MARITIME NAVIGATION SYSTEMS
DERA FRASER
Fort Cumberland Road
Portsmouth
PO4 9LJ

Electro-Magnetic Compatibility Testing

Report on the Testing
of
McMurdo EPIRB G4 GPS

DERA/SS/PS/R/EMC/TT - 03/2000/1.0

Cover + iv + 2 pages + Appendices

Issue 1.0- Date:- May 2000

Commissioned by;

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Issue	Date	Details of Changes
1.0	May 2000	First Issue

Distribution List

Copy No	Recipient	Location
1 - 2	Mr. J. Norrish	McMurdo Limited
3	Head of Type Approval	Notified Body 0191 Marine Type Approval DERA Fraser
Master	Type Test File	DERA Fraser

ELECTRO-MAGNETIC COMPATIBILITY TESTING

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EMC Testing

Report on the Testing
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EPIRB G4

1 Introduction

1.1 The Maritime Navigational Systems (MNS), DERA Fraser, Portsmouth, part of the Defence Evaluation and Research Agency is an independent Shoreside test laboratory equipped to conduct Type Approval and Prototype Testing of Marine Navigational and Safety Equipment. The Test Laboratories at DERA Fraser have been Accredited by the United Kingdom Accreditation Service (UKAS) for Performance and Environmental testing on a wide range of Marine Navigational and Safety Equipment. This accreditation embraces EN45001, EN29000, and ISO/IEC Guide 25.

The tests conducted on the EPIRB G4 were designed to prove compliance with the EMC tests contained in British Standard BS EN 60945:1997.

The Emergency Position-Indicating Radio Beacon (EPIRB) G4 is a float free maritime distress beacon that transmits on 2 frequencies, 406.028 MHz and 121.5MHz. At 406.028 MHz it transmits a digital distress signal to satellites. The 121.5MHz signal is for search and rescue operations. In addition, the beacon contains a GPS module. This module receives the GPS signal and encodes the latitude and longitude on the message it transmits.

The EPIRB consists of two mouldings a transparent top dome and a main body. The main body is sprayed internally with a conductive coating to achieve good EMC performance. The EPIRB is activated automatically when in the water or it can be switched on manually. The EPIRB also has a Xenon flash tube which is visible through the clear top dome. The bottom moulding houses the 9V lithium battery and 2 printed circuit boards. The EPIRB is programmed via an infra-red data link, enabling the vessels unique identity number to be programmed in.

1.2 The Following tests of EN 60945:1997, were conducted on the submitted sample of the EPIRB G4 distress beacon.

Test Clause	Description of Test	Date of Test	Result of Test
Clause 9.3	Radiated Emissions	13-4-00	Pass
Clause 10.4	RF electromagnetic field 80 MHz - 1000 MHz	11-4-00	Pass
Clause 10.9	Electrostatic Discharge	13-4-00	Pass

Clauses 9.2,10.2, 10.3, 10.5, 10.6, 10.7 10.8, are not applicable because this equipment is battery powered and has no external cables.

An additional test was requested by the manufacturer to cover an FCC requirement. This test was 47CFR Ch1 (10-1-97 Edition).

The standard reports sheets for these tests are contained in Appendix A.

2. Equipment under Test

2.1 The equipment submitted comprised of 1 item, EPIRB model G4. This item formed the complete system.

2.2 The unit was designated:-

EPIRB Type: G4 Sr. No: B0004

The system was powered by a lithium battery of 9V.

3 Build Standard of Test Samples

3.1 The test sample provided by McMurdo was stated as representative of the normal production build.

4 Conduct of Testing.

4.1 The EMC tests were each conducted in accordance with the DERA Fraser laboratory's standard test method NETL/M/100 for the basic standards referred to in BS EN 60945.

4.2 Immunity tests involving continuous phenomena were conducted to indicated levels marginally above the specification criteria to allow for the uncertainty of measurement in the test equipment producing the disturbing signal.

4.3 The tests were conducted with the EPIRB transmitters active at 121 MHz and 406 MHz. For the radiated emissions test only the antenna was removed to reduce the transmitted power level. Guard bands were set up either side of the 121 MHz and 406 MHz frequencies when radiated emissions and radiated immunity testing was conducted.

4.4 To enable monitoring of the GPS receiver an LED was linked to the GPS acquisition circuitry in such a way that if the receiver lost signal lock the LED would turn off.

5 Conclusions.

5.1 The test sample of a McMurdo EPIRB G4 has now successfully passed a series of tests which indicate its compliance with the EMC criteria of both BS EN 60945:1997 and FCC 47CFR Ch 1 (10 - 1 - 97 Edition).

APPENDIX A

Test Report Sheets

on

The McMurdo EPIRB G4

to the EMC Immunity requirements of

BS EN 60945:1997

(consists of 5 pages)

Maritime Navigation Systems
Type Test Results Sheet
General Requirement Specification
IEC 945 : 1996 (BS EN 60945 : 1997)

Manufacturer: McMurdo **File Ref.** TT 03/2000

Equipment Name: EPIRB G4 **Issue Date :** May 2000

	Description	Type Number	Serial numbers
1	EPIRB	G4	B0004

Software Version Installed on Equipment Under Test			
	Description	Software Version	Part Number
	G4 Firmware	V 1.1.82	82567

Requirement	Clause	Test Results
5. METHODS OF TESTING AND REQUIRED TEST RESULTS		
	5.2.1	Test site used during testing was:- Defence Evaluation and Resaerch Agency - Fraser, Portsmouth. Conditions during testing were within the range 25 ± 10 deg. C; 50% ± 25% RH; 960 ± 100mb. Unless otherwise stated.

Manufacturer: McMurdo

File Ref. TT 03/2000

Equipment Name: EPIRB G4

Issue Date : May 2000

9. UNWANTED ELECTROMAGNETIC EMISSIONS	9.1	General - The level of highest emissions was established and recorded during testing. Limits in the controlling software were set as per those listed in table 5 of EN 60945.
Radiated emissions 30MHz-1GHz 'E' field **Note;-** 150KHz-30MHz 'H' field This test was not conducted as the EUT was battery powered and it was concluded that there would be no source of emissions at these frequencies. Uncertainty of measurement for a confidence level of 95%-5.4, + 5.4dB	9.3.2	The EUT was placed in the anechoic chamber on a wooden support, and bonded to the ground plane. The test antenna was at a height of 1.5m and arranged to be 3m from the nearest point of the EUT. The measurements obtained from the system by the receiver operating in quasi-peak detection mode were compared against the limits as defined in table 5 of EN 60945:1997. These limits were programmed into the software that controlled the receiver. Measurements were conducted over the frequency range of 30 MHz to 1 GHz. **Result** The system showed no emissions above the specification limit. Plots of results can be seen in Appendix C

Manufacturer: McMurdo

File Ref. TT 03/2000

Equipment Name: EPIRB G4

Issue Date : May 2000

Spurious Radiation **FCC 47CFR** **Special Test Requested By Customer**		Spurious Frequencis as defined in clause 2.997 of 47CFR were mesured (9 kHz to 4.06028 GHz). The allowable bandwidths for the modulation schemes are defined in clause 80.025f of 47CFR. This equates to 25 kHz for the 121.5 MHz signal and 20 kHz for the 406.028 MHz signal. The emissions limits close to the carrier for the EPIRB are defined in clause 80.211e of 47CFR. This results in limits of –25 dBc betwwen ± 6.25 kHz and ± 12.5 kHz away from the carrier for the 121.65 MHz frequency. For the 406.028 MHz frequency the –25 dBc limits lie between ± 5 kHz and ± 10 kHz away from the carrier. Outside this frequency range, the limit is –30dBc. The measurements were conducted over the frequency range of 1 GHz to 4.04028 GHz. A wide band horn antenna coupled to a spectrum analyser was used to measure the spurious radiation levels. See appendix E for plots. **Result** The system showed no emissions above the specification limit. Plots of results can be seen in Appendix D

Maritime Navigation Systems
Type Test Results Sheet
General Requirement Specification
IEC 945 : 1996 (BS EN 60945 : 1997)

Manufacturer: McMurdo **File Ref.** TT 03/2000

Equipment Name: EPIRB G4 **Issue Date :** May 2000

10. IMMUNITY TO ELECTROMAGNETIC ENVIRONMENT	10.1	General :The equipment was mounted as it would be when in normal operation and earthed to the ground plane via earth bonding. The EUT was evaluated against the performance and operating conditions criteria as defined in para. 10.1. of EN 60945 The tests and associated performance criteria were conducted as listed in table 6 of para. 10.1. of EN 60945
Immunity to Radiated Radio Frequencies Uncertainty of measurement for a confidence level of 95% - 0, +15%	10.4.2	The test was conducted in an Anechoic Screened Room which was calibrated in accordance to IEC 1000 - 4 - 3:1995 The calibration of the chamber has been conducted as defined in IEC 1000 - 4 - 3 using the 16 point calibration technique to construct a calibration file. The equipment is placed in the chamber and the calibration file is re-run. An isotropic field sensor was placed close to the equipment under test to monitor the RF field strength. The equipment was set up in accordance with figure 9. of EN 60945 The equipment was continuously monitored using CCTV fibre optic links. The software was programmed with the field strength, frequency range and modulation as described in para. 10.4.2 of EN 60945. The field was generated using both vertical and horizontal polarisation with the system fully operational. The system was continuously monitored for changes outside the manufacturers specifications **Result** The system showed no malfunction or Deviation from normal performance

Manufacturer: McMurdo **File Ref.** TT 03/2000

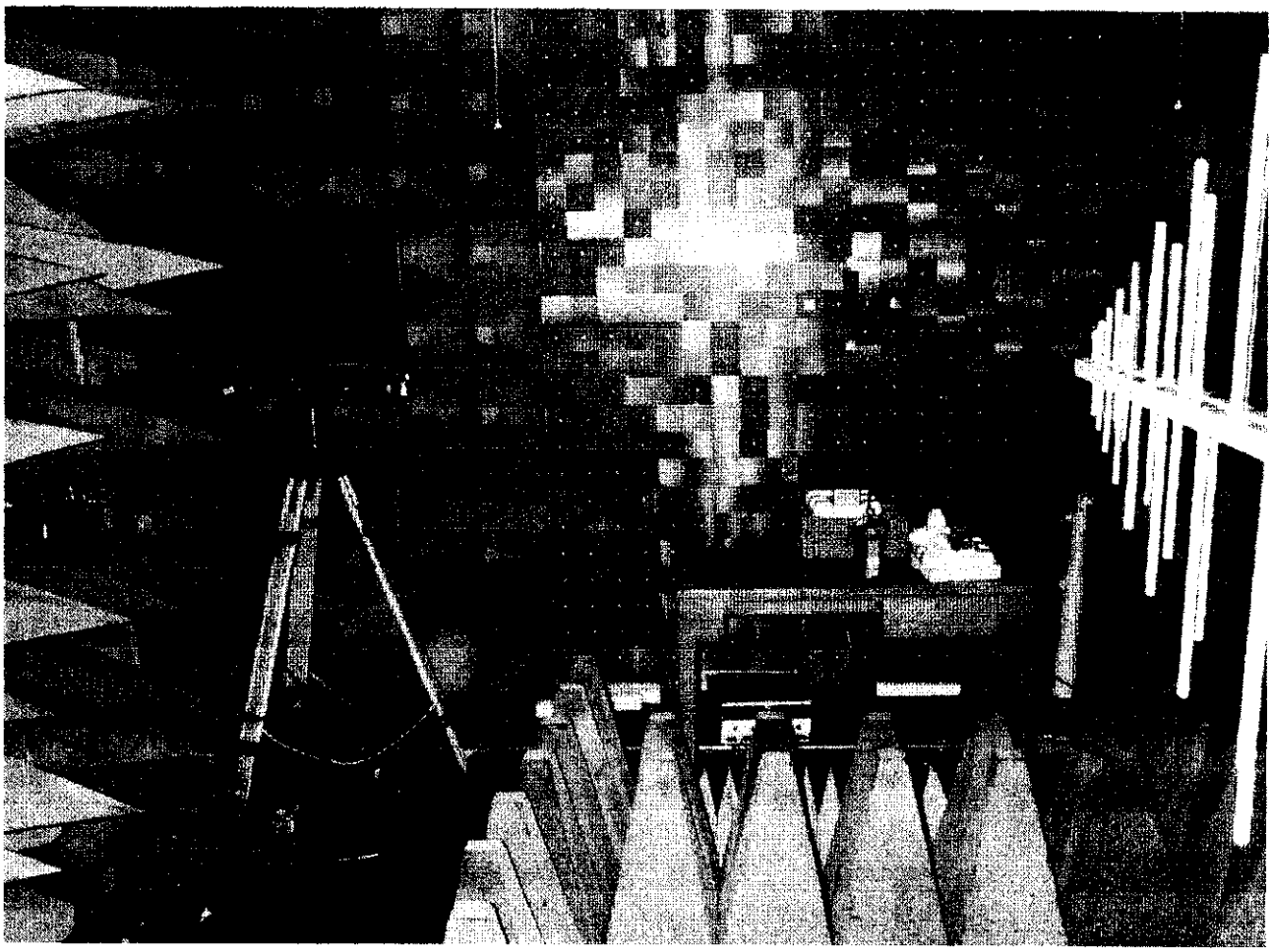
Equipment Name: EPIRB G4 **Issue Date :** May 2000

Immunity to electrostatic discharge Uncertainty of measurement for a confidence level of 95% for pulse characteristics 2% (1V to 15kV)	10.9.2	The test was carried out in accordance with BS EN 61000 - 4 - 2. using an electrostatic discharge generator. Because the EUT body mouldings were made of plastic no discharges were possible against the body. Only 2 fixing screws were showing and a discharge not possible against either of these An insulating layer covered the antenna and no discharge was possible. The EUT was placed on but insulated from a horizontal coupling plane and subjected to 10 positive and 10 negative indirect discharges of 6KV. This was repeated with the vertical coupling plane in 4 positions at 90 degrees to each other ariund the EUT. After the test the EUT was checked to ensure that the equipment remained within the manufacturer's agreed specification. **Result** The system showed no malfunction or deviation from normal performance.

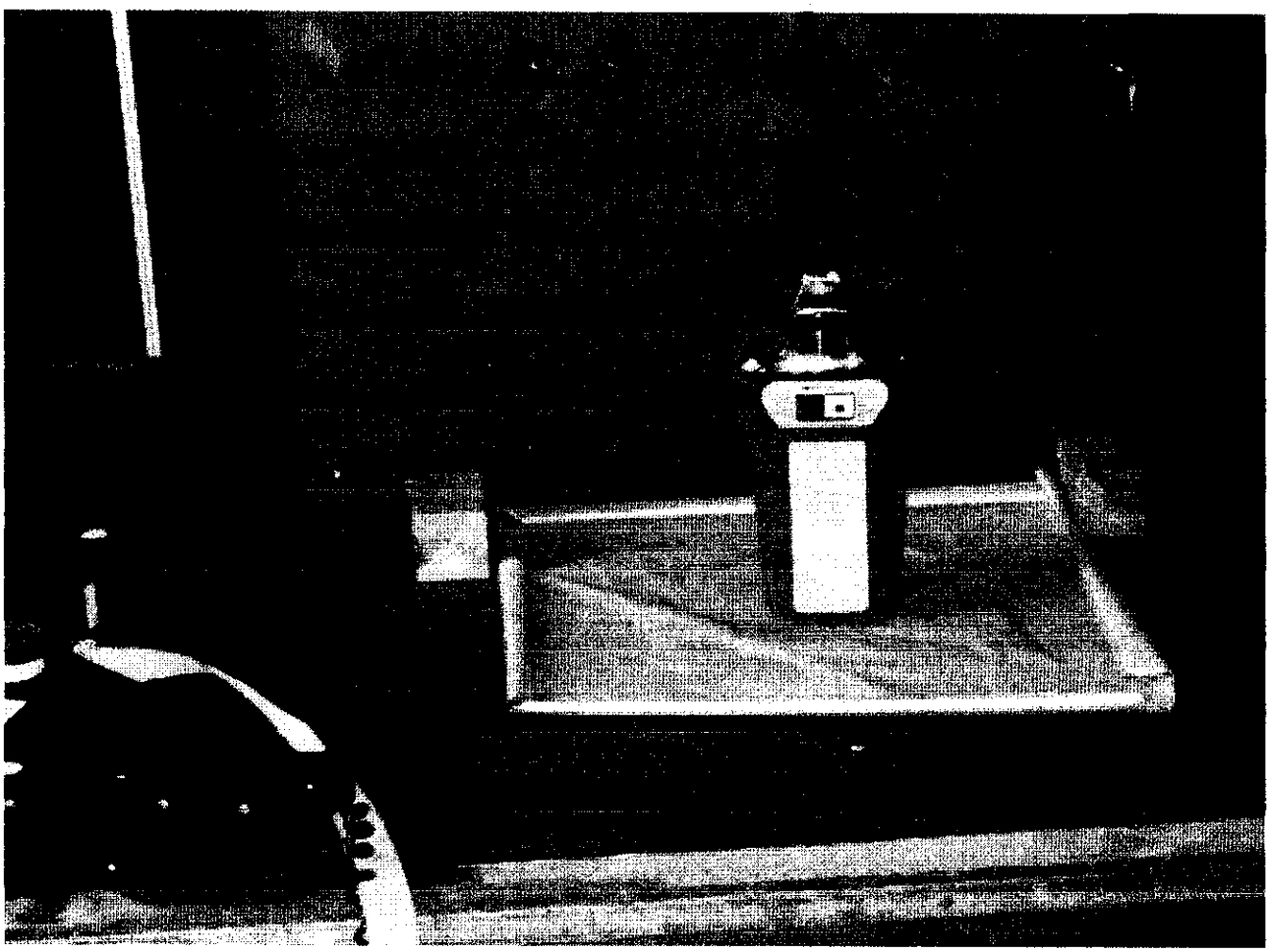
APPENDIX B

Photographs of EPIRB G4

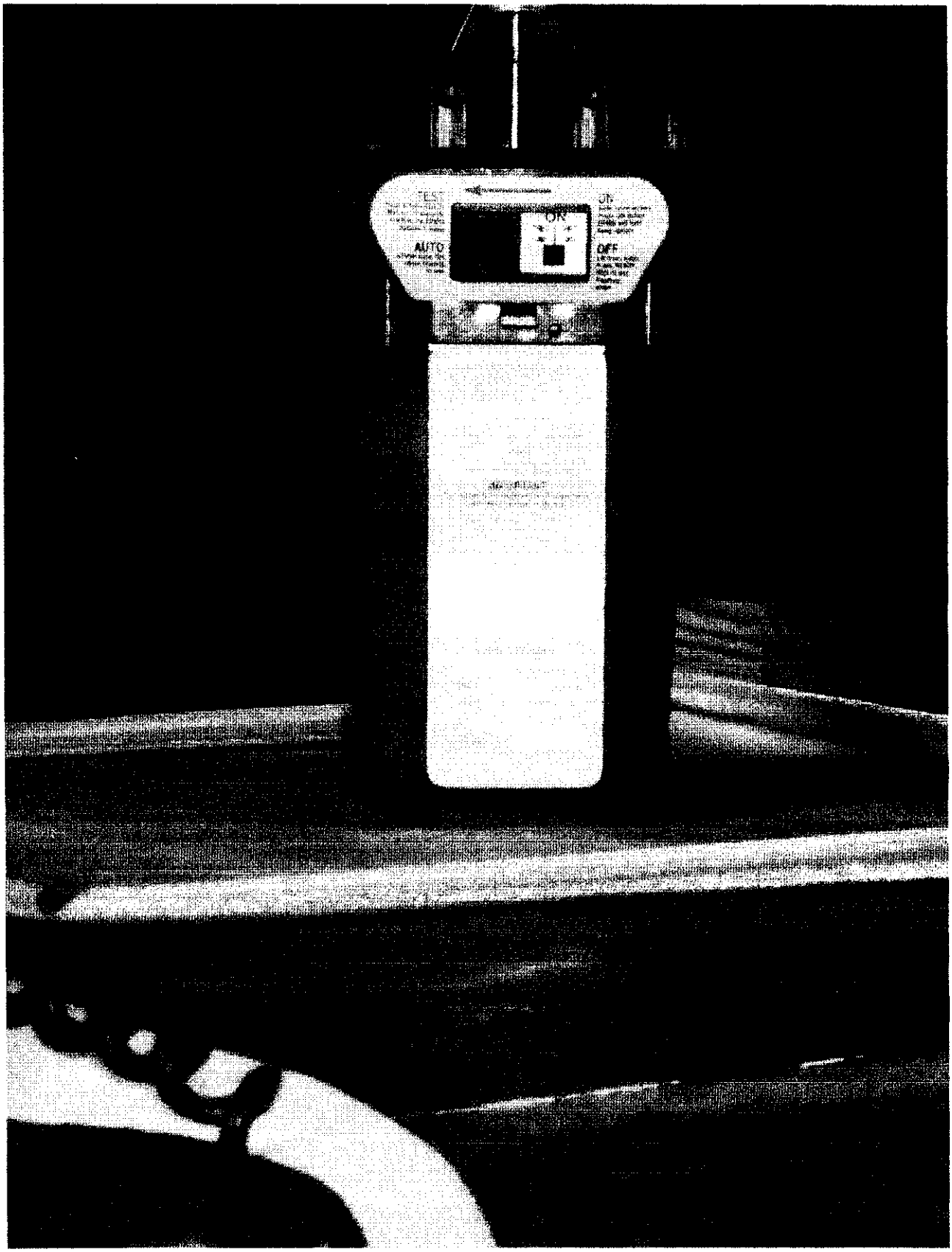
(consists of 3 pages)



Photograph 1 View of EPIRB during radiated immunity testing



Photograph 2 View of EPIRB G4 during ESD testing showing vertical and horizontal coupling planes



Photograph 3 View of EPIRB G4 Identification details.

APPENDIX C

Radiated Emissions Plots

Taken during testing of

EPIRB G4

to Clause 9.3 BS EN 60945:1997

Both the 121 MHz and 406 MHz transmitters were active during radiated emissions measurements. To reduce the level of the transmitted power the antenna was removed. The high energy emissions seen on the plots are a result of the harmonics generated by the transmissions.

(Consists of 10 pages)

Note on APPENDIX C for pages 1 to 10 of 10.

Please see separate Electronic file for APPENDIX C which is designated :-

G4 EMC TEST Report No DERA-SS-PS-R-EMC-TT-03-2000-1.0 APPENDIX D (colour)

These are in the format of a Word Document with Paint Shop Pro (6) Images inserted.

This is due to file sizes which are very large if in Acrobat format (.pdf).

APPENDIX D

Spurious Radiation Plots

Taken during testing of

EPIRB G4

to FCC 47CFR Ch1 (10-1-97 Edition)

Plots 1 – 3 show the close to carriers emissions of the 121 MHz frequency
Plots 4 – 6 show the close to carrier emissions of the 406 MHz frequency
Plots 7 – 18 are of spurious emissions between 1 GHz and 4.06 GHz

(Consists of 20 pages)

Diagram showing measured close to carrier emissions levels at 121.649 MHz

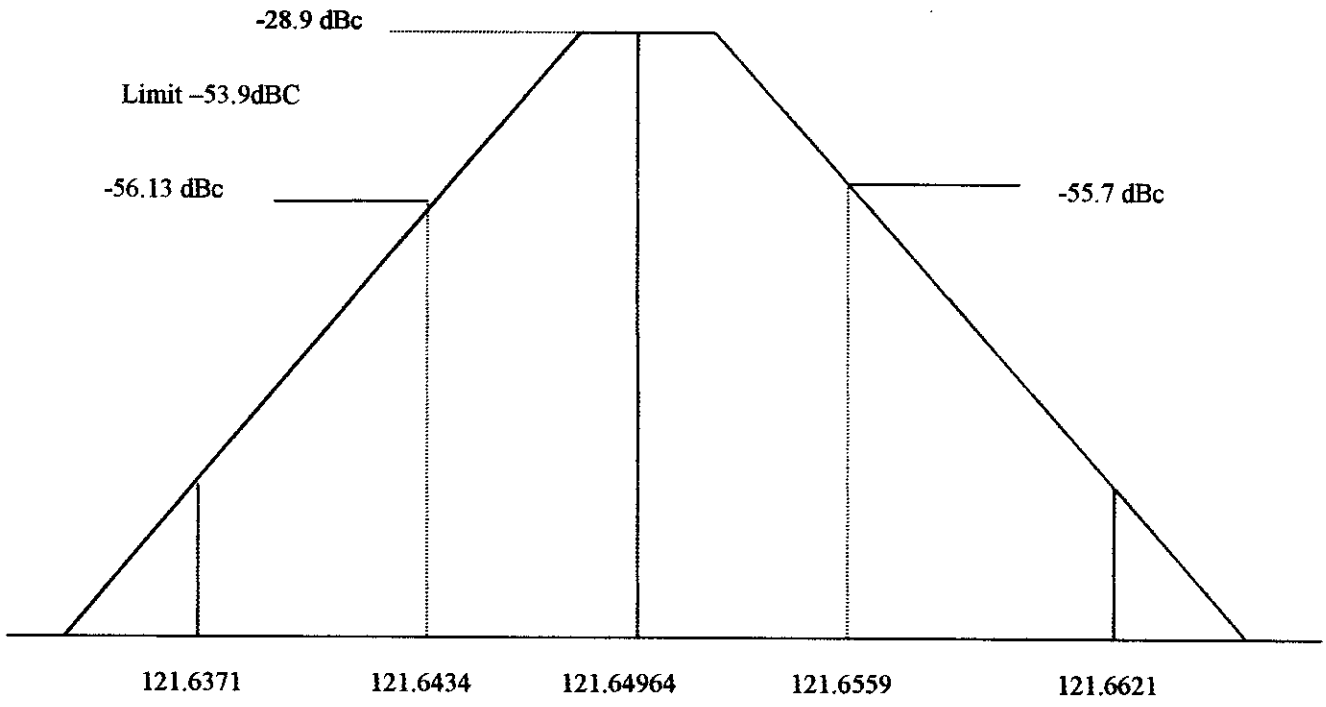
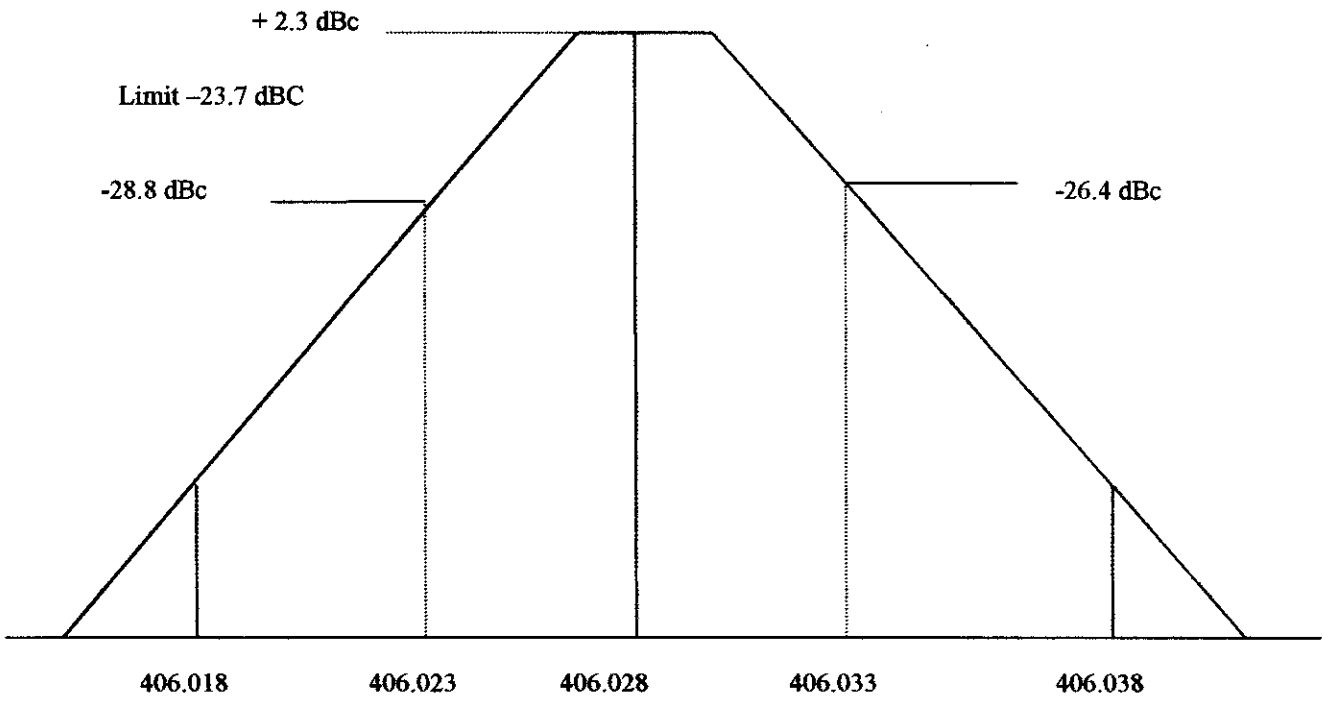
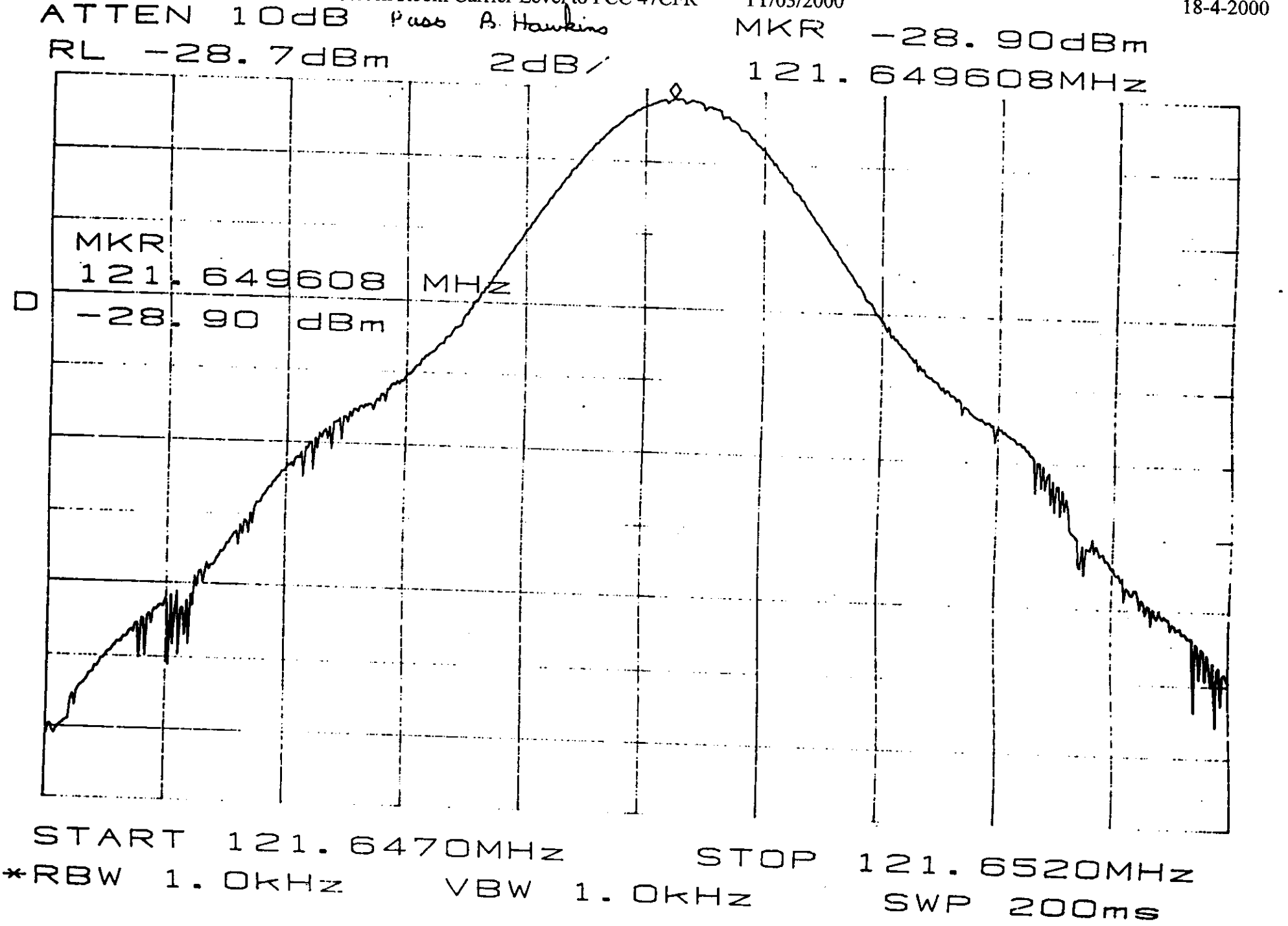


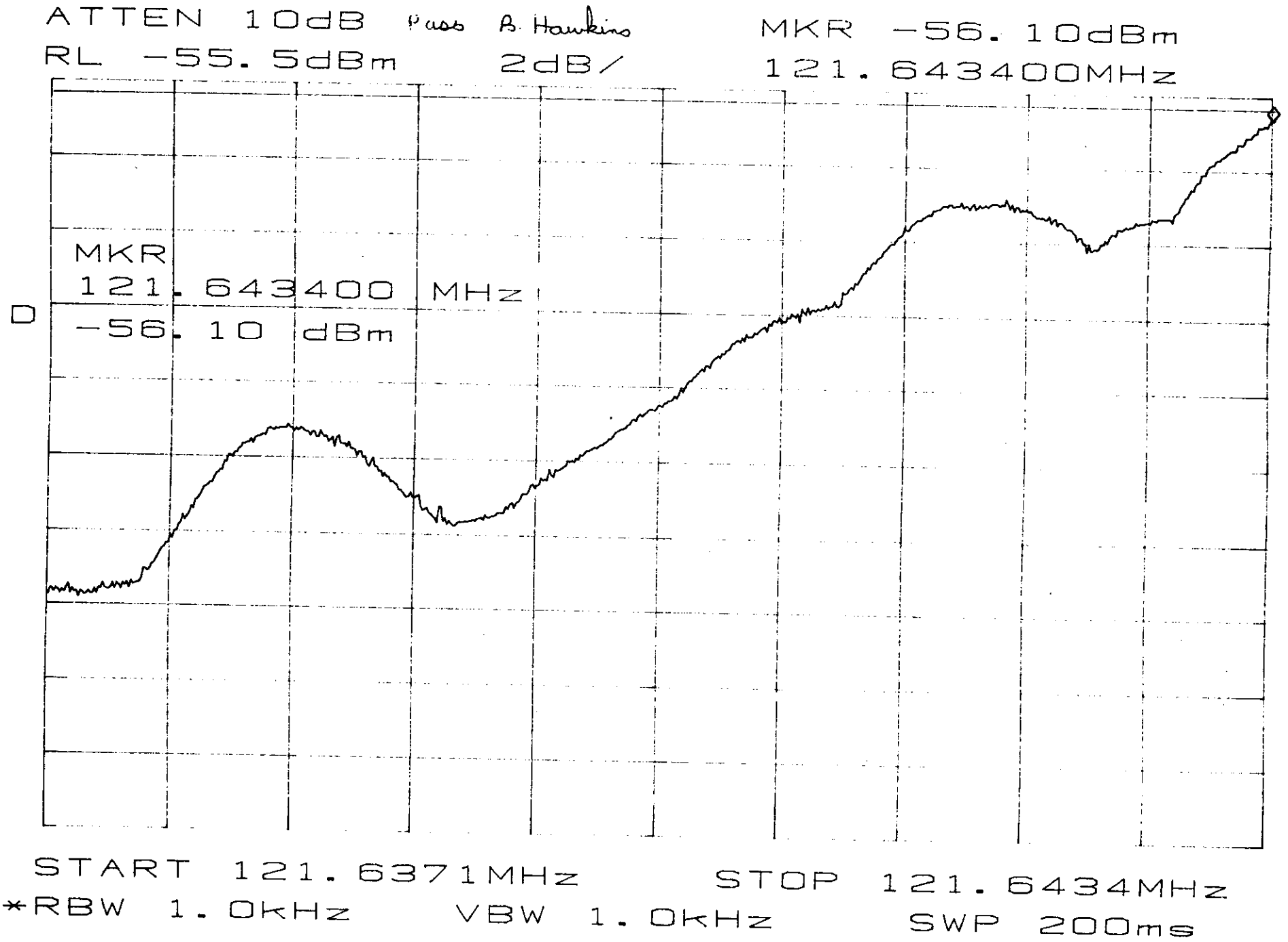
Diagram showing measured close to carrier emissions levels at 406.028 MHz



Plot 1 McMurdo EPIRB G4 Anechoic Screen Room Carrier Level to FCC 47CFR TT/03/2000 18-4-2000



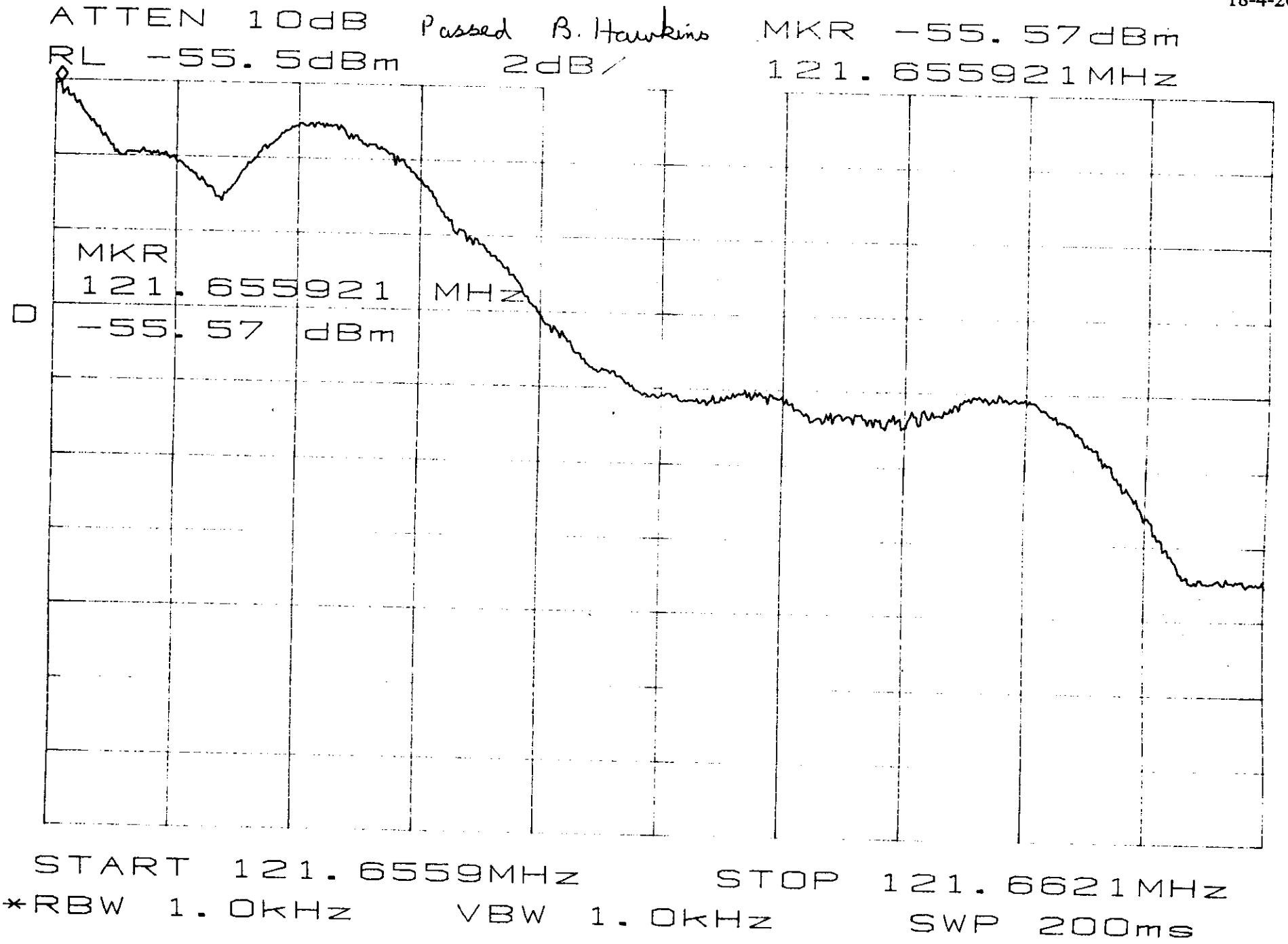
Plot 2 McMurdo EPIRB G4 Anechoic Screen Room Carrier Level to FCC 47CFR TT/03/2000 18-4-2000



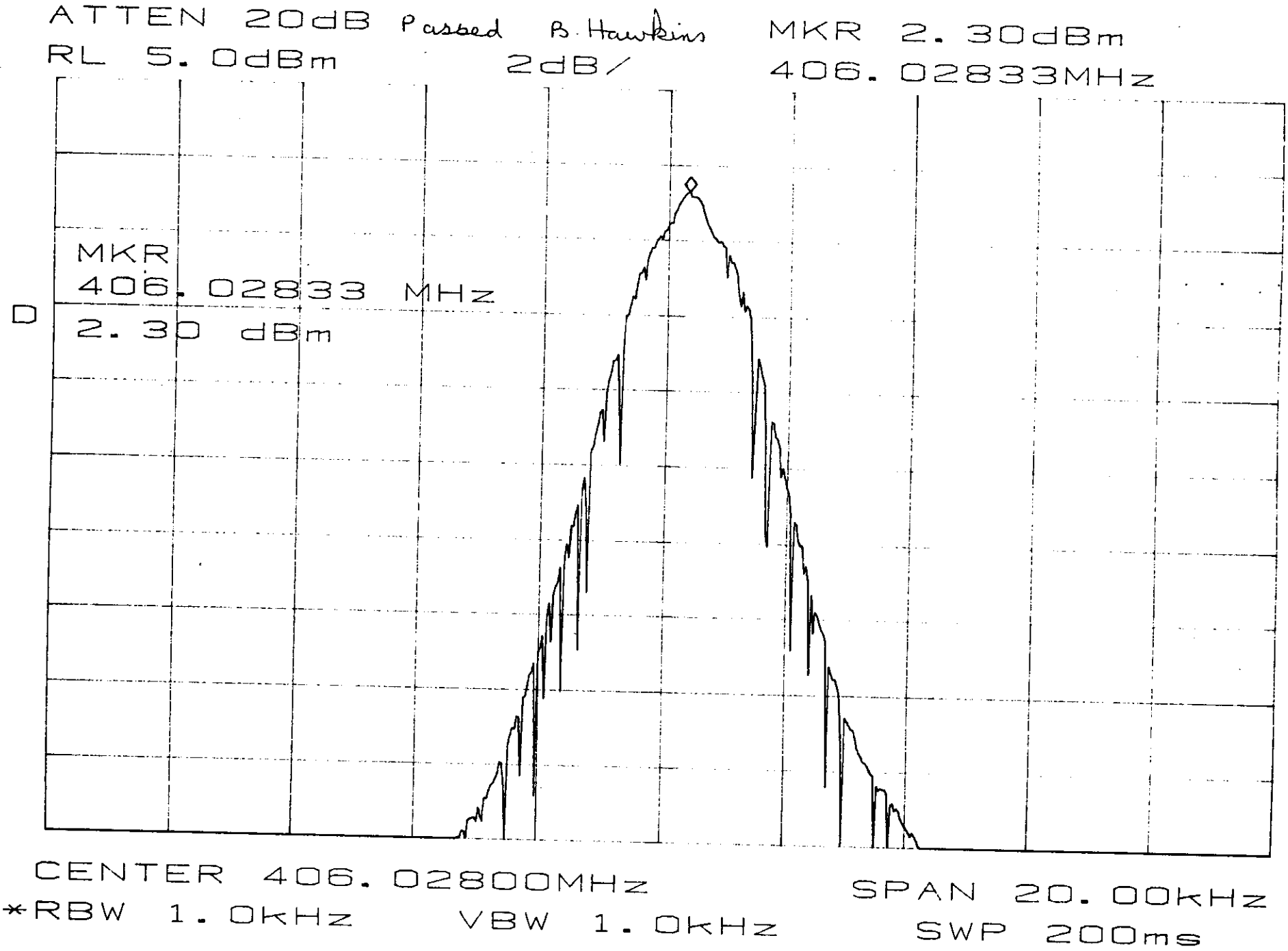
Plot 3

McMurdo EPIRB G4 Anechoic Screen Room Carrier Level to FCC 47CFR TT/03/2000

18-4-2000



Plot 4 McMurdo EPIRB G4 Anechoic Screen Room Carrier Level to FCC 47CFR TT/03/2000 18-4-2000



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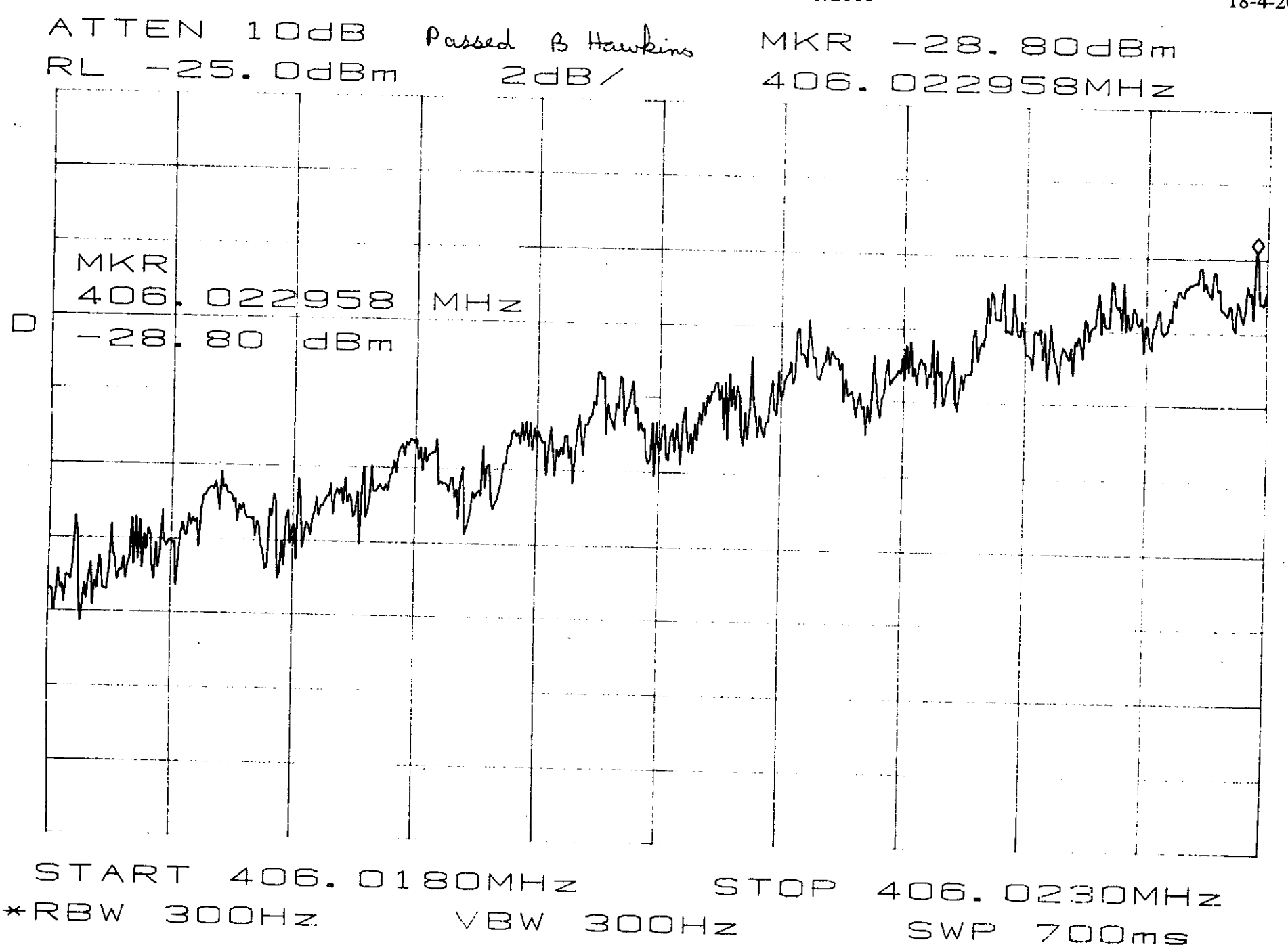

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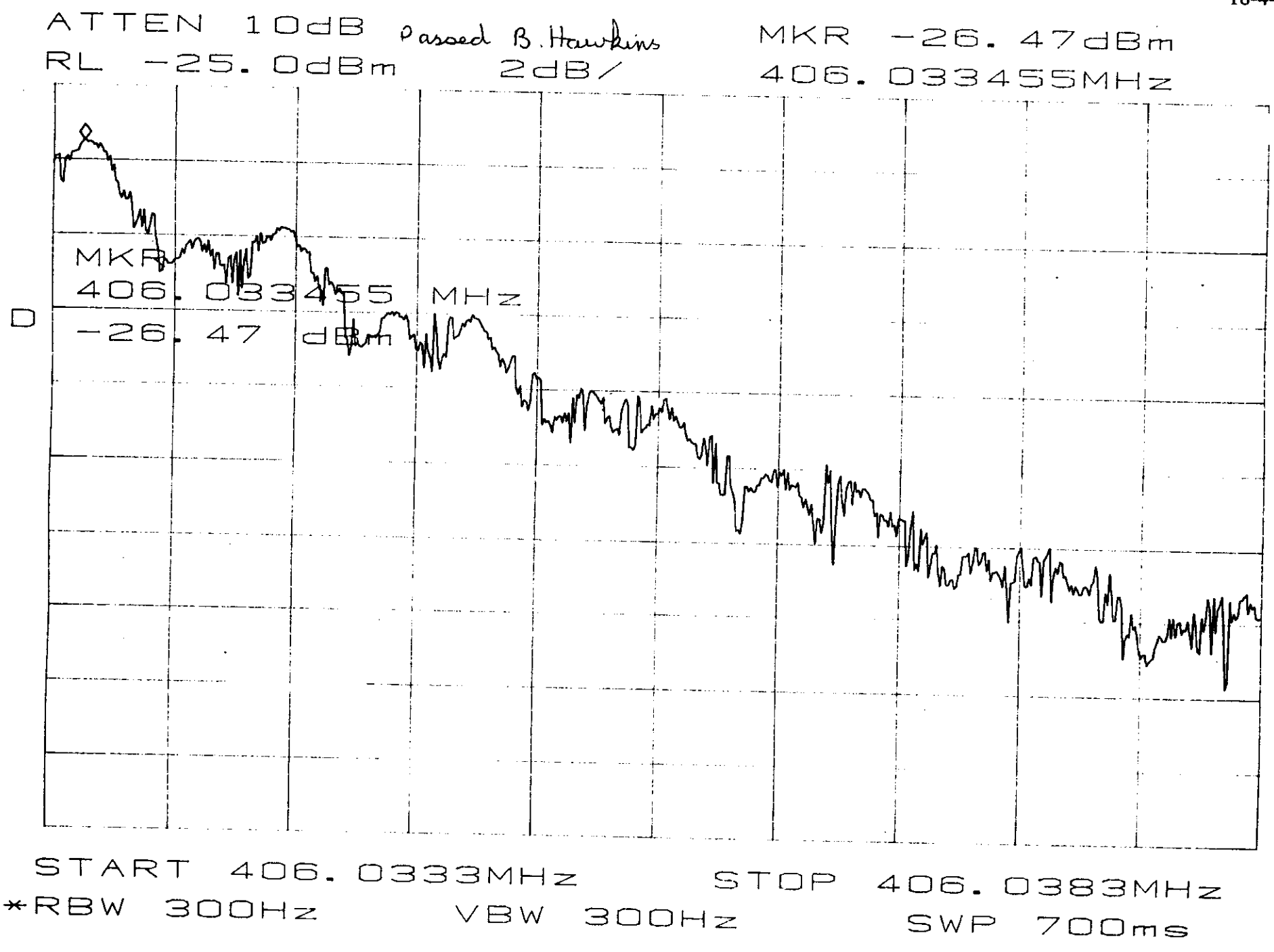

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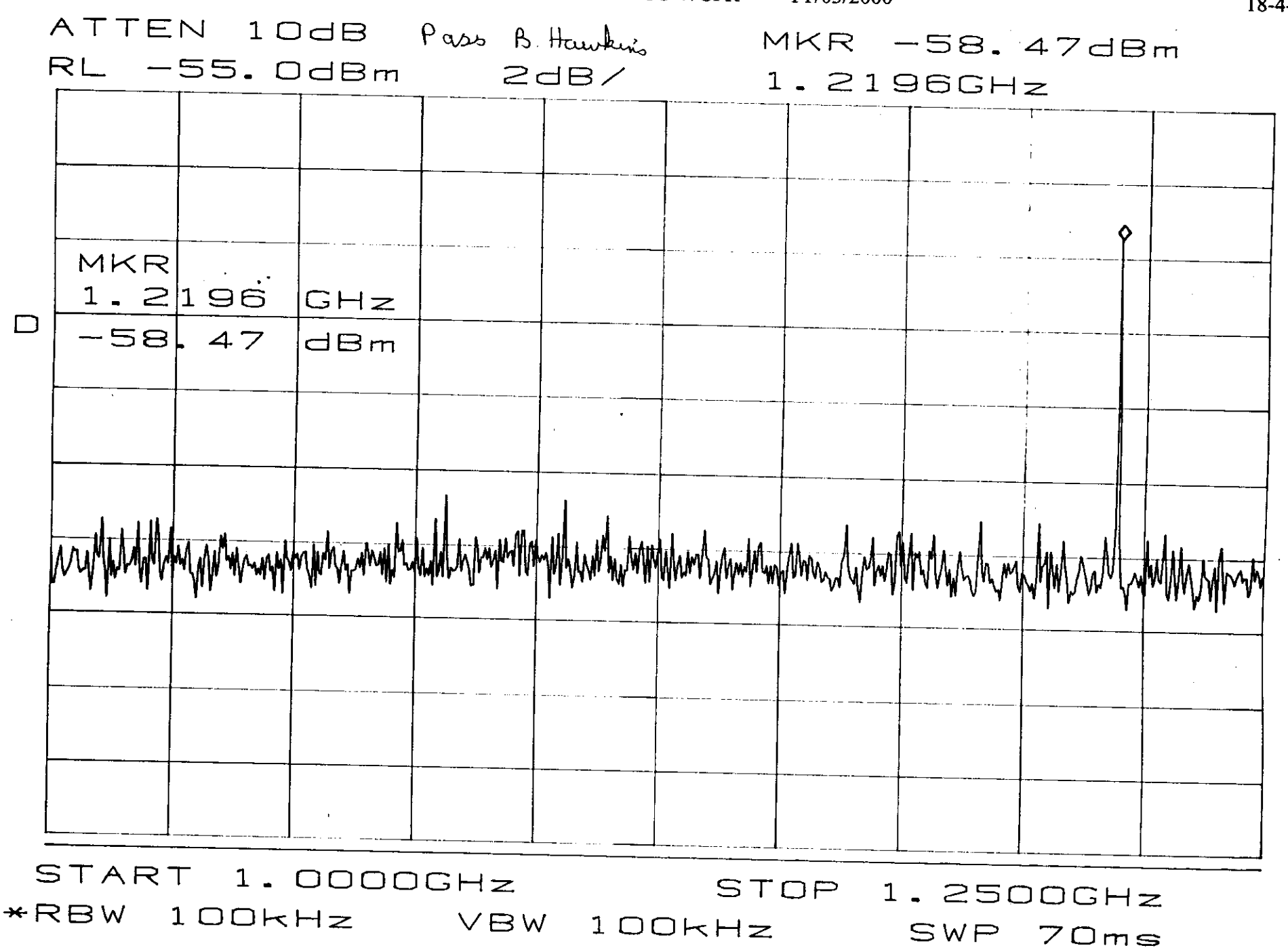

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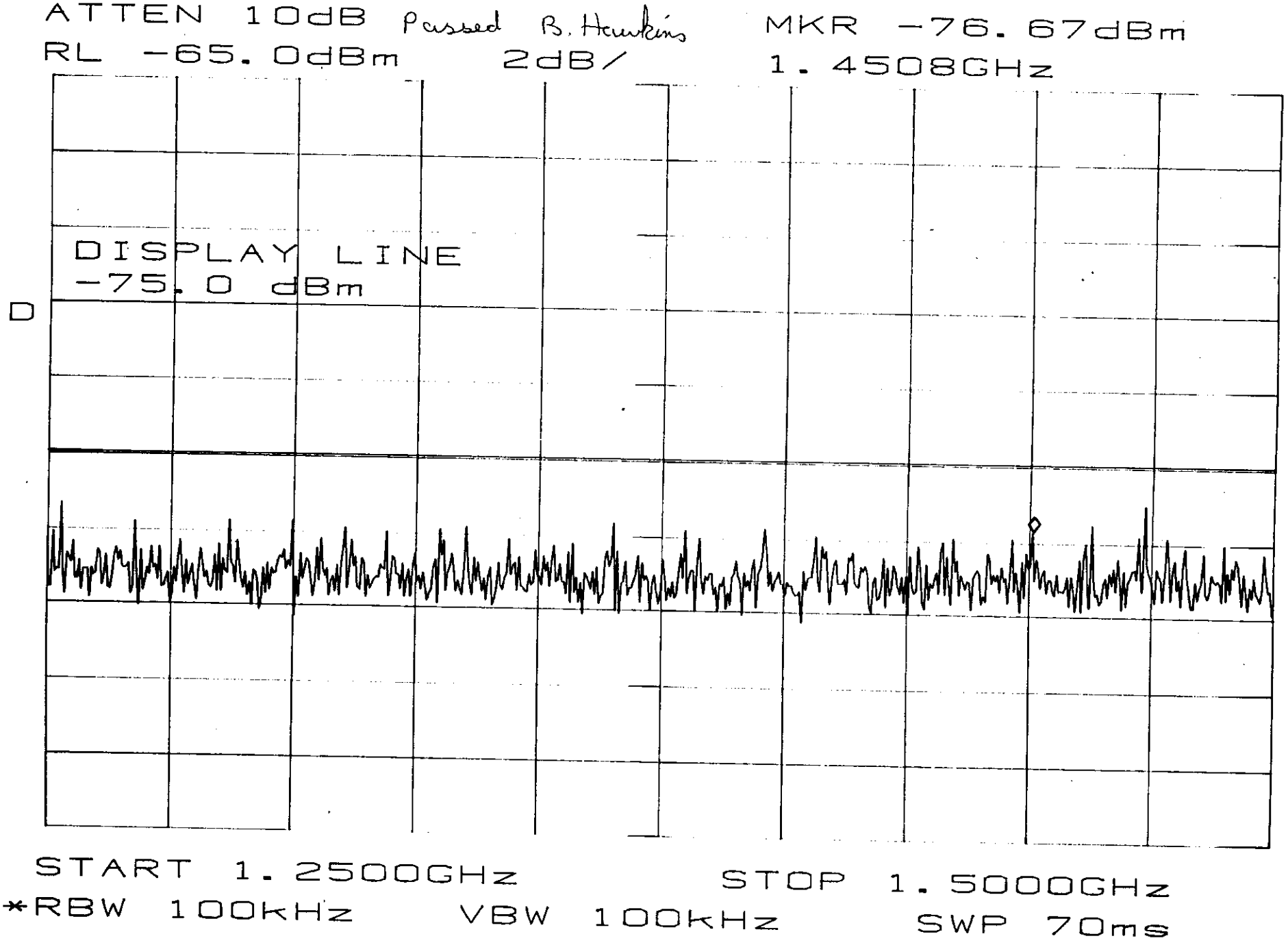

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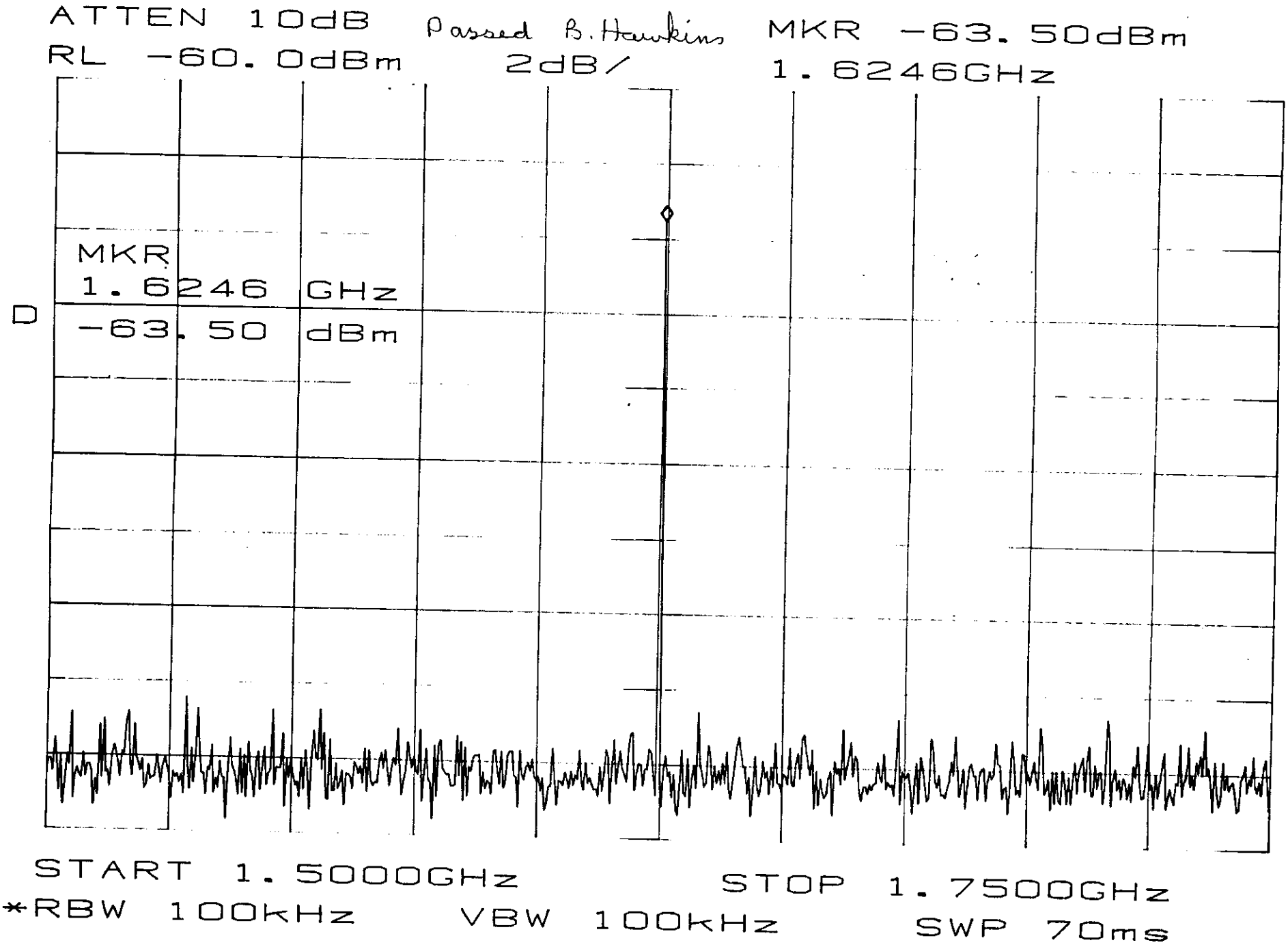

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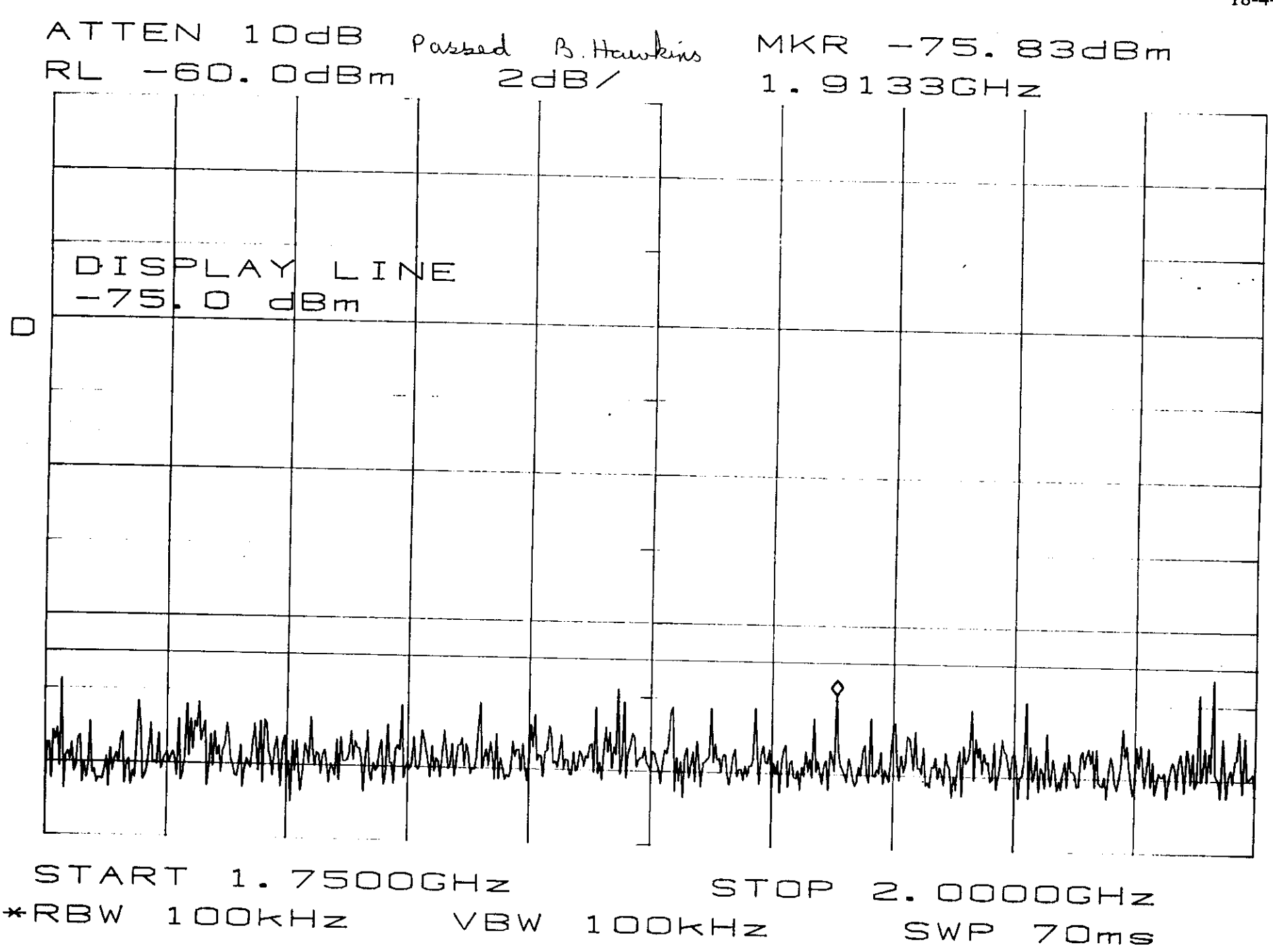

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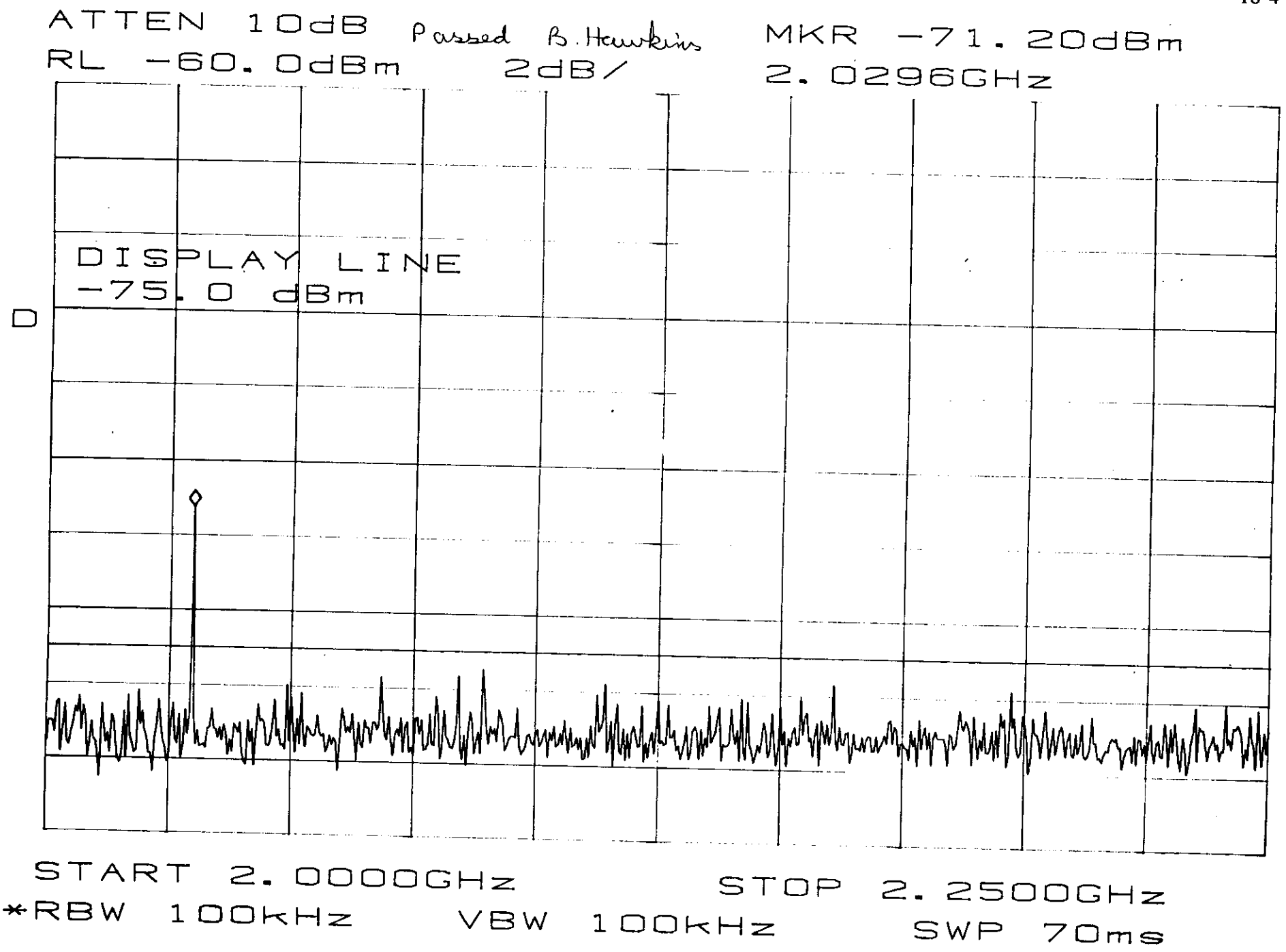
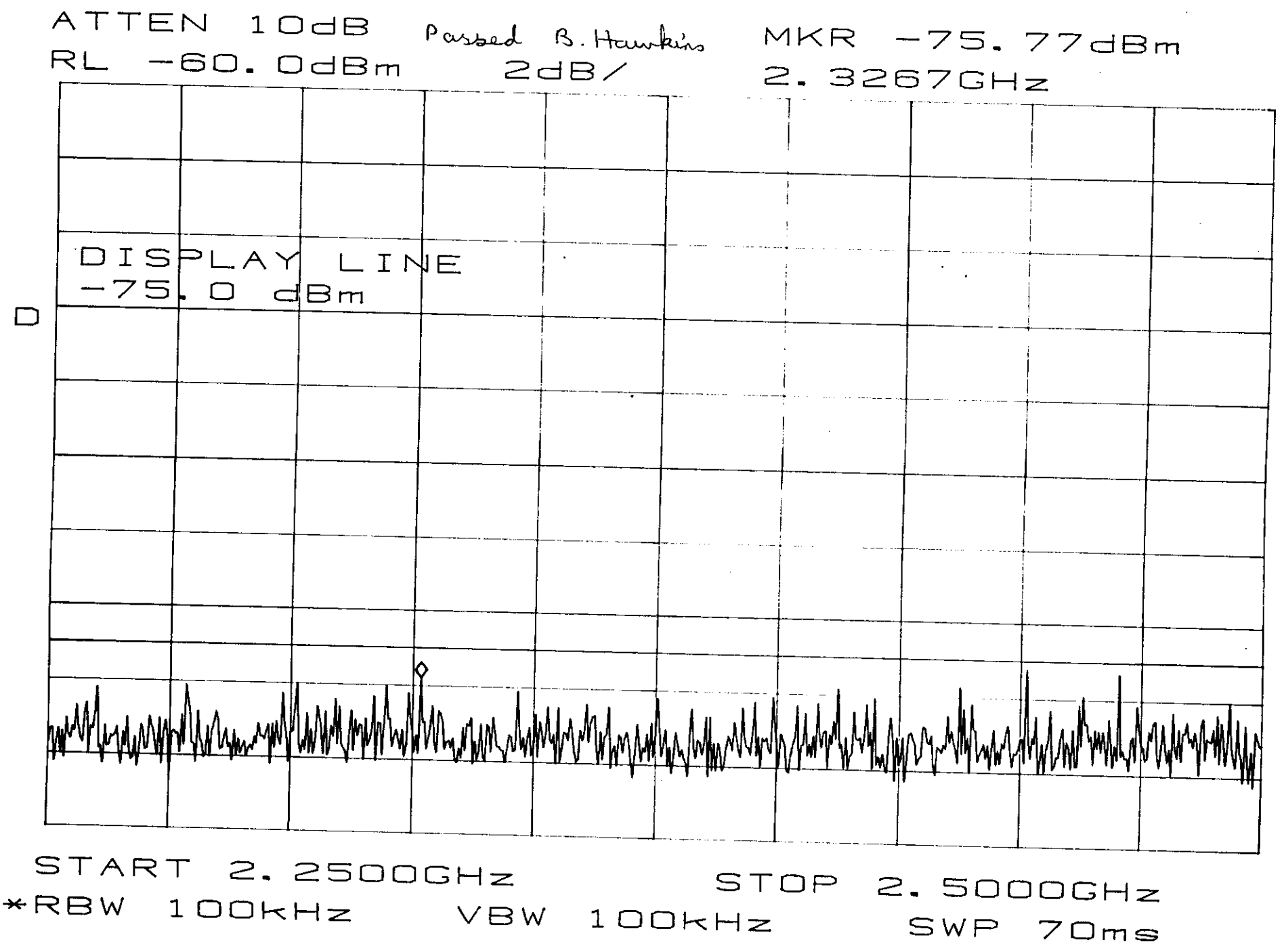
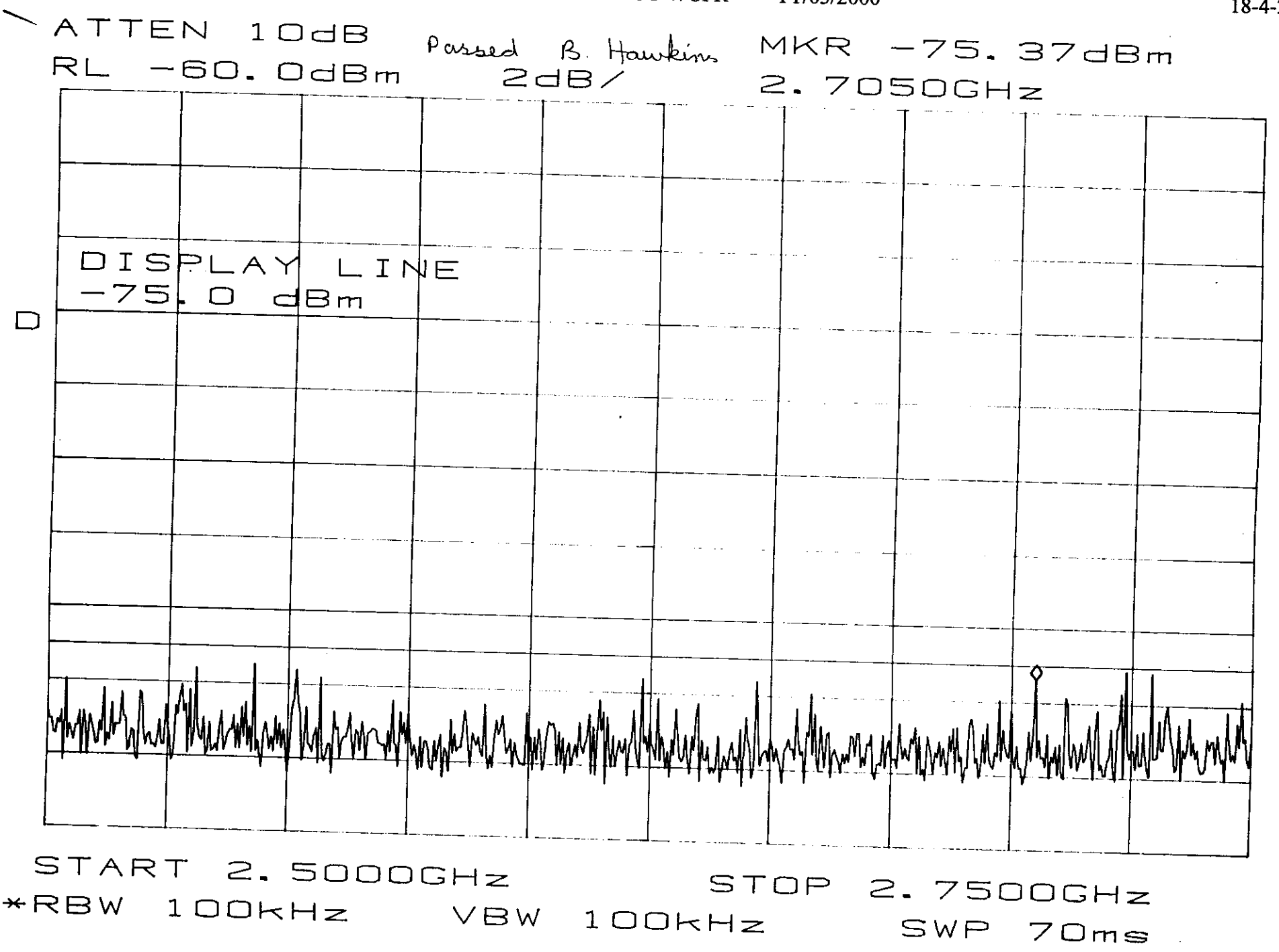
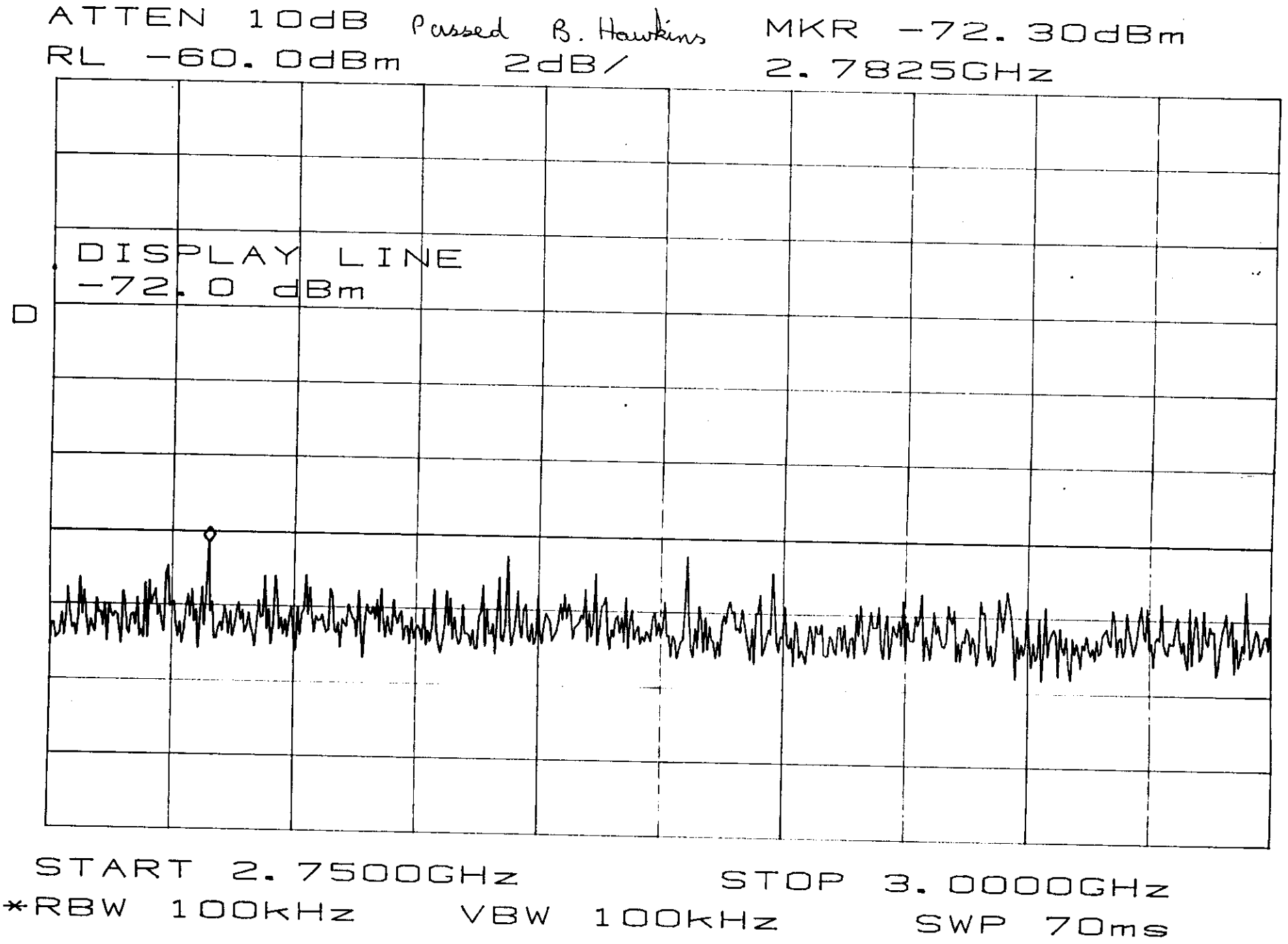



ATTEN 10dB
Passed B. Hawkins
MKR -75.77dBm
RL -60.0dBm
2dB/
2.3267GHz
DISPLAY LINE
-75.0 dBm
D
START 2.2500GHz
STOP 2.5000GHz
*RBW 100kHz
VBW 100kHz
SWP 70ms

Plot 13 McMurdo EPIRB G4 Anechoic Screen Room Carrier Level to FCC 47CFR TT/03/2000 18-4-2000



Plot 14 McMurdo EPIRB G4 Anechoic Screen Room Carrier Level to FCC 47CFR TT/03/2000 18-4-2000



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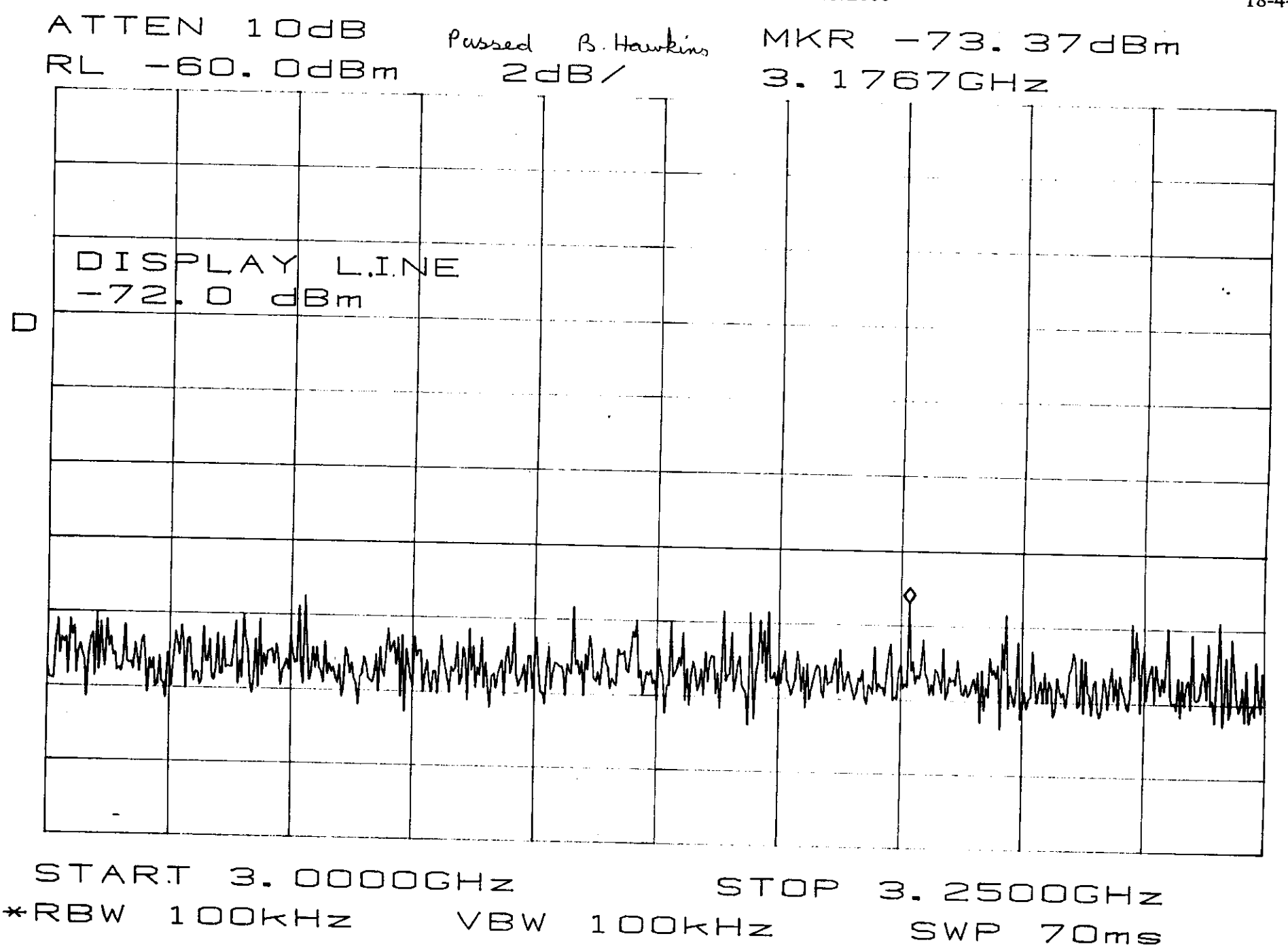

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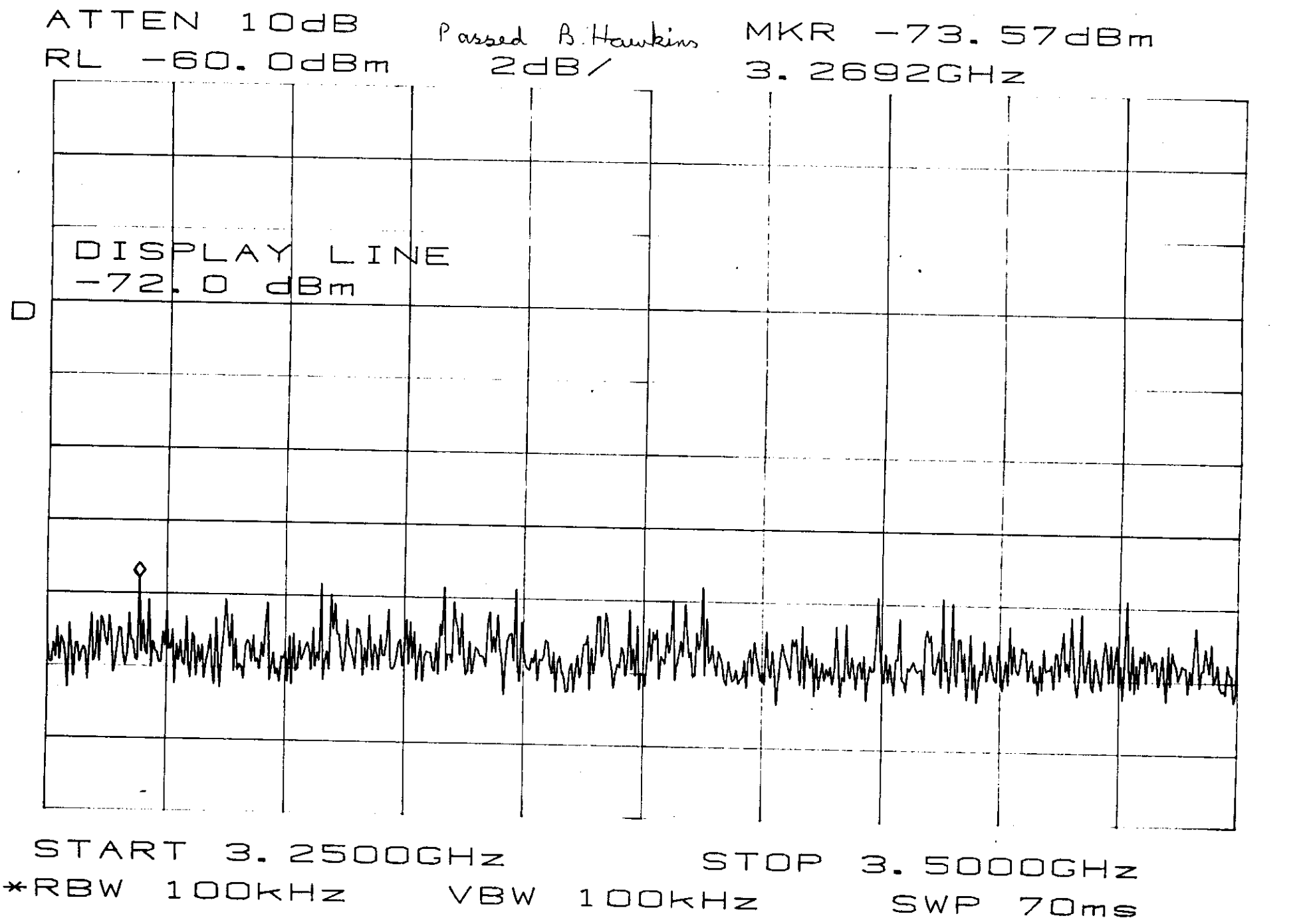

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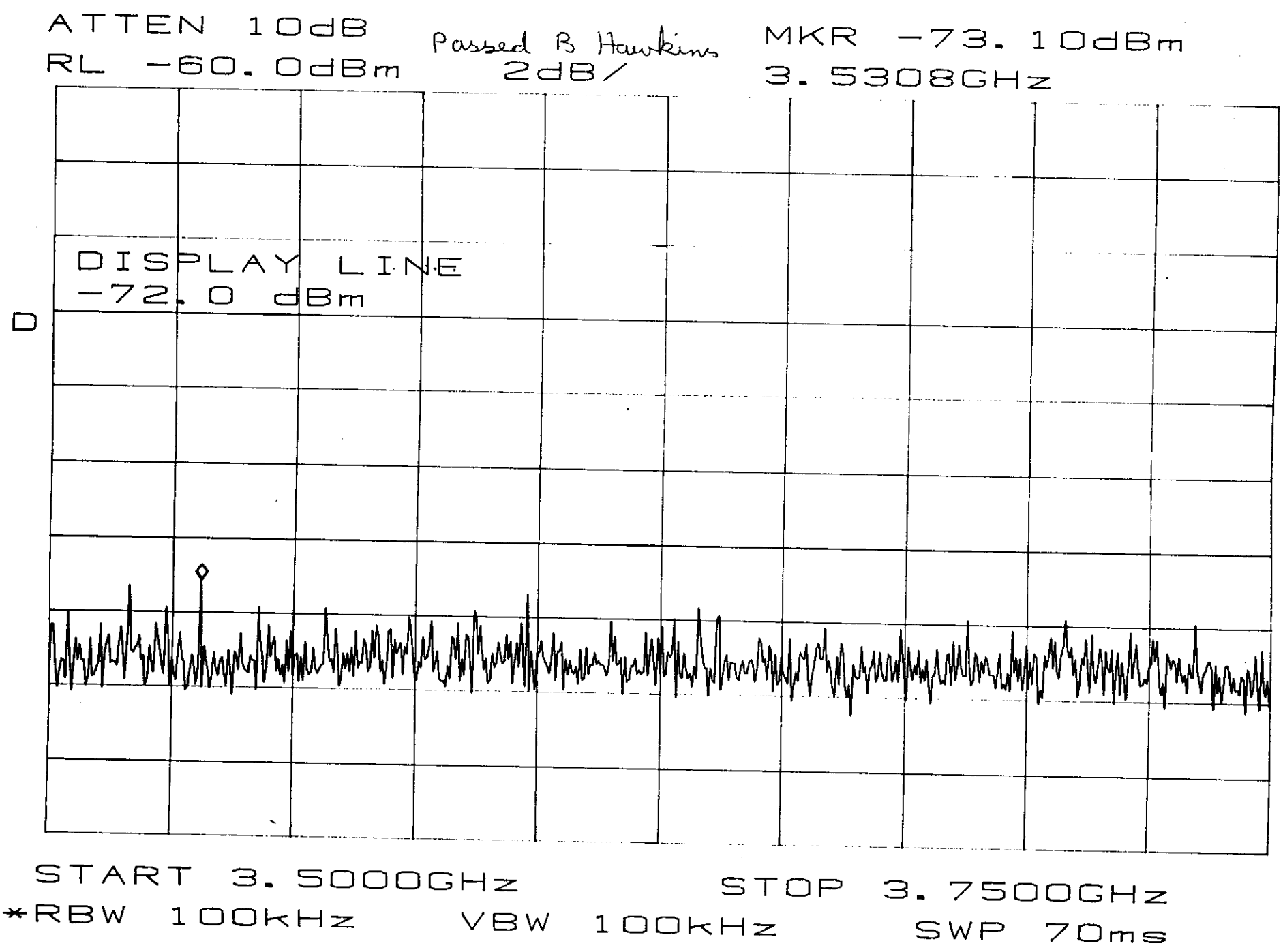

Plot 18 McMurdo EPIRB G4 Anechoic Screen Room Carrier Level to FCC 47CFR TT/03/2000 18-4-2000