

WORKABOUT CCD SCANNER HANDHELD COMPUTER

**Support Documentation for
FCC Application For Equipment Authorisation**

FCC ID: ILPWORKACCD

Prepared by : Richard Scott

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^{1/} Location of FCC ID positioned on Identification Nameplate Detail -
Refer to Part 7.

Part 1 - Introduction

The Workabout CCD Scanner is an enhanced version of the base Workabout which was certified with the FCC ID: IPLWORKA in February 1995. It is a handheld computer designed primarily for the corporate market and has a CCD Barcode Scanner integrated into the top section of the unit. Information can be entered directly via the keyboard or by using the integral CCD Barcode Scanner. Data can be stored in internal RAM. A number of built-in applications allow the user to perform a variety of personal organisation tasks such as diary, database or calculator. Alternatively, the user may write programs for a specific application. The Workabout CCD Scanner offers a multi-tasking operating system allows several applications to be run simultaneously. Two external communications ports are located in the base section of the unit, an RS232 port via a 9 pin D-type socket and a Psion PFS port via an 11 pin LIF socket.

The Workabout CCD Scanner is powered by two internally fitted 1.5V "A" size NiCd batteries with a lithium backup cell. The Workabout CCD Scanner can be powered and the batteries recharged by plugging into a Workabout Docking Station with a mains adapter.

Part 2 - Test Configuration

The Workabout CCD Scanner was tested according to FCC Part 15 Subpart B Class B with a test configuration as shown below in Figure 1.

The Workabout CCD Scanner was mounted in a Workabout Docking Station, connection being via the LIF-PFS port. The Docking Station was fitted with an Psion HC Integral Printer, the combination being powered from a mains adapter. The RS232 port on the CCD Scanner was connected to a PC via an RS232 cable.

During the test a program stored internally performed the following functions sequentially and then repeated the sequence throughout the duration of the test :

- The CCD Scanner was activated for 5 seconds.
- The RS232 Comms link to the PC was exercised by sending a complete character set 5 times, a program on the PC mirroring activity from the Comms port on the PC monitor.
- The LIF-PFS port and the HC Printer were exercised via the Docking Station by the Workabout CCD Scanner instructing the HC Printer to print a complete character set 5 times.

This test configuration was selected as it represented the worst case emission where all ports are being utilised.

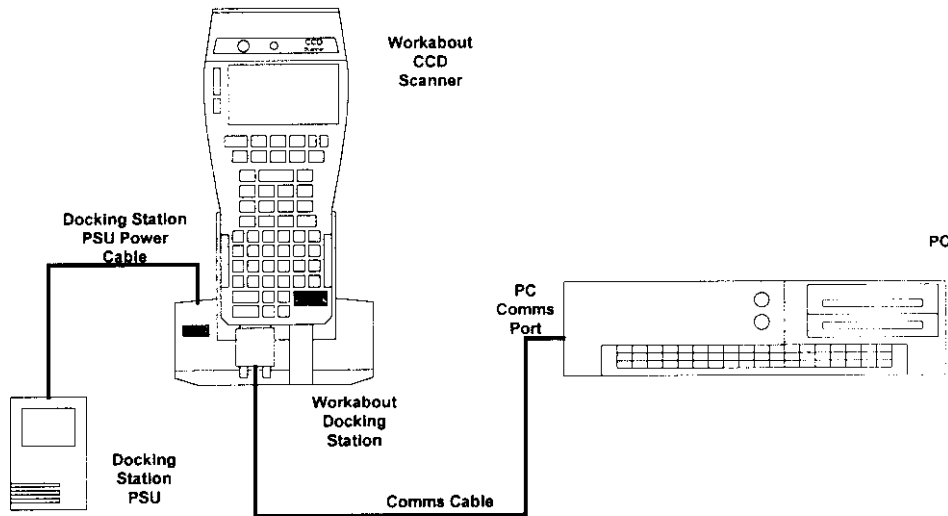


Figure 1 Test Configuration

Part 3.1 - Technical Description

The electronics circuitry of the Workabout CCD Scanner is contained on five boards which are connected internally by either board to board header connectors or flexible circuits. A Functional Block Diagram is shown at the end of this section.

The main board (which is also used in the base Workabout) provides all basic functions of the hand-held computer. This board also contains all the memory components of 1Mb RAM, 2Mb Flash Solid State Disk and 2Mb of Masked ROM for the Operating system. The LIF-PFS expansion port and associated circuitry is also contained on the main board.

The RS232/TTL Expansion board is connected directly to the main board via a 26 way header, the boards being mounted back to back. This board contains circuitry for both the RS232 and TTL interfaces. The RS232 port is routed via a flexible circuit to a 9 pin D-type connector in the base of the unit and is used for external communications. The TTL port is used internally to interface to the Scanner Head Driver Board via a flexible circuit.

The Scanner Head Driver Board is mounted behind the LCD and contains all the interface circuitry to maintain control over the Scanner Head. The main batteries are located on this board. This board is connected to the Main Board and the RS232/TTL Expansion Board via a flexible circuit which also carries power. The optical imaging and reading components, "good read" led, buzzer and Lithium backup battery are also mounted on this board.

The Scanner Illuminator Board is located in the top section of the unit and is connected to the Scanner Head Driver Board by a flexible circuit.

Part 3.2 - Functional Block Diagram

A Functional Block Diagram of the Workabout CCD Scanner is shown below in Figure 2.

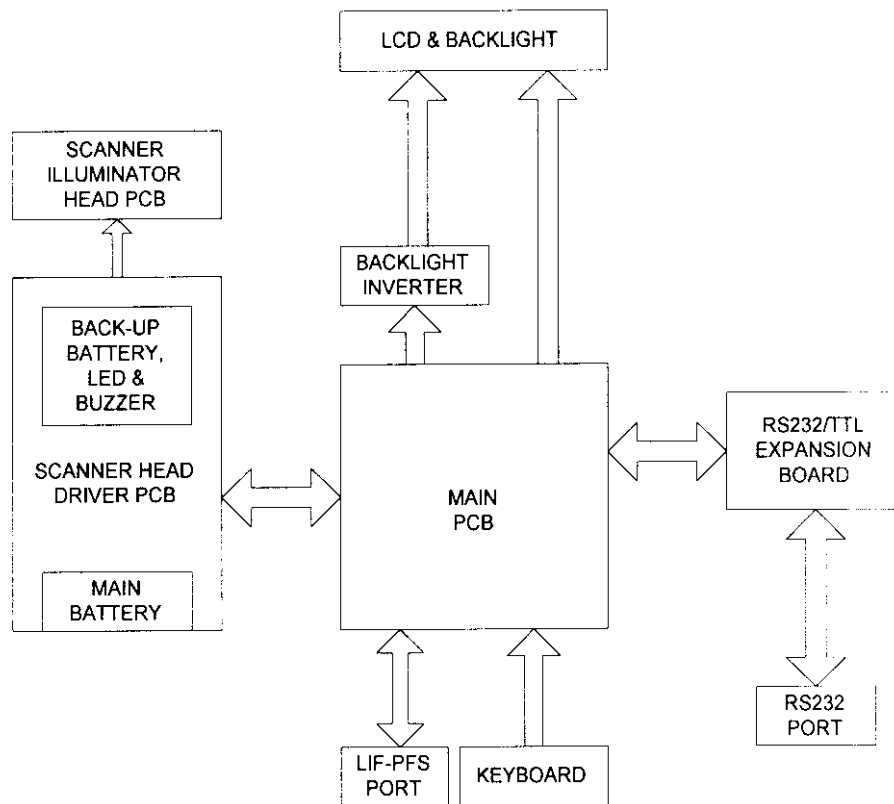


Figure 2 - Functional Block Diagram

Part 3.3 - Workabout Docking Station / HC Thermal Printer

The Workabout Docking Station is a peripheral designed to enhance the capability of the Workabout Handheld Computer. It is fitted with an HC thermal printer (which is plugged into the rear of the Docking Station). The Docking Station / Printer combination are included in the test configuration to ensure a maximum emissions situation and are not deemed to be part of the equipment under test.

Both the Workabout Docking Station and the HC Thermal printer carry FCC ID markings as :-

Workabout Docking Station : ILPWXDOCA

HC Thermal Printer : ILPHCP384A

The Docking Station can provide the following functions :

- To supply dc power to the Workabout CCD Scanner.
- To provide a charging function for the Workabout CCD Scanner internal battery.
- To provide the Workabout CCD Scanner with the ability to print.

Part 5 - Description of Interference Suppression Measures

The following Interference Suppression Techniques were employed in the design of the Workabout CCD Scanner :

- The Main board is of 6 layer construction with ground and power planes.
- The RS232/TTL Expansion board is of 4 layer construction with ground and power planes.
- Low-pass filters were implemented on all clock signals.
- By-pass and decoupling capacitor techniques were employed.
- All flexible circuits were designed with an embedded ground plane.
- Ferrite blocks were used at interface connectors.
- A common-mode choke was used at the dc power input.

The following revisions of PCBs were used in this submission :-

Main Board	Drg. No.	7800-0001	Revision 1.1
RS232/TTL Expansion Board	Drg. No.	7800-0004	Revision 2.0
CCD Illuminator Board	Code No.	661169011	Revision A.
CCD Driver Board	Code No.	661292010	Revision A.
CCD Optical Board	Code No.	661293010	Revision A.

PART 6 - Test Modes Description and Software

The test software was designed to activate all available ports/peripherals to simulate a worst case emission from a worst case test configuration. Since the operating system supports multi-tasking, some ports/peripherals can be functioning at the same time. The following functions are activated during the test:

Test 1 : Communications

The Workabout CCD Scanner sent a repetitive transmission of five complete character sets over the RS232 cable to the Comms port of the PC. The PC was running test software which echoed Comms Port activity to the monitor to enable a visual check of correct activity.

Test 2 : Scanning

The Workabout CCD Scanner repetitively activates the Scanner CCD for 5 seconds.

Test 3 : Printing

The Workabout CCD Scanner repetitively prints five lines of a full character set on the HC Thermal Printer. This is achieved by the Workabout communicating with the Printer via the Docking Station.

Test 4 : Battery Charging Function

The Workabout Docking Station was powered by a 110Vac input ac/dc mains adapter. The Workabout Docking Station supplied power to the host Workabout CCD Scanner and also charged the internal battery pack of the Workabout CCD Scanner.

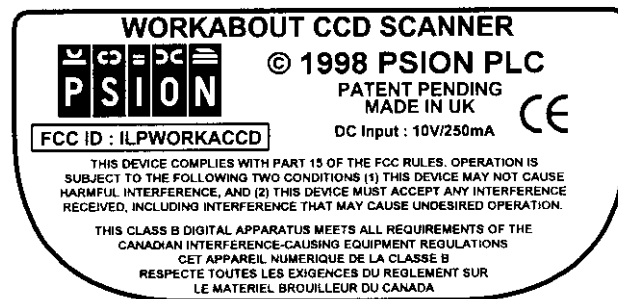
Software

The Workabout CCD Scanner was running Test Program "Rfs3c2v6", Version 2.6 in a multi-tasking mode.

The PC was running Test Program "Ttestpc", Version 2.0F.

Part 7 - Identification Nameplate Detail

A copy of the proposed identification details for the Workabout CCD Scanner Handheld Computer is shown below. This label will be fitted to the rear panel label recess.



Part 8 FCC Information to be included in the User Guide

The following information will be included in the User Guide :

FCC Information for the USA

Radio and Television Interference

This equipment utilises radio frequency energy and if used contrary to the instructions in the user guide, may cause interference to radio and television reception.

All Workabout models comply with class A limits of part 15 of the FCC rules. Models displaying either an FCC ID or an FCC logo comply with Class B limits.

Limits for Class A computing devices

This equipment has been tested and found to comply with the limits for a Class A computing device pursuant to part 15 of the FCC Rules. These are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Limits for Class B computing devices

This equipment has been tested and found to comply with the limits for a Class B computing device pursuant to Part 15 of FCC Rules. These are designed to provide reasonable protection against harmful interference in a residential installation. This equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation distance between the equipment and the receiver.
- If you are using the Workabout with a mains adaptor, plug it into an outlet which is on a different circuit from that to which the receiver is connected.
- Consult an authorised Psion dealer or an experienced radio/television technician for help.

Important

This equipment must be used with shielded interconnect cables. Suitable cables can be obtained from an authorised Psion dealer

The FCC may withdraw the users right to operate this equipment if the user modifies the Workabout (or an expansion module) without Psion approval.

Further reference:- a booklet entitled "How to identify and resolve radio - tv interference problems", prepared by the FCC, available from the US Government Printing Office, Washington DC 20402. Stock No. 004-000-00345-4

Appendix 1

FCC FORM 731

Test Report



Report No 228/000303

Client Psion Industrial plc
Unit 92
Milton Park
Abingdon
OX14 4RY

Contact: Mr R Scott

Authority & date Purchase Order 6004265 dated 10 February 1998

Items tested Workabout CCD Scanner

Specifications Code of Federal Regulations 47, Part 15, Subpart B §15.109 (a)

Results Radiated Emissions 30 to 1000 MHz, Class B PASS

Prepared by R Tetnowski (EMC Engineer)

Authorized by T S Sohi (Head of EMC Section)

Issue Date 18 March 1998

Conditions of issue



TESTING
No. 0135

This Test Report is issued subject to the conditions stated in current issue of *Test Leaflet 1* 'General conditions relating to acceptance of testing'. The results contained herein apply only to the particular sample/s tested and to the specific tests carried out, as detailed in this Test Report. The issuing of this Test Report does not indicate any measure of Approval, Certification, Supervision, Control or Surveillance by BSI of any product. No extract, abridgement or abstraction from a Test Report may be published or used to advertise a product without the written consent of the Director, BSI Product Testing, who reserves the absolute right to agree or reject all or any of the details of any items or publicity for which consent may be sought.

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INTRODUCTION

Psion Industrial plc supply the Workabout CCD Scanner product and it is their intention to market this equipment in the USA.

At the request of the client the following test programme was performed:

Radiated Disturbance

30 to 1000 MHz

It was not relevant to perform AC Powerline Conducted Emissions since the equipment under test is battery powered. Battery charger is already compliant.

This Report describes the measurements made in accordance with ANSI C63.4-1992 and the results obtained.

A full technical description of the site located at Unit 5, Finway Road, Hemel Hempstead, Herts., HP2 4SQ, England, where all measurements were made, has been submitted to the Commission. This description has been reviewed by the Commission and found to be in compliance with the requirements of Part 2, Subpart J, §2.948 of the regulations. The description has been placed on file by the Commission and the site added to the list of facilities whose measurement data will be accepted by the Commission.

The equipment used to perform all measurements is recorded in Appendix 1.

PRODUCT INFORMATION**Client**

Company name: Psion Industrial plc
Address: Unit 92
Milton Park
Abingdon
OX14 4RY
Contact name: Mr R Scott
Telephone number: 01235 443 082
Fax number: 01235 443 110

Sample for Test

Product name/Model: Workabout CCD Scanner
Serial No: Not stated on the sample
Brief description: Handheld computer with a CCD bar code scanner integrated into the top section. The sample has LIF and RS-232 interfaces fitted
Supply: Battery powered
Length: 240 mm
Width: 90 mm
Height: 70 mm
Cables Connected: RS-232 shielded 9-way cable connected to comm port of the supporting PC
Normal operating modes: Sample can operate as a handheld computer, scan bar codes, communicate via RS-232 port, operate printer and charge its batteries when connected to a docking station
Operating modes during tests: The sample prints a line to the printer, sends a full character set out the RS-232 port and then activates the scanner. This sequence is repeated throughout the test
During the test the sample was placed in a docking station which allowed the sample to operate for prolonged periods

Throughout this Report the above is referred to as the 'EMC test mode'

Reasons for choice of modes: Worst case emissions as all functions are exercised

Support Equipment

Type	Serial No	Comment
PC	332F21663	HP VECTRA 486/25VL
Docking station	DNA802098	PSION docking station for workabouts
HC printer		Fitted to docking station

Date sample received: 19 February 1998

Date tests started: 19 February 1998

Date tests completed: 19 February 1998

RADIATED DISTURBANCE FIELD STRENGTH: 30 to 1000 MHz

The level of radiated disturbance field strength emitted by the sample, in the frequency range 30 to 1000 MHz, was assessed against Class B limits defined in Code of Federal Regulations 47, Part 15, Subpart B, §15.109 (a).

The measurements of radiated interference were made with the sample installed in an RF semi-anechoic chamber. The chamber meets the full volumetric requirements for normalised site attenuation as specified in ANSI C63.4. The semi-anechoic chamber permits the measurement of radiated interference at a distance of 3 m from the sample and, because it meets the normalised site attenuation requirements, it can be used to formally declare conformance with standards where measuring at 3 m is permitted. The limits in §15.109 of the above regulations are specified at a distance of 3 m.

The methods used to measure radiated field strength are in accordance with Clause 8 of ANSI C63.4-1992, the configuration of the sample was in accordance with Clause 6 of ANSI C63.4 and the sample was operating in the EMC test mode. The sample was placed on a non conducting table measuring 1.5 m x 1.0 m, 0.8 m above the floor of the measuring site as specified in Clause 6.2 of ANSI C63.4 for tabletop equipment. All cables were arranged in accordance with Figure 9 (c) of ANSI C63.4. The actual test set up was photographed and is shown in photographs 1 and 2.

Radiated interference limits are specified with a quasi-peak detector. It is not possible to fully investigate the behaviour of the equipment using a quasi-peak detector and the following measuring strategy was employed:

The radiated interference field strength was first measured with a peak detector at fixed turntable angles of 0°, 90°, 180° and 270°. At each of these angles the antenna height was fixed at 1 m for both vertical and horizontal polarisation. The results of these scans for vertical polarisation are shown in figures 1 to 4 while figures 5 to 8 show the results for horizontal polarisation.

The preliminary measurements produce a large number of suspect frequencies which cannot all be fully evaluated. The 6 worst case frequencies were selected for further investigation. At each frequency, the turntable, antenna height and polarisation were first set to the values originally recorded during the preliminary investigation. The peak signal close to the original frequency was then located and the receiver was manually tuned to that frequency. It is possible, for some selected frequencies, that the signal finally chosen is not close to the original frequency. This can occur if there was a band of signals, all varying with time, and the original frequency scan did not detect the largest peak within the band. The manual selection process will allow the largest signal within the band to be detected.

The turntable was then fully rotated from 0 to 360° with the antenna both vertically and horizontally polarised. This measurement is used to determine the worst case azimuth angle of the turntable.

For each polarisation the turntable was then set to the worst case azimuth and the antenna was scanned over a height range from 1 to 4 m to determine the worst case height for each polarisation.

Having determined the worst case azimuth, height and polarisation, the antenna was then set to that azimuth, height and polarisation and a final measurement was taken over a 15 s period using a quasi-peak detector. The results of these final measurements are shown in table 1.

Table 1: Final measurements made with a quasi-peak detector

Frequency MHz	Level dB μ V	Limit dB μ V	Margin dB	Pol	Height cm	Azimuth Deg	Pass/Fail
30.718	35.4	40.0	- 4.6	V	100	302	PASS
32.656	32.6	40.0	- 7.4	V	100	343	PASS
96.024	35.3	43.5	- 8.2	V	100	270	PASS
99.832	36.2	43.5	- 7.3	V	100	245	PASS
187.474	38.9	43.5	- 4.6	H	170	269	PASS
360.976	40.2	46.0	- 5.8	H	100	86	PASS

The sample tested meets the requirements for radiated disturbance field strength emissions of Code of Federal Regulations 47, Part 15, Subpart B, §15.109 (a) for Class B equipment.

The measurement uncertainty for radiated disturbance field strength for a confidence probability of not less than 95 % is ± 4.2 dB. The margin between the measured field strength and the Class B limit is greater than this uncertainty at all frequencies in table 1.

Figure 1

19. Feb 98 11:11

228/000303
Vertical 0 Degrees

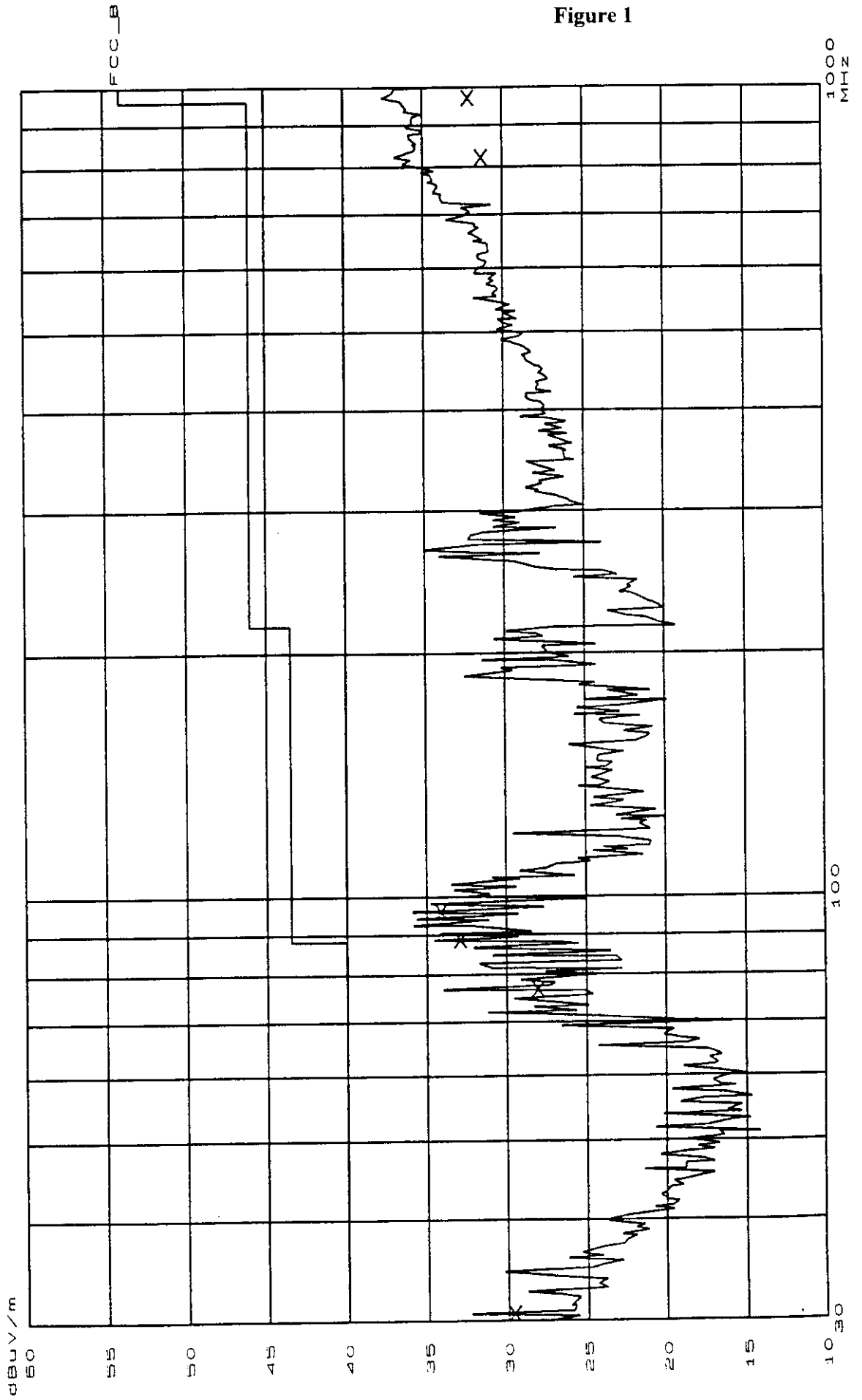


Figure 2

19. Feb 98 11:19

228/000303
Vertical 90 Degrees

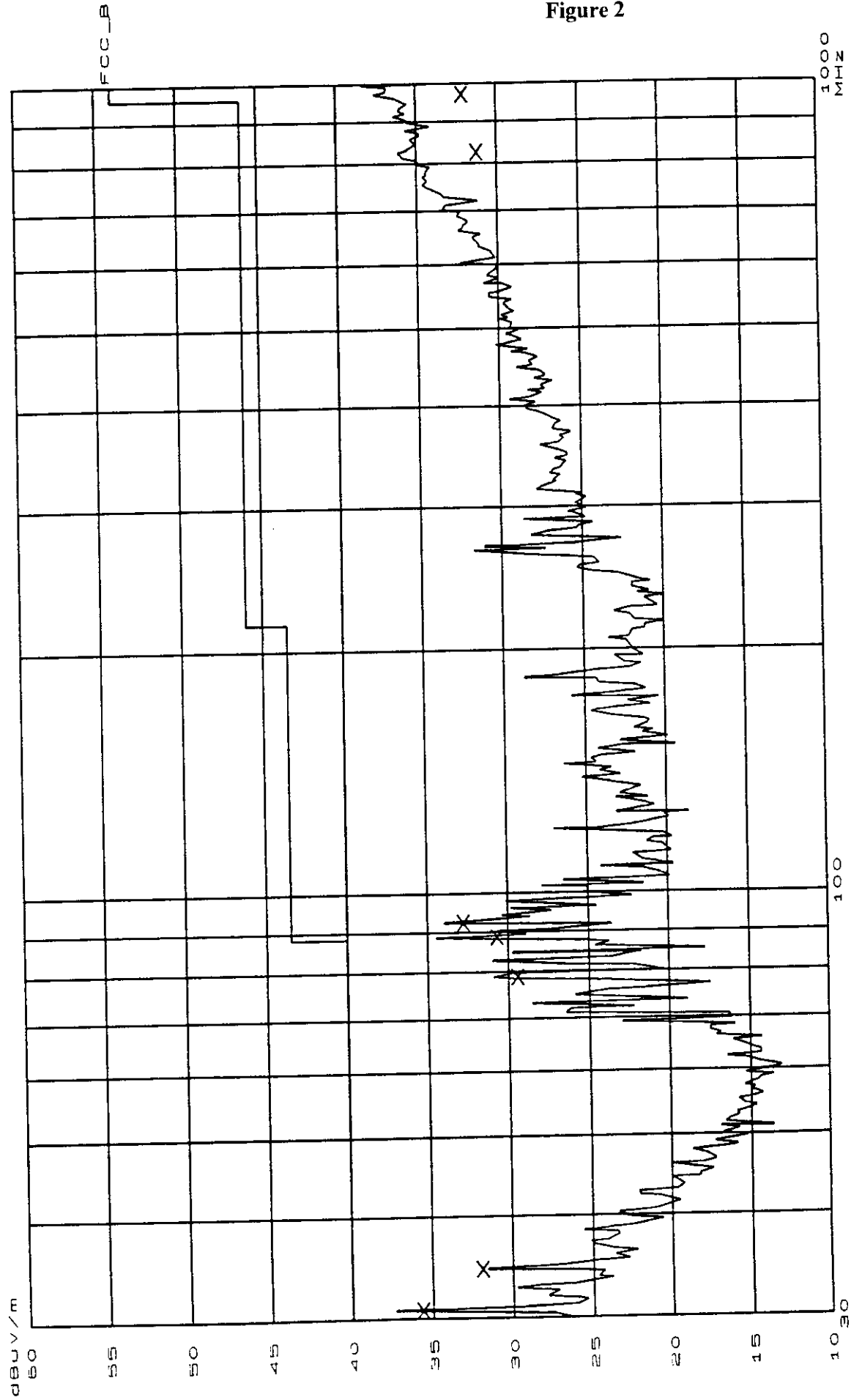


Figure 3

19. Feb 98 11:27

228/000303
Vertical 180 Degrees

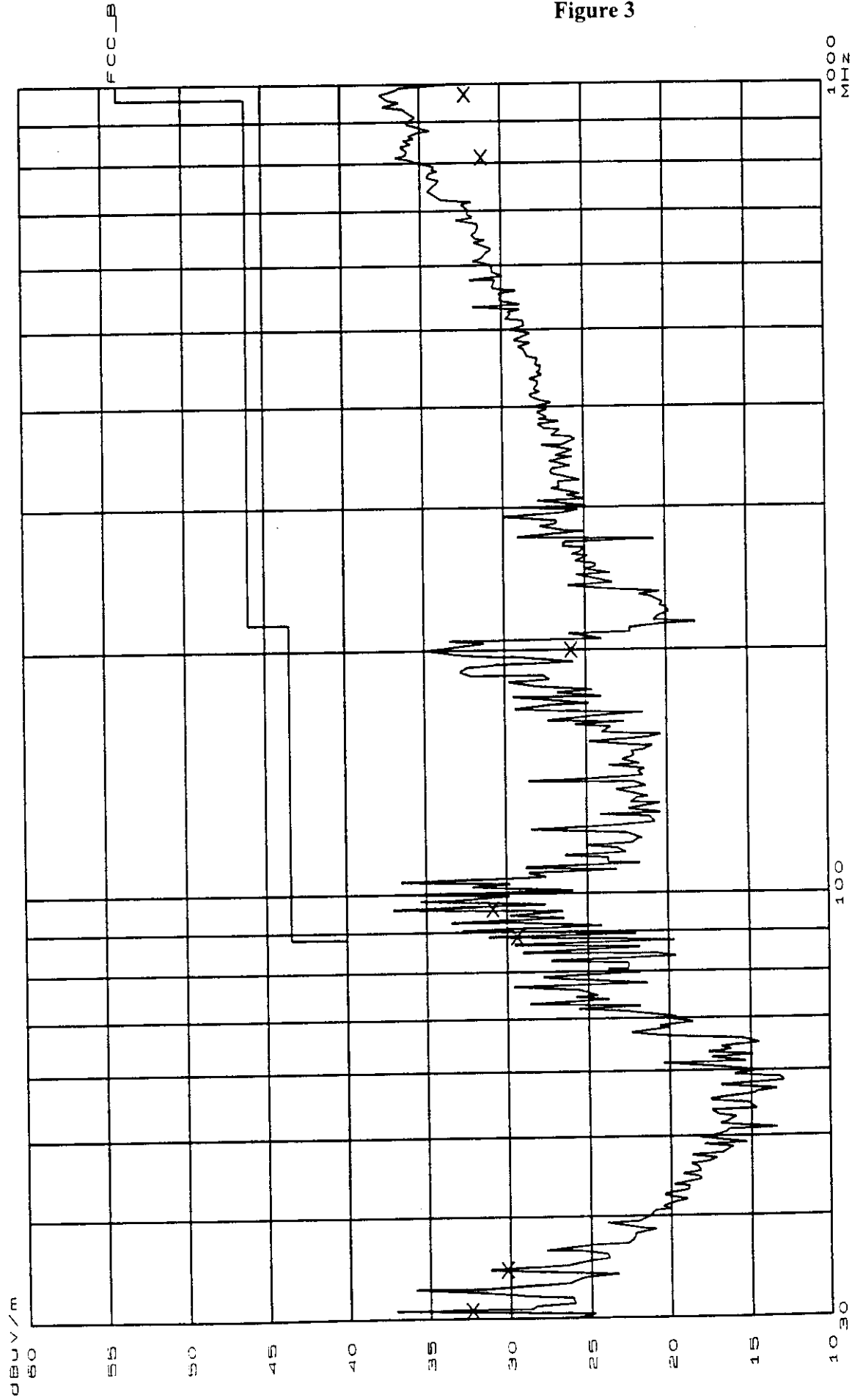


Figure 4

19. Feb 98 11:35

228/000303
Vertical 270 Degrees

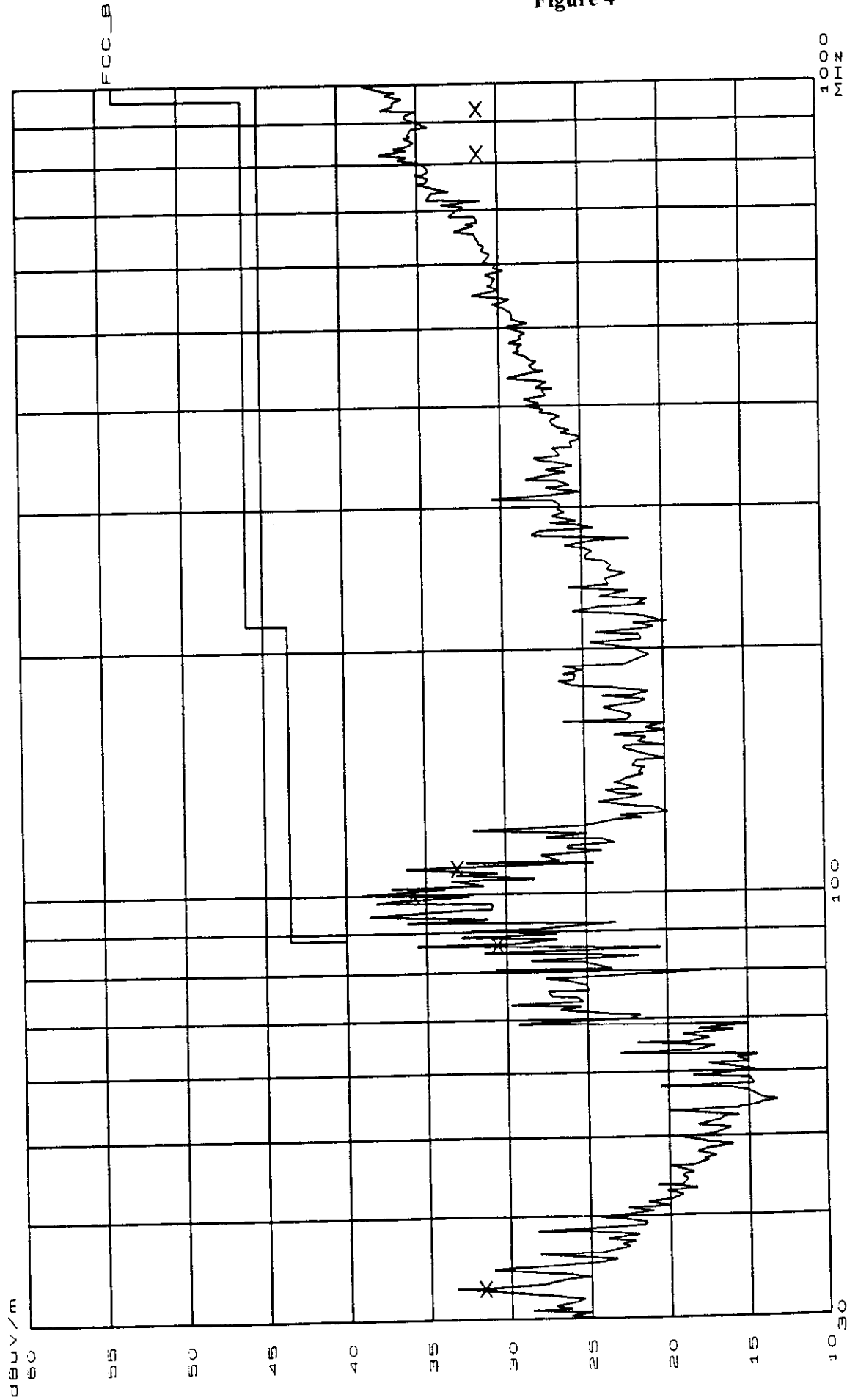


Figure 5

19. Feb 98 12:06

228/000303
Horizontal 0 Degrees

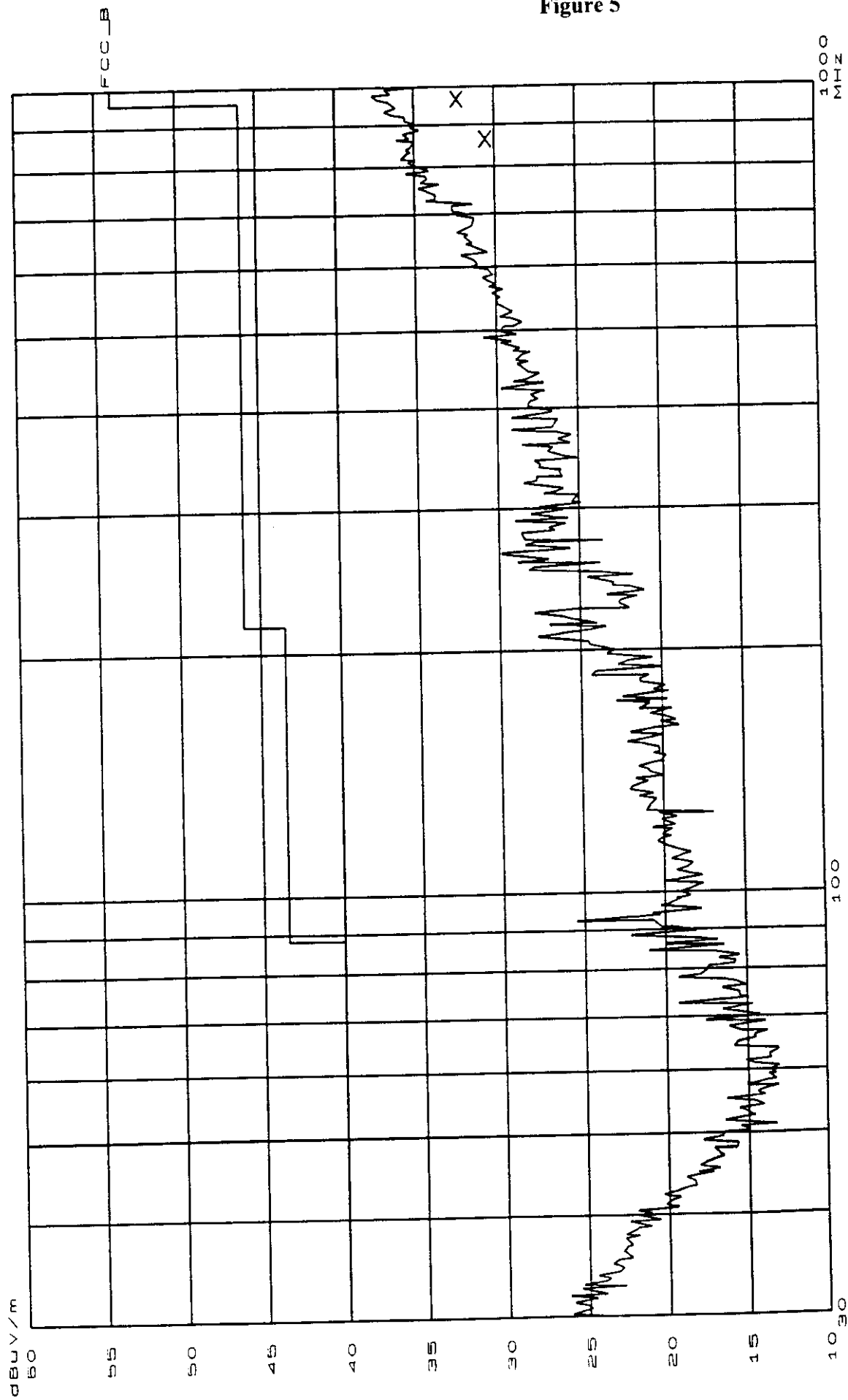


Figure 6

19. Feb 98 11:57

228/000303
Horizontal 90 Degrees

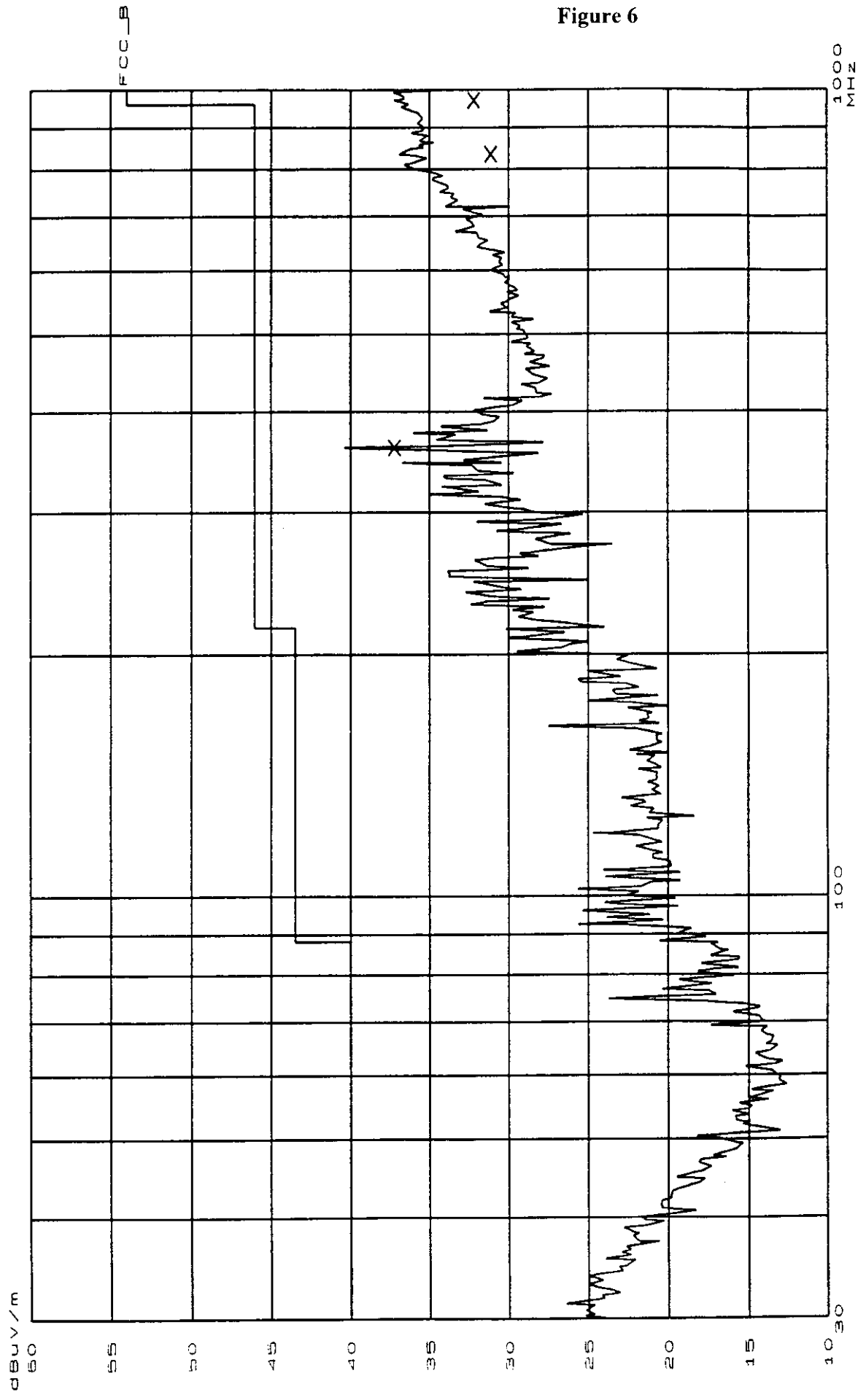


Figure 7

19. Feb 98 11:49

228/000303
Horizontal 180 Degrees

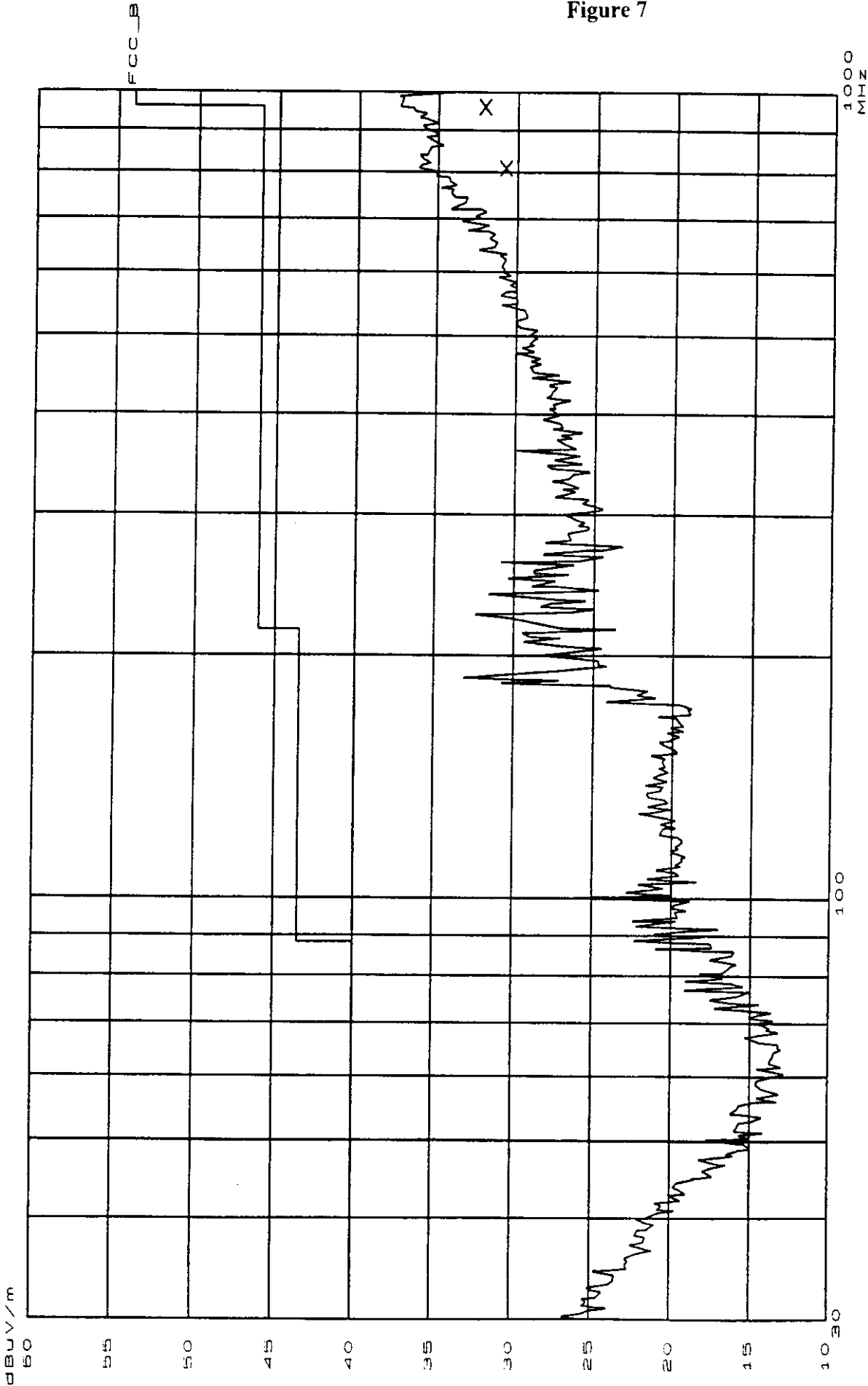
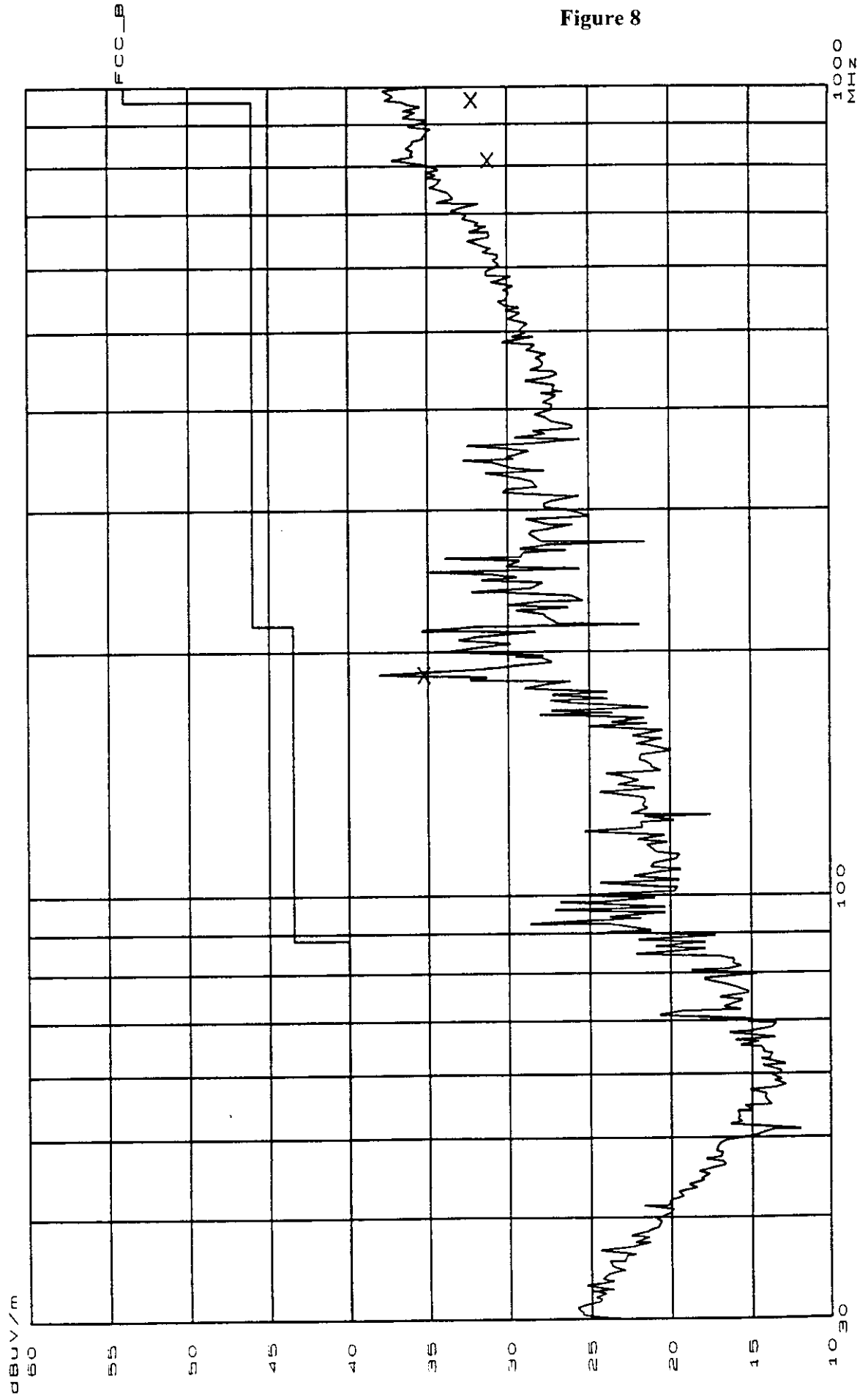


Figure 8

19. Feb 98 11:42

228/000303
Horizontal 270 Degrees



APPENDIX 1 EQUIPMENT USED

Inventory No	Description
7000058	EMI measuring receiver 20 to 1000 MHz
7000150	Bilog antenna
7000154	RF semi-anechoic chamber
7000216	Coaxial cable
7000217	Coaxial cable
7000218	Coaxial cable