




TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Madge Networks Ltd.
Cardbus Mk2

To: FCC Part 15: 1997 Class B

Test Report Serial No:
RFI/EMCB1/RP38646A

This Test Report Is Issued Under The Authority Of Brian Watson Technical Director: 	Checked By: 
Tested By: 	Release Version No: PDF01
Issue Date: 6 May 1999	Test Date: 1 April 1999 to 5 April 1999

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RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

**Test Of: Madge Networks Ltd.
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To: FCC Part 15: 1997 Class B**

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Cardbus Mk2

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EMC Department

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1. Client Information

Company Name:	Madge Networks Ltd.
Address:	Wexham Springs Framework Road Wexham Slough SL3 6PJ Berks
Contact Name:	Mr Charlie Blackham.

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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	Madge Networks Ltd
Model Name or Number	Cardbus Mk2
Unique Type Identification	PCB-01
Serial Number	002152
Country Of Manufacture	UK
F.C.C. ID Number	Not applicable
Date Of Receipt	1 April 1999

2.2. Description Of EUT

The card (EUT) provides an interface between a personal computer and a token ring network.

2.3. Modifications Incorporated In EUT

None.

2.4. Additional Information Related To Testing

Power Supply Requirement:	Nominal 115 V, 60 Hz AC Mains Supply 13 Amp (max)
Intended Operating Environment:	Commercial, Light industry
Weight:	100 to 200 g
Dimensions:	PCB 130mm x 80 mm
Interface Ports:	One 15-way connector supports a category 5 lode able fitted with an RJ45 plug. The EUT is internal to the Support Computer and is fitted into the cardbus slot.
Cycle Time:	Less than 1 sec.

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2.5. Support Equipment

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

Description	PC
Brand Name	Compaq
Model Name or Number	Armada 7400
Serial Number	890BXL30312
F.C.C. ID Number	Tested to comply with FCC Standards - for home or office use
Cable Length And Type	Direct Internal Connection
Connected to Port	Cardbus slot

Description	Laptop Transformer
Brand Name	Compaq
Model Name or Number	2912
Serial Number	00002210
F.C.C. ID Number	None stated by client
Cable Length And Type	2 m DC
Connected to Port	DC Power In on Laptop

Description	Printer
Brand Name	Hewlett Packard
Model Name or Number	C2164A
Serial Number	ES573120MV
F.C.C. ID Number	B94C2164X
Cable Length And Type	Parallel to Centronics 1.5 m
Connected to Port	Parallel Port on PC

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Support Equipment Continued

Description	Token Ring Hub
Brand Name	Madge Networks Ltd
Model Name or Number	SmartLAM UTP
Serial Number	F9A53D
F.C.C. ID Number	Verified
Cable Length And Type	6 m UTP cable
Connected to Port	RJ45 Socket on EUT

Description	Mouse
Brand Name	Logitech
Model Name or Number	ML38
Serial Number	L150716317
F.C.C. ID Number	DZLM04
Cable Length And Type	EUT internal to PC
Connected to Port	Serial Port

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3. Test Specification, Methods & Procedures

3.1. Test Specification

Reference:	FCC Part 15: 1997 Class B
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

3.2.1. 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 (1987)

Title: Specification for Radio Interference measuring apparatus and measurement methods.

3.2.2. At the client's request, measurements were performed to clauses 15.107 (e) and 15.109 (g) of 47CFR Part 15:1997, Subpart B. Therefore the test limits applied were as detailed in section 5.1 and section 6 of EN 55022: 1994, using Measuring Equipment Specified in CISPR 16-1: 1993 (Title: Specification for Radio Interference Measuring Apparatus and Measurement Methods), but the methods and procedures applied were as listed in section 3.2.1 above.

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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.

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4. Deviations From The Test Specification

None.

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5. Operation Of The EUT During Testing

5.1. Operating Conditions

The EUT was tested in a normal laboratory environment.

During testing, the EUT was powered by nominal 115 V, 60 Hz, AC mains supply 13 Amp (max)

5.2. Operating Modes

The EUT was tested in the following operating mode: Continuous 16 MBit/s transmission rate.

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: The EUT is sending and receiving to and from the Hub Switch. The printer, monitor, hard and floppy disk drives are all exercised.

The reason for choosing this configuration was that it was defined by the client as being typical of normal use and likely to be a worst case with regard to 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.

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6. Summary Of Test Results

6.1. Summary Of Tests

Test Name	Specification Reference (Clause Number)	Port Type	Compliance Status
AC Powerline Conducted Emissions	Section 15 of C.F.R. 47: 1997	AC Mains Input	Complied
Electric Field Strength Emissions	Section 15 of C.F.R. 47: 1997	Enclosure	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.

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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. At the client's request, measurements were performed to clauses 15.107 (e) and 15.109 (g) of 47CFR Part 15:1997, Subpart B. Therefore the test limits applied were as detailed in section 5.1 and section 6 of EN 55022: 1994, using Measuring Equipment Specified in CISPR 16-1: 1993 (Title: Specification for Radio Interference Measuring Apparatus and Measurement Methods).

7.1.3. The measurement uncertainties stated were calculated in accordance with the requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Section 8 for details of measurement uncertainties.

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7.2. Test Results For AC Mains Conducted Emissions

7.2.1. Quasi-Peak Detector Measurements On Live And Neutral Lines

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

7.2.1.2. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector:

Frequency (MHz)	Line	Q-P Level (dBmV)	Q-P Limit (dBmV)	Margin (dB)	Result
0.177	Neutral	60.3	64.6	4.3	Complied
0.179	Live	62.9	64.5	1.6	Complied
0.206	Neutral	45.3	63.3	18.0	Complied
0.223	Live	45.3	62.7	17.4	Complied
0.266	Live	51.8	61.2	9.4	Complied
0.266	Neutral	49.7	61.2	11.5	Complied
0.354	Neutral	42.9	58.8	15.9	Complied
0.355	Live	44.2	58.8	14.6	Complied
0.398	Neutral	42.7	57.8	15.1	Complied
0.443	Neutral	44.2	57.0	12.8	Complied
0.453	Live	50.4	56.8	6.4	Complied
0.532	Live	39.4	56.0	16.6	Complied
0.619	Neutral	44.4	56.0	11.6	Complied
16.000	Live	50.0	60.0	10.0	Complied
16.000	Neutral	52.0	60.0	8.0	Complied

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7.2.2. Average Detector Measurements On Live And Neutral Lines

7.2.2.1. Following the initial scans and Quasi-Peak measurements, further measurements were made at the relevant frequencies using an average detector. The measured levels were as follows:

Frequency (MHz)	Line	Av. Level (dBmV)	Av. Limit (dBmV)	Margin (dB)	Result
0.177	Neutral	49.6	54.6	5.0	Complied
0.179	Live	51.1	54.5	3.4	Complied
0.206	Neutral	19.3	53.3	34.0	Complied
0.223	Live	26.6	52.7	26.1	Complied
0.266	Live	43.9	51.2	7.3	Complied
0.266	Neutral	41.3	51.2	9.9	Complied
0.354	Neutral	36.4	48.8	12.4	Complied
0.355	Live	44.3	48.8	4.5	Complied
0.398	Neutral	25.6	47.8	22.2	Complied
0.443	Neutral	38.2	47.0	8.8	Complied
0.453	Live	43.6	46.8	3.2	Complied
0.532	Live	36.2	46.0	9.8	Complied
0.619	Neutral	36.5	46.0	9.5	Complied
16.000	Live	35.0	50.0	15.0	Complied
16.000	Neutral	37.8	50.0	12.2	Complied

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7.3. Test Results For Radiated Emissions

7.3.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

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

7.3.1.2. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector at a test distance of 10m:

Frequency (MHz)	Ant. Pol.	Q-P Level (dBmV/m)	Limit (dBmV/m)	Margin (dB)	Result
46.012	Vert.	26.2	30.0	3.8	Complied
66.517	Vert.	22.4	30.0	7.6	Complied
130.057	Vert.	26.6	30.0	3.4	Complied
195.089	Vert.	28.0	30.0	2.0	Complied
199.404	Vert.	20.6	30.0	9.4	Complied
232.805	Vert.	26.6	37.0	10.4	Complied
260.117	Horiz.	28.6	37.0	8.4	Complied
325.147	Vert.	30.2	37.0	6.8	Complied
357.663	Vert.	25.7	37.0	11.3	Complied
390.176	Vert.	32.0	37.0	5.0	Complied
910.410	Vert.	36.7	37.0	0.2	Complied

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8. Measurement Uncertainty

8.1. Company Policy, as based on the UKAS Accreditation Standard, M10, paragraph 12.11 (o), states that Test Reports shall include estimated uncertainty of the calibration or test result (this information need only appear in test reports and test certificates where it is relevant to the validity or application of the test result, where a client's instructions so require or where uncertainty affects compliance to a specification or limit).

8.2. The global uncertainties have been calculated in accordance with UKAS NIS 81 (Edition 1, May 1994) as follows:

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Conducted Emissions	0.15 MHz to 30 MHz	95%	+/- 2.2 dB
Radiated Emissions	30 MHz to 1000 MHz @ 10 m	95%	+/- 4.1 dB

8.3. Measurement uncertainties have been applied in accordance with UKAS document NIS 81 (edition 1, May 1994), and in the absence of any specification criteria, guidance, or code of practice, compliance has been judged on the basis of shared risk.

8.4. In the case of emissions tests, the measured value of the disturbance from the product sample shall be compared directly with the limits. If the measured value is equal to or less than the limit the product is deemed to pass the test.

8.5. In the case of immunity tests, the equipment is deemed to pass the test if it fulfils the stated performance criteria at the required or a higher severity level. The measurement uncertainty has been taken into account in the calibration procedures stated in the relevant basic standard.

8.6. The methods used to calculate the above uncertainties are in line with those used for calibration laboratories contained in UKAS document NIS 3003 Edition 8 "The Expression of Uncertainty and Confidence in Measurement" May 1995, which align with international recommendations "Guide to the Expression of Uncertainty in Measurement" ISO/IEC/OIML/BIPM (Prepared by ISO/TAG 4: January 1993).

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Appendix 1. Test Equipment Used

Instrument	Manufacturer	Model Number	RFI No.
Bilog Antenna	Chase	CBL6111	A259
Bilog Antenna	Chase	CBL6111	A490
Narda 771-03 Attenuator	Narda	771-03	A262
OATS Positioning Controller	Rohde & Schwarz	HCC	A276
OATS Antenna Mast	Rohde & Schwarz	HCM	A277
Cable	Rosenberger	UFA 210A-1-3937-50x50	C327
Cable	Andrews	None	C341
Cable	Andrews	None	C342
Cable	Rosenberger	UFA210A-1-1182-704704	C459
Spectrum Monitor	Rohde & Schwarz	EZM	M003
ESVP Receiver	Rohde & Schwarz	ESVP	M023
Temperature/Humidity Meter	RS Components	212-124	M117
Turntable Controller	R.H.Electrical Services	RH351	M173
OATS Turntable	British Turntable Ltd	S36069	M174
Site 1	RFI	1	S201
ESH3-Z5 Single Phase LISN	Rohde & Schwarz	ESH3-Z5	A191
ESH3-Z2 Pulse Limiter	Rohde & Schwarz	ESH-Z2	A286
BNC Cable	Rosenberger	RG142	C364
Cable	Rosenberger	RG142XX-002-RFIB	C456
Receiver / Spectrum Analyser System	Rohde & Schwarz	ESBI	M090
Site 9	RFI	9	S209

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

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Appendix 2. Measurement Methods

A2.1. AC Mains Conducted Emissions

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

A2.1.2. The test was performed in a shielded enclosure with the equipment arranged as detailed in the standard on a wooden bench using the floor of the screened enclosure as the ground reference plane.

A2.1.3. Initial measurements in the form of swept scans covering the entire measurement band were performed in order to identify frequencies on which the EUT was generating interference. In order to minimise the time taken for these swept measurements, a Peak detector was used in conjunction with the appropriate detector IF measuring bandwidths (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

A2.1.4. During the swept measurements (and also during subsequent final measurements on single frequencies) 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.

A2.1.5. Following the initial scans, a graph was 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 (at individual frequencies) using the appropriate detector function.

A2.1.6. The test equipment settings for conducted emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements
Detector Type:	Peak	Quasi-Peak (CISPR)/Average
Mode:	Max Hold	Not applicable
Bandwidth:	10 kHz*	9 kHz*
Amplitude Range:	60 dB	20 dB
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

* Where measurements were made below 150 kHz a 200 Hz bandwidth was used.

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A2.2. Radiated Emissions

A2.2.1. Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for a Quasi-Peak detector.

A2.2.2. 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.

A2.2.3. 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 receiver with a Quasi-Peak detector.

A2.2.4. 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.

A2.2.5. All measurements on the open area test site were performed using broadband antennas at a test distance of 10m.

A2.2.6. 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.

A2.2.7. The test equipment settings for radiated emissions measurements were as follows:

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

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Appendix 3. Test Configuration Drawings

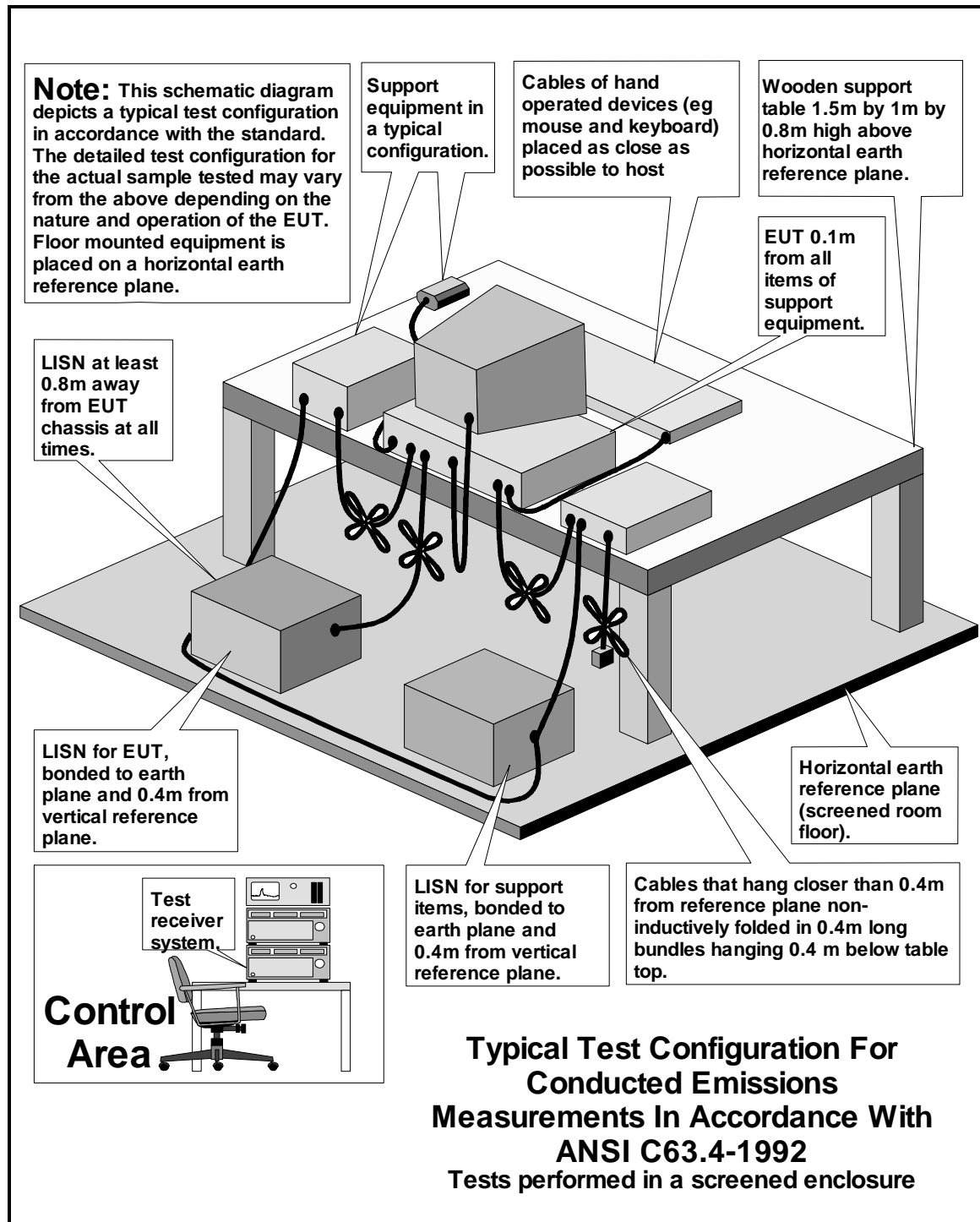
This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\38646ETF01\EMICON	Test configuration for measurement of conducted emissions
DRG\38646ETF01\EMIRAD	Test configuration for measurement of radiated emissions
DRG\38646ETF01\001	Schematic Diagram of the EUT, support equipment and interconnecting cables used for the test

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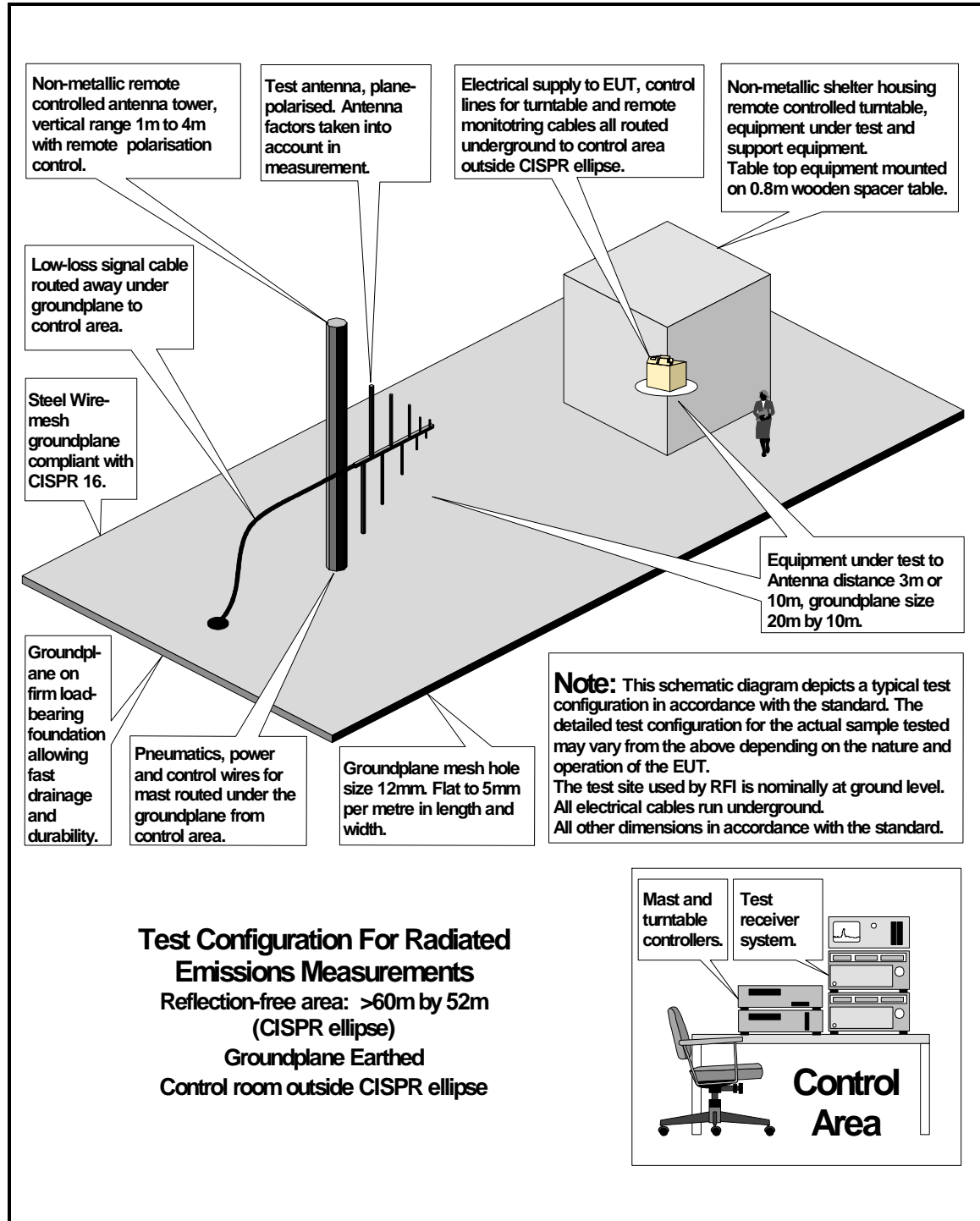
DRG\38646ETF01\EMICON



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DRG\38646ETF01\EMIRAD

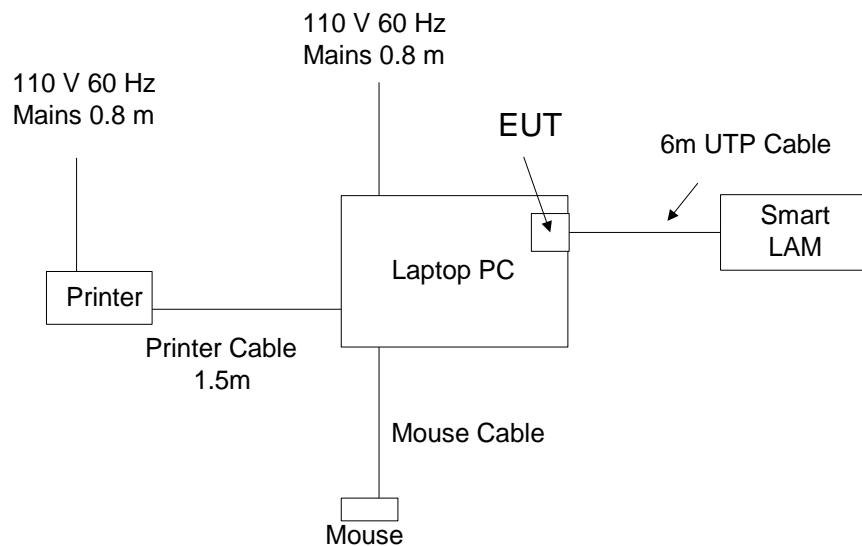


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DRG\38646ETF01\001

Configuration of EUT and Support Equipment



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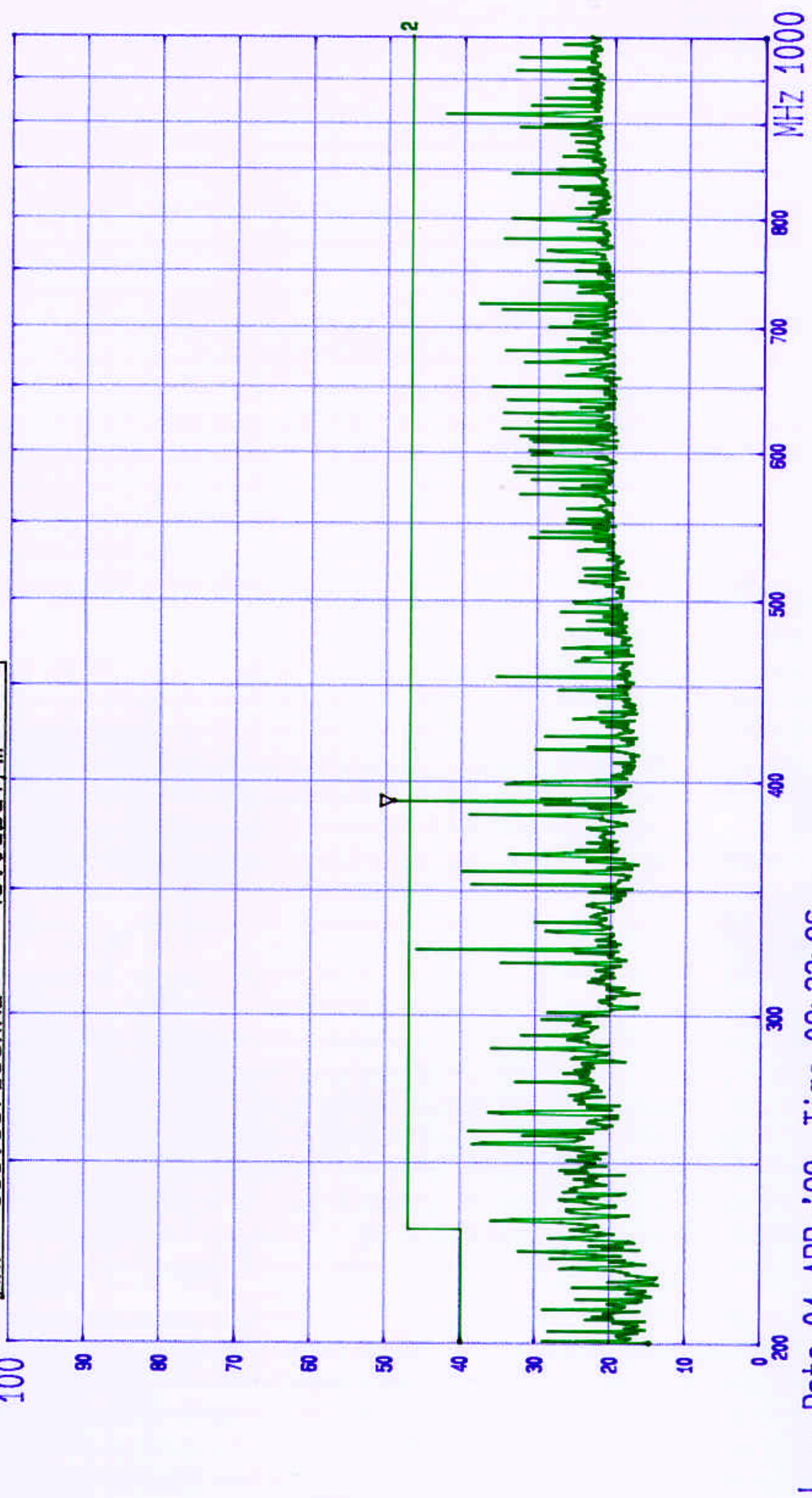
Appendix 4. Graphical Test Results

This appendix contains the following graphs:

Graph Reference Number	Title
GPH\38646JD01\004	Scan of radiated electric field: both polarisations (30 to 200 MHz)
GPH\38646JD01\005	Scan of radiated electric field: non-polarised (200 to 1000 MHz)
GPH\38646JD01\007	Scan of conducted emissions 0.150 to 30 MHz: Live Line
GPH\38646JD01\008	Scan of conducted emissions 0.150 to 30 MHz: Neutral Line

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Mkr 389.687168kHz 49.0dBuV/m

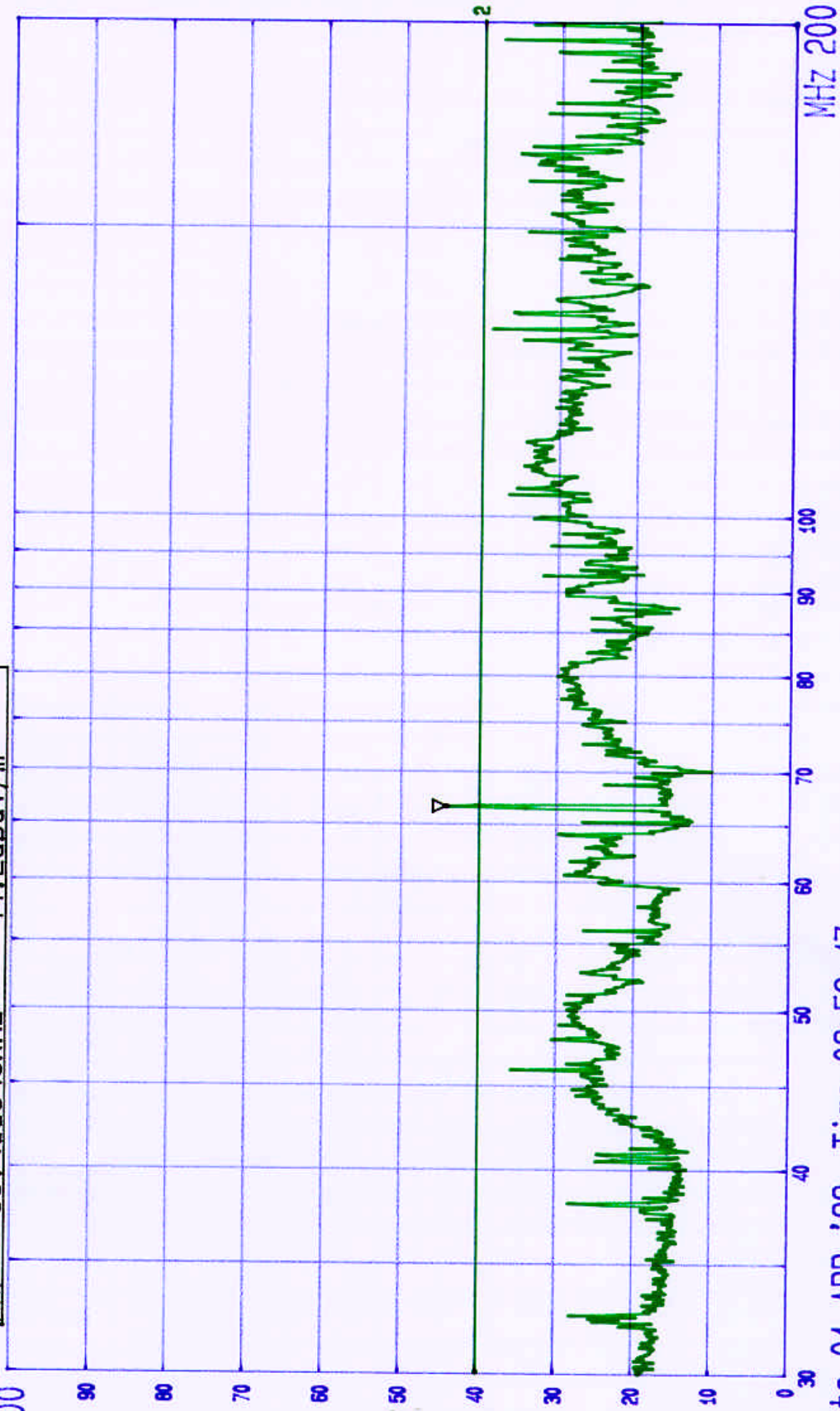


---- Date 01.APR.'99 Time 09:33:26
Radiated, Tested by RFI for Madge Networks
Class B limit QP EUT: Cardbus MK2

EN55022: 1998
GPH/38646/JD01/004

Mkr 66.411546KHz 44.2dBuV/m

dBuV/m
100



---- Date 01.APR.'99 Time 09:52:47
Radiated. Tested by RFI for Madge Networks
Class B limit GP EUT: Cardbus Mk2

EN55022: 1998
GPH/38646/JD01/005

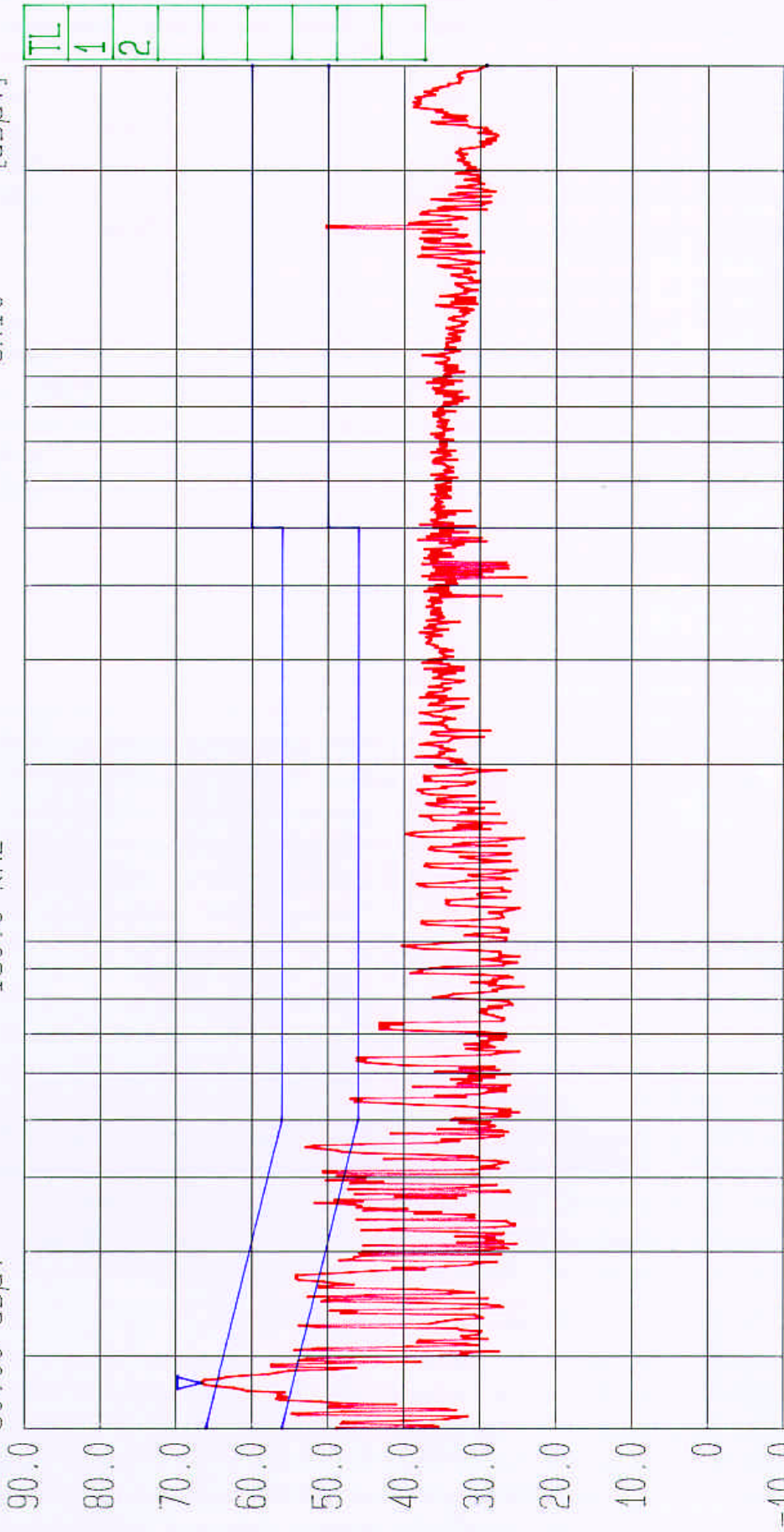


Date 05.May.'99 Time 16:07:28

Ref.Lvl 90.00 dBµV
Marker 66.49 dBµV
180.0 kHz

Res.Bw 9 kHz [imp]
TG.Lvl off
CF.Stp 2.985 MHz

Vid.Bw 10 kHz
RF.Att 20 dB
Unit [dBµV]



Start 150 kHz
Span 29.85 MHz
Center 2.12132 MHz
Sweep 60 ms
Stop 30 MHz

Conducted. Tested by RFI for Madge Networks. EUT: Cardbus Mk2.
Class B Limit.

EN55022: 98/CISPR22
GPH/38646/JD01/007



Date 05.May.'99 Time 16:19:54

Ref.Lvl 90.00 dBuV

Marker

61.61 dBuV

177.9 KHz

Res.Bw

TG.Lvl

CF.Stp

9 KHz [imp]

off

2.985 MHz

Vid.Bw

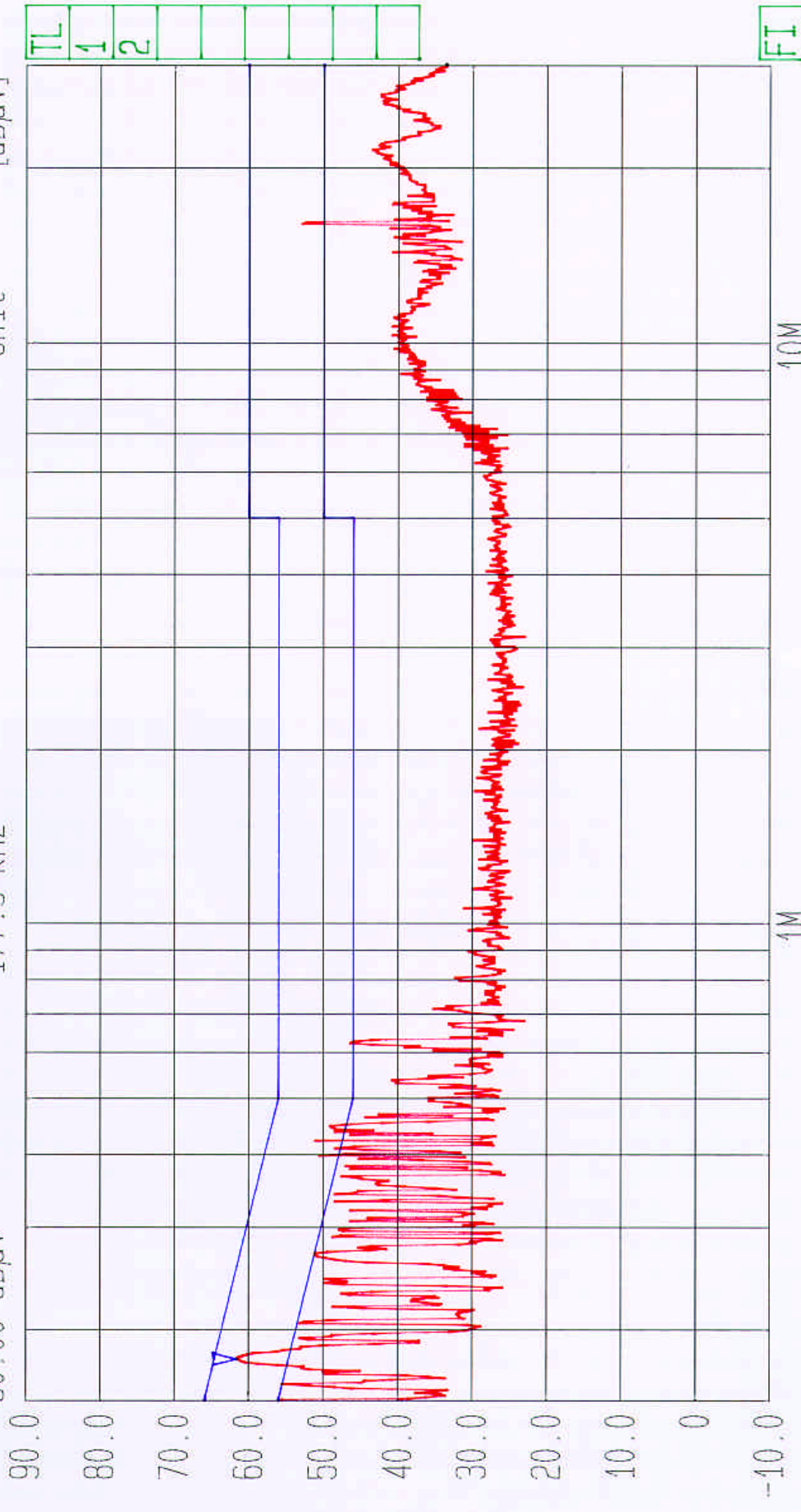
RF.Att

Unit

10 KHz

20 dB

[dBuV]



Start

150 KHz

Span

29.85 MHz

Center

2.12132 MHz

Sweep

340 ms

Stop

30 MHz

Conducted. Tested by RFI for Madge Networks. EUT: Carabus Mk2. Class B Limit. Neutral Line.

EN55022: 98/CISPR22
GPH/38646/JD01/008

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Appendix 5. Photographs of EUT

This appendix contains the following photographs:

Photo Reference Number	Title
PHT\38646\001	Side view of conducted emissions.
PHT\38646\002	Front view of conducted emissions.
PHT\38646\003	Rear view of radiated emissions.
PHT\38646\004	Front view of radiated emissions.

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PHT\38646\001 Side view of conducted emissions.



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Cardbus Mk2
To: FCC Part 15: 1997 Class B

PHT\38646\002 Front view of conducted emissions.



EMC Department

Test Of: Madge Networks Ltd.
Cardbus Mk2
To: FCC Part 15: 1997 Class B

PHT\38646\003 ear view of radiated emissions.



EMC Department

Test Of: Madge Networks Ltd.
Cardbus Mk2
To: FCC Part 15: 1997 Class B

PHT\38646\004 Front view of radiated emissions.

