

TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Quantel Ltd.
2116-22-018 Hand Control and
2116-29-018 Hand Control Dock

To: FCC Part 15: 2000
Sections 15.249 and 15.109

Test Report Serial No:
RFI/EMCB1/RP42535A

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|---|--|
| This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director:  | Checked By:  |
| Tested By:  | Release Version No: PDF01 |
| Issue Date: 20 November 2001 | Test Dates: 4 October 2001 |

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| Radio Frequency Investigation Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, ENGLAND. Tel: +44 (0) 1256 851193 Fax: +44 (0) 1256 851192 | Registered in England, No. 211 7901. Registered Office: Ewhurst Park, Ramsdell, Basingstoke, Hampshire RG26 5RQ |  UKAS TESTING 0644 |
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RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: **Quantel Ltd.**

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: **FCC Part 15: 2000 Class A Section 15.249 and 15.109**

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 2 of 37

Issue Date: 20 November 2001

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RADIO FREQUENCY INVESTIGATION LTD.

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Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 3 of 37

Issue Date: 20 November 2001

Table of Contents

| | |
|--|----|
| 1. Client Information | 4 |
| 2. Equipment Under Test (EUT)..... | 5 |
| 3. Test Specification, Methods And Procedures..... | 10 |
| 4. Deviations From The Test Specification..... | 11 |
| 5. Operation Of The EUT During Testing | 12 |
| 6. Summary Of Test Results..... | 13 |
| 7. Measurements, Examinations And Derived Results..... | 14 |
| 8. Measurement Uncertainty..... | 22 |
| Appendix 1. Test Equipment Used..... | 23 |
| Appendix 2. Measurement Methods | 24 |
| Appendix 3. Test Configuration Drawings | 26 |
| Appendix 4. Graphical Test Results | 29 |

RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 4 of 37

Issue Date: 20 November 2001

1. Client Information

| | |
|----------------------|---|
| Company Name: | Quantel Ltd. |
| Address: | 31 Turnpike Road Newbury Berkshire RG14 2NX. |
| Contact Name: | Mr. D. Bowman. |

RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 5 of 37

Issue Date: 20 November 2001

2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification Of Equipment Under Test (EUT)

| | |
|------------------------------------|-----------------|
| Brand Name: | Quantel |
| Model Name or Number: | Hand Control |
| Unique Type Identification: | 2116-22-018 |
| Serial Number: | 252553/3 |
| Country of Manufacture: | United Kingdom |
| FCC ID Number: | None stated |
| Date of Receipt: | 02 October 2001 |

| | |
|------------------------------------|-------------------|
| Brand Name: | Quantel |
| Model Name or Number: | Hand Control Dock |
| Unique Type Identification: | 2116-29-018 |
| Serial Number: | 820254/1 |
| Country of Manufacture: | United Kingdom |
| FCC ID Number: | None stated |
| Date of Receipt: | 02 October 2001 |

2.2. Description Of EUT

The Hand Control is a hand held (mouse/puck type) control low power radio transmitter. It uses 5 push button switches, a switch joystick, analog joystick and inertial sensors as some of the control functions for Quantel iQ series video editing/effects equipment

The Hand Control Dock is the radio receiver for the data transmitted from the Hand Control. Hand Control Data received by the Hand Control Dock is passed to the Quantel iQ mainframe by an RS485 serial data link.

The Hand Control Dock is connected to the iQ control system by a 4 way (2 tw/pr) power/data cable. As well as being the receiver for Hand Control data it provides a parking bay and battery charging point for the Hand Control.

The Hand Control and Hand Control Dock are component parts of the Quantel iQ Control Station which is used to control the various editing, retouching, animation, clip loading, playout and data entry functions of the Quantel iQ video editing/effects system.

2.3. Modifications Incorporated In EUT

When the Hand Control functionality is set to transfer switch status data to the iQ system via the LP radio link and Hand Control Dock, a change of switch status data causes the Hand Control to transmit the switch status data packet for one second.

In order that the radiated power level of the RF module may easily be measured, the Hand Control can be loaded with a test version of firmware, which causes it to transmit full time.

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

2.4. Additional Information Related To Testing

| | |
|--|--|
| Power Supply Requirement: | Internal battery supply of 2.5 V DC (Hand Control) External supply of 24 V DC (Hand Control Dock) |
| Current Rating | 2 Amps |
| Intended Operating Environment: | Commercial, Light Industrial and controlled EMC |
| Weight: | <150g |
| Dimensions: | L160 x W60 x H40 |
| Interface Ports: | RS485 Serial Data Interface (Hand Control Dock Only) |
| Type of Device | Cordless Hand Control |
| Antenna Details | Permanently attached antenna |
| Type of Modulation | FM |
| Number of Tx Channels | 1 |
| Method of Frequency Generation | SAW stabilised oscillator |
| Category of Receiver | Superheterodyne Highest Local Oscillator Frequency: 914.5 MHz |

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

2.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

| | |
|-------------------------------|--|
| Description: | iQ control station Tablet |
| Brand Name: | Quantel |
| Model Name or Number: | 2116-21-006 |
| Serial Number: | 250316-5 |
| FCC ID Number: | None stated by client |
| Cable Length And Type: | 3m 2 tw/pr power/data cable. Quantel part no 2116-54-010 |
| Connected to Port: | w/s port of control station PSU module |

| | |
|-------------------------------|--|
| Description: | iQ control station Control Interface/PSU |
| Brand Name: | Quantel |
| Model Name or Number: | 2116-25-006 |
| Serial Number: | 252888-4 |
| FCC ID Number: | None stated by client |
| Cable Length And Type: | 200m CAT5 straight data cable |
| Connected to Port: | Mainframe RS485 data port |

| | |
|-------------------------------|-------------------------------------|
| Description: | Tower PC |
| Brand Name: | DAN |
| Model Name or Number: | P200 |
| Serial Number: | 307900.005 |
| FCC ID Number: | None stated by client |
| Cable Length And Type: | up to 200m CAT5 straight data cable |
| Connected to Port: | M/F port on control interface/PSU |

| | |
|-------------------------------|-----------------------|
| Description: | Keyboard |
| Brand Name: | DELL |
| Model Name or Number: | AT102 |
| Serial Number: | K9207-049755 |
| FCC ID Number: | GYUM97SK |
| Cable Length And Type: | 2m multicore screened |
| Connected to Port: | keyboard port of PC |

RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 9 of 37

Issue Date: 20 November 2001

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

Support Equipment (continued)

| | |
|-------------------------------|------------------|
| Description: | Mouse |
| Brand Name: | Microsoft |
| Model Name or Number: | 45713 |
| Serial Number: | 1523614 |
| FCC ID Number: | C3KSMP1 |
| Cable Length And Type: | 1.5m multicore |
| Connected to Port: | mouse port of PC |

| | |
|-------------------------------|---------------------------|
| Description: | Monitor |
| Brand Name: | DAN |
| Model Name or Number: | CD-1764TR |
| Serial Number: | 309448 004255 |
| FCC ID Number: | None stated by client |
| Cable Length And Type: | 1.5m multicore SVGA cable |
| Connected to Port: | SVGA port of PC |

3. Test Specification, Methods And Procedures

3.1. Test Specification

| | |
|-------------------------|---|
| Reference: | FCC Part 15: 2000 (Sections 15.249 and 15.109) |
| Title: | Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices: Digital Devices. |
| Comments: | A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules. |
| Purpose of Test: | To determine whether the equipment complied with the requirements of the specification for the purposes of certification |

3.2. Methods And Procedures

The methods and procedures used were as detailed in:

ANSI C63.2 (1987)

Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (1992)

Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1988)

Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)

Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1 (1993)

Title: Specification for radio disturbance and immunity measuring apparatus and methods. Part 1. Radio disturbance and immunity measuring apparatus.

3.3. Definition Of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the Methods & Procedures section above. Appendix 1 contains a list of the test equipment used.

RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 11 of 37

Issue Date: 20 November 2001

4. Deviations From The Test Specification

None.

5. Operation Of The EUT During Testing

5.1. Operating Conditions

The EUT was tested in a normal laboratory environment.

During testing, the Hand Control was powered by an internal battery supply of 2.5V DC supply.

During testing, the Hand Control Dock was powered by an external supply of 24V DC.

5.2. Operating Modes

The EUT was tested in the following operating mode:

Running diagnostic interrogation software on the PC, which accesses and logs the status of all of the component parts of the control station.

The reason for choosing this mode was that it was defined by the client as being likely to be the worst case with regards EMC.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

All connected and responding to diagnostic interrogation. The EUT was configured, connected to the relevant support equipment, as shown in the diagram given in Appendix 3 of this report.

The reason for choosing this configuration was that it was defined by the client as being likely to be the worst case with regards EMC.

NB Section 2 of this report contains a full list of support equipment used and Appendix 3 contains a schematic diagram of the test configuration.

RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 13 of 37

Issue Date: 20 November 2001

6. Summary Of Test Results

6.1. Radiated Emissions

| Range Of Measurements | Specification Reference | Compliancy Status |
|--|-------------------------------|-------------------|
| Electric Field Strength, 30 MHz to 10000 MHz | Section 15 of C.F.R. 47: 2000 | Complied |

6.2. Location Of Tests

All the measurements described in this report were performed at the premises of Radio Frequency Investigation Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, England.

7. Measurements, Examinations And Derived Results

7.1. General Comments

7.1.1. This section contains test results only. Details of the test methods and procedures can be found in Appendix 2 of this report.

7.1.2. Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 8 for details of measurement uncertainties.

7.2. Test Results For Radiated Emissions (30 to 1000 MHz): Hand Control in Transmit Mode.

7.2.1. Electric Field Strength Measurements

7.2.1.1. Measurements were performed FCC Part 15.249.

7.2.1.2. The client has stated that the highest clock frequency for the EUT was 914.5 MHz. Therefore tests were performed up to 10 GHz.

7.2.1.3. Plots of the initial scans can be found in Appendix 4.

7.2.1.4. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector, at a test measurement distance of 3 meters (results incorporate antenna factors and cable losses):

7.2.1.5. The indicated emission at 914.501 MHz is the fundamental frequency.

| Frequency (MHz) | Ant. Pol. | Q-P Level (dB _m V/m) | Limit (dB _m V/m) | Margin (dB) | Result |
|-----------------|-----------|---------------------------------|-----------------------------|-------------|----------|
| 125.245 | Vert. | 14.4 | 43.5 | 29.1 | Complied |
| 258.052 | Vert. | 19.8 | 46.0 | 26.2 | Complied |
| 914.501 | Horiz | 37.7 | 94.0 | 56.3 | Complied |

7.3. Test Results For Radiated Emissions (30 to 10000 MHz): Hand Control Dock and Hand Control in Standby Mode.

7.3.1. Electric Field Strength Measurements

7.3.1.1. Measurements were performed to FCC Part 15.109 Class A (Unintentional-Radiators).

7.3.1.2. The client has stated that the highest clock frequency for the EUT was 914.5 MHz. Therefore tests were performed up to 10 GHz.

7.3.1.3. Plots of the initial scans can be found in Appendix 4.

7.3.1.4. The following was performed using a Quasi-Peak detector, at a test measurement distance of 3 meters (results incorporate antenna factors and cable losses):

7.3.1.5. There were no spurious emissions detected within 20 dB of the limit for this mode and in this frequency band. Therefore no measurements were taken in accordance with FCC Part 15.31 (o)

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

7.4. Test Results For Radiated Emissions (1 GHz to 4 GHz): Hand Control in Transmit Mode.

7.4.1. Electric Field Strength Measurements

7.4.1.1. Measurements were performed to FCC Part 15.249.

7.4.1.2. The client has stated that the highest clock frequency for the EUT was 914.5 MHz. Therefore tests were performed up to 10 GHz.

7.4.1.3. All emissions above 1 GHz were measured at a distance of 1m, this is in accordance with FCC Part 15. 31(f)(1), therefore a correction factor of -9.5 dB was used to correct the measured value. The correction factor was calculated as follows where 1 and 3 are the respective test distances:-

$$20 \log \frac{1}{3} = \text{Correction Factor}$$

7.4.1.4. Plots of the initial scans can be found in Appendix 4.

7.4.1.5. The following tables list frequencies at which emissions were measured using Peak and Average detector functions:

Highest Average Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Average Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Average Level (dBmV/m) | Average Limit (dBmV/m) | Average Margin (dB) | Result |
|-----------------|------------------------|-------------------------------|---------------------|-----------------|-------------------------------|------------------------|---------------------|----------|
| 1818.111 | Vert. | 8.5 | 21.7 | 0.8 | 31.0 | 53.9 | 22.9 | Complied |
| 3619.828 | Vert. | 14.2 | 21.0 | 1.2 | 36.4 | 53.9 | 17.5 | Complied |

Highest Peak Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Peak Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Peak Level (dBmV/m) | Peak Limit (dBmV/m) | Peak Margin (dB) | Result |
|-----------------|------------------------|----------------------------|---------------------|-----------------|----------------------------|---------------------|------------------|----------|
| 1818.111 | Vert. | 18.5 | 21.7 | 0.8 | 41.0 | 73.9 | 32.9 | Complied |
| 3619.828 | Vert. | 24.5 | 21.0 | 1.2 | 46.7 | 73.9 | 27.2 | Complied |

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

7.5. Test Results For Radiated Emissions (1 GHz to 4 GHz): Hand Control Dock and Hand Control in Standby Mode.**7.5.1. Electric Field Strength Measurements**

7.5.1.1. Measurements were performed to FCC Part 15.109 Class A (Unintentional-Radiators).

7.5.1.2. The client has stated that the highest clock frequency for the EUT was 914.5 MHz. Therefore tests were performed up to 10 GHz.

7.5.1.3. All emissions above 1 GHz were measured at 1m, this is in keeping with FCC Part 15. 31(f)(1). Therefore a correction factor of -9.5 dB was used to correct the measured value. The correction factor was calculated as follows where 1 and 3 are the respective test distances:-

$$20 \log \frac{1}{3} = \text{Correction Factor}$$

7.5.1.4. Plots of the initial scans can be found in Appendix 4.

7.5.1.5. The following tables list frequencies at which emissions were measured using Peak and Average detector functions:

Highest Average Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Average Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Average Level (dBmV/m) | Average Limit (dBmV/m) | Average Margin (dB) | Result |
|-----------------|------------------------|-------------------------------|---------------------|-----------------|-------------------------------|------------------------|---------------------|----------|
| 1801.4443 | Vert. | 15.9 | 21.7 | 0.8 | 38.4 | 53.9 | 15.5 | Complied |
| 3626.1333 | Vert. | 14.5 | 21.0 | 1.18 | 36.7 | 53.9 | 17.2 | Complied |

Highest Peak Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Peak Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Peak Level (dBmV/m) | Peak Limit (dBmV/m) | Peak Margin (dB) | Result |
|-----------------|------------------------|----------------------------|---------------------|-----------------|----------------------------|---------------------|------------------|----------|
| 1801.4443 | Vert. | 26.5 | 21.7 | 0.8 | 49.0 | 73.9 | 24.9 | Complied |
| 3626.1333 | Vert. | 24.5 | 21.0 | 1.18 | 46.7 | 73.9 | 27.2 | Complied |

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

7.6. Test Results For Radiated Emissions (4 GHz to 10 GHz): Hand Control Standby Mode

7.6.1. Electric Field Strength Measurements

7.6.1.1. Measurements were performed to FCC Part 15.109 Class A (Unintentional-Radiators).

7.6.1.2. The client has stated that the highest clock frequency for the EUT was 914.5 MHz. Therefore tests were performed up to 10 GHz.

7.6.1.3. All emissions above 1 GHz were measured at 1m, this is in keeping with FCC Part 15. 31(f)(1). Therefore a correction factor of -9.5 dB was used to correct the measured value. The correction factor was calculated as follows where 1 and 3 are the respective test distances:-

$$20 \log \frac{1}{3} = \text{Correction Factor}$$

7.6.1.4. Plots of the initial scans can be found in Appendix 4.

7.6.1.5. The following tables list frequencies at which emissions were measured using Peak and Average detector functions:

Highest Average Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Average Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Average Level (dBmV/m) | Average Limit (dBmV/m) | Average Margin (dB) | Result |
|-----------------|------------------------|-------------------------------|---------------------|-----------------|-------------------------------|------------------------|---------------------|----------|
| 4.5020 | Horiz. | 16.9 | 24.2 | 1.21 | 42.3 | 53.9 | 11.6 | Complied |
| 5.1727 | Horiz. | 15.5 | 24.4 | 1.66 | 41.6 | 53.9 | 12.3 | Complied |
| 6.54655 | Horiz. | 14.6 | 26.9 | 1.52 | 43.0 | 53.9 | 10.9 | Complied |
| 9.48055 | Vert. | 12.0 | 30.7 | 1.65 | 44.4 | 53.9 | 9.5 | Complied |

Highest Peak Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Peak Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Peak Level (dBmV/m) | Peak Limit (dBmV/m) | Peak Margin (dB) | Result |
|-----------------|------------------------|----------------------------|---------------------|-----------------|----------------------------|---------------------|------------------|----------|
| 4.5020 | Horiz. | 27.0 | 24.2 | 1.21 | 52.4 | 73.9 | 21.5 | Complied |
| 5.1727 | Horiz. | 25.5 | 24.4 | 1.66 | 51.6 | 73.9 | 22.3 | Complied |
| 6.54655 | Horiz. | 25.5 | 26.9 | 1.52 | 53.4 | 73.9 | 20.5 | Complied |
| 9.48055 | Vert. | 21.5 | 30.7 | 1.65 | 53.9 | 73.9 | 20.0 | Complied |

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

7.7. Test Results For Radiated Emissions (4 GHz to 10 GHz): Hand Control Transmit Mode.

7.7.1. Electric Field Strength Measurements

7.7.1.1. Measurements were performed to FCC Part 15.249

7.7.1.2. The client has stated that the highest clock frequency for the EUT was 914.5 MHz. Therefore tests were performed up to 10 GHz.

7.7.1.3. All emissions above 1 GHz were measured at 1m, this is in keeping with FCC Part 15. 31(f)(1). Therefore a correction factor of -9.5 dB was used to correct the measured value. The correction factor was calculated as follows where 1 and 3 are the respective test distances:-

$$20 \log \frac{1}{3} = \text{Correction Factor}$$

7.7.1.4. Plots of the initial scans can be found in Appendix 4.

7.7.1.5. The following tables list frequencies at which emissions were measured using Peak and Average detector functions:

Highest Average Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Average Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Average Level (dBmV/m) | Average Limit (dBmV/m) | Average Margin (dB) | Result |
|-----------------|------------------------|-------------------------------|---------------------|-----------------|-------------------------------|------------------------|---------------------|----------|
| 4.897770 | Horiz. | 19.6 | 24.2 | 1.21 | 45.0 | 53.9 | 8.9 | Complied |
| 5.864444 | Vert. | 14.1 | 24.4 | 1.66 | 40.2 | 53.9 | 13.7 | Complied |
| 6.53111 | Vert. | 13.9 | 26.9 | 1.52 | 42.3 | 53.9 | 11.6 | Complied |
| 9.942290 | Horiz. | 9.9 | 30.7 | 1.65 | 42.3 | 53.9 | 11.7 | Complied |

Highest Peak Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Peak Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Peak Level (dBmV/m) | Peak Limit (dBmV/m) | Peak Margin (dB) | Result |
|-----------------|------------------------|----------------------------|---------------------|-----------------|----------------------------|---------------------|------------------|----------|
| 4.89777 | Horiz. | 29.5 | 24.2 | 1.21 | 54.9 | 73.9 | 19.0 | Complied |
| 5.864444 | Vert. | 24.5 | 24.4 | 1.66 | 50.7 | 73.9 | 23.3 | Complied |
| 6.53111 | Vert. | 24.5 | 26.9 | 1.52 | 52.9 | 73.9 | 21.0 | Complied |
| 9.942290 | Horiz. | 20.5 | 30.7 | 1.65 | 52.9 | 73.9 | 21.0 | Complied |

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

7.8. Test Results For Radiated Emissions (4 GHz to 10 GHz): Hand Control Dock. Standby Mode.

7.8.1. Electric Field Strength Measurements

7.8.1.1. Measurements were performed to FCC Part 15.109 Class A (Unintentional-Radiators).

7.8.1.2. The client has stated that the highest clock frequency for the EUT was 914.5 MHz. Therefore tests were performed up to 10 GHz.

7.8.1.3. All emissions above 1 GHz were measured at 1m, this is in keeping with FCC Part 15. 31(f)(1). Therefore a correction factor of -9.5 dB was used to correct the measured value. The correction factor was calculated as follows where 1 and 3 are the respective test distances:-

$$20 \log \frac{1}{3} = \text{Correction Factor}$$

7.8.1.4. Plots of the initial scans can be found in Appendix 4.

7.8.1.5. The following tables list frequencies at which emissions were measured using Peak and Average detector functions:

Highest Average Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Average Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Average Level (dBmV/m) | Average Limit (dBmV/m) | Average Margin (dB) | Result |
|-----------------|------------------------|-------------------------------|---------------------|-----------------|-------------------------------|------------------------|---------------------|----------|
| 4.98647 | Vert. | 18.8 | 24.2 | 1.21 | 44.2 | 53.9 | 9.7 | Complied |
| 5.10108 | Vert. | 16.2 | 24.4 | 1.66 | 42.3 | 53.9 | 11.6 | Complied |
| 6.25472 | Vert. | 13.7 | 26.9 | 1.52 | 42.1 | 53.9 | 11.8 | Complied |
| 9.47619 | Horiz. | 12.0 | 30.7 | 1.65 | 44.4 | 53.9 | 9.5 | Complied |

Highest Peak Level:

| Frequency (GHz) | Antenna Polarity (H/V) | Peak Detector level (dBmV) | Antenna factor (dB) | Cable loss (dB) | Actual Peak Level (dBmV/m) | Peak Limit (dBmV/m) | Peak Margin (dB) | Result |
|-----------------|------------------------|----------------------------|---------------------|-----------------|----------------------------|---------------------|------------------|----------|
| 4.98647 | Vert. | 29.5 | 24.2 | 1.21 | 54.9 | 73.9 | 19.0 | Complied |
| 5.10108 | Vert. | 26.5 | 24.4 | 1.66 | 52.6 | 73.9 | 21.3 | Complied |
| 6.25472 | Vert. | 23.5 | 26.9 | 1.52 | 51.9 | 73.9 | 22.0 | Complied |
| 9.47619 | Horiz. | 21.5 | 30.7 | 1.65 | 53.9 | 73.9 | 20.0 | Complied |

8. Measurement Uncertainty

8.1. No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

8.2. The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

8.3. The uncertainty of the result may need to be taken into account when interpreting the measurement results.

8.4. The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

| Measurement Type | Range | Confidence Level | Calculated Uncertainty |
|--------------------|--------------------------------|------------------|------------------------|
| Radiated Emissions | 30 MHz to 1000 MHz @ 1m and 3m | 95% | +/- 5.26 dB |
| Radiated Emissions | 30 MHz to 1000 MHz @ 10m | 95% | +/- 5.1 dB |
| Radiated Emissions | 1 GHz to 18 GHz | 95% | +/- 4.18 dB |

8.5. The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

Appendix 1. Test Equipment Used

| Instrument | Manufacturer | Model | RFI No. |
|-------------------------------------|-------------------------|-----------------------|---------|
| Horn Antenna | Eaton | 9188-2 | A027 |
| Horn Antenna | Eaton | 91888-2 | A028 |
| 2 to 4 GHz Eaton Horn Antenna | Eaton | 91889-2 | A031 |
| WG 14 Microwave Horn | Flann Microwave | 14240-20 | A254 |
| WG 16 Microwave Horn | Flann Microwave | 16240-20 | A255 |
| OATS Positioning Controller | Rohde & Schwarz | HCC | A276 |
| 3 dB attenuator (9) | Suhner | 6803.17.B | A392 |
| WG 14 horn | Flann | 14240-20 | A427 |
| WG 12 horn | Flann | 12240-20 | A428 |
| Bilog Antenna | Chase | CBL6111A | A490 |
| Cable | RFI | None | C055 |
| Cables | Rosenberger | UFA210A-1-1181-70x70 | C160 |
| Cable | RFI | None | C334 |
| C564-N-2 | Rosenberger | UFA 210A-1-0787-70x70 | C564 |
| Spectrum Monitor | Rohde & Schwarz | EZM | M003 |
| ESVP Receiver | Rohde & Schwarz | ESVP | M023 |
| ESMI Spectrum Analyser / Receiver | Rohde & Schwarz | ESMI | M069 |
| Thermometer/Humidity Meter | Maplin | Precision Gold | M075 |
| Receiver / Spectrum Analyser System | Rohde & Schwarz | ESBI | M088 |
| Turntable Controller | R.H.Electrical Services | RH351 | M173 |
| Baro/Hygro/Thermo meter | Oregon Scientific | BA888 | M292 |
| Site 1 | RFI | 1 | S201 |
| Site 2 | RFI | 2 | S202 |
| Site 9 | RFI | 9 | S209 |

NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

Appendix 2. Measurement Methods

A2.1. Radiated Emissions: FCC Part 15

A2.1.1. Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

A2.1.2. Initial measurements covering the entire measurement band in the form of swept scans in a shielded enclosure were performed in order to identify frequencies on which the EUT was generating interference. This determined the frequencies on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

A2.1.3. The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested on the open area test site, at the appropriate distance, using a measuring receivers with a Quasi-Peak detector (below 1000 MHz), where applicable, for measurements above 1000 MHz average and peak detectors were used.

A2.1.4. For the main (final) measurements the EUT was arranged on a non-conducting table on an open area test site, as detailed in the specification.

A2.1.5. All measurements on the open area test site were performed using broadband antennas.

A2.1.6. On the open area test site, at each frequency where a signal was found, the levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m. At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

Test Of: Quantel Ltd.**2116-22-018 Hand Control and 2116-29-018 Hand Control Dock****To: FCC Part 15: 2000 Class A Section 15.249 and 15.109**

A2.1.7. The test equipment settings for radiated emissions measurements were as follows:

| Receiver Function | Initial Scan | Final Measurements Below 1GHz | Final Measurements Above 1 GHz |
|--------------------------|-------------------------------------|--------------------------------------|---------------------------------------|
| Detector Type: | Peak | Quasi-Peak (CISPR) | Peak/Average |
| Mode: | Max Hold | Not applicable | Not applicable |
| Bandwidth: | 100 kHz < 1000MHz 1MHz > 1000MHz | 120 kHz | 1 MHz |
| Amplitude Range: | 60 dB | 20 dB | 20 dB (typical) |
| Measurement Time: | Not applicable | > 1 s | > 1 s |
| Observation Time: | Not applicable | > 15 s | > 15 s |
| Step Size: | Continuous sweep | Not applicable | Not applicable |
| Sweep Time: | Coupled | Not applicable | Not applicable |

RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 26 of 37

Issue Date: 20 November 2001

Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

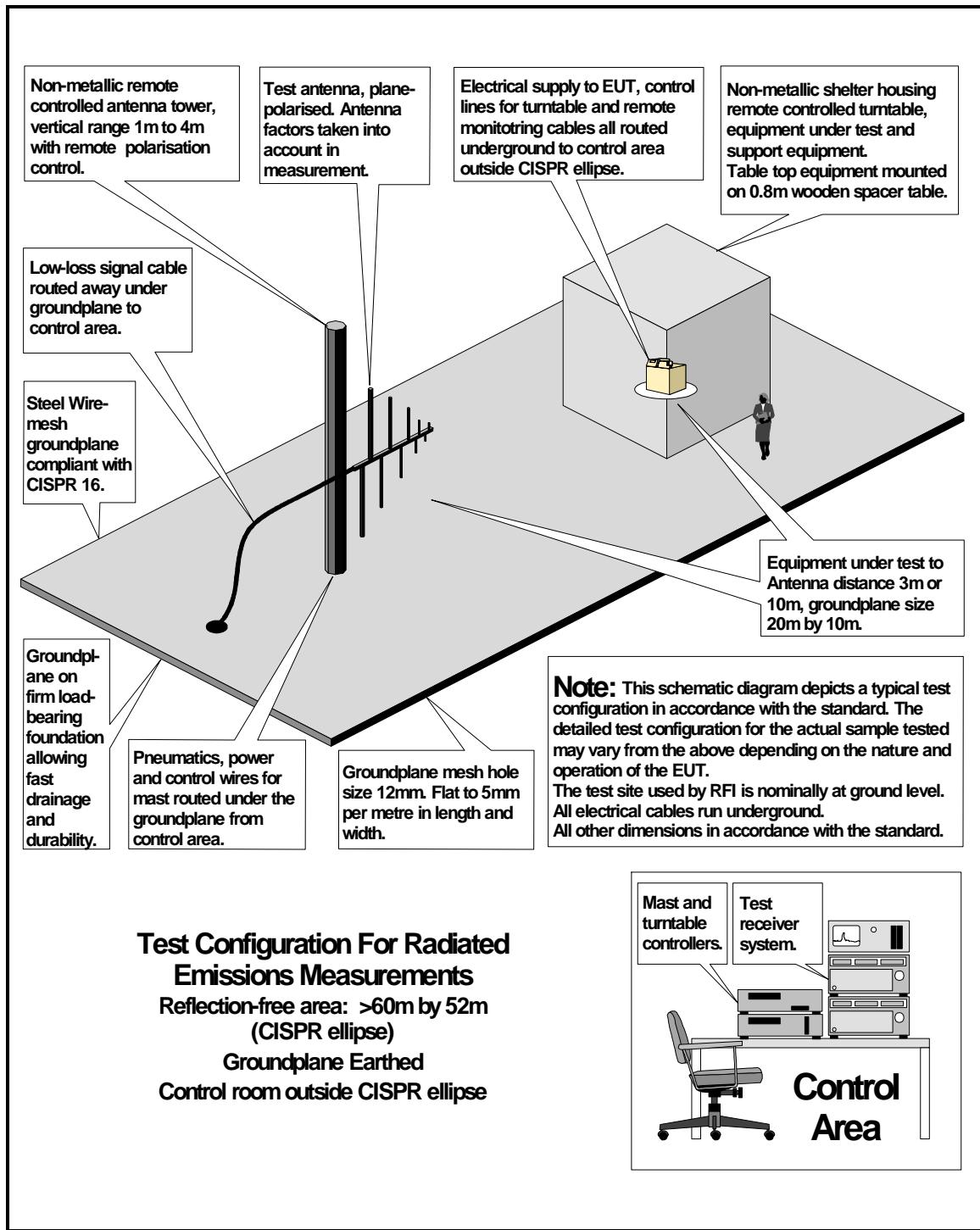
| Drawing Reference Number | Title |
|---------------------------------|--|
| DRG\42535\JD01\JD02\EMIRAD | Test configuration for measurement of radiated emissions |
| DRG\42535\JD01\JD02\001 | Schematic diagram of the EUT, support equipment and interconnecting cables used for the test |

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

DRG\42535\JD01\JD02\EMIRAD

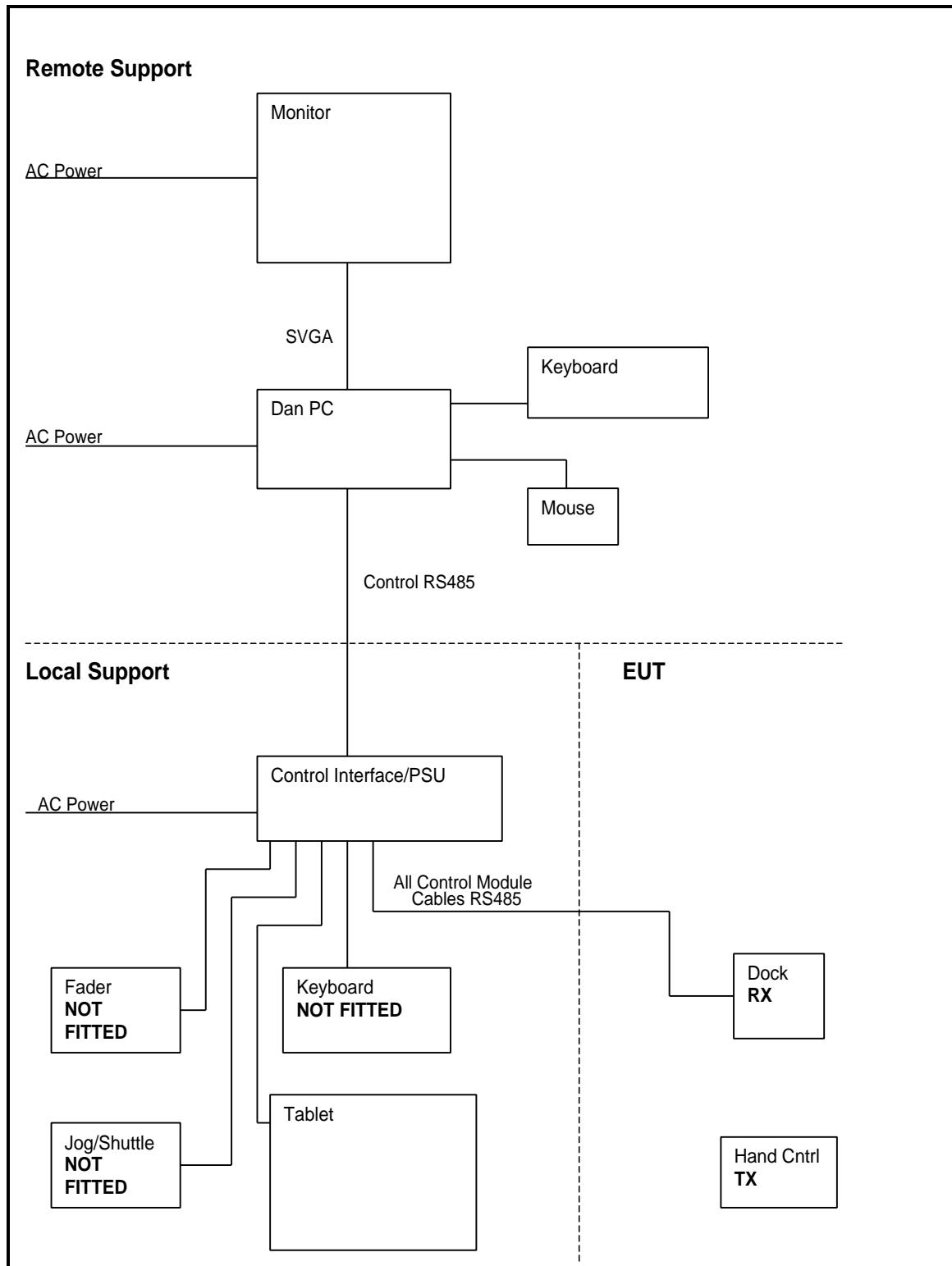


Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

DRG\42535\JD01\JD02\001



Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

Appendix 4. Graphical Test Results

This appendix contains the following graphs:

| Graph Reference Number | Title |
|------------------------|--|
| GPH\42535JD02\RE01 | Radiated Emissions (4GHz to 5 GHz) EUT: Hand Control |
| GPH\42535JD02\RE02 | Radiated Emissions (5 GHz to 6 GHz) Transmit Mode EUT: Hand Control |
| GPH\42535JD02\RE03 | Radiated Emissions (4 GHz to 5 GHz) Standby Mode EUT: Hand Control |
| GPH\42535JD02\RE04 | Radiated Emissions (5 GHz to 6 GHz) Standby Mode EUT: Hand Control |
| GPH\42535JD02\RE05 | Radiated Emissions (6 GHz to 8 GHz) Standby Mode EUT: Hand Control |
| GPH\42535JD02\RE06 | Radiated Emissions (6 GHz to 8 GHz) Transmit Mode EUT: Hand Control |
| GPH\42535JD02\RE07 | Radiated Emissions (8 GHz to 10 GHz) Transmit Mode EUT: Hand Control |
| GPH\42535JD02\RE08 | Radiated Emissions (8 GHz to 10 GHz) Standby Mode EUT: Hand Control |
| GPH\42535JD03\RE09 | Radiated Emissions (8 GHz to 10 GHz) EUT: Hand Control Dock |
| GPH\42535JD03\RE10 | Radiated Emissions (6 GHz to 8 GHz) EUT: Hand Control Dock |
| GPH\42535JD03\RE11 | Radiated Emissions (5 GHz to 6 GHz) EUT: Hand Control Dock |
| GPH\42535JD03\RE12 | Radiated Emissions (4 GHz to 5 GHz) EUT: Hand Control Dock |
| GPH\42535JD03\RE13 | Radiated Emissions (928 MHz to 1 GHz) EUT: Hand Control Dock |
| GPH\42535JD03\RE14 | Radiated Emissions (928 MHz to 1 GHz) EUT: Hand Control Dock and Hand Control |

These pages are not included in the total number of pages for this report.

RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: **Quantel Ltd.**

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: **FCC Part 15: 2000 Class A Section 15.249 and 15.109**

TEST REPORT

S.No: RFI/EMCB1/RP42535A

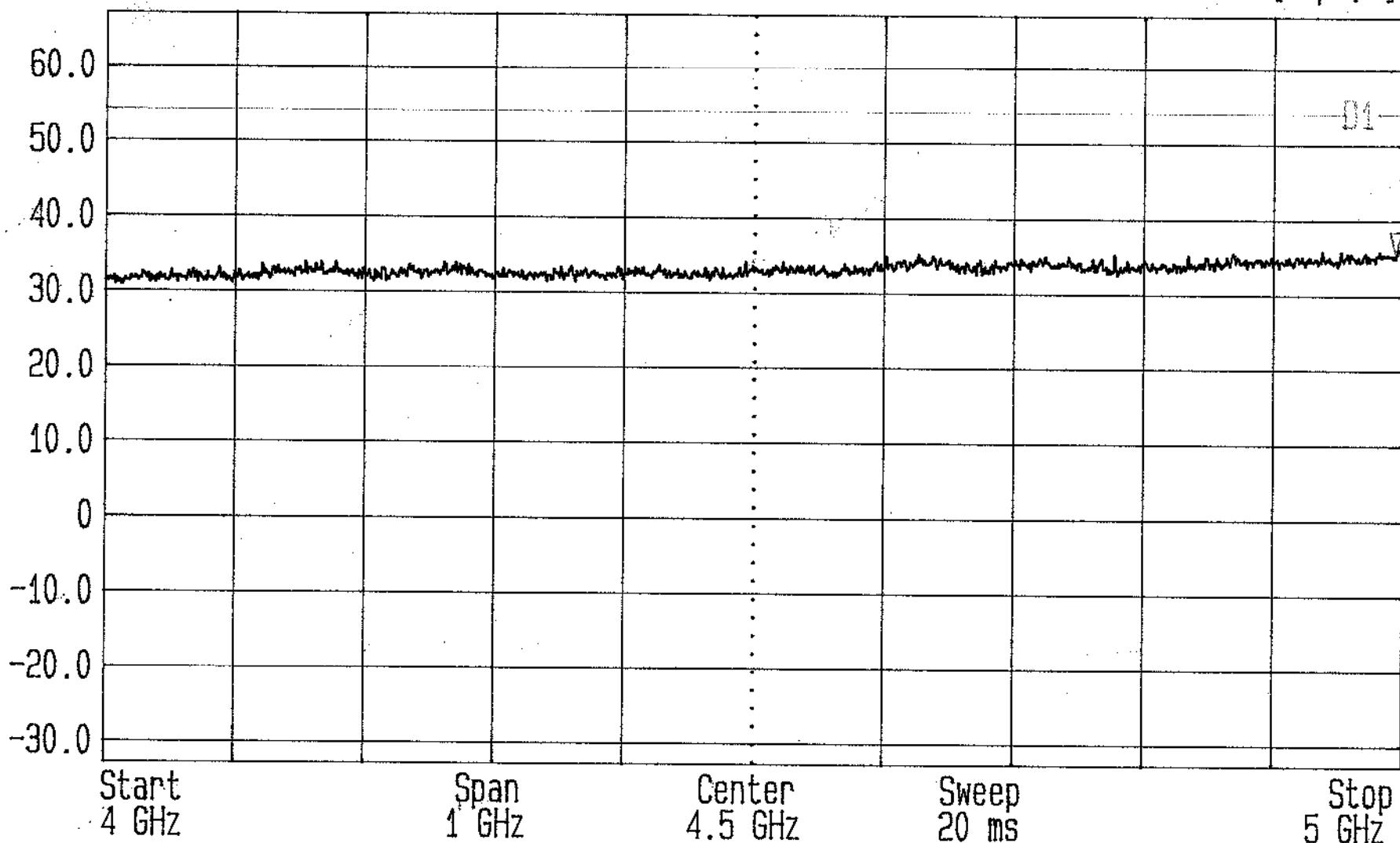
Page 30 of 37

Issue Date: 20 November 2001

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Date 02.Oct.'01 Time 17:10:27
Ref.Lvl Marker 35.42 dB*
67.00 dB* 4.9955 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off RF.Att 15 dB
CF.Stp 100.000 MHz Unit [dB μ V/m]

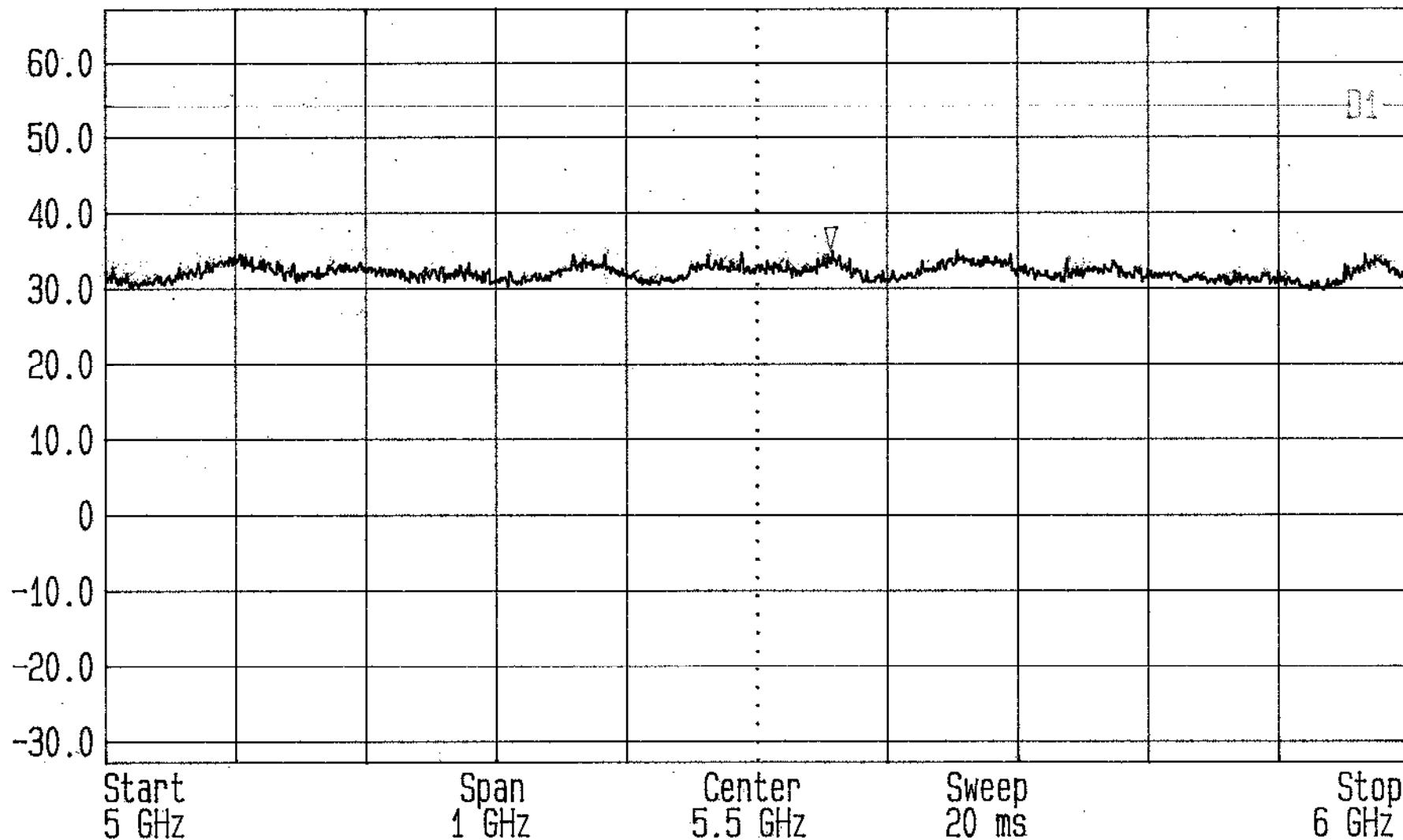


Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control OPCOND : Transmit Mode

SPEC : FCC Part15.249
GRH/42535/02/RE001

Date 03.Oct.'01 Time 10:03:31
Ref.Lvl Marker 34.96 dB*
67.00 dB* 5.5577 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off RF.Att 5 dB
CF.Stp 100.000 MHz Unit [dB μ V/m]

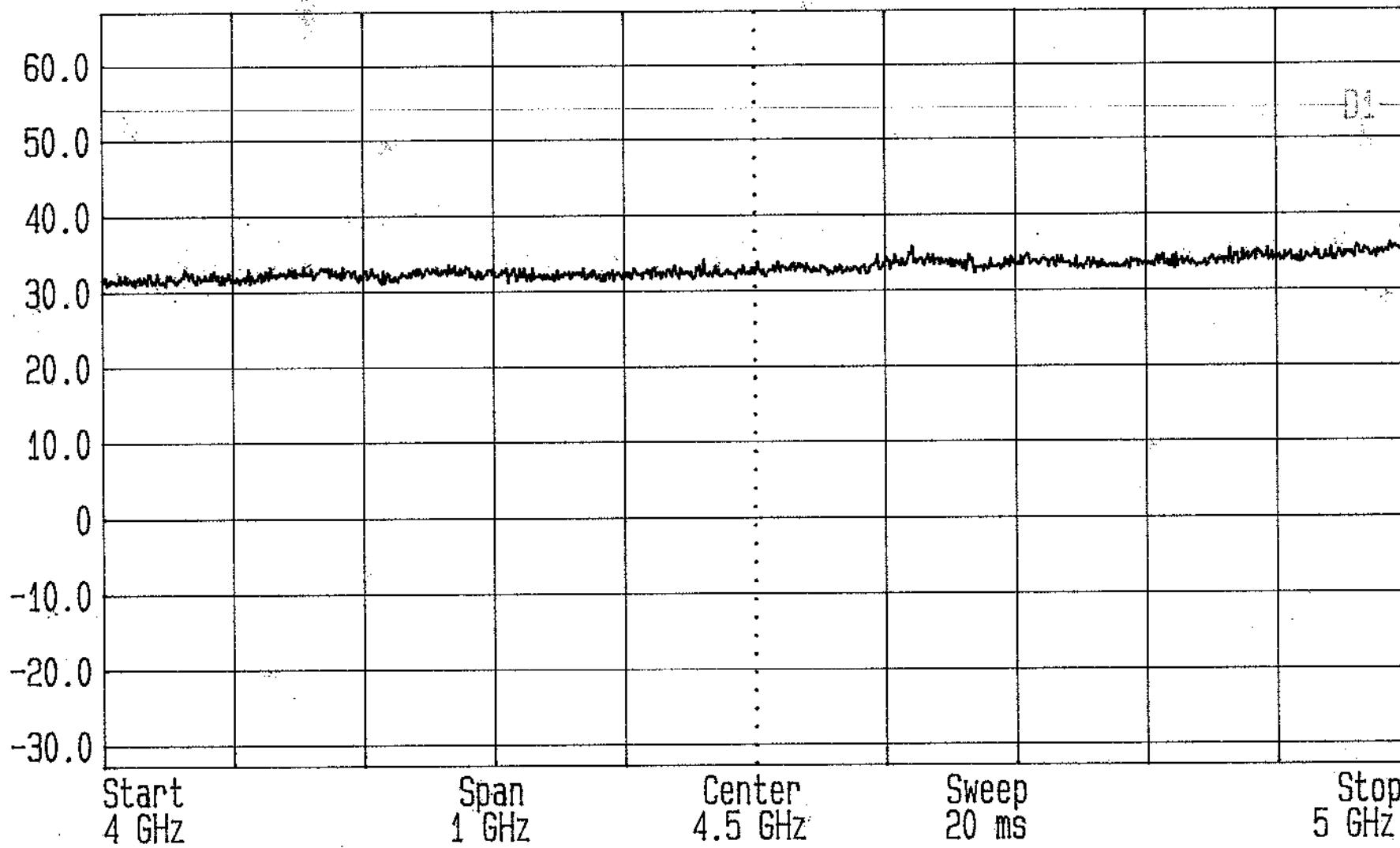


Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control SOURCE : Transmit Mode

SPEC : FCC Part 15.249
EPA/42935/02/RE002

Date 03.Oct.'01 Time 10:09:40
Ref.Lvl Marker 35.31 dB*
67.00 dB* 5.0000 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off RF.Att 5 dB
CF.Stp 100.000 MHz Unit [dB μ V/m]

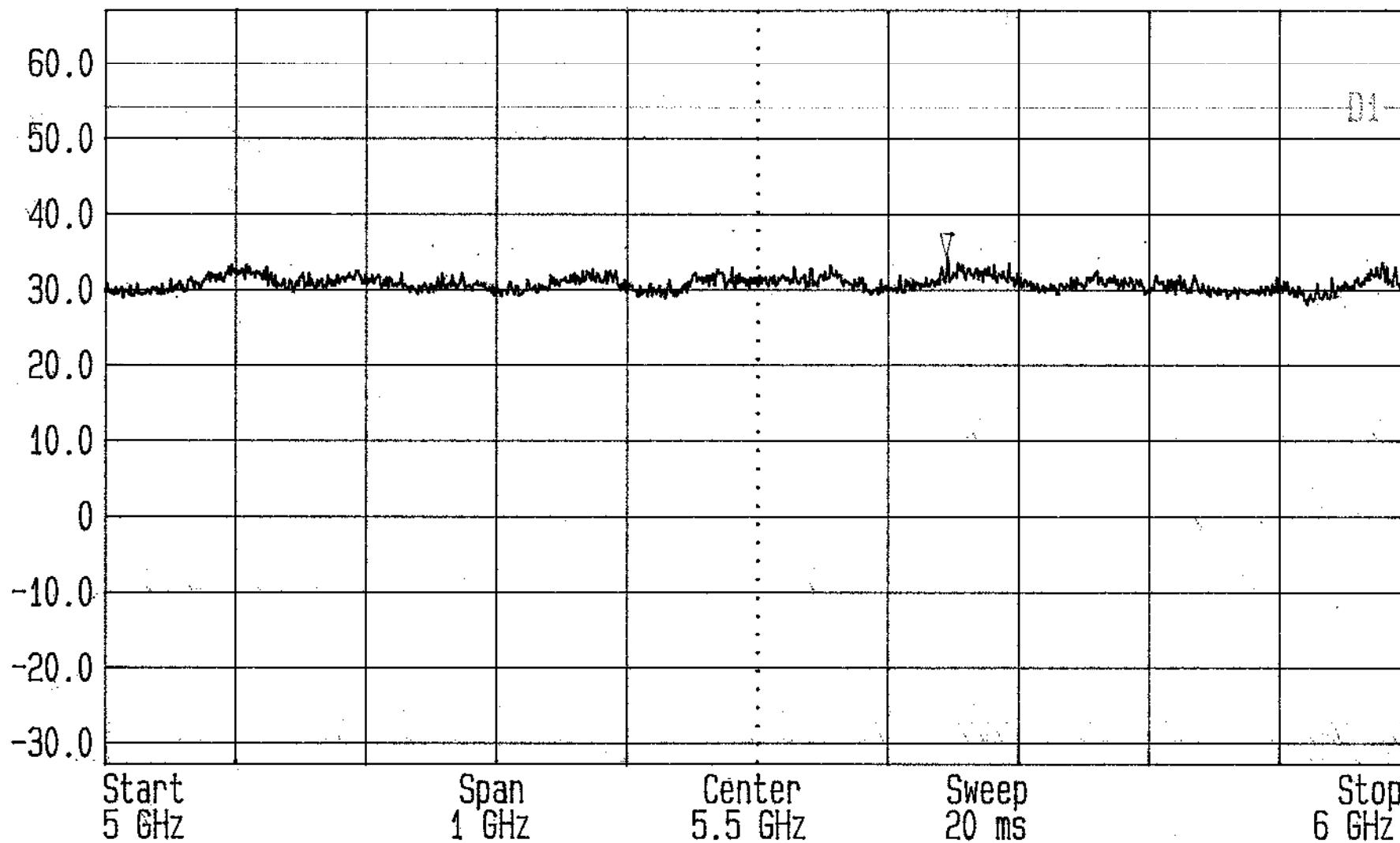


Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control OPCOND : Standby Mode

SPEC : FCC Part15.109
GPN:42635/02/REC03

Date 03.Oct.'01 Time 10:16:15
Ref.Lvl Marker 34.48 dB*
67.00 dB* 5.6455 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off RF.Att -5 dB
CF.Stp 100.000 MHz Unit [dB μ V/m]

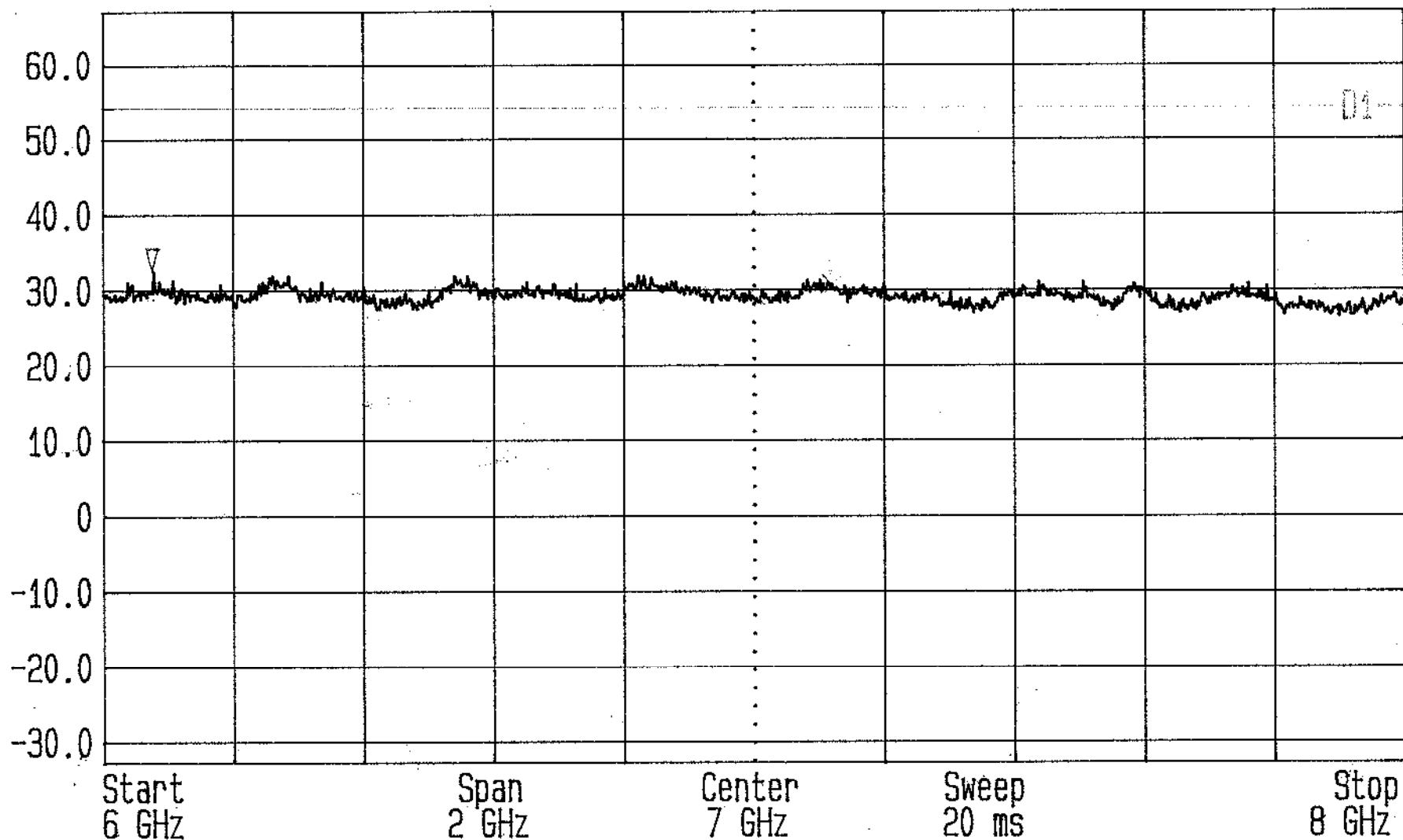


Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control OPCODE : Standby Mode

SPEC : FCC Part 15.109
GPH/42535/02/RE004

Date 03.Oct.'01 Time 10:21:29
 Ref.Lv1 Marker 32.52 dB*
 67.00 dB* 6.0777 GHz

| Res.Bw | 1.0 MHz [3dB] | Vid.Bw | 1 MHz |
|--------|---------------|--------|----------------|
| TG.Lvl | off | RF.Att | 5 dB |
| CF.Stp | 200.000 MHz | Unit | [dB μ V/m] |

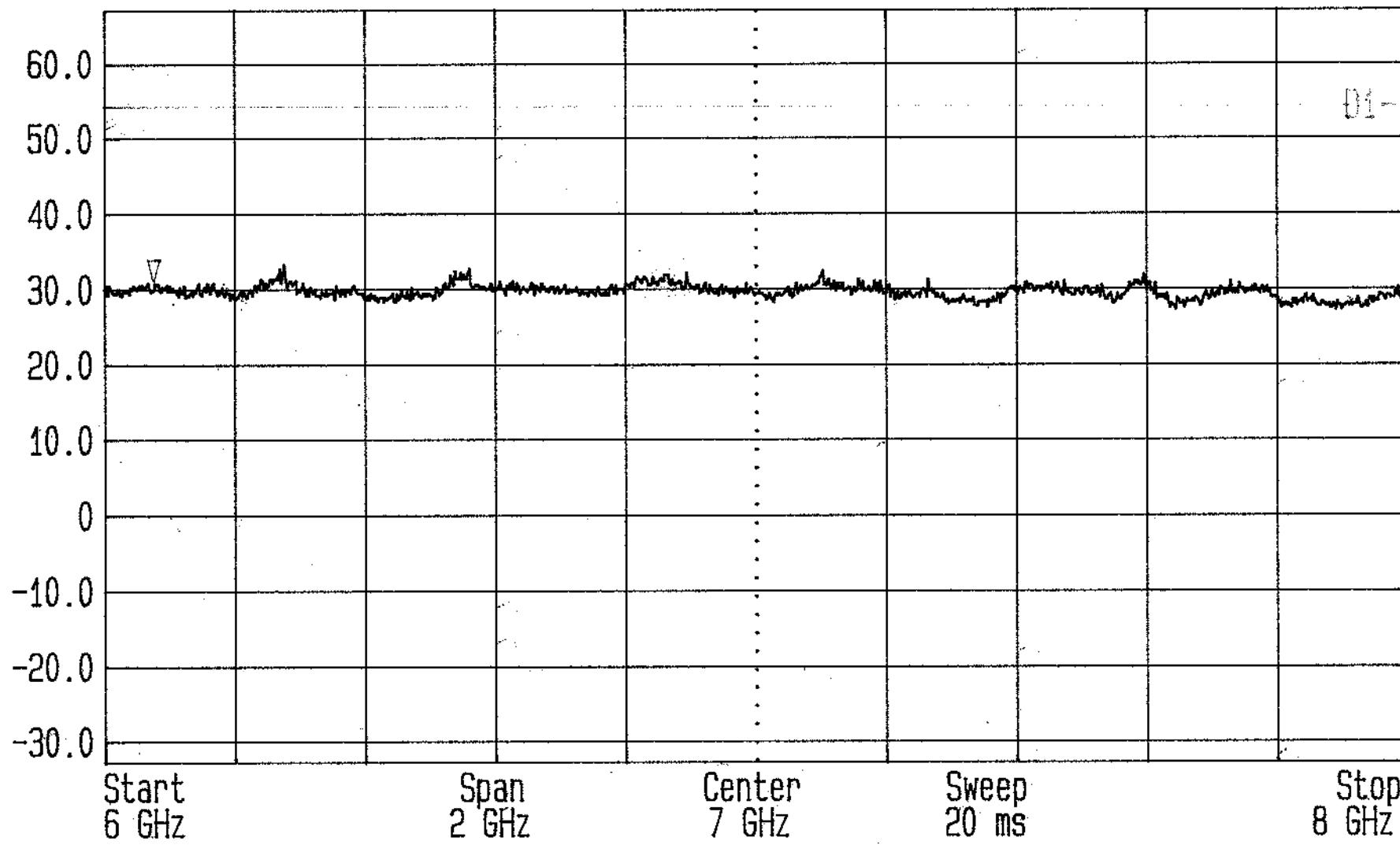


Radiated Emissions Testing For Quantel by RFI Ltd.
 EUT : Hand Control OPCOND : Standby Mode

SPEC : FCC Part 15.109
 GPH/42535/02/HEC05

Date 03.Oct.'01 Time 10:57:49
Ref.Lvl Marker 30.77 dB*
67.00 dB* 6.0777 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off RF.Att 5 dB
CF.Stp 200.000 MHz Unit [dB μ V/m]

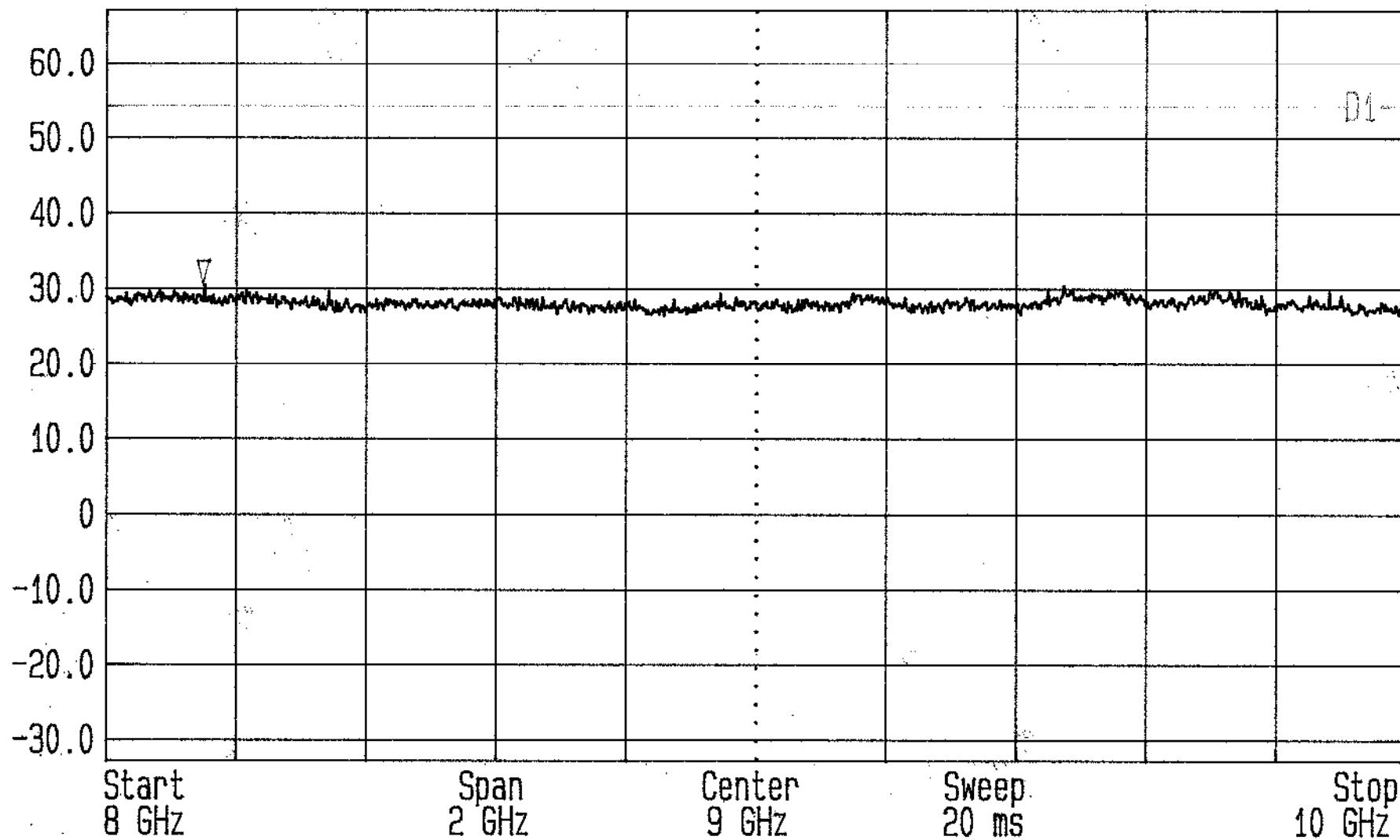


Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control
OPCOND : Transmit Mode

SPEC : FCC Part15.249
CPH/42935/02/REC006

Date 03.Oct.'01 Time 14:14:37
Ref.Lvl Marker 30.57 dB*
67.00 dB* 8.1511 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off RF.Att 5 dB
CF.Stp 200.000 MHz Unit [dB μ V/m]

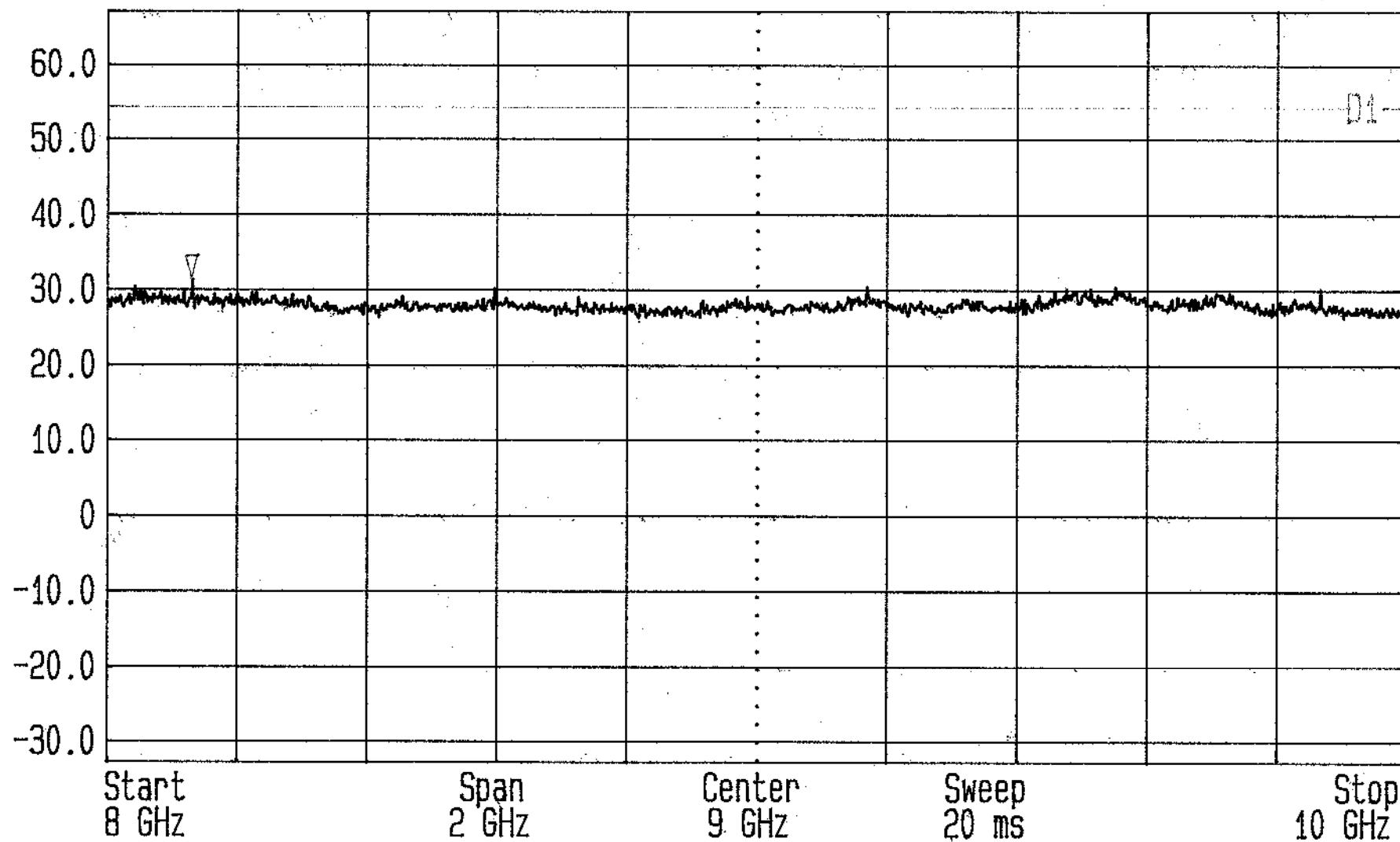


Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control OPCOND : Transmit Mode

SPEC : FCC Part15.249
GPH/42535/02/RE007

Date: 03.Oct.'01 Time: 11:18:38
Ref.Lvl Marker 31.23 dB*
67.00 dB* 8.1311 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off RF.Att 5 dB
CF.Stp 200.000 MHz Unit [dB μ V/m]

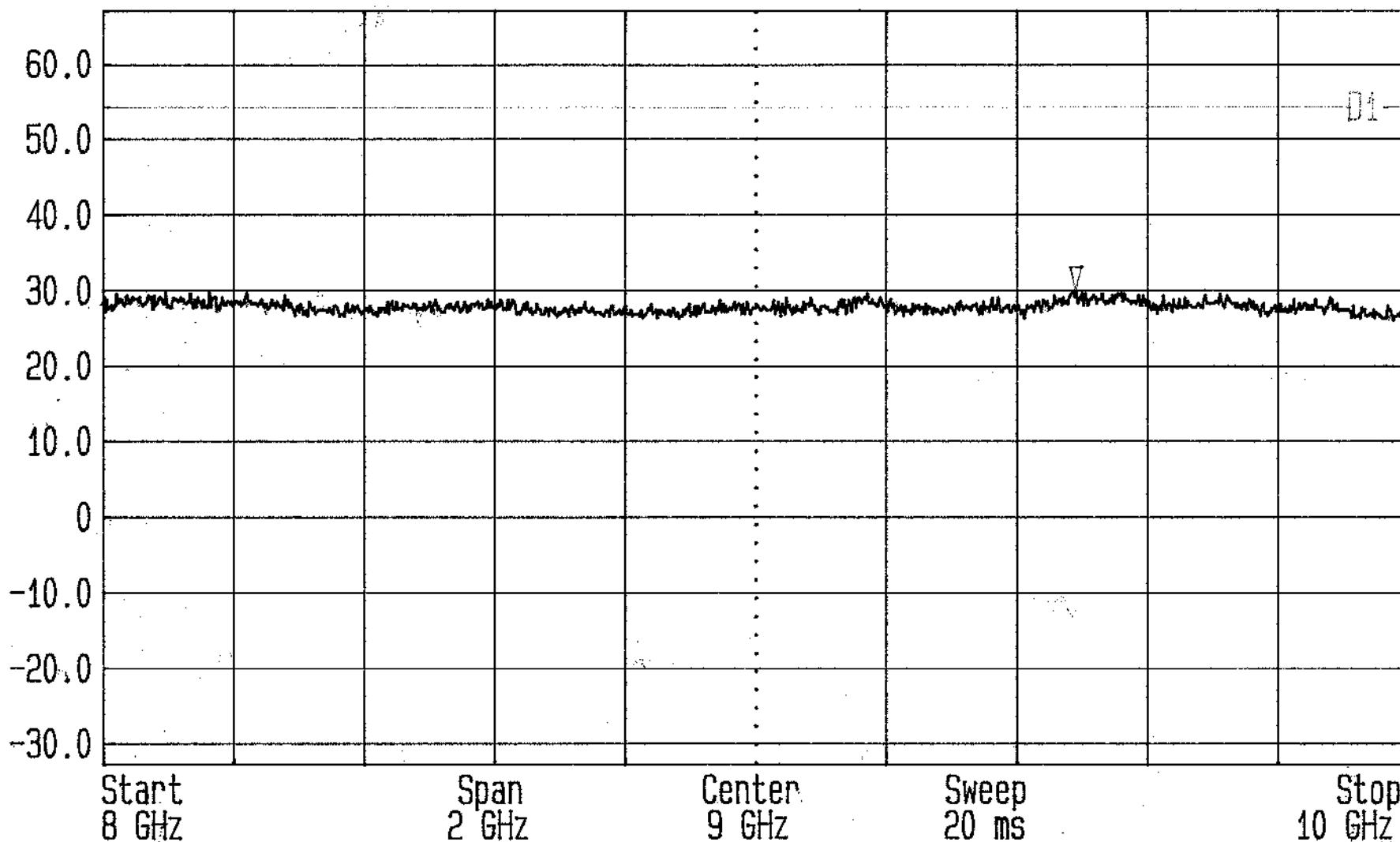


Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control OPCOND : Standby Mode

SPEC : FCC Part 15.109
GPN/42535/02/HE008

Date 03.Oct.'01 Time 11:50:30
Ref.Lvl Marker 29.80 dB*
67.00 dB* 9.4911 GHz

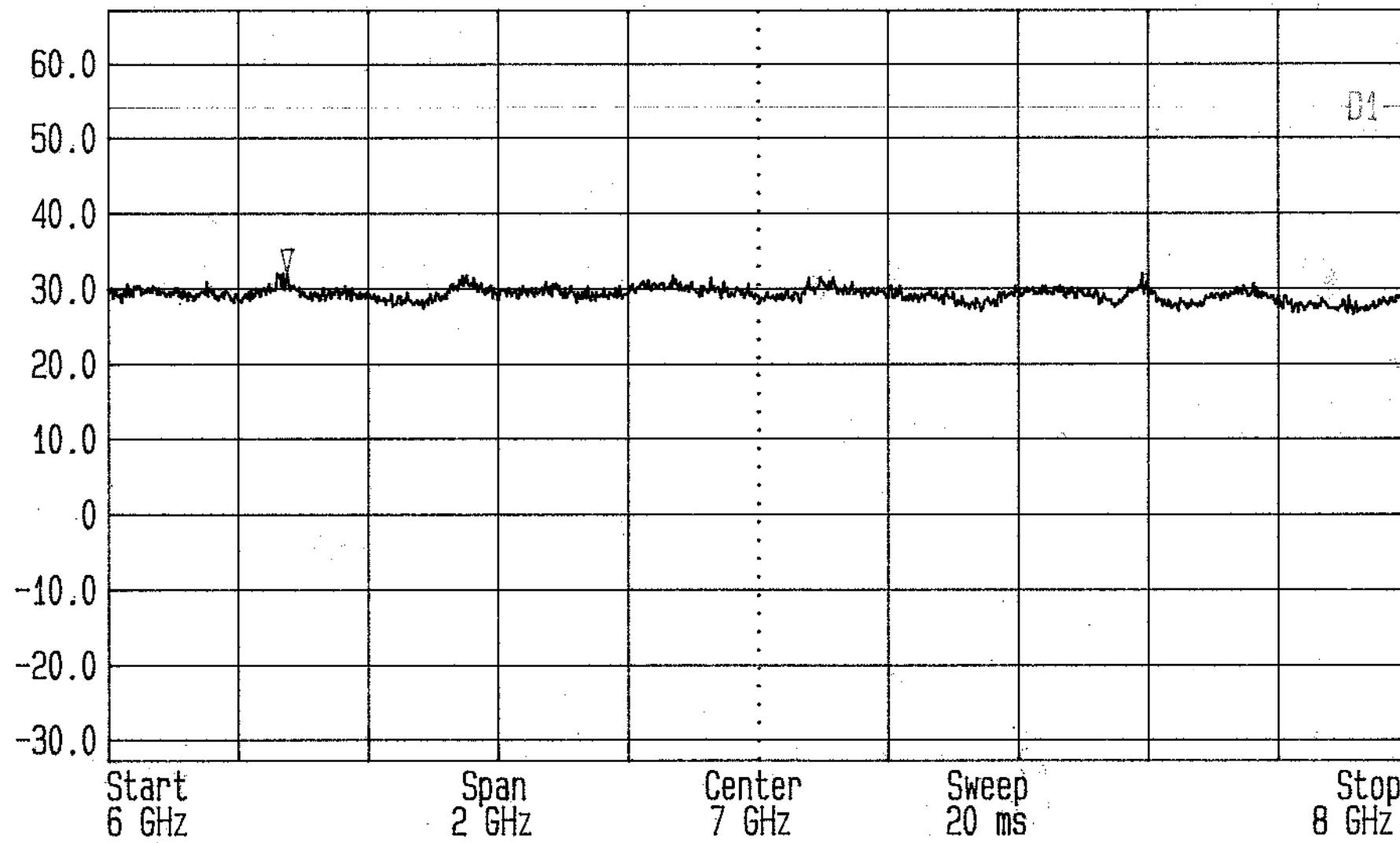
Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off RF.Att 5 dB
CF.Stp 200.000 MHz Unit [dB μ V/m]



Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control Deck

SPEC : FCC Part15.109
6PH/42535/02/RE009

Date 03.Oct.'01 Time 11:57:10
 Ref.Lvl Marker 32.41 dB* CF.Stp 1.0 MHz [3dB] Vid.Bw 1 MHz
 67.00 dB* 6.2755 GHz TG.Lvl off RF.Att 5 dB
 [dB μ V/m]

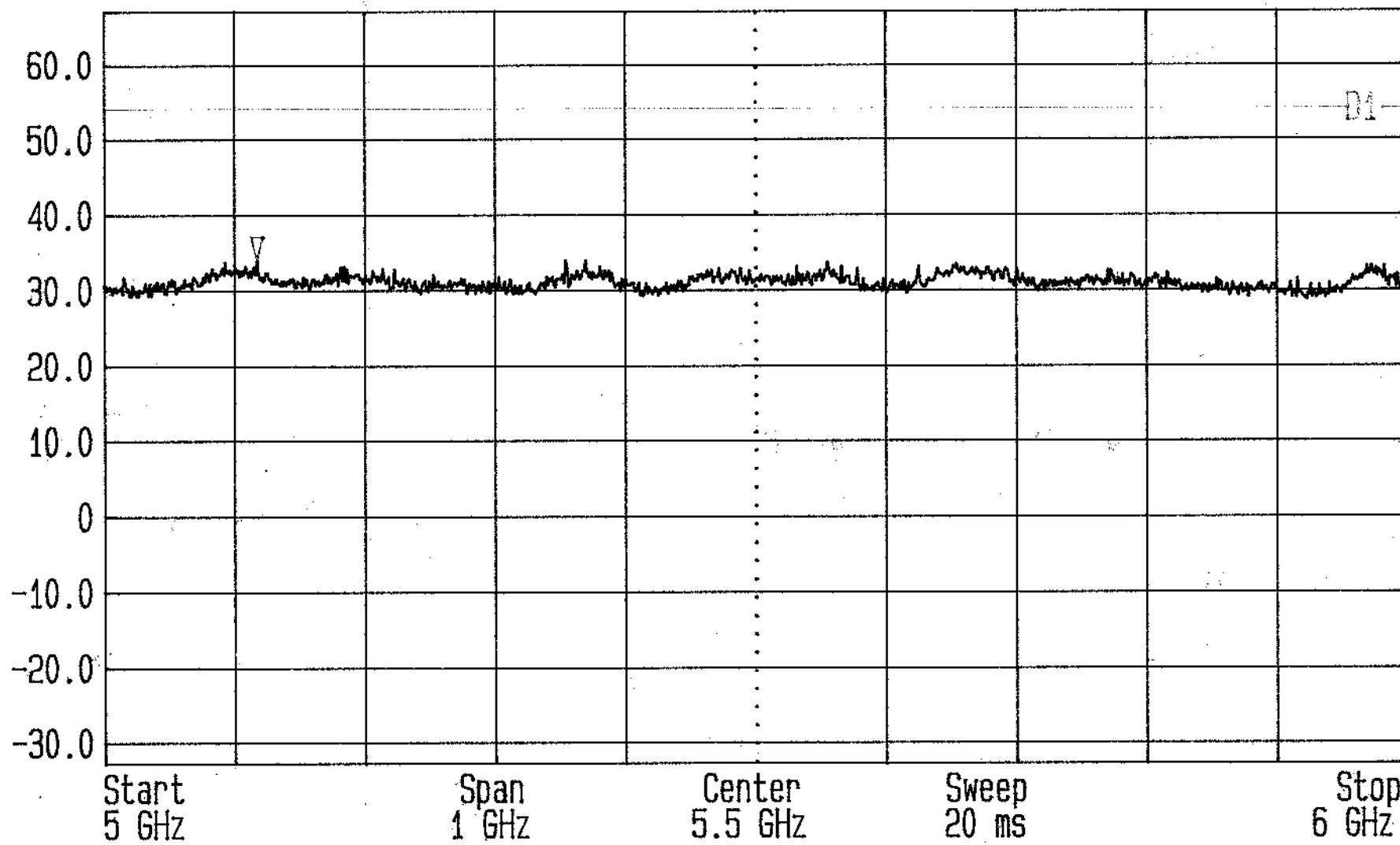


Radiated Emissions Testing For Quantel by RFI Ltd.
 EUT : Hand Control Dock

SPEC : FCC Part15.109
 GPH/42535/02/RE010

Date 03.Oct.'01 Time 12:03:45
 Ref.Lvl Marker 34.12 dB*
 67.00 dB* 5.1177 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
 TG.Lvl off
 CF.Stp 100.000 MHz RF.Att 5 dB
 [dB μ V/m]

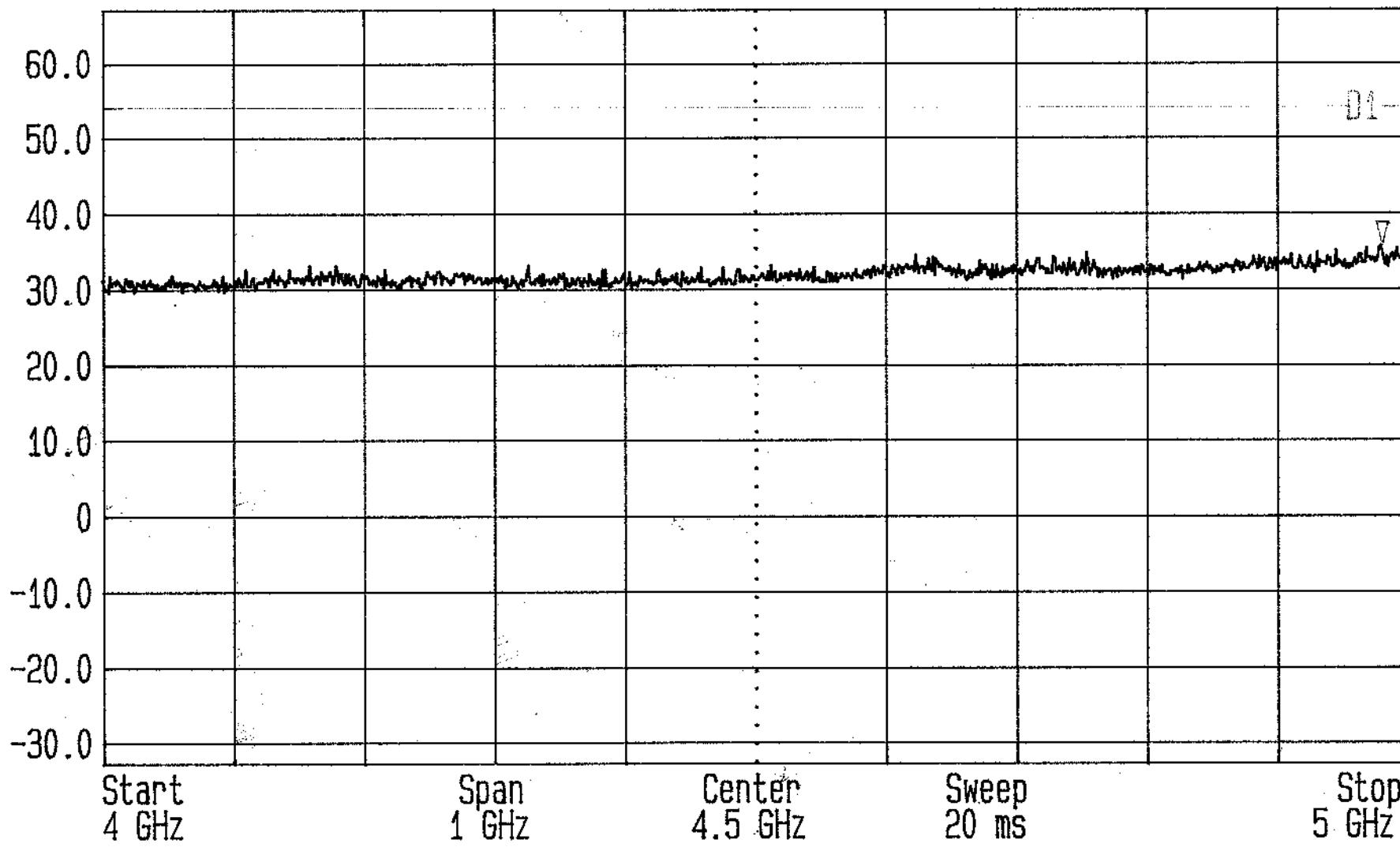


Radiated Emissions Testing For Quantel by RFI Ltd.
 EUT : Hand Control Dock

SPEC : FCC Part 15.109
 GPR/42535/02/RE011

Date 03.Oct.'01 Time 12:09:05
Ref.Lvl Marker 35.87 dB*
67.00 dB* 4.9800 GHz

Res.Bw 1.0 MHz [3dB] Vid.Bw 1 MHz
TG.Lvl off
CF.Stp 100.000 MHz RF.Att 5 dB
RF.Unt [dBμV/m]



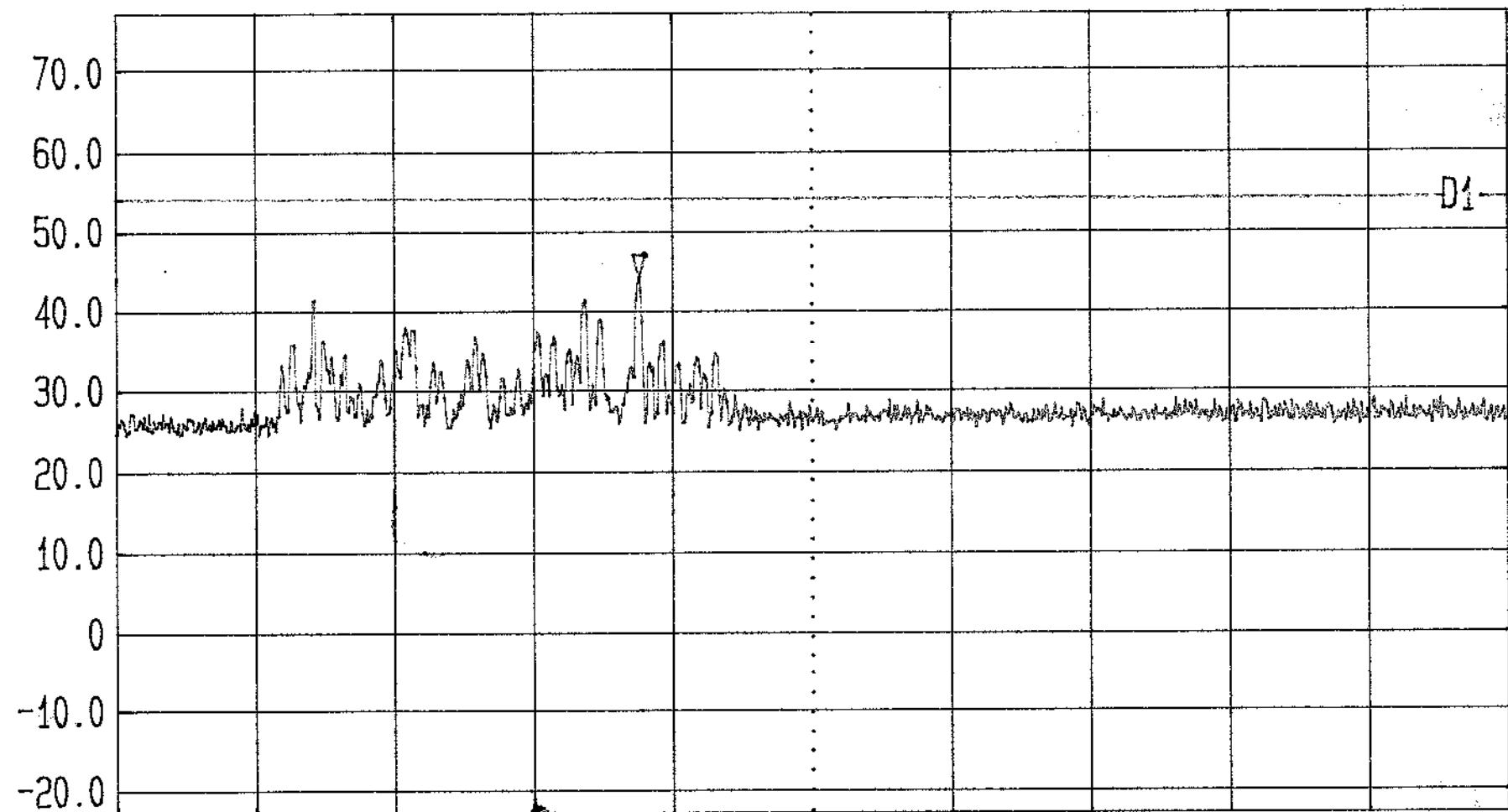
Radiated Emissions Testing For Quantel by RFI Ltd.
EUT : Hand Control Dock

SPEC : FCC Part15.109
6PH/42626/02/RE012



Date 03.Oct.'01 Time 17:03:32
Ref.Lvl Marker 43.71 dB*
77.00 dB* 955.04 MHz

Res.Bw 120 kHz [imp] Vid.Bw 3 MHz
TG.Lvl off RF.Att 10 dB
CF.Stp 7.200 MHz Unit [dB μ V/m]



Start
928 MHz

Span
72 MHz

Center
964 MHz

Sweep
40 ms

Stop
1 GHz

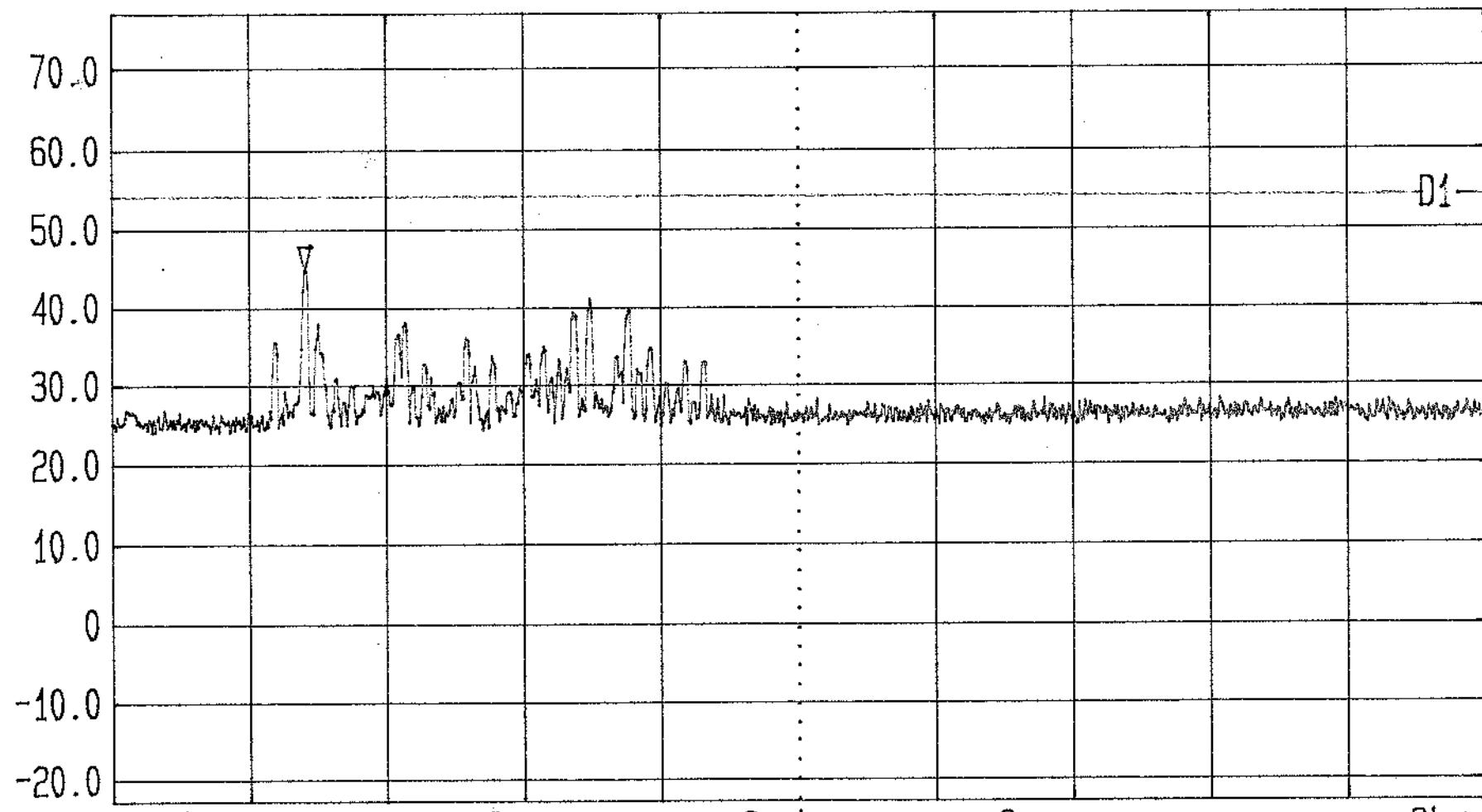
Radiated Emissions for Quantel by RFI Ltd.
EUT : Hand Control Transmit Mode

SPEC : FCC Part 15.209
GPH/42535/JD02/RE13



Date 04.Oct.'01 Time 10:15:56
Ref.Lvl Marker 44.73 dB*
77.00 dB* 938.08 MHz

Res.Bw 120 kHz [imp] Vid.Bw 100 kHz
TG.Lvl off RF.Att 10 dB
CF.Stp 7.200 MHz [dB μ V/m]
Unit



Start
928 MHz

Span
72 MHz

Center
964 MHz

Sweep
40 ms

Stop
1 GHz

Radiated Emissions testing for Quantel by RFI L td.
EUT : Hand Control Dock+ Hand Control

SPEC : FCC Part 15.109
GPH/42535/JD03/RE14

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

Graphical Test Results (continued)

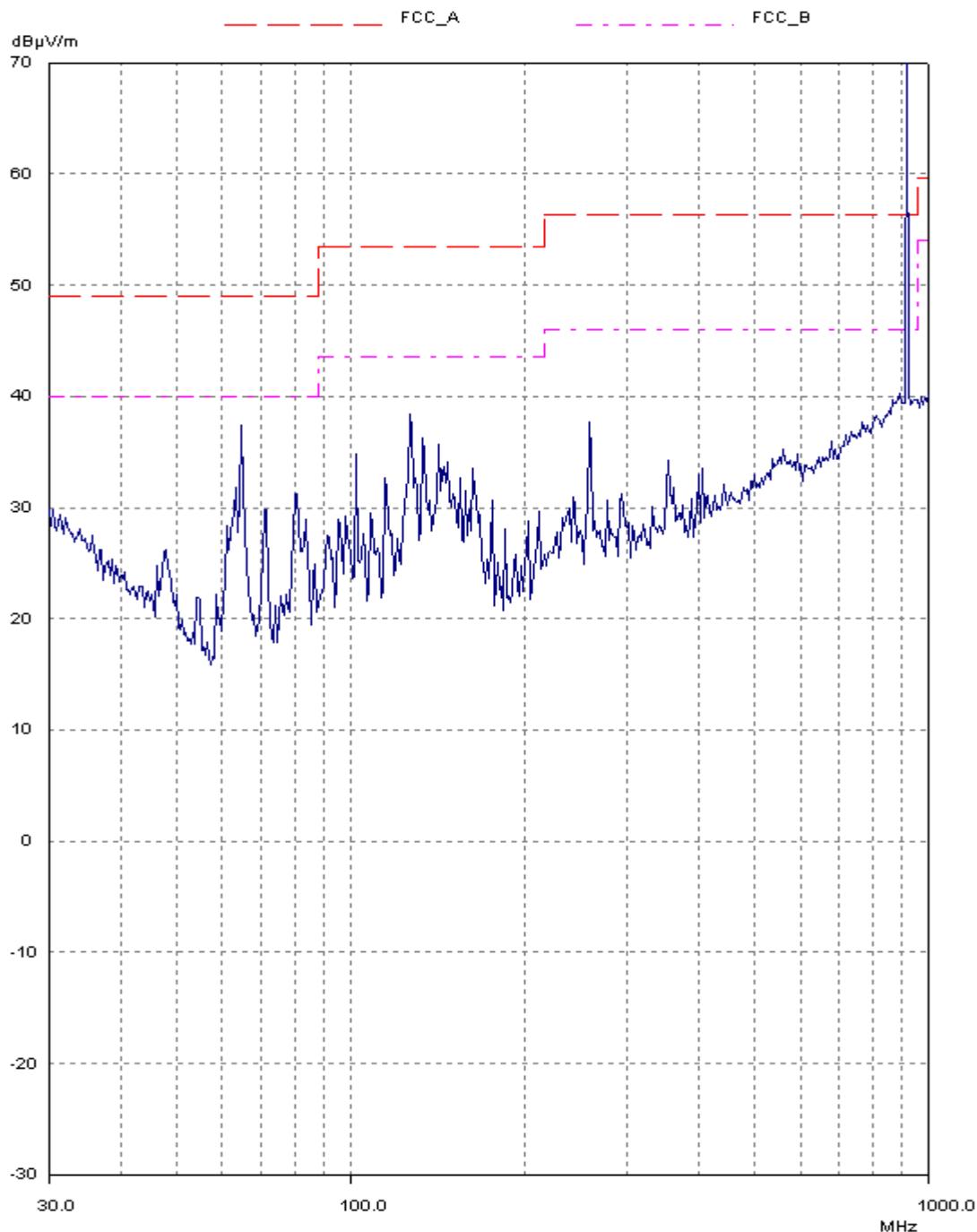
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| GPH\42535JD03\RE16 | Radiated Emissions (30 MHz to 1 GHz) EUT:- Hand Control and Hand Control Dock in Standby Mode. |
| GPH\42535JD03\RE17 | Radiated Emissions (1 GHz to 2 GHz) EUT: Hand Control and Hand Control Dock in Standby Mode. |
| GPH\42535JD03\RE18 | Radiated Emissions (1 GHz to 2 GHz) EUT: Hand Control in Transmit Mode. |
| GPH\42535JD03\RE19 | Radiated Emissions (2 GHz to 4 GHz) EUT: Hand Control in Transmit Mode. |
| GPH\42535JD03\RE20 | Radiated Emissions (2 GHz to 4 GHz) EUT: Hand Control and Hand Control Dock in Standby Mode. |

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

GPH\42535JD03\RE15

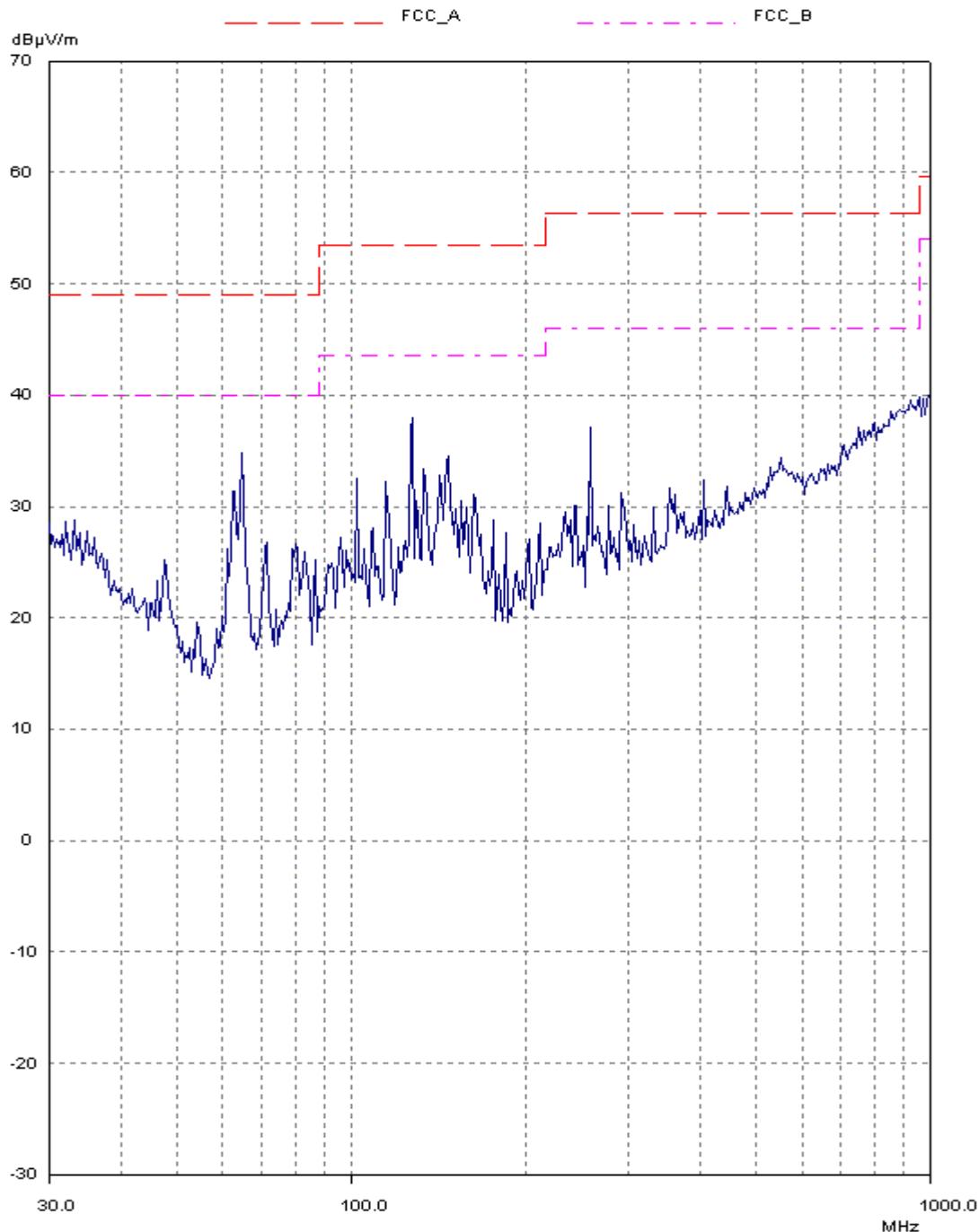


Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

GPH\42535JD03\RE16

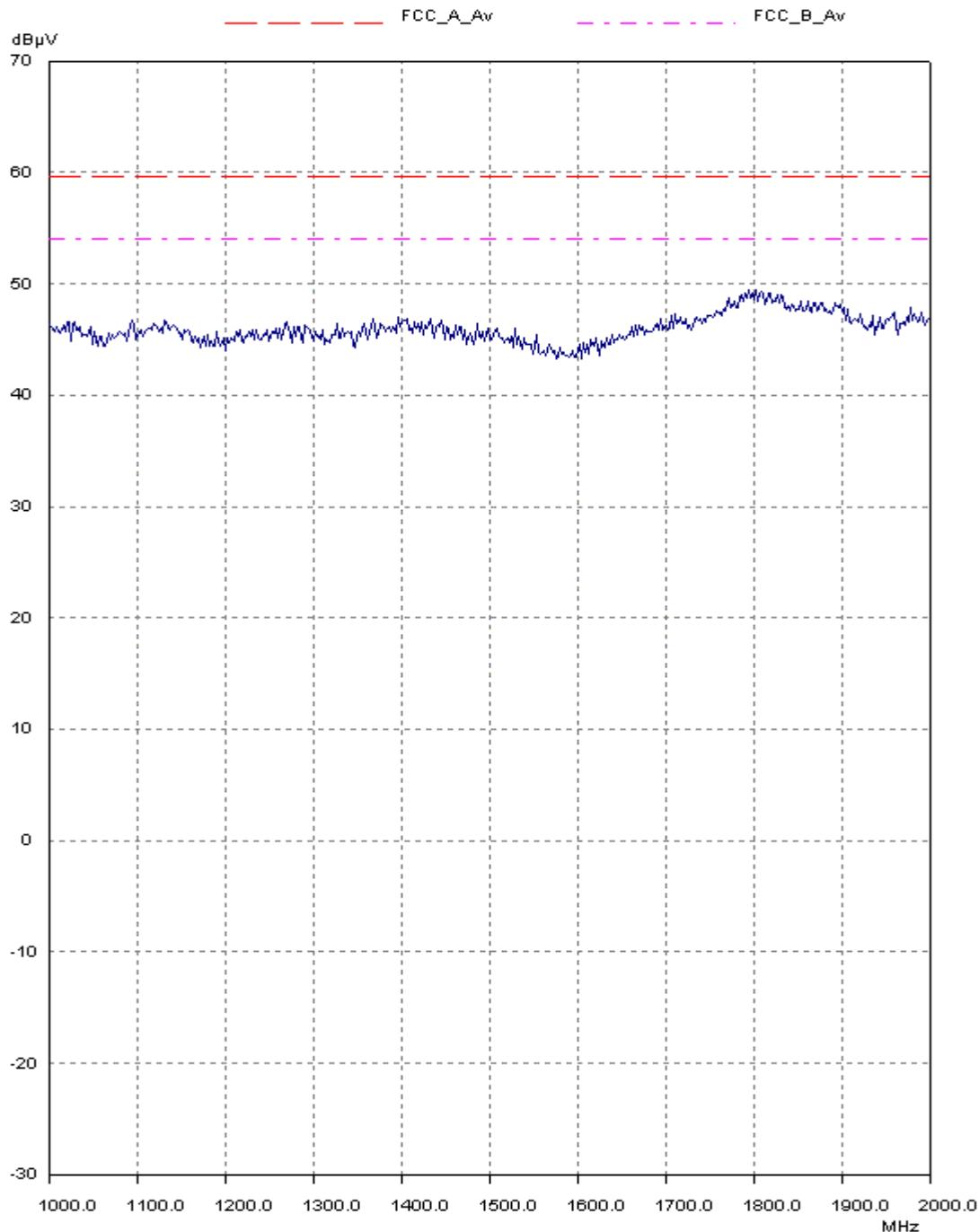


Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

GPH\42535JD03\RE17

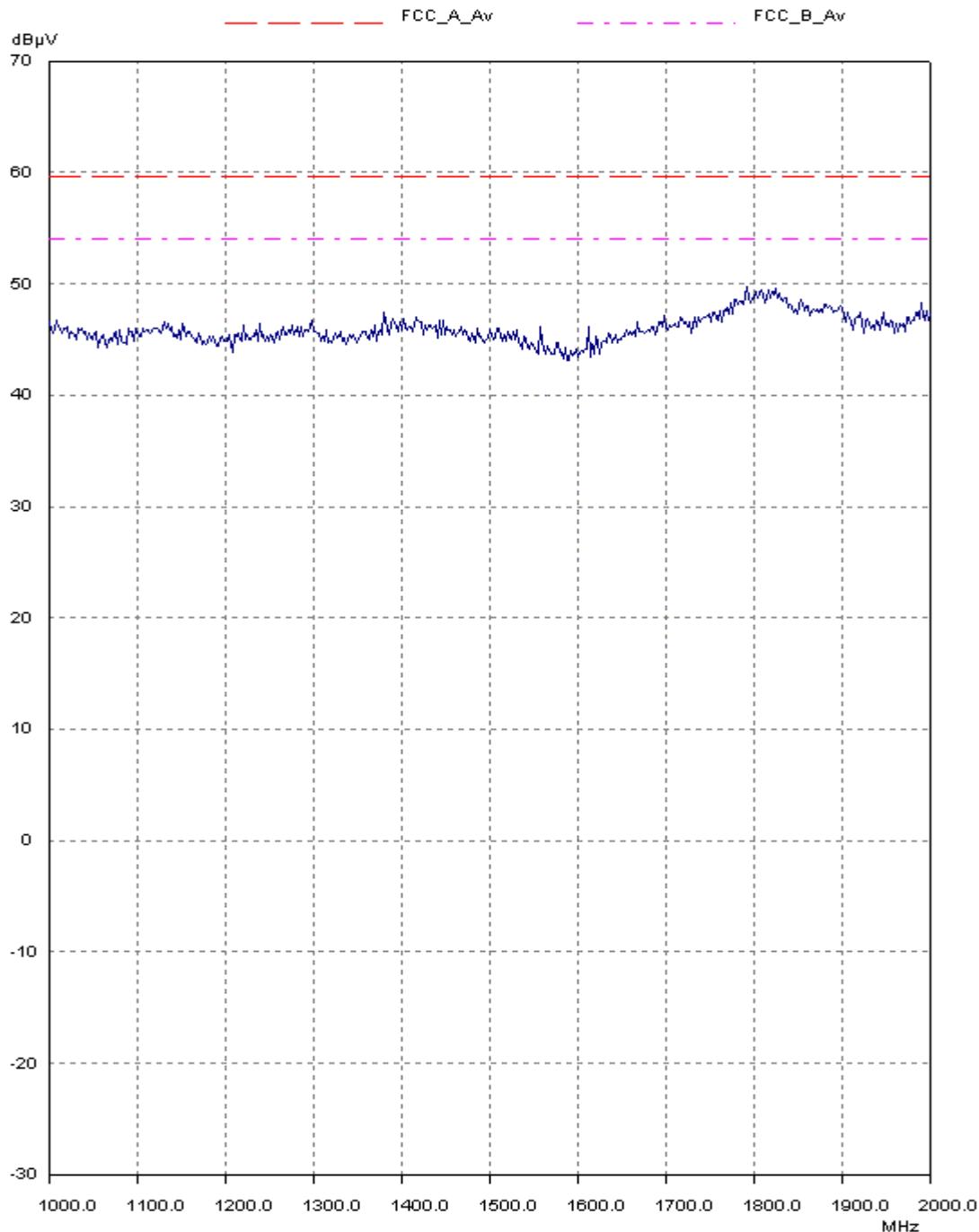


Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

GPH\42535JD03\RE18



RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

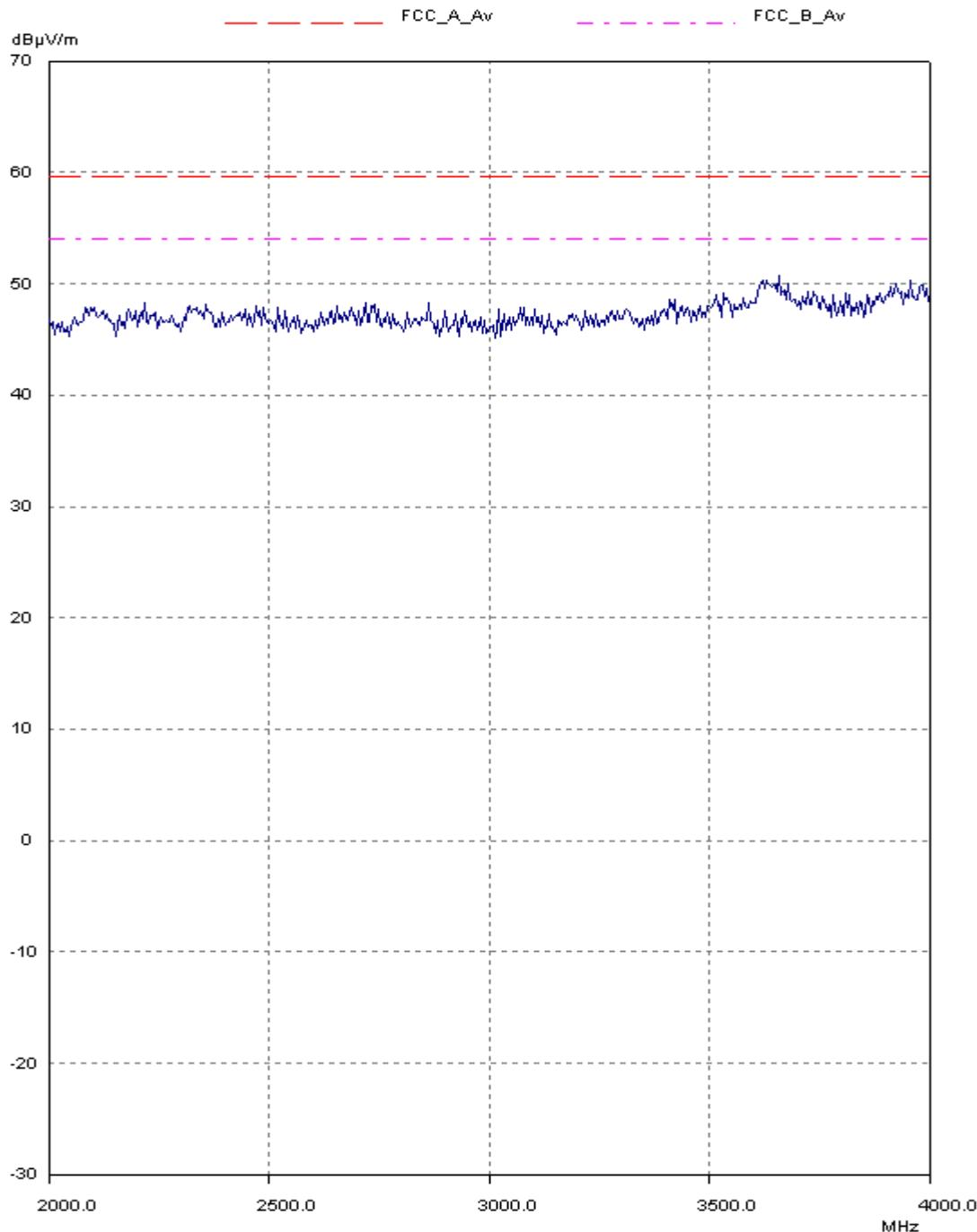
TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 36 of 37

Issue Date: 20 November 2001

GPH\42535JD03\RE19



RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Test Of: Quantel Ltd.

2116-22-018 Hand Control and 2116-29-018 Hand Control Dock

To: FCC Part 15: 2000 Class A Section 15.249 and 15.109

TEST REPORT

S.No: RFI/EMCB1/RP42535A

Page 37 of 37

Issue Date: 20 November 2001

GPH\42535JD03\RE20

