

**SMITH ELECTRONICS, INC.
ELECTROMAGNETIC COMPATIBILITY LABORATORIES**

RADIO-FREQUENCY EMISSIONS TEST REPORT

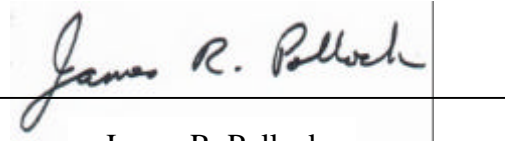
FOR

HEXAGRAM, INC.

DCU II
DATA COLLECTOR UNIT
RECEIVER
Model 9975
FCC ID: LLB9975

September 20, 2006

Prepared by:

A handwritten signature in black ink that reads "James R. Pollock". The signature is written in a cursive style and is positioned above a horizontal line that spans the width of the signature area.

James R. Pollock

Prepared for:

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TEST REPORT

OBJECTIVE

Measurements were performed between July 26 and September 15, 2006, to determine if the Hexagram DCU II, Model 9975 was in compliance with the FCC emissions requirements of 15.107, 15.109 and 15.111 for a digital device and receiver.

SUMMARY

The Hexagram DCU II Model 9975 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 II would be considered a Class A digital device but is required 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	July 26 – September 15, 2006
EQUIPMENT UNDER TEST	DCU II Hexagram Model 9975 Data Collection Unit Receiver/Digital Device
TEST SPECIFICATION	FCC Part 15 15.107 (a), 15.109(a), and 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: 11/05
Quasi-Peak Adapter	Hewlett Packard Model: 85650A SN: 2043A00350 Calibrated: 11/05
Spectrum Analyzer	Hewlett-Packard Type 8593EM SN: 3536A00147 Calibrated: 7/06
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 DCU II, Data Collector Unit contains two Data Radio Model 3473-2W transceiver modules. One, (RX-2), is used as a transceiver and the other, (RX-1), is used only as a receiver. The DCU II is a battery powered system with a 120 VAC powered charger. The system is intended to be centrally located in an area with a distribution of Hexagram Meter Transmitting Units (MTUs). The MTUs periodically transmit utility meter data which is received and stored by the DCU II. The transmitter in the DCU II can be used to provide time synchronization or to transmit information such as rate changes to the CPU of individual MTUs. At predetermined intervals, the DCU transmits the collected data to a central location using a cellular telephone installed within the DCU II enclosure. The transceiver modules are contained in a copper housing. The DCU II electronics, including the transceiver and cell phone modules, are installed within a plastic housing, which is, in turn, mounted in a stainless steel, weatherproof enclosure. The two antennas for the transceivers and the cell phone antenna are mounted externally to the outer enclosure.

The DCU II also contains the digital hardware and software necessary for operation and data storage, and could thus be considered a Class A digital device as well as a receiver.

The receivers and transmitter are to tune within the 450 MHz – 470 MHz band. The receivers are super-heterodyne receivers with an IF frequency of 86.85 MHz. The local oscillator (LO) of the system operates 86.85 MHz above the tuned frequency. The receiver input not associated with the transmitter, (RX-1), contains a sharp band-pass filter at the tuned frequency that reduces any off-frequency input signal and also contains the LO frequency and its harmonics within the system.

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

MEASUREMENTS PERFORMED

Antenna Power Conduction	Page 5
Radiated Receiver/Digital Emission	Page 14
AC Line Conducted Emissions	Page 27

The receivers and microprocessor portions of the DCU II were examined for radiated emissions per Part 15, and have been determined to comply with the appropriate sections of that part (15.107, 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 ports of the DCU II receivers was, in turn, attached to the spectrum analyzer input port with a 0.6 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 0.6 dB at 5 GHz. The emissions over the frequency range of 0 to 5 GHz were measured in two analyzer scans, 0 – 2.921 GHz and 2.679 – 5 GHz. The -57 dB level is shown on each scan. The measured values were not closer than 3 dB below the limit level. The closest level observed was at about 2.73 GHz when tuned to 460 MHz. At this frequency the cable loss is about 0.4 dB giving a clearance of 3.2 dB to the limit. The highest levels are shown in Table 1, and all emissions are seen in Figs. 1 – 6.

Table 1
RX-2 Antenna Terminal Receiver Emission

Tuned Freq.	Emiss. Freq.	Signal Level	Coax Loss	Level	dB under -57
460 MHz	2.73 GHz	-60.6 dBm	0.4 dB	-60.2 dBm	3.2
450 MHz	1.08 GHz	-62.5 dBm	0.2 dB	-62.3 dBm	5.3
460 MHz	3.28 GHz	-62.9 dBm	0.4 dB	-62.5 dBm	5.5
450 MHz	3.22 GHz	-63.1 dBm	0.4 dB	-62.7 dBm	5.7
460 MHz	0.546 GHz	-63.0 dBm	0.2 dB	-62.8 dBm	5.8

RADIATED EMISSIONS

The radiated emissions from the DCU II system were examined in the shielded room and on the open-field test site. The room measurements were made at a distance of 1 meter, with others at 3 m. The receiver and cell-phone antennas were installed and set up as can be seen in Pictorial 1.

The receiver/digital device portions of the DCU II were investigated from 30 MHz to 5GHz. Figures 7 - 13 show the scans made between 30 MHz & 1000 MHz with the enclosure closed as for normal operation. The plots show 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 few emissions could be detected in the room at one meter, it was determined not necessary to make open field measurements at three meters for all frequencies. Open field measurements were made with the receivers tuned to 460 MHz and the results are seen in Table 2. Some emissions were only detectable with the enclosure door open.

The following figures, 14 – 19, show the plots made between 1 GHz and 5 GHz. with the enclosure door closed and the system powered. Few emissions are observed during these measurements. An ambient signal seen in the plots is at 1.202 GHz. This is just past 1 division on the low frequency plots. As the emissions observed at the one meter distance were all more than 15 dB below the limit and near the noise floor, it was determined not practical to make the open field measurements.

Table 2
 Open Field Test Summary, Radiated Emissions
 Hexagram DCU II
 Model 9975
 Test Date August 17, 2006
 Measurement Distance, 3 meters

Freq. MHz	Signal dBuV	Antenna Factor	Coax Factor	E UV/m	dB vs. FCC A	dB vs. FCC B	Antenna Type
30.4	12.0	7.8	0.7	11.7	-28.2	-18.6	BICON V
400.0	10.0	15.1	2.0	22.8	-29.7	-18.9	LOGP V
400.0	10.0	15.1	2.0	22.8	-29.7	-18.9	LOGP H

No other signals were observed from the DCU II. The unit was rotated and the antenna scanned in height to find the maximum signal strengths.

All limit lines shown for radiated emissions were determined by subtracting the antenna factor and coax loss from the appropriate limit. This is the equivalent of adding those factors to the signal level.

CONDUCTED EMISSIONS

As the DCU II is provided with a 120 VAC powered charging system, conducted emissions measurements were made with both receivers tuned to 460 MHz and the system charging a “low” battery. The DCU II was set up 40 cm from the shielded room wall, which served as the ground plane. All other metallic surfaces were at least 80 cm distant. Both the hot and neutral lines were measured with reference to ground and the frequencies between 150 kHz and 30 MHz examined. The results of the measurements are found in Figs. 16 & 17, and are below the required limits.

CONCLUSION

The DCU II was examined for AC conducted emissions, radiated emissions between 30 MHz and 5 GHz and antenna terminal emissions up to 5 GHz. No emissions above the required limits were observed. Therefore the DCU II is in compliance with the requirements of 15.107 for conducted emissions, 15.109 for radiated emissions and 15.111 for antenna terminal emissions. The Model 9975 DCU II does meet the requirements of Part 15 for receivers and digital devices.



Conducted Emissions Test Set-up



Radiated Emissions Test Set-up

Pictorial 1
Model 9975 DCU II
Open Field Test Set-ups

Antenna Terminal Power

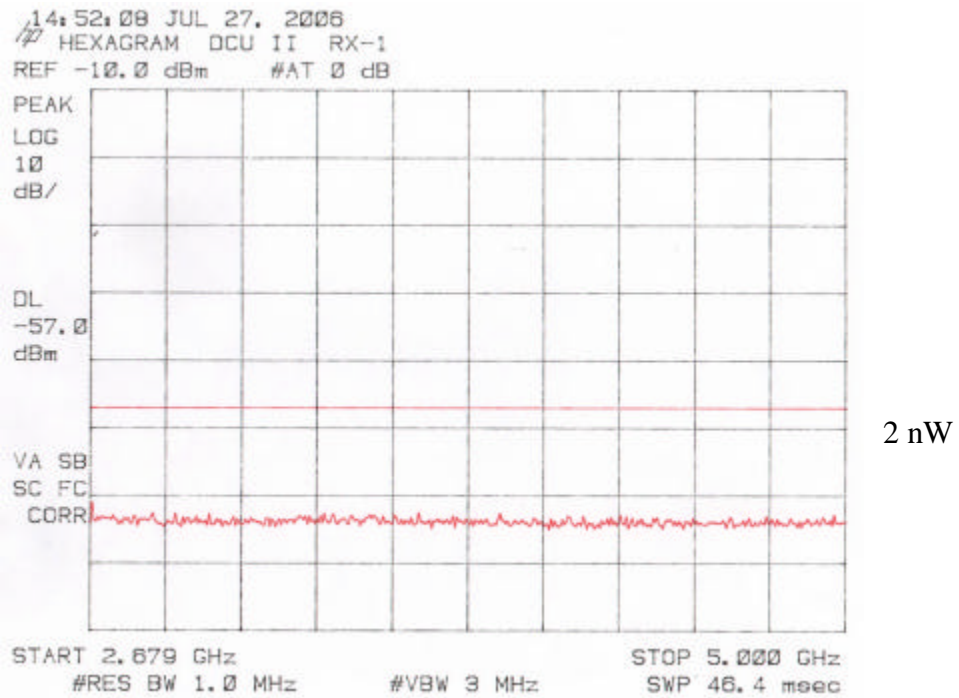
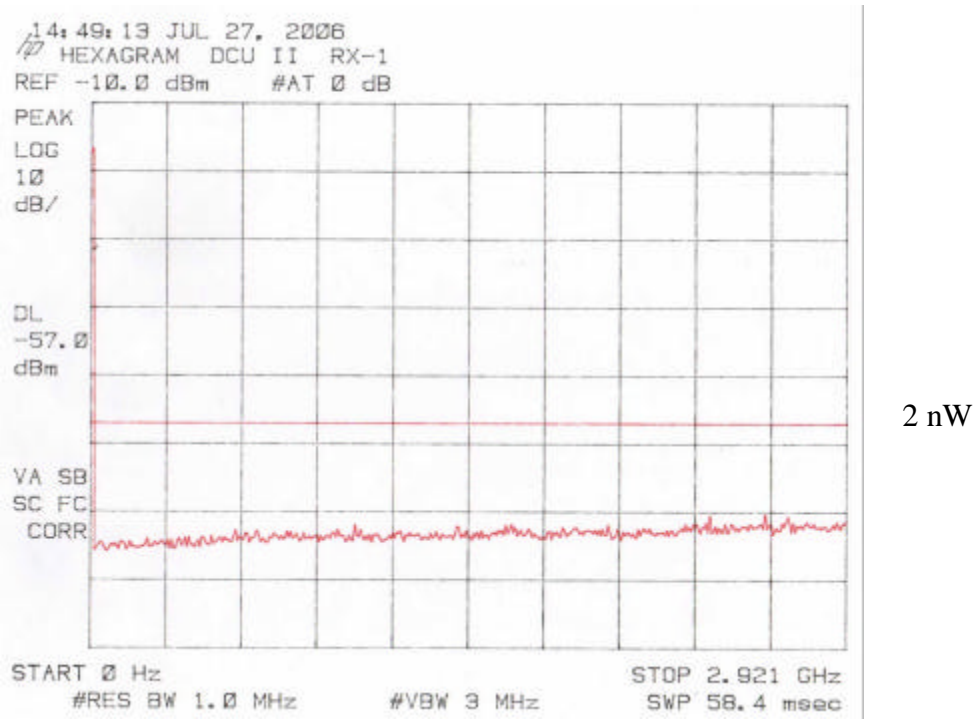


Fig. 1
Antenna Terminal Power
RX-1 450 MHz w/Filter

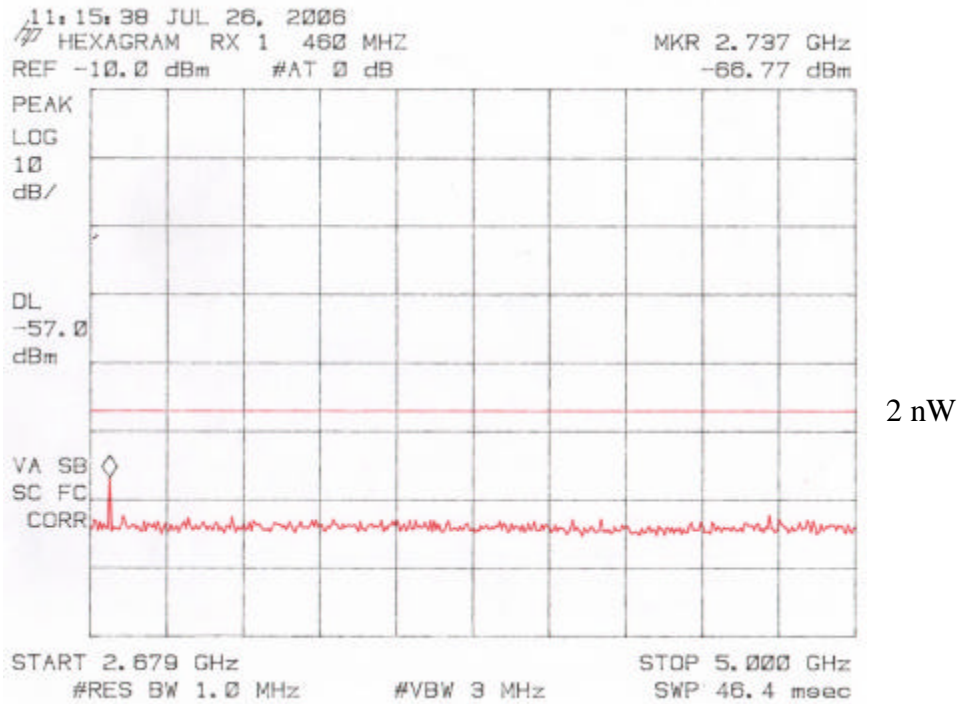
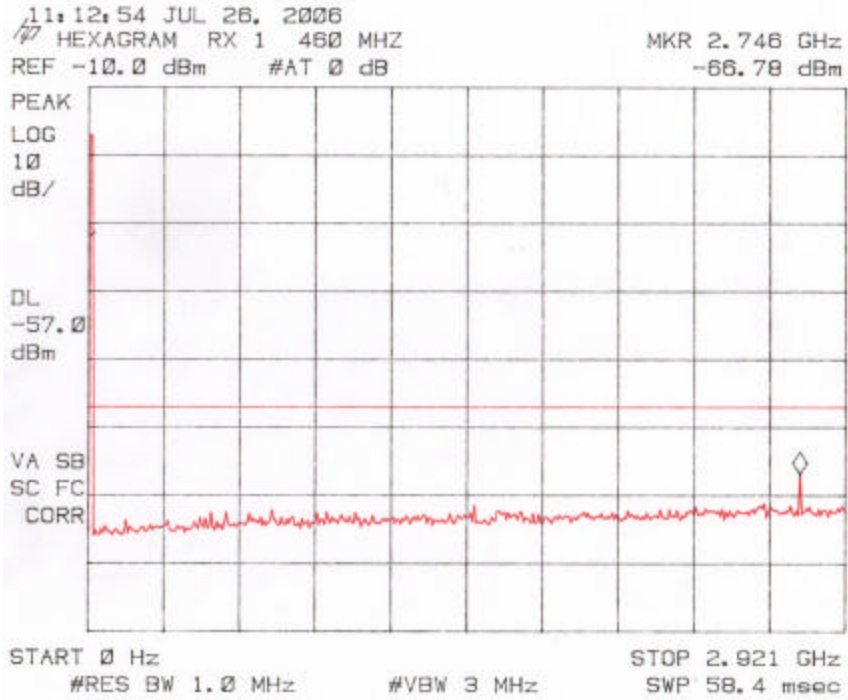
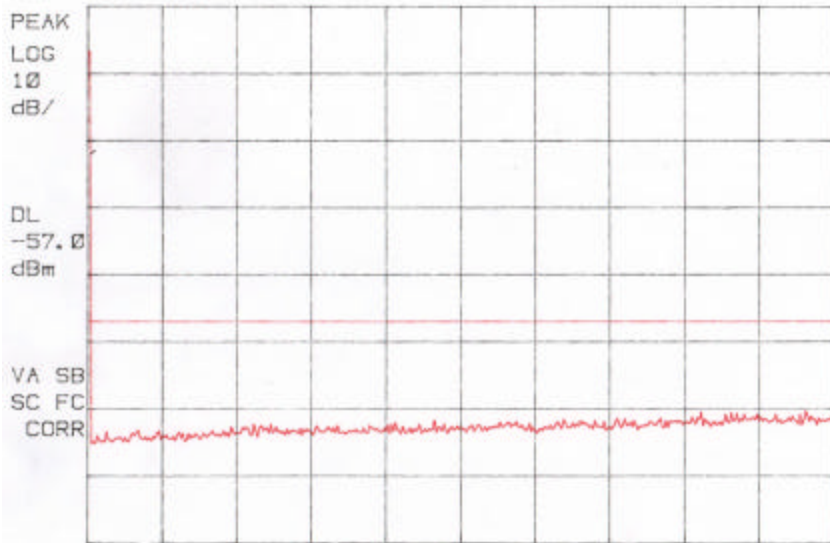


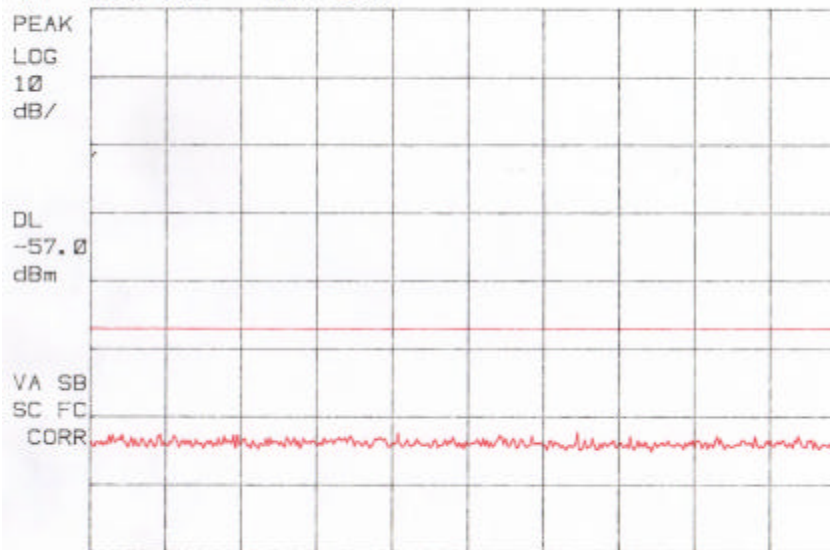
Fig. 2
 Antenna Terminal Power
 RX-1 460 MHz w/Filter

14:59:52 JUL 27, 2006
HEXAGRAM DCU II RX-1 469 MHZ
REF -10.0 dBm #AT 0 dB



START 0 Hz STOP 2.921 GHz
#RES BW 1.0 MHz #VBW 3 MHz SWP 58.4 msec

14:56:31 JUL 27, 2006
HEXAGRAM DCU II RX-1 469 MHZ
REF -10.0 dBm #AT 0 dB



START 2.679 GHz STOP 5.000 GHz
#RES BW 1.0 MHz #VBW 3 MHz SWP 46.4 msec

Fig. 3
Antenna Terminal Power
RX-1 469 MHz w/Filter

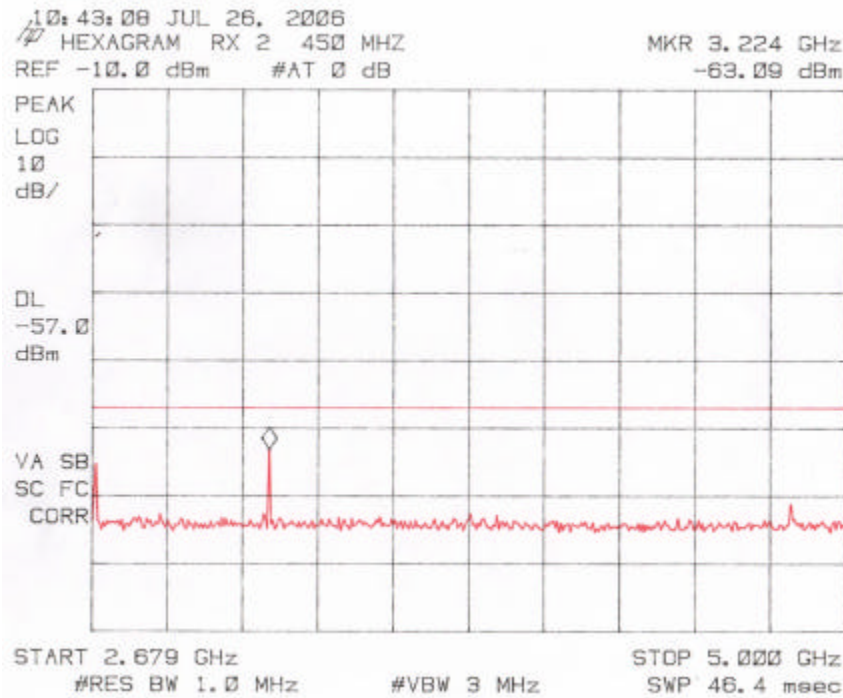
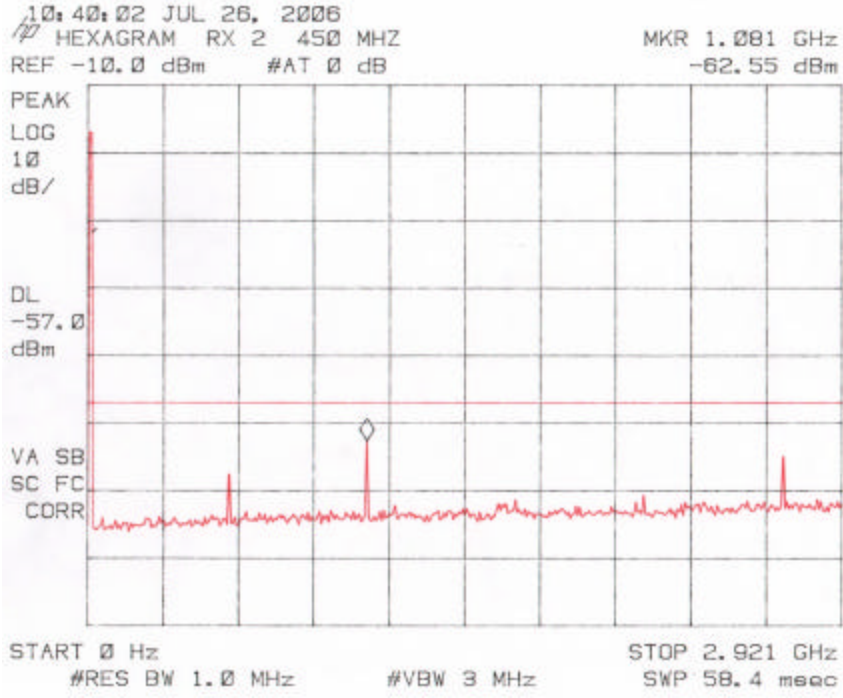


Fig. 4
 Antenna Terminal Power
 RX-2 450 MHz No Filter

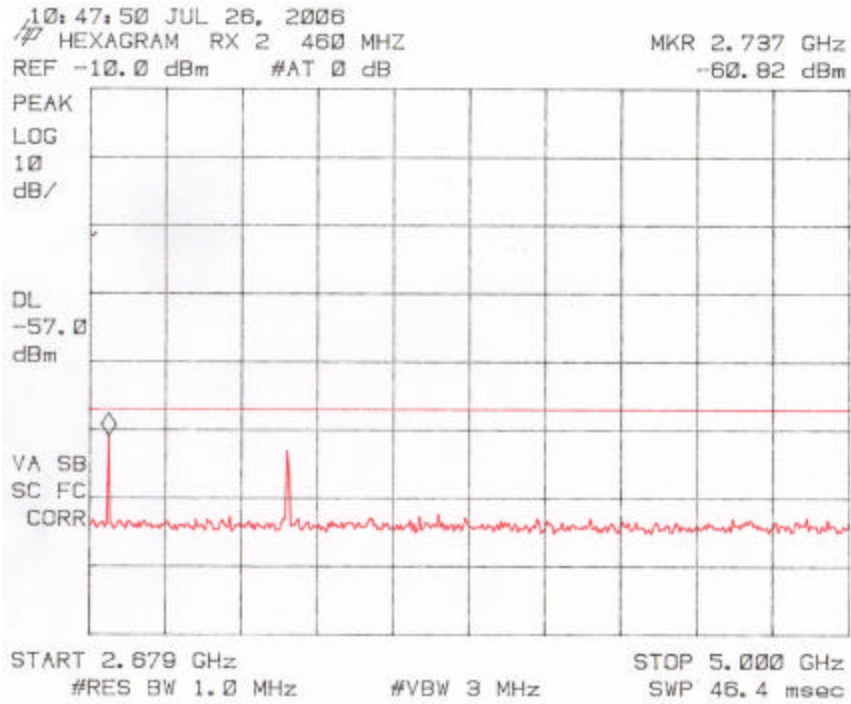
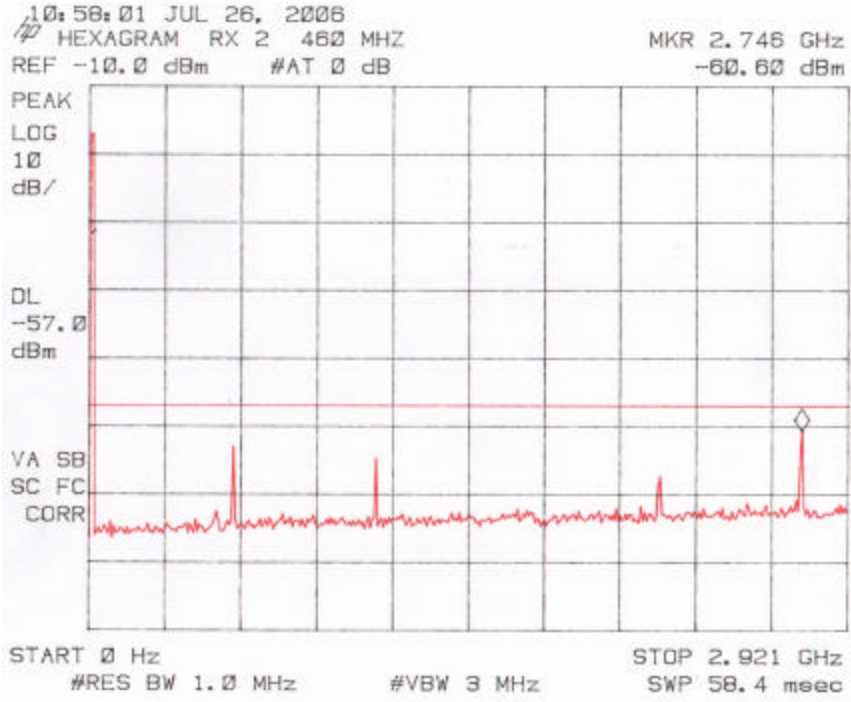


Fig. 5
 Antenna Terminal Power
 RX 2 460 MHz No Filter

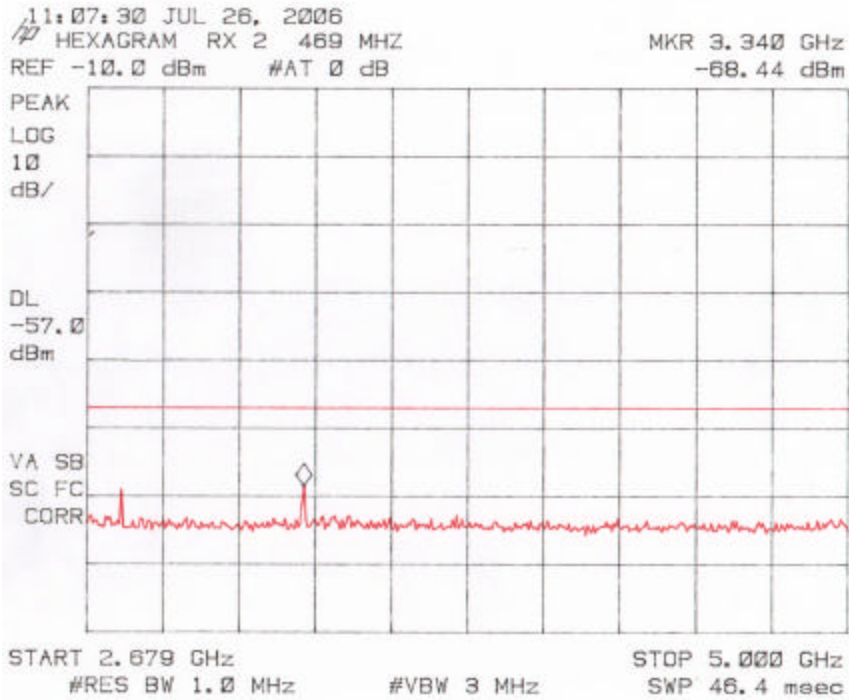
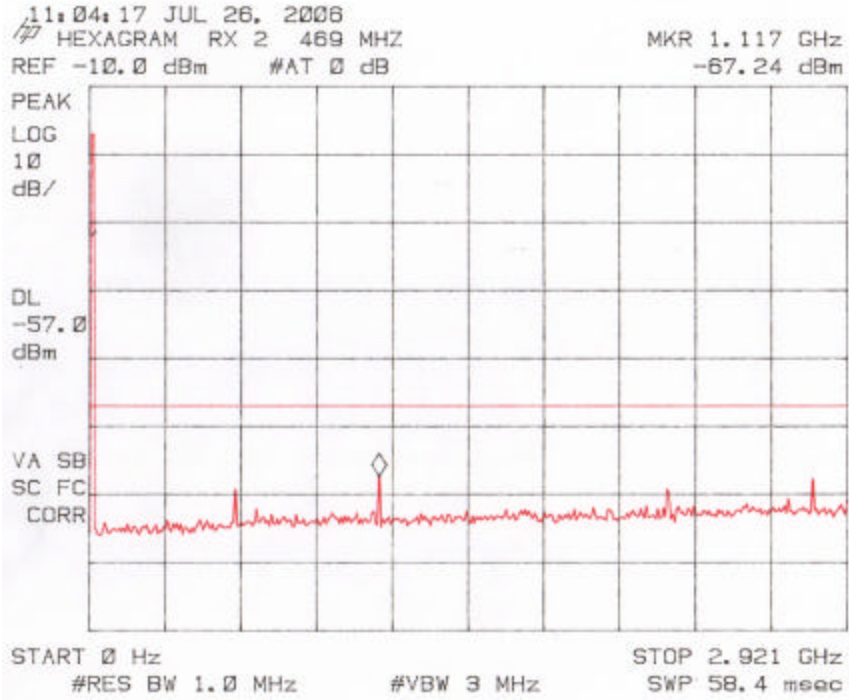
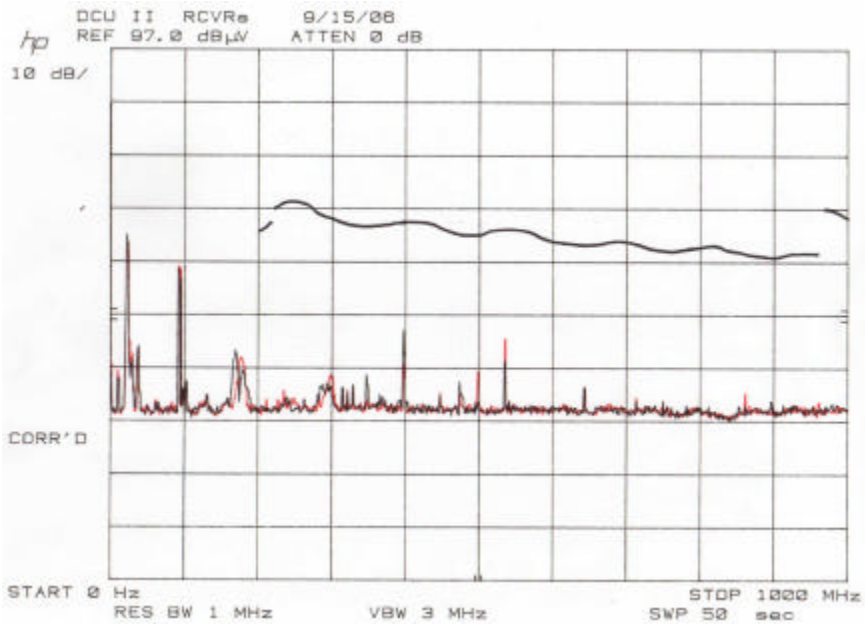
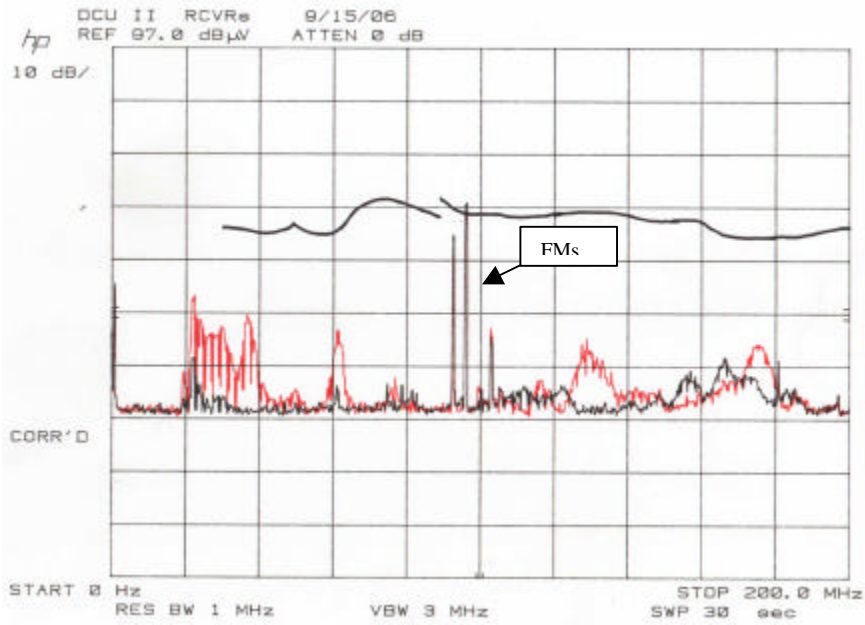


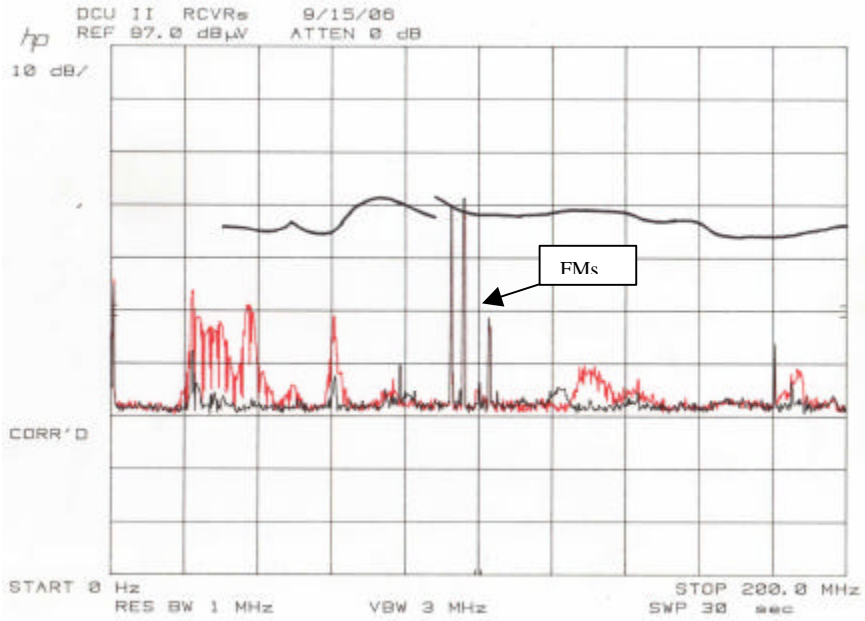
Fig. 6
 Antenna Terminal Power
 RX-2 469 MHz No Filter

Radiated & Spurious Emission

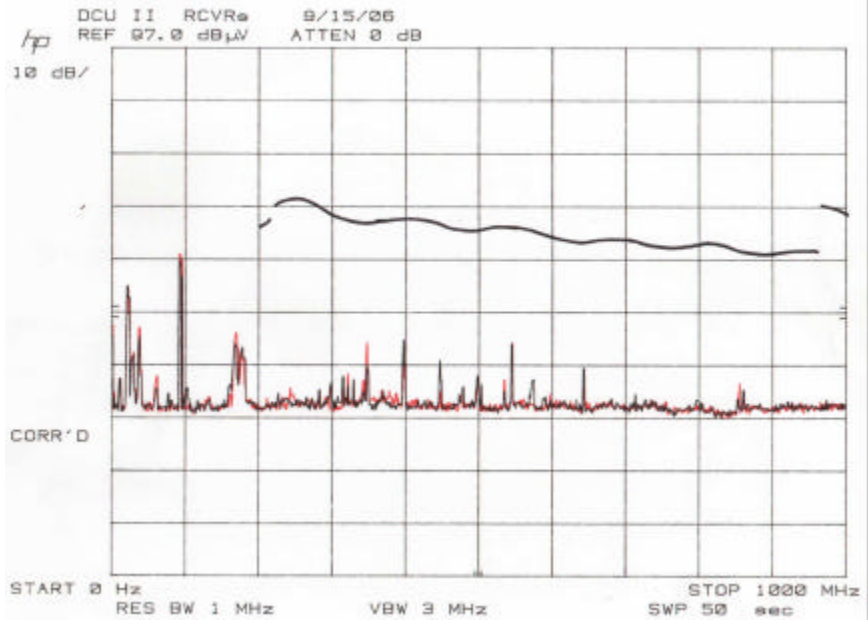


Red = Vertical
 Black - Horizontal

Fig. 7
 Radiated/Spurious Emissions
 RX-1 450 MHz
 30 MHz – 1000 MHz



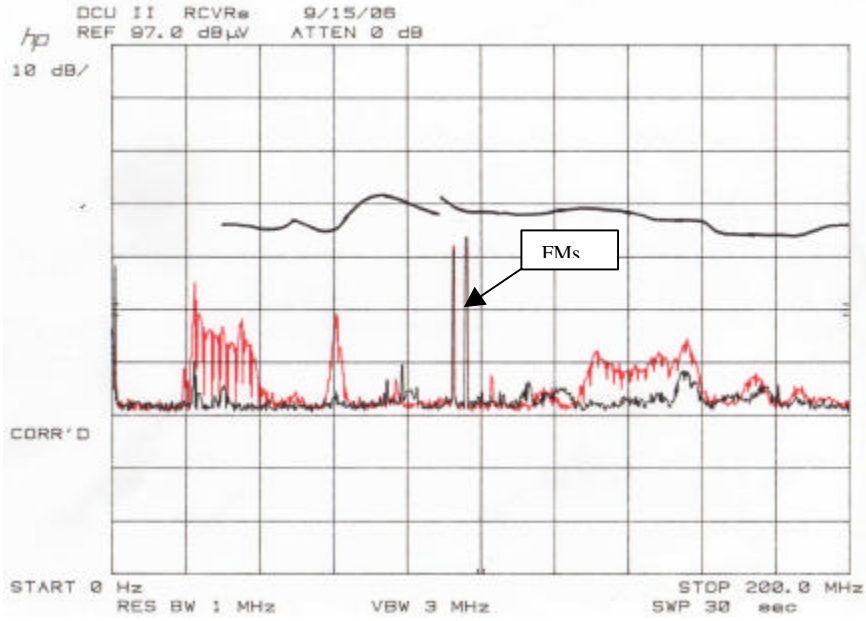
Class B Limit



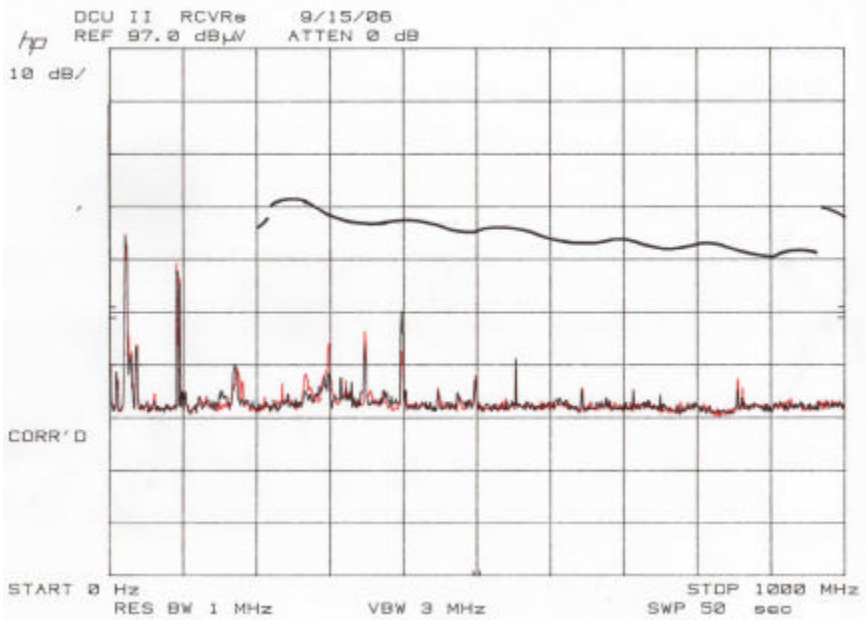
Class B Limit

Red = Vertical
 Black = Horizontal

Fig. 8
 Radiated/Spurious Emissions
 RX-1 460 MHz
 30 MHz – 1000 MHz



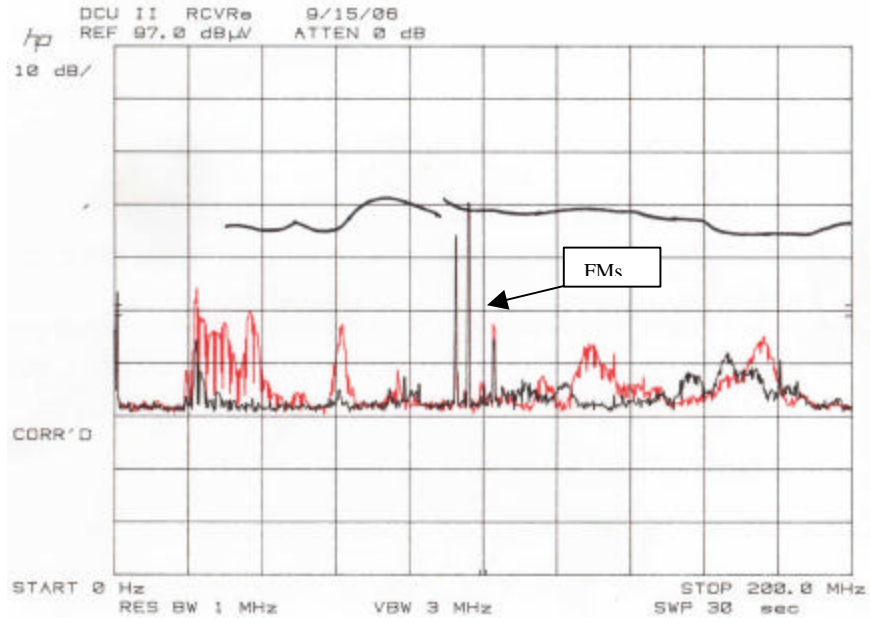
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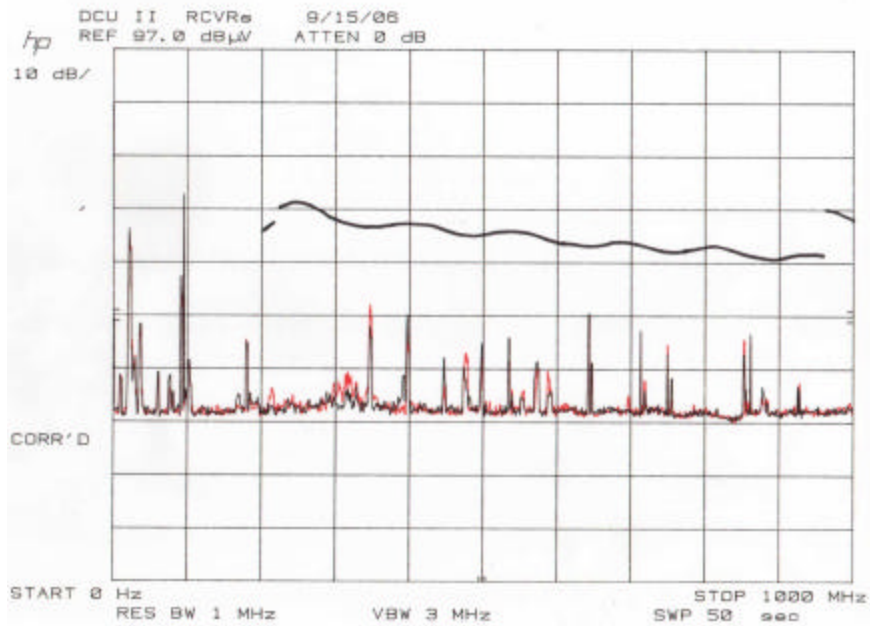
Class B Limit

Red = Vertical
 Black = Horizontal

Fig. 9
 Radiated/Spurious Emissions
 RX-1 469 MHz
 30 MHz – 1000 MHz



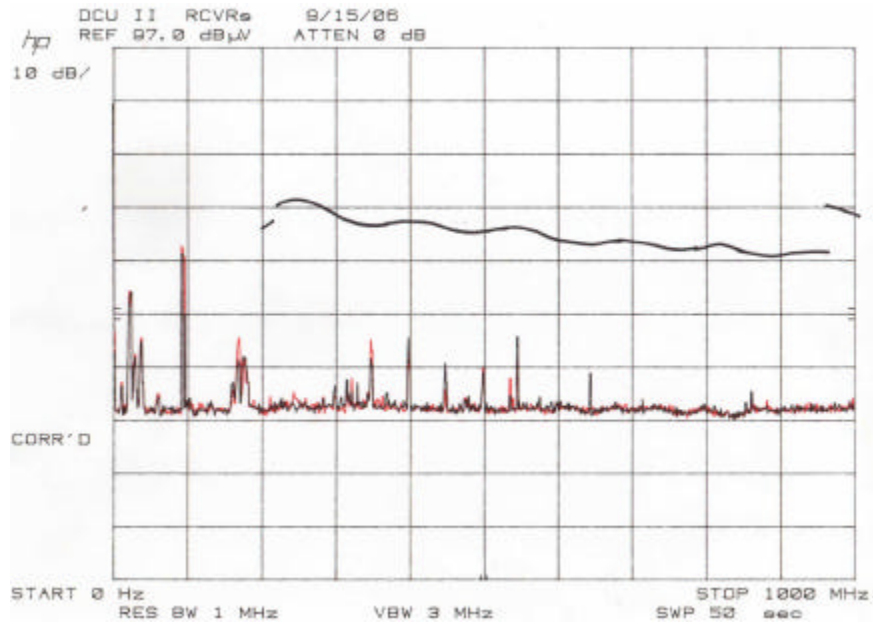
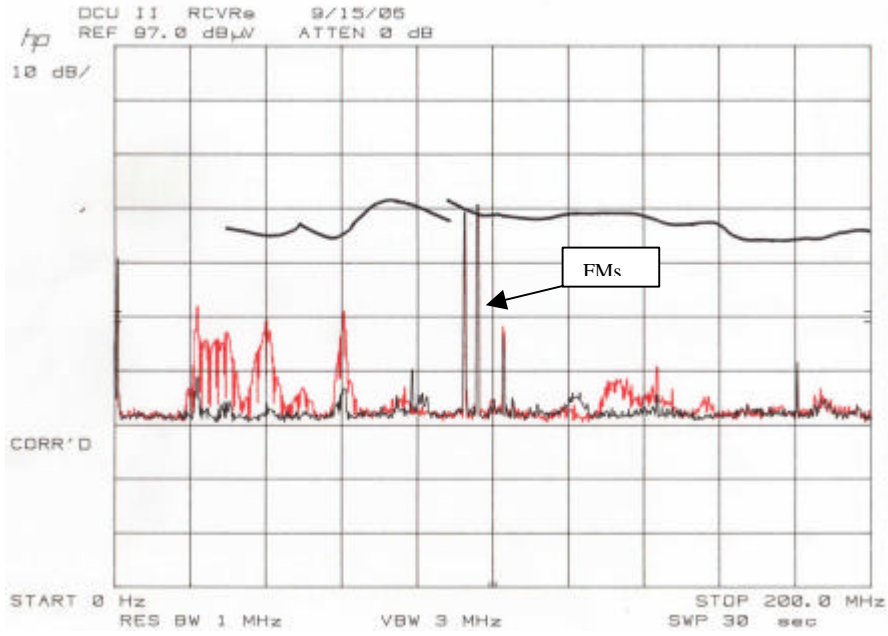
Class B Limit



Class B Limit

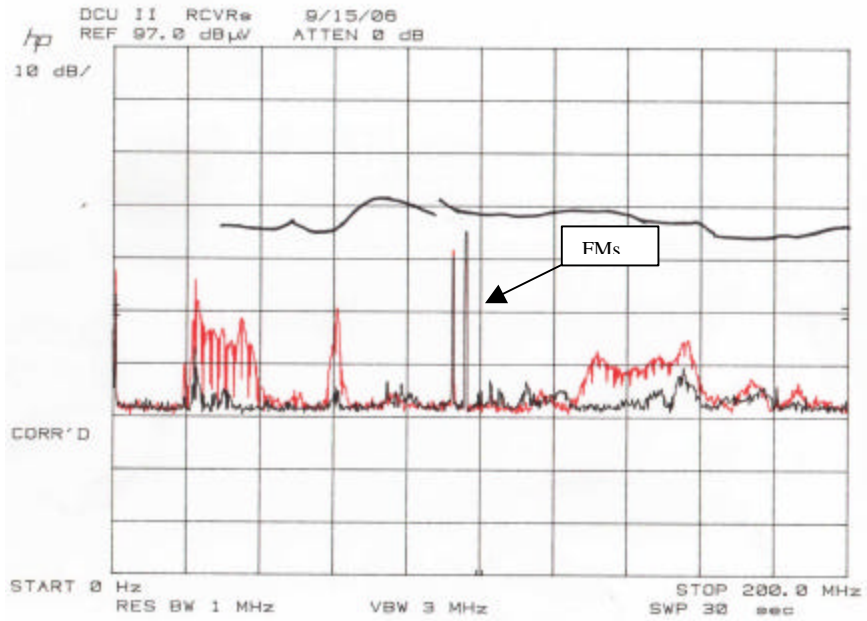
Red = Vertical
 Black = Horizontal

Fig. 10
 Radiated/Spurious Emissions
 Rx-2 450 MHz
 30 – 1000 MHz

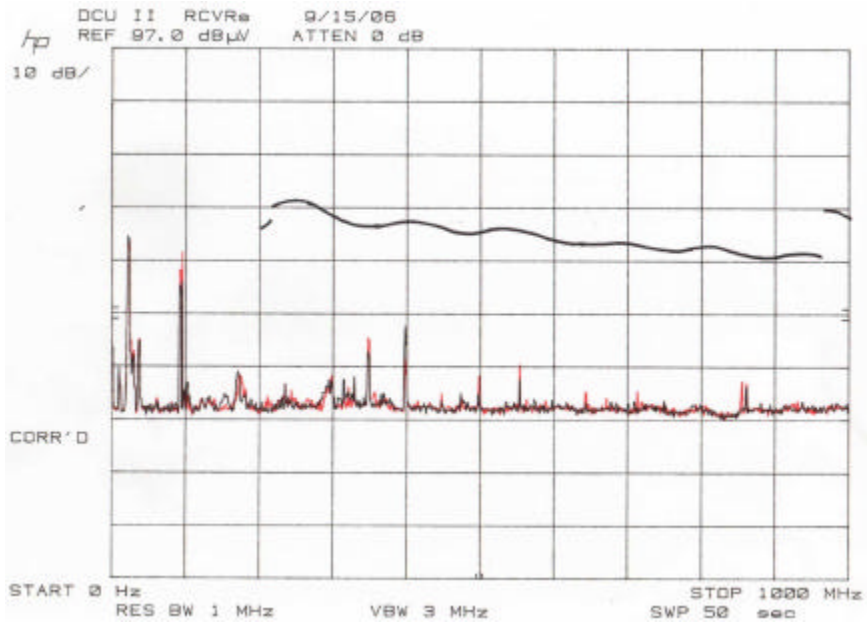


Red = Vertical
 Black = Horizontal

Fig. 11
 Radiated/Spurious Emissions
 RX-2 460 MHz
 30 MHz – 1000 MHz



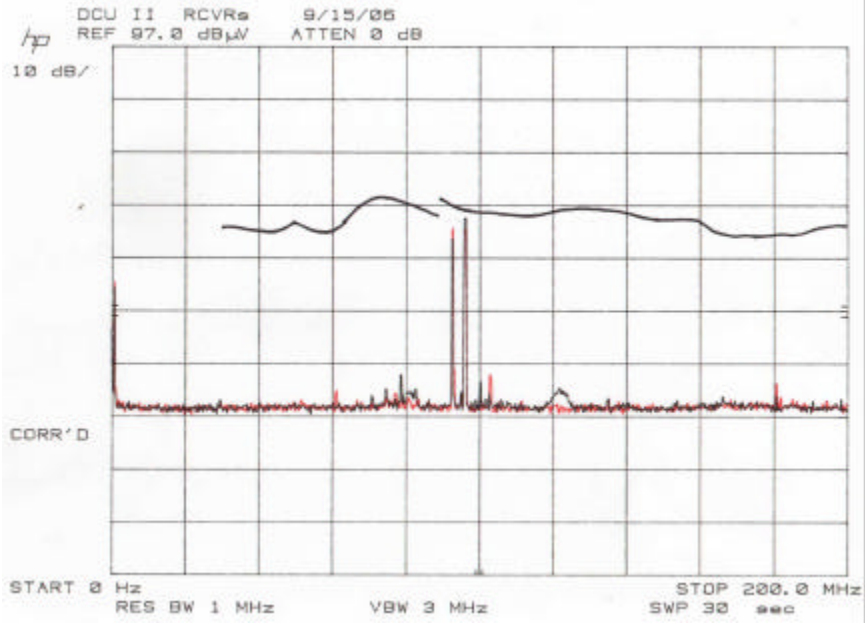
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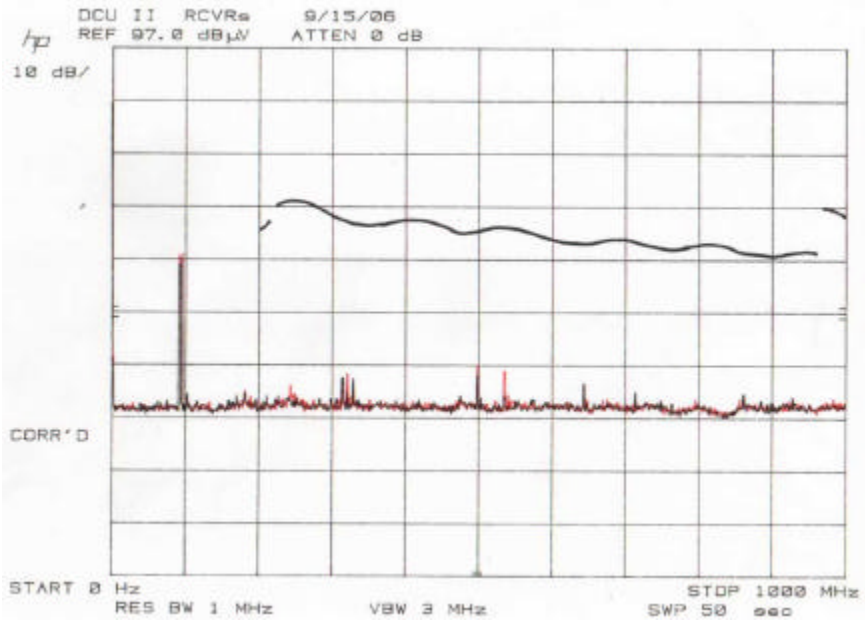
Class B Limit

Red = Vertical
 Black = Horizontal

Fig. 12
 Radiated/Spurious Emissions
 RX-2 469 MHz
 30 MHz – 1000 MHz



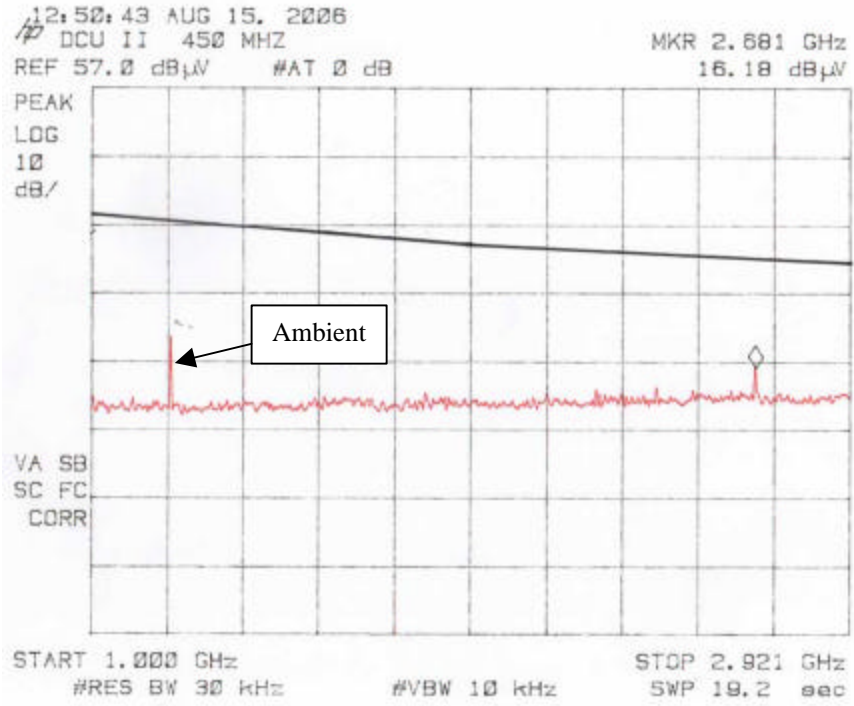
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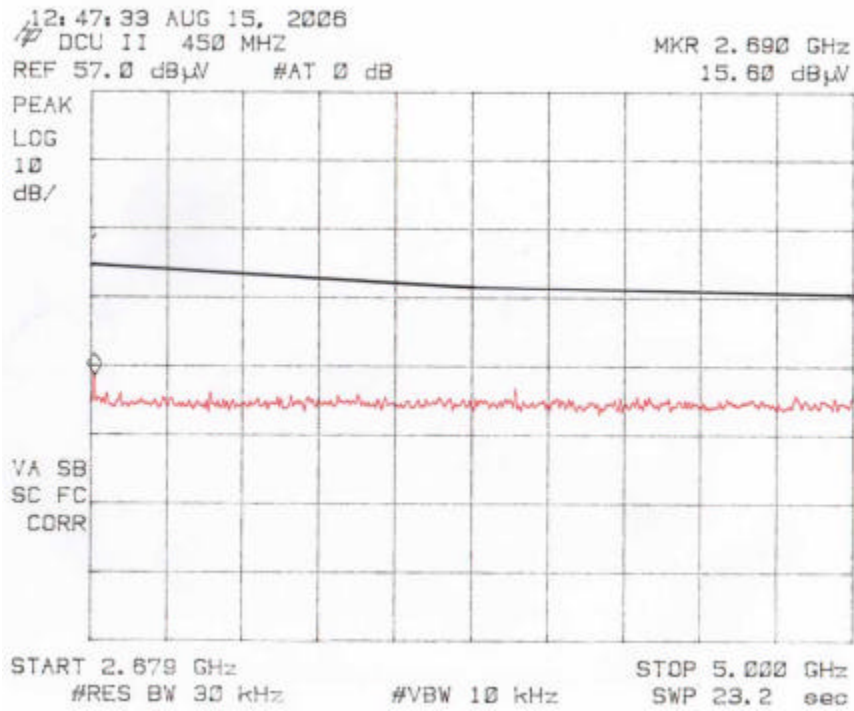
Class B Limit

Red = Vertical
 Black = Horizontal

Fig. 13
 Radiated/Spurious Emissions
 Ambient
 30 MHz – 1000 MHz

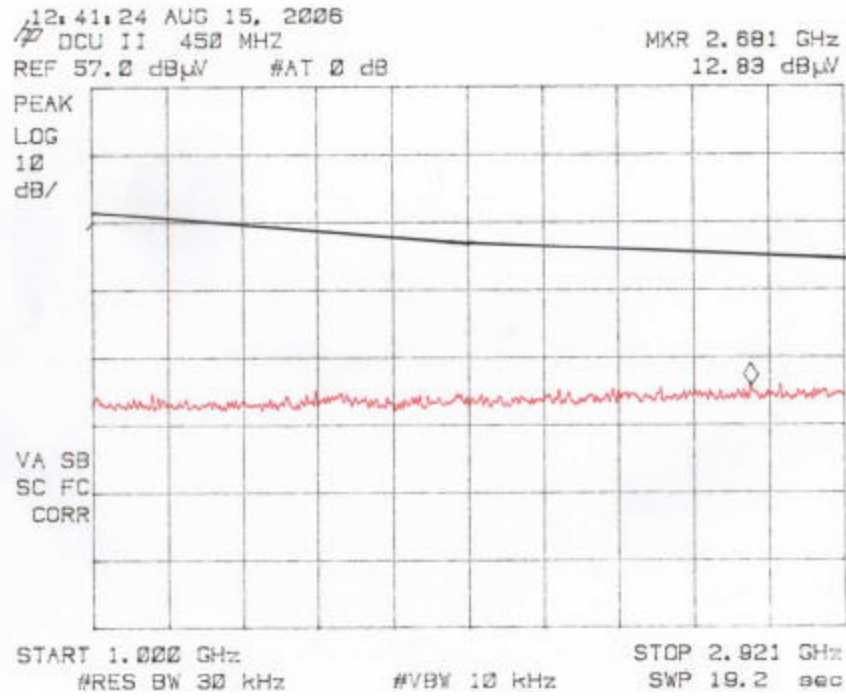


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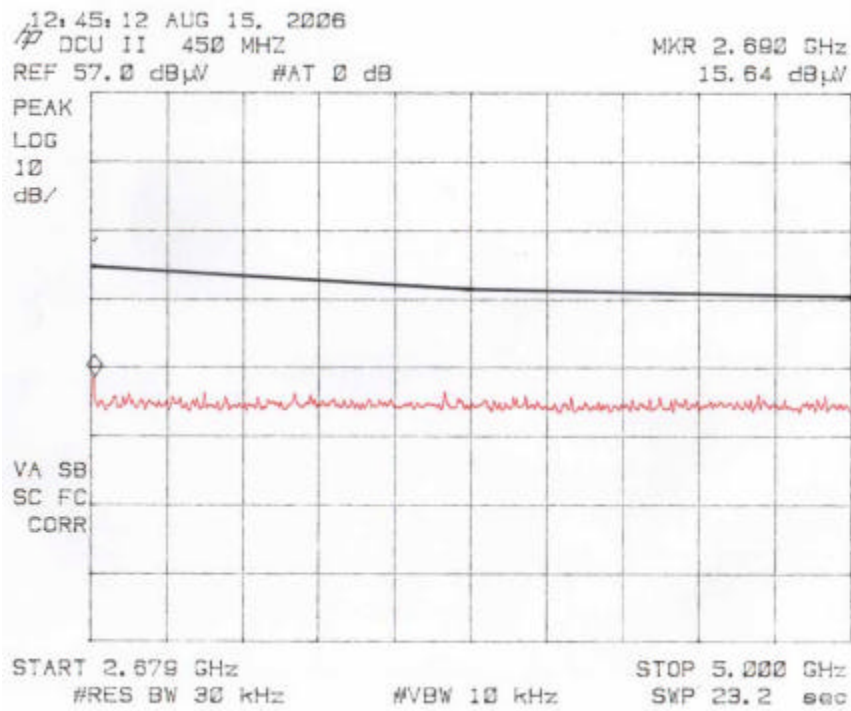


Class B Limit

Fig. 14
 Radiated/Spurious Emissions
 DCU II Receivers
 450 MHz Horizontal
 1 GHz – 5 GHz

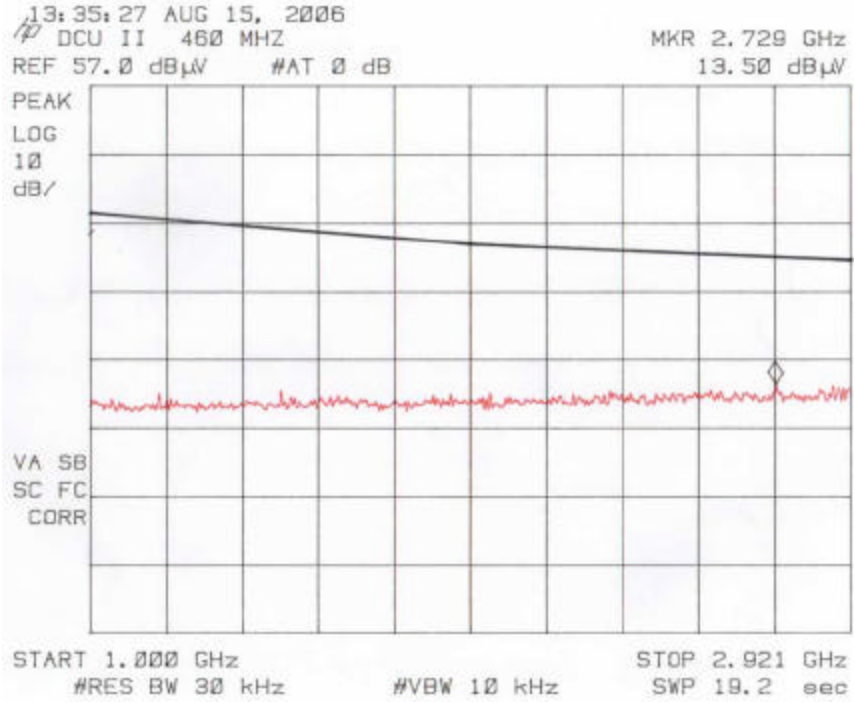


Class B Limit

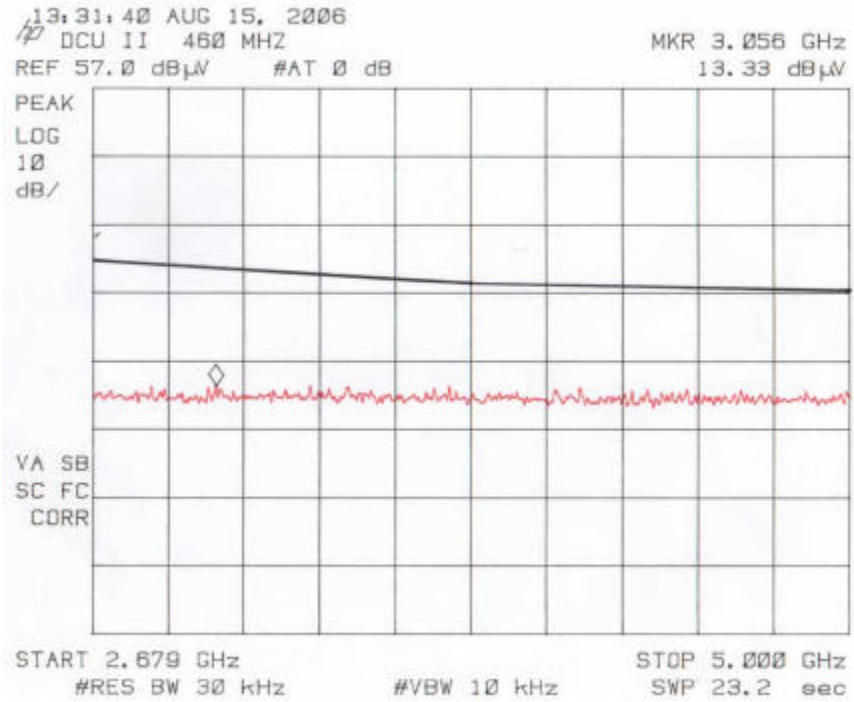


Class B Limit

Fig. 15
 Radiated/Spurious Emissions
 DCU II Receivers
 450 MHz Vertical
 1 GHz – 5 GHz



Class B Limit



Class B Limit

Fig. 16
 Radiated/Spurious Emissions
 DCU II Receivers
 460 MHz Horizontal
 1 GHz – 5 GHz

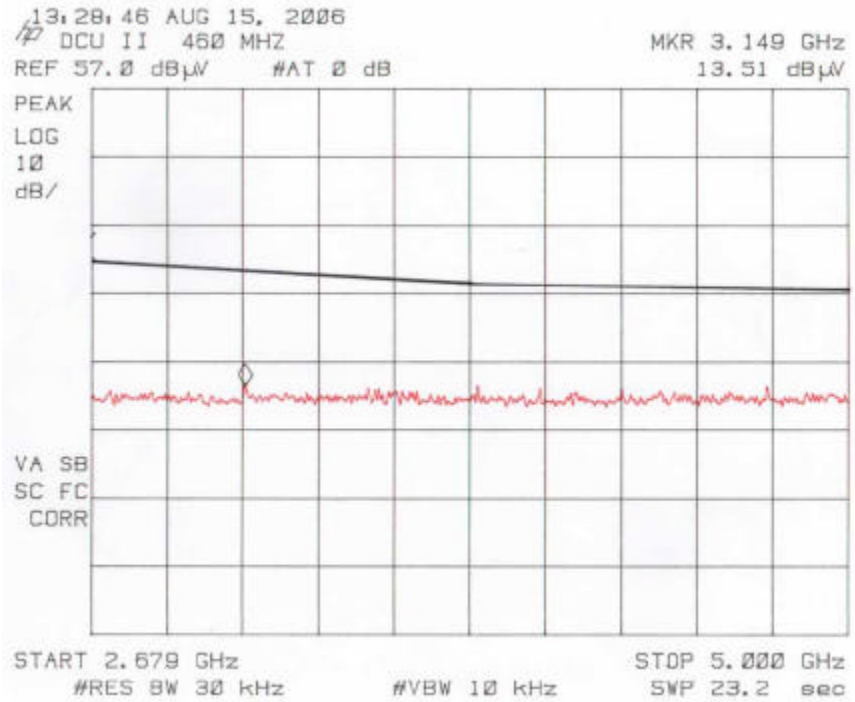
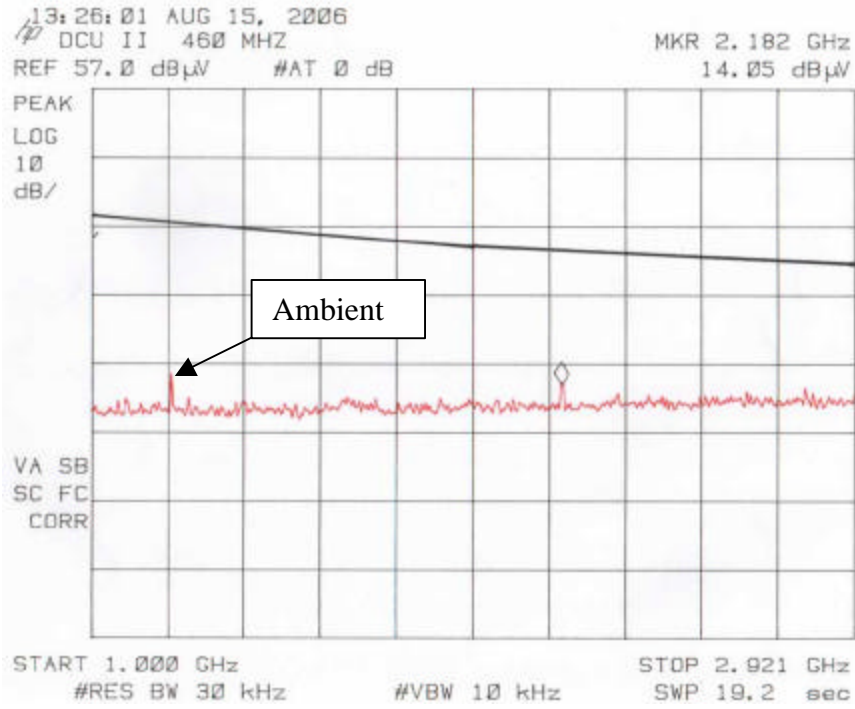
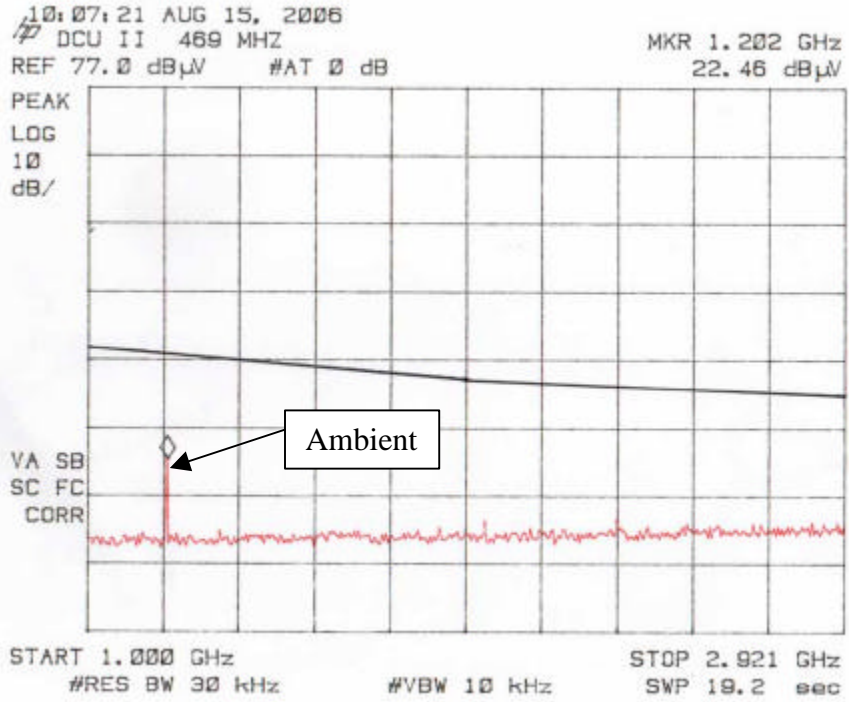
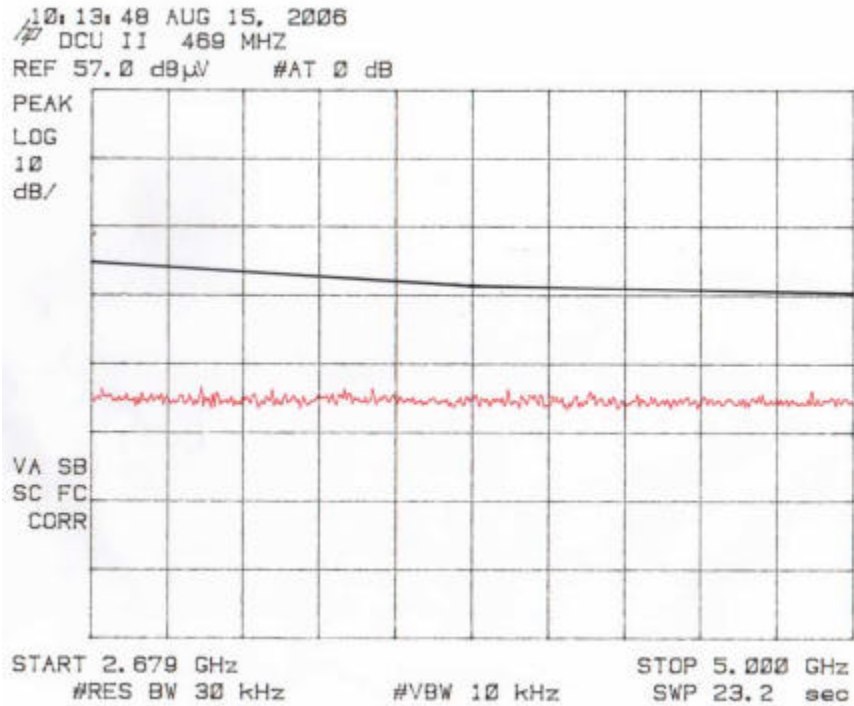


Fig. 17
 Radiated/Spurious Emissions
 DCU II Receivers
 460 MHz Vertical
 1 GHz – 5 GHz

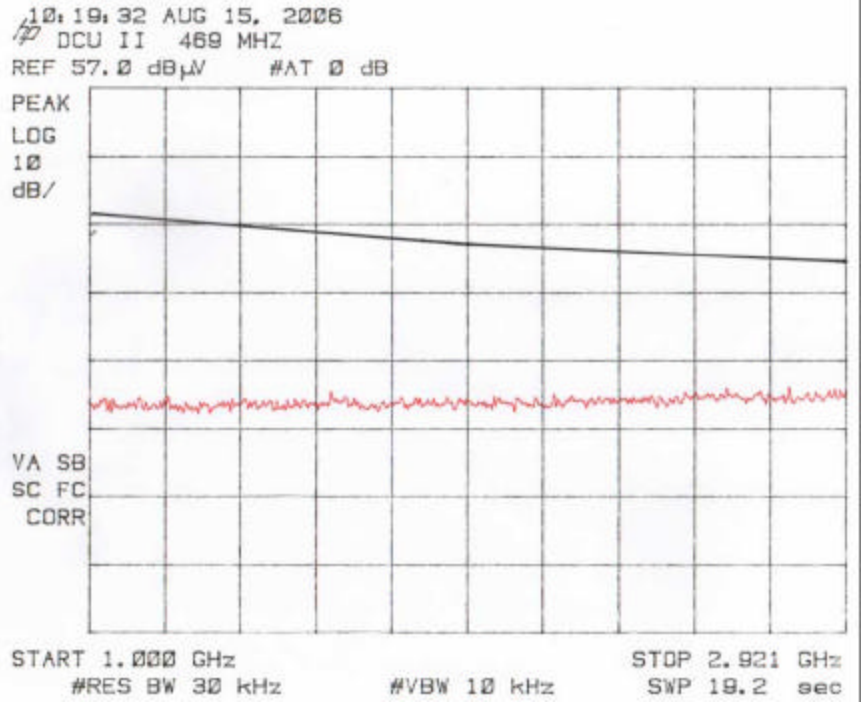


Class B Limit

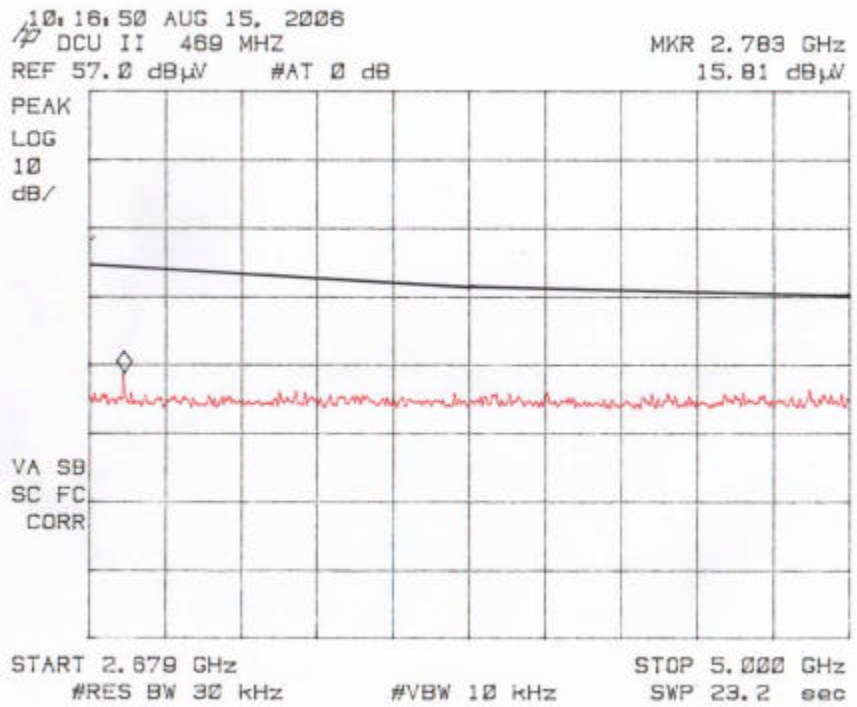


Class B Limit

Fig. 18
 Radiated/Spurious Emissions
 DCU II Receivers
 469 MHz Horizontal
 1 GHz – 5 GHz



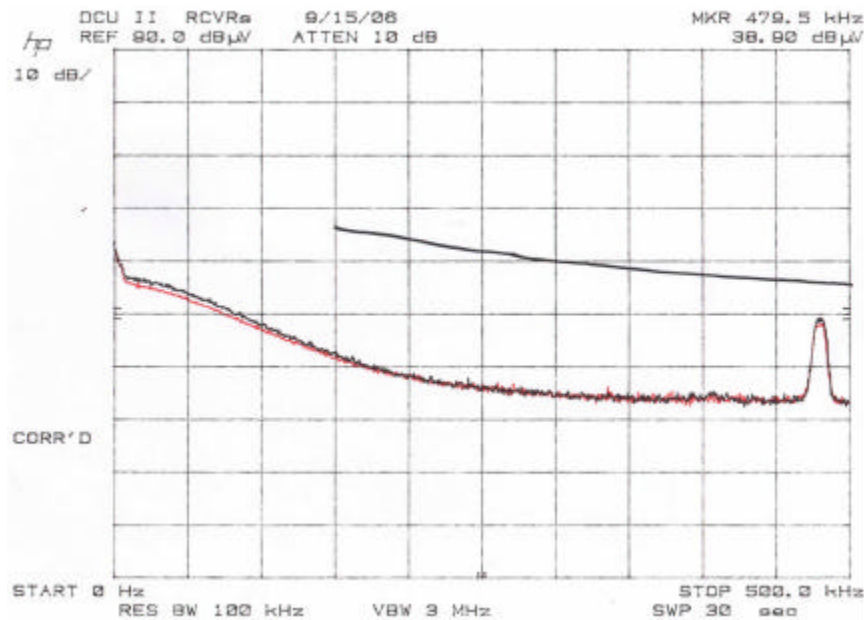
Class B Limit



Class B Limit

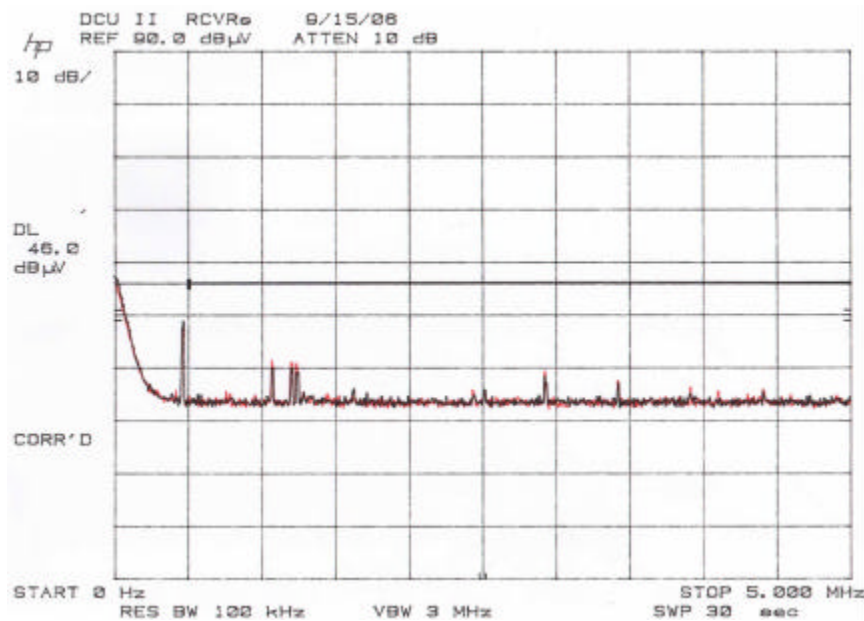
Fig. 19
 Radiated/Spurious Emissions
 DCU II Receivers
 469 MHz Vertical
 1 GHz – 5 GHz

Conducted Emissions



Peak

Class B
Avg. Limit

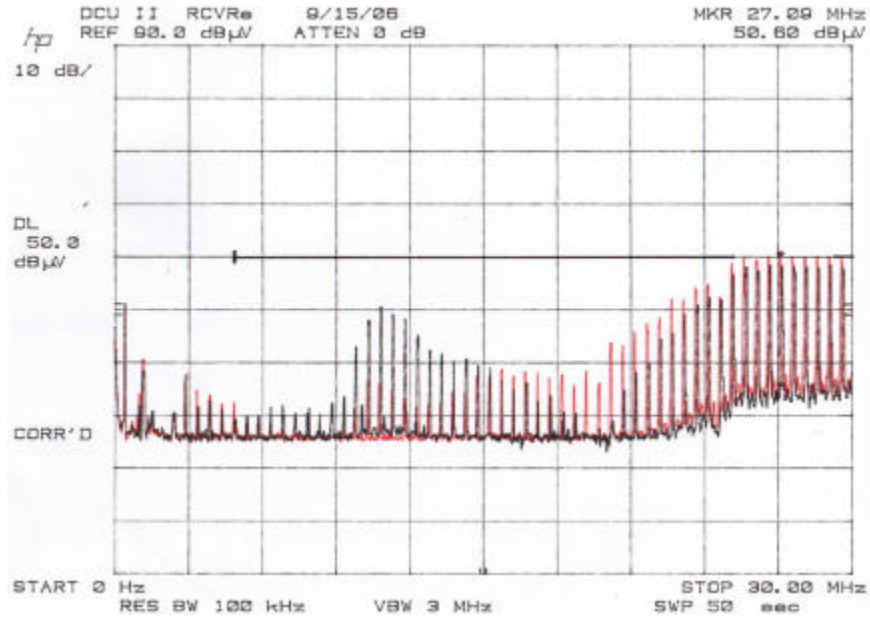


Peak

Class B
Avg. Limit

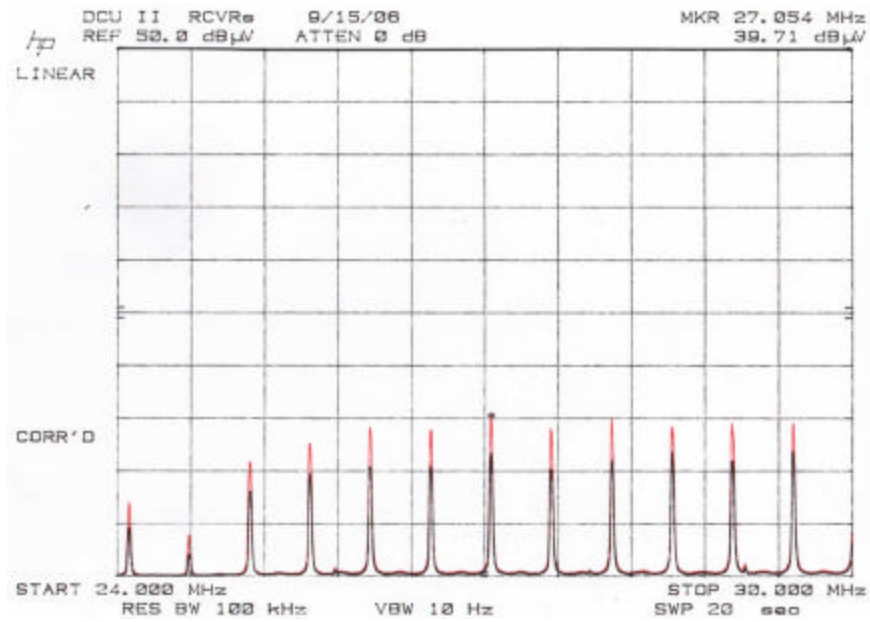
Red = Neutral
Black = Hot

Fig. 20
Conducted Emissions
DCU II
150 kHz – 5.0 MHz



Peak

Class B
 Avg. Limit



Class B
 Avg. Limit

Avg. Trace

Red = Neutral
 Black = Hot

Fig. 21
 Conducted Emissions
 DCU II
 5.0 MHz – 30.0 MHz