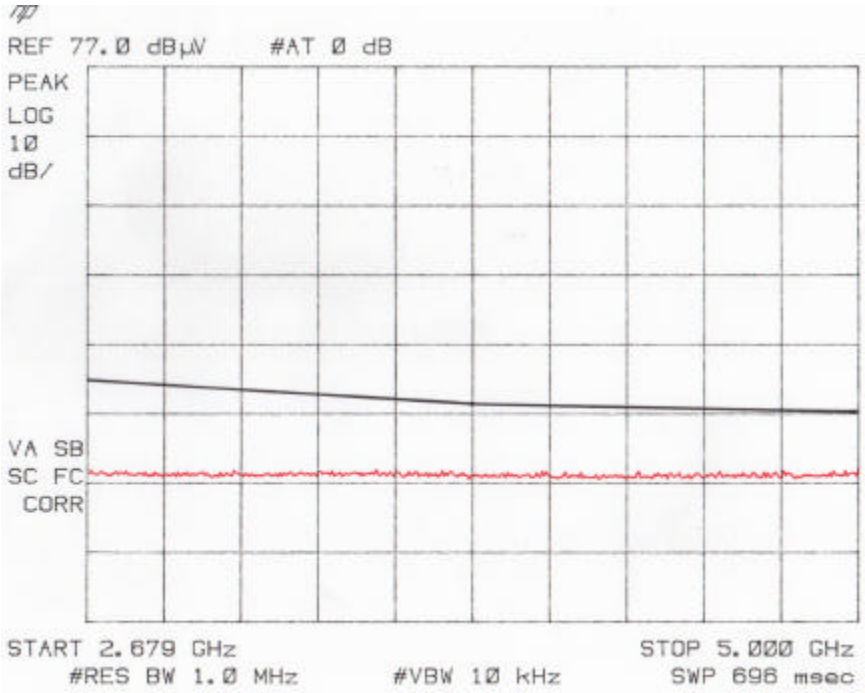
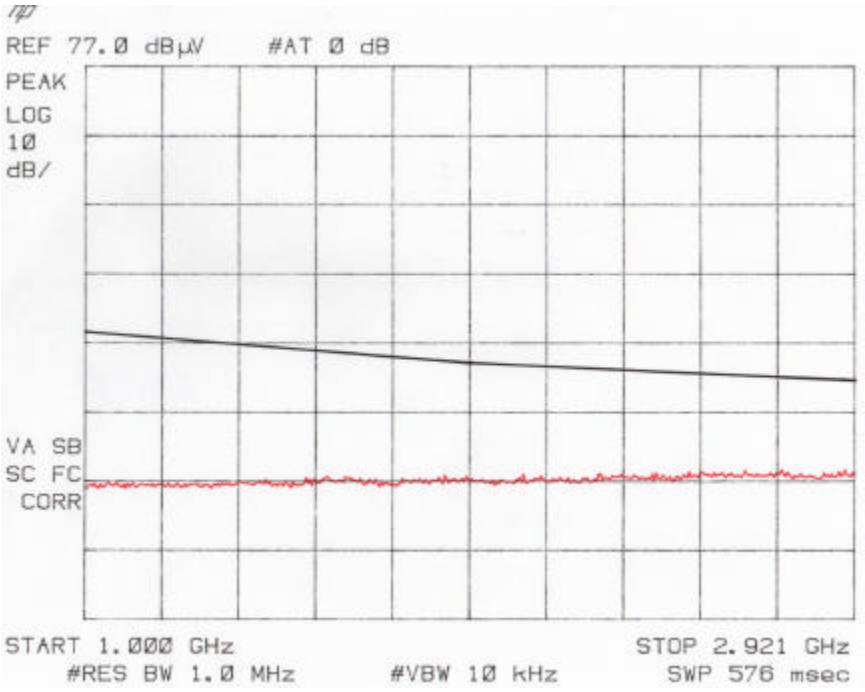


Class B Limit

Fig. 13
Spurious Emissions 460.1 MHz
Cabinet Closed
1 – 5 GHz Vertical



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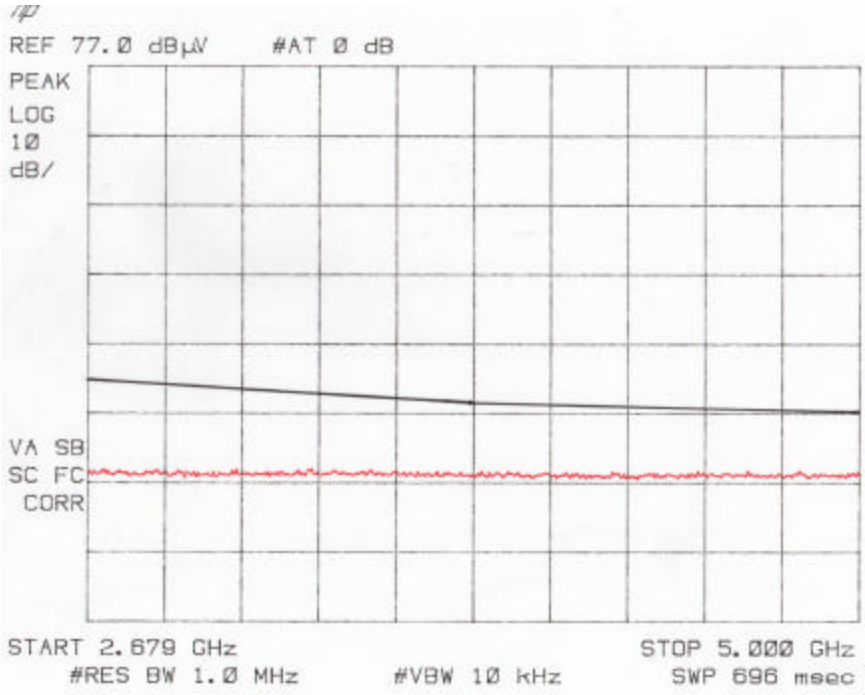
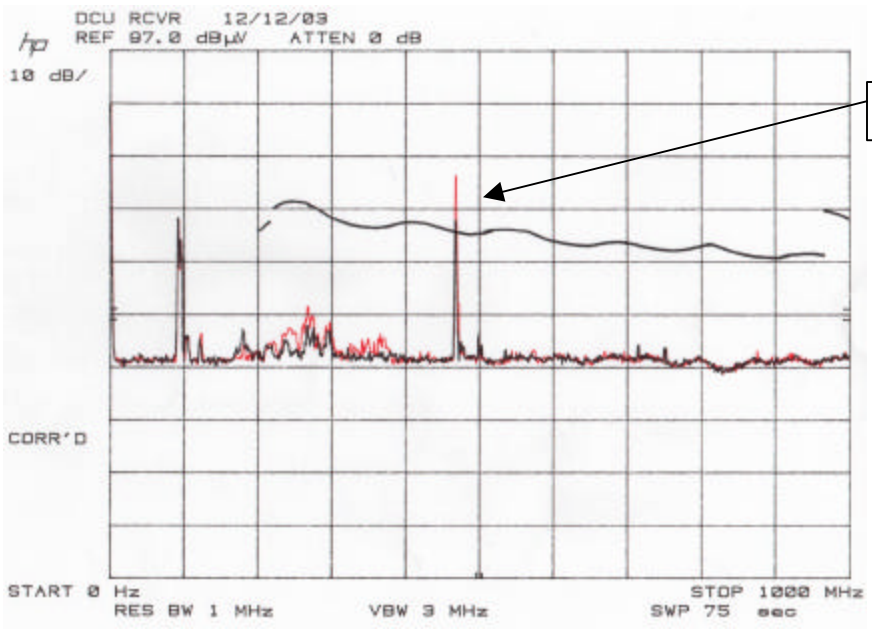


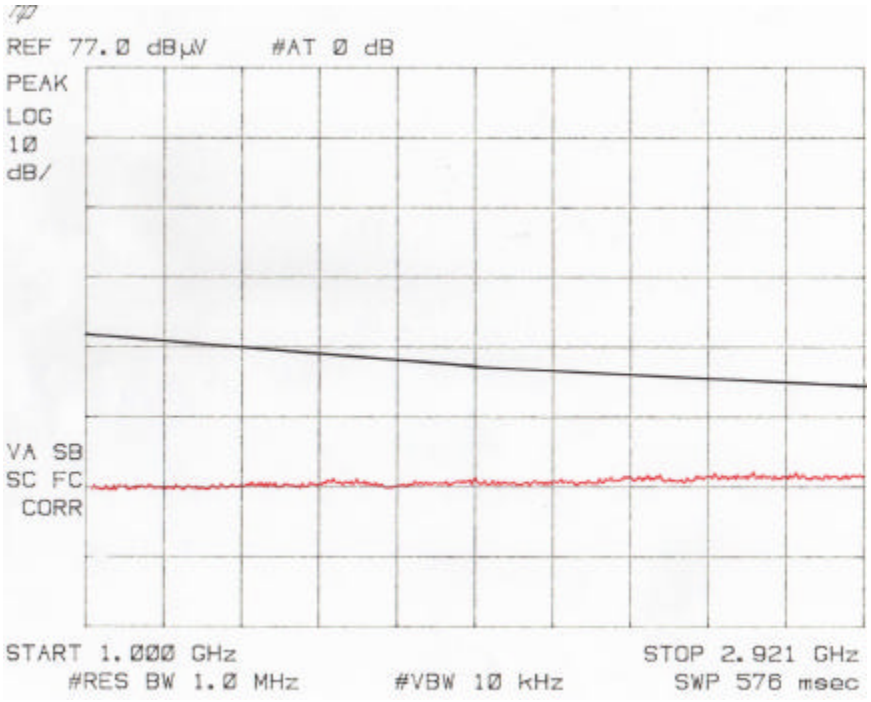
Class B Limit

Fig. 14
Spurious Emissions 460.1 MHz
Cabinet Closed
1 – 5 GHz Horizontal

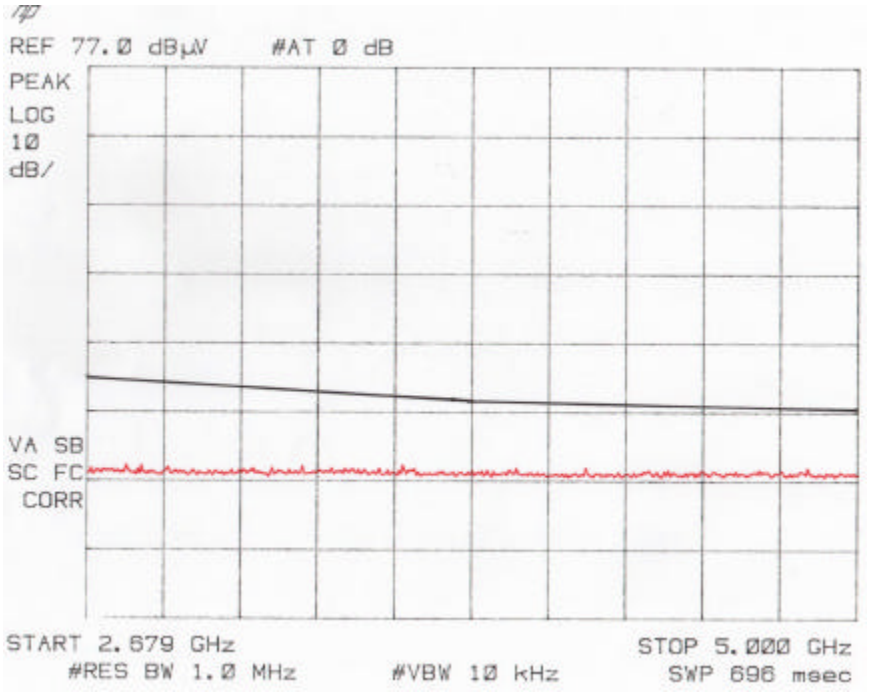


Red = Vertical
Black = Horizontal

Fig. 15
Spurious Emissions 470 MHz
Cabinet Closed
200 – 1000 MHz H / V

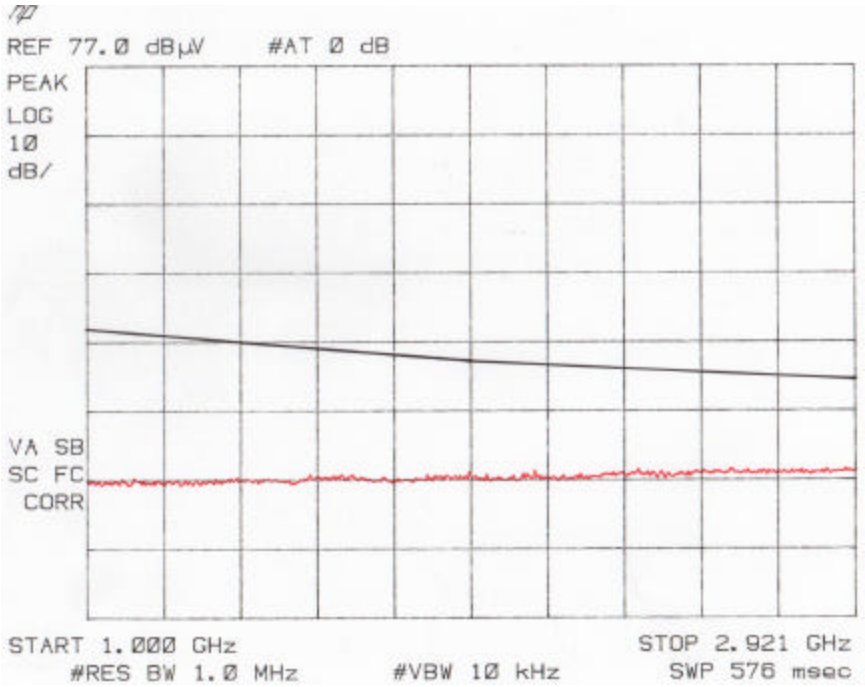


Class B Limit

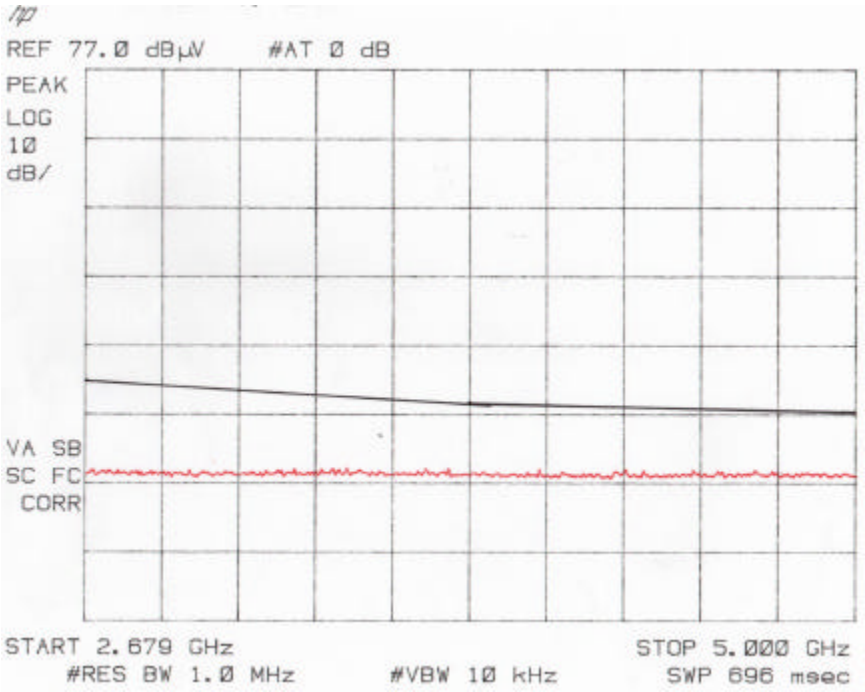


Class B Limit

Fig. 16
Spurious Emissions 470 MHz
Cabinet Closed
1 – 5 GHz Vertical

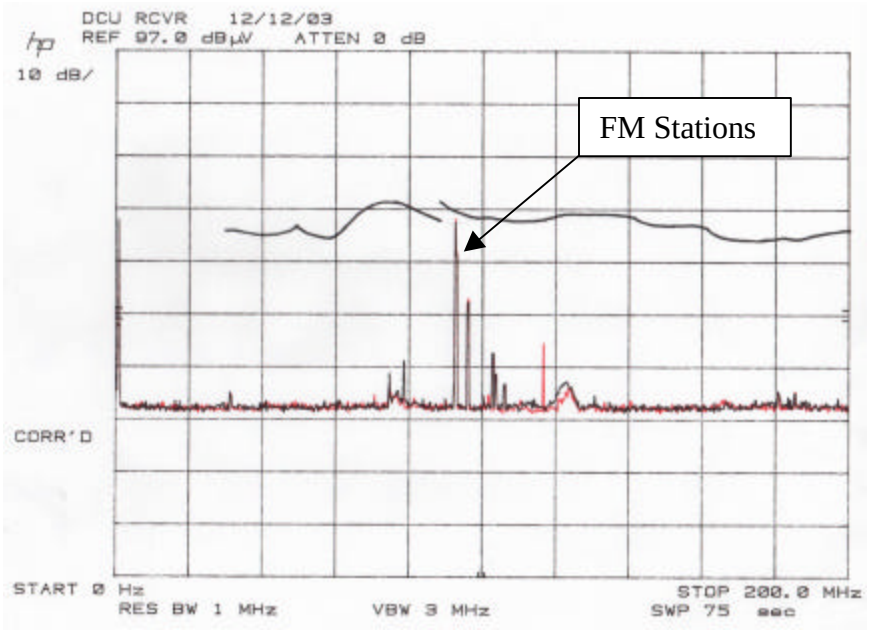


Class B Limit

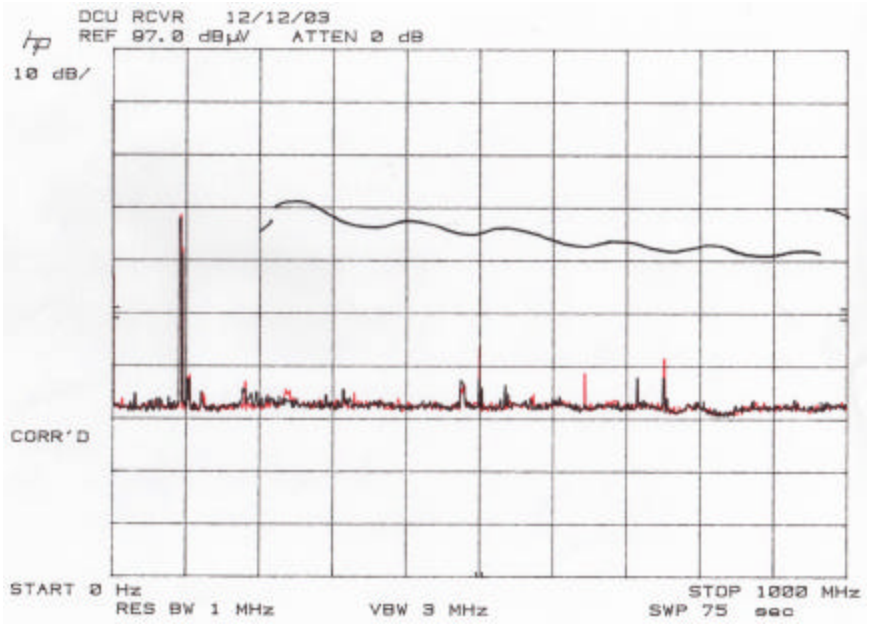


Class B Limit

Fig. 17
Spurious Emissions 470 MHz
Cabinet Closed
1 – 5 GHz Horizontal



Class B Limit



Class B Limit

Red – Vertical
Black = Horizontal

Fig. 18
Ambient Levels
30 MHz – 1000 MHz