TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test Of: Madge Networks Ltd.
PCI-HS Interface Card

To: FCC Part 15: 1998 Class B

Test Report Serial No:
RFI/EMCB1/RP39307ETF01A

This Test Report Is Issued Under The Authority Of Brian Watson Technical Director: 	**Checked By:** 
Tested By: 	**Release Version No: PDF01**
Issue Date: 05 August 1999	**Test Date: 27 July 1999 to 28 July 1999**

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1. Client Information

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

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	PCI-HS
Unique Type Identification	151-324-06
Serial Number	BAD999
Country Of Manufacture	UK
F.C.C. ID Number	Not applicable
Date Of Receipt	27 July 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:	130 x 80 mm
Interface Ports:	Two Token Ring ports: one subminiture-D and one RJ45, either of which may be used at any one time. The subminiture-D supports IBM STP cable. The RJ45 supports either category 3 to 5 STP or category 3 to 5 UTP. The EUT is internal to the Support Computer and is connected to the PCI bus expansion slot.
Cycle Time:	Less than 1 sec.

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	CPW 5100 6300 1P 64/4G/2D
Serial Number	8834BR030101
F.C.C. ID Number	Test to comply with FCC standards - for home or office use
Cable Length And Type	EUT internal to PC
Connected to Port	PCI bus slot

Description	SVGA MONITOR
Brand Name	Hewlett Packard
Model Name or Number	D2817A
Serial Number	JP55006381
F.C.C. ID Number	ACJ93312120
Cable Length And Type	SVGA cable 2m
Connected to Port	SVGA port on support PC

Description	Keyboard
Brand Name	Compaq
Model Name or Number	296433-031
Serial Number	B0A260B39G275
F.C.C. ID Number	AQ6-22K15
Cable Length And Type	Integral 1.5m
Connected to Port	Keyboard mini DIN on support PC

Support Equipment (continued)

Description	Mouse
Brand Name	Compaq
Model Name or Number	M-S38
Serial Number	F06C10DSBGD4XG
F.C.C. ID Number	DZL211107
Cable Length And Type	Integral 2m
Connected to Port	Mouse mini DIN on support PC

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 1.5m
Connected to Port	Parallel port to PC

Description	Token Ring Switch
Brand Name	Madge Networks Ltd
Model Name or Number	Ringswitch Express
Serial Number	RSE002
F.C.C. ID Number	Verified
Cable Length And Type	6m UTP cable or 6m CAT5 STP cable
Connected to Port	RJ45 socket on EUT

Description	Laptop Computer
Brand Name	Compaq
Model Name or Number	Armada 7400
Serial Number	7903CHS20078
F.C.C. ID Number	Tested to comply with FCC standards - for home or office use
Cable Length And Type	EUT internal to PC
Connected to Port	Cardbus slot

Support Equipment (continued)

Description	Token Ring Adapter Card
Brand Name	Madge Networks Ltd
Model Name or Number	Cardbus MK2
Serial Number	002159
F.C.C. ID Number	Verified
Cable Length And Type	2m UTP cable, connected to Ringswitch
Connected to Port	Port 1:8 of Ringswitch Express

3. Test Specification, Methods & Procedures

3.1. Test Specification

Reference:	FCC Part 15: 1998 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

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.

4. Deviations From The Test Specification

At the request of the client the following deviations were incorporated into the test procedure:

Testing was performed against the limits specified in EN 55022:1998, Class B.

At the clients request, the Remote support equipment was powered by a nominal 230 V, 50 Hz AC Mains Supply 13 Amp (max)

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 data passing at 100 Mbit/s.

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 data to and from the support Laptop, via the switch. The printer, monitor, hard and floppy disk drives were 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.

6. Summary Of Test Results

6.1. Summary Of Tests

Test Name	Specification Reference (Clause Number)	Port Type	Compliancy Status
AC Powerline Conducted Emissions	EN 55022 1998, Clause 5, Table 2	AC Mains	Complied
Electric Field Strength Emissions	EN 55022: 1998, Clause 6, Table 6	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.

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. 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.

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 Section 7.4.

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 (dBµV)	Q-P Limit (dBµV)	Margin (dB)	Result
0.168	Neutral	54.0	65.1	11.1	Complied
0.198	Neutral	45.2	63.7	18.5	Complied
0.252	Neutral	43.1	61.7	18.5	Complied
0.297	Neutral	40.5	60.3	19.8	Complied
5.526	Live	38.6	60.0	21.4	Complied
15.977	Neutral	37.2	60.0	22.8	Complied

7.3. Test Results For AC Mains Conducted Emissions

7.3.1. Average Detector Measurements On Live And Neutral Lines

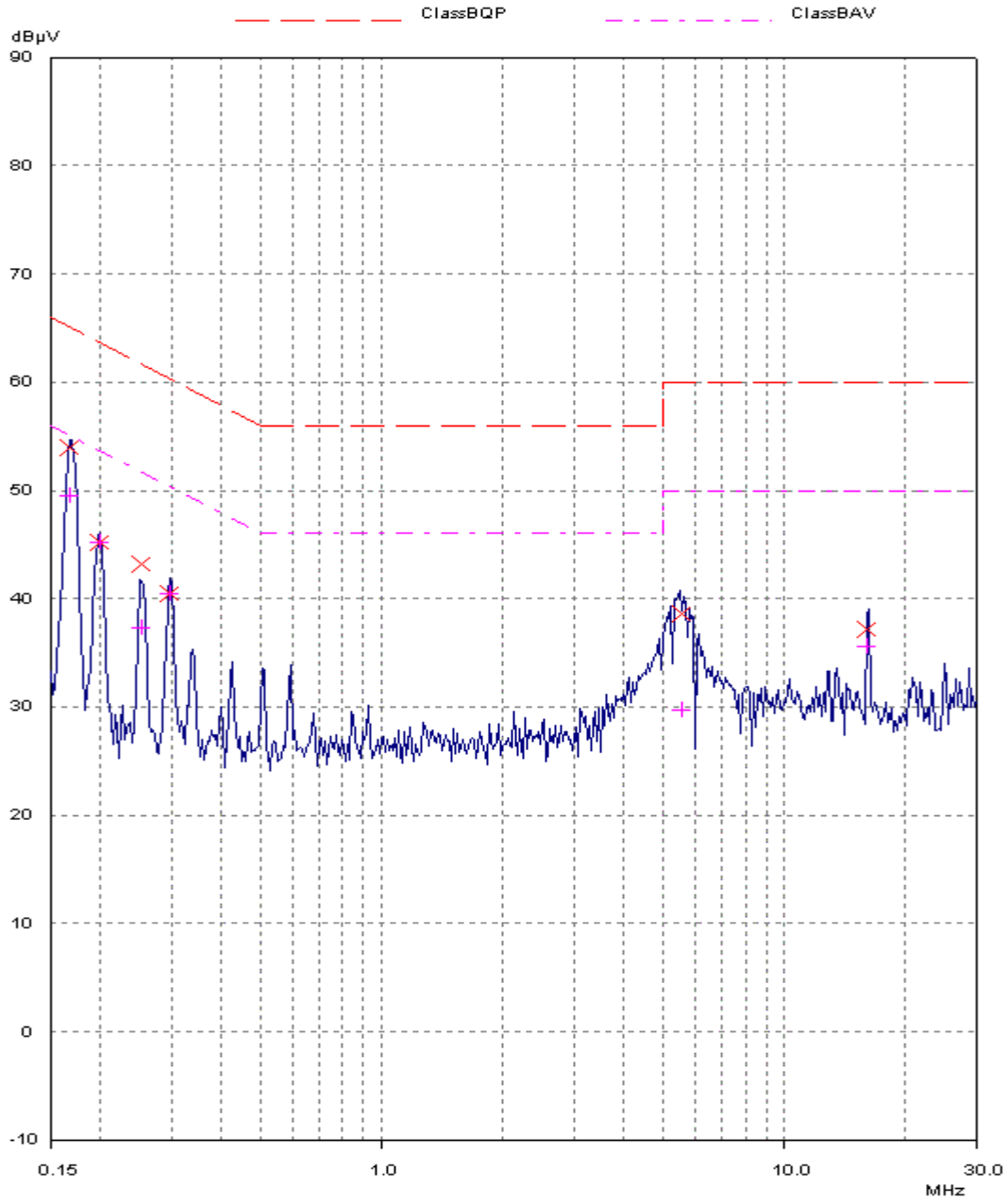
7.3.1.1. Plots of the initial scans can be found in Section 7.4.

7.3.1.2. The following table lists frequencies at which emissions were measured using an Average detector:

Frequency (MHz)	Line	Av. Level (dBµV)	Av. Limit (dBµV)	Margin (dB)	Result
0.168	Live	49.6	55.1	5.5	Complied
0.198	Neutral	45.1	53.7	8.6	Complied
0.252	Live	37.3	51.7	14.4	Complied
0.297	Neutral	40.4	50.3	9.9	Complied
5.526	Neutral	29.7	50.0	20.4	Complied
15.977	Neutral	35.6	50.0	14.5	Complied

7.4. Scan of Conducted Emissions

7.4.1. The following graph was produced as a result of a preliminary scan using max hold mode, incorporating a Peak detector with reference to both the Live and Neutral Lines.



7.5. Test Results For Radiated Emissions

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

7.5.1.1. Plots of the initial scans can be found in Section 7.6.

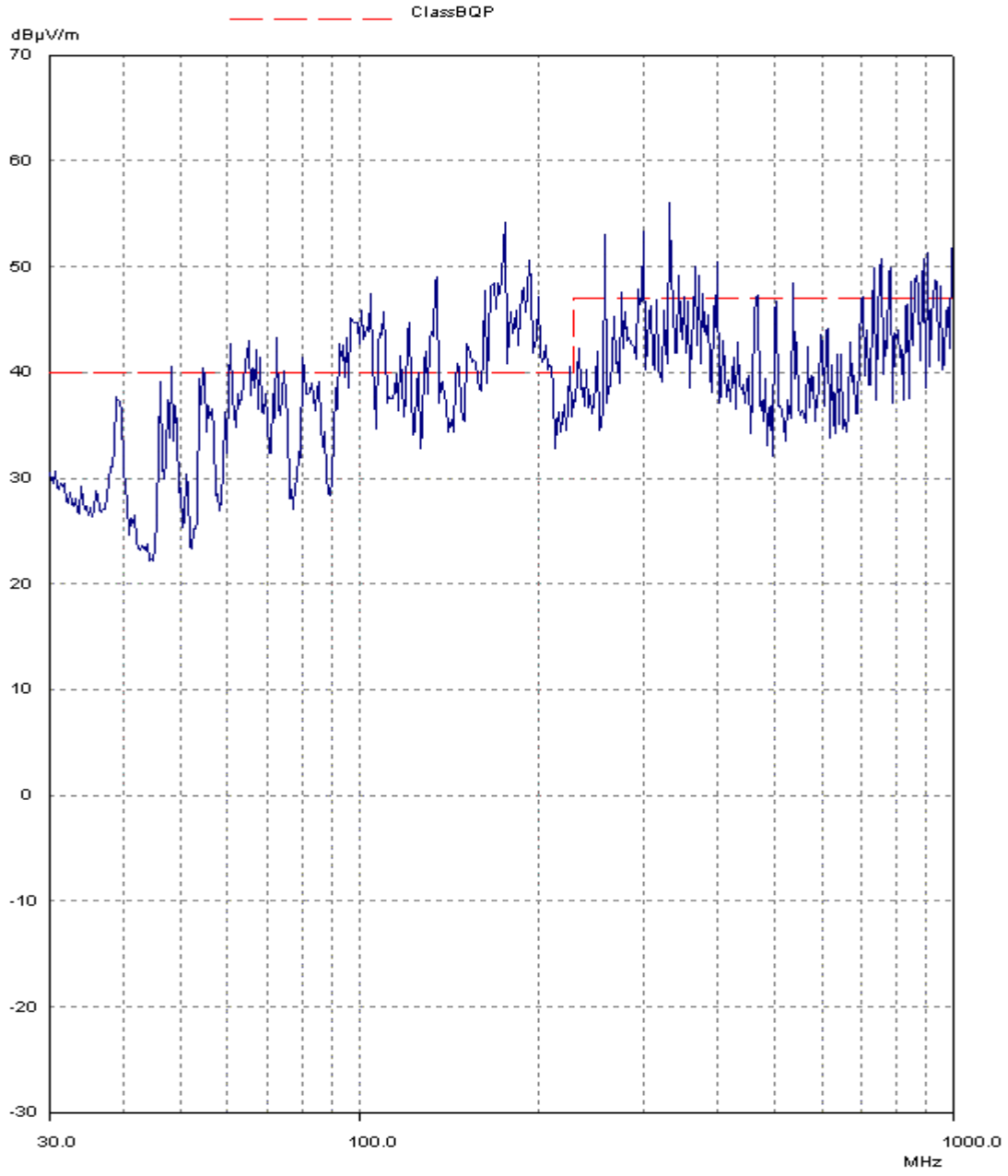
7.5.1.2. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector:

Frequency (MHz)	Ant. Pol.	Q-P Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
60.001	Vert.	22.5	30.0	7.5	Complied
64.371	Vert.	19.3	30.0	10.7	Complied
72.167	Vert.	17.7	30.0	12.3	Complied
79.604	Vert.	18.5	30.0	11.5	Complied
96.009	Horiz.	33.4	40.5	7.1	Complied (Note 1)
102.400	Horiz.	26.8	30.0	3.2	Complied
109.608	Vert.	19.6	30.0	10.4	Complied
133.308	Vert.	28.4	30.0	1.6	Complied
166.634	Vert.	24.4	30.0	5.6	Complied
174.967	Vert.	16.0	30.0	14.0	Complied
193.476	Vert.	11.5	30.0	18.5	Complied
257.958	Vert.	27.0	37.0	10.0	Complied
299.942	Vert.	26.5	37.0	10.5	Complied
330.715	Vert.	28.5	37.0	8.5	Complied
399.922	Vert.	26.1	37.0	10.9	Complied
463.000	Vert.	30.5	37.0	6.5	Complied
533.242	Vert.	35.0	37.0	2.0	Complied
749.227	Vert.	41.4	47.5	6.1	Complied (Note 1)
793.705	Vert.	29.3	37.0	7.7	Complied
859.863	Horiz.	36.2	37.0	0.8	Complied
888.520	Horiz.	33.4	37.0	3.6	Complied

1. Due to the presence of close, high ambient signals, this emission was measured at a test distance of 3 metres. The specification limit line was extrapolated accordingly as directed in Clause 11.4 (a) of EN 55022: 1994.

7.6. Scan of Radiated Emissions

7.6.1. The following graph was produced as a result of initial preliminary exploratory scans. These scans were performed at a 3 metre test distance to all four sides of the EUT in both antenna polarisation's. The scans were performed in a shielded enclosure using a max hold mode incorporating a Peak detector.



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 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. The uncertainty evaluation has been carried out in accordance with UKAS requirements:

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 @ 3 m	95%	+/- 4.9 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 M 3003 Edition 1“The Expression of Uncertainty and Confidence in Measurement” December 1997, which align with international recommendations “Guide to the Expression of Uncertainty in Measurement” ISO/IEC/OIML/BIPM (Prepared by ISO/TAG 4: January 1993).

Appendix 1. Test Equipment Used

Instrument	Manufacturer	Model Number	RFI No.
ESH3-Z2 Pulse Limiter	Rohde & Schwarz	ESH3-Z2	A003
ESH3-Z5 Single Phase LISN	Rohde & Schwarz	ESH3-Z5	A191
Bilog Antenna	Chase	CBL6111	A259
Narda 771-03 Attenuator	Narda	771-03	A262
OATS Positioning Controller	Rohde & Schwarz	HCC	A276
Bilog Antenna	Chase	CBL6111A	A490
Cables	Rosenberger	UFA210A-1-1181-70x70	C160
Cable	Andrews	None	C341
Cable	Andrews	None	C342
Cable	Rosenberger	UFA210A-1-1181-70x70	C344
Cable	Rosenberger	RG142XX-001-RFIB	C454
Cable	Rosenberger	RG142XX-002-RFIB	C456
Cable	Rosenberger	UFA210A-1-1182-704704	C459
N-Type Coaxial Cable	Rosenberger	UFA210A-1-3937-504504	C468
ESVP Receiver	Rohde & Schwarz	ESVP	M002
Spectrum Monitor	Rohde & Schwarz	EZM	M003
Receiver / Spectrum Analyser System	Rohde & Schwarz	ESBI	M090
Temperature/Humidity Meter	RS Components	212-146	M114
Turntable Controller	R.H.Electrical Services	RH351	M173
Site 1	RFI	1	S201
Site 12	RFI	12	S212

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

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.

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.

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

Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\39307ETF01\EMICON	Test configuration for measurement of conducted emissions
DRG\39307ETF01\EMIRAD	Test configuration for measurement of radiated emissions
DRG\39307ETF01\001	Schematic Diagram of the EUT, support equipment and interconnecting cables used for the test

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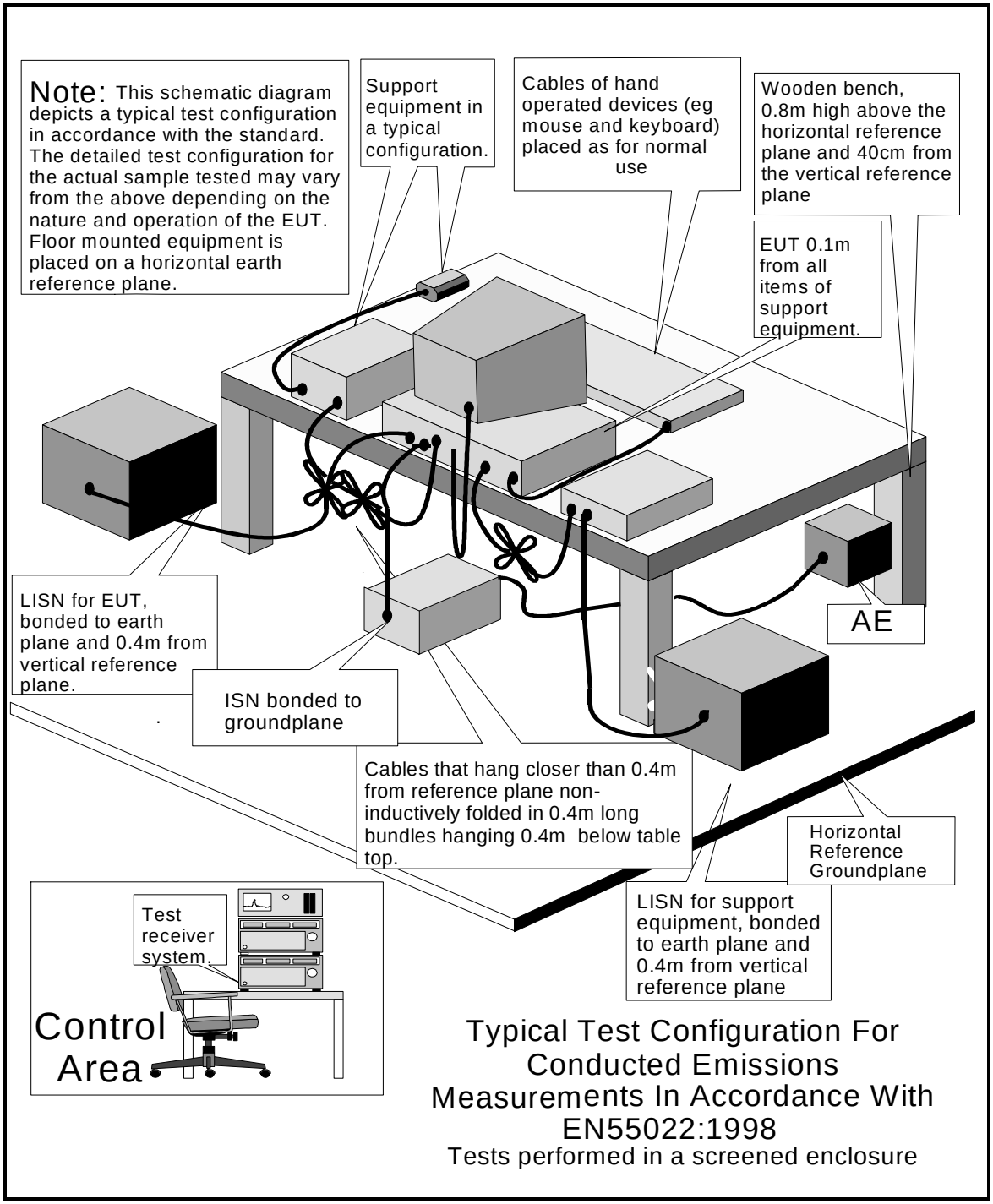
PCI-HS Interface Card
To: **FCC Part 15: 1998 Class B**

DRG\39307ETF01\EMICON



Typical Test Configuration For Conducted Emissions Measurements In Accordance With EN55022:1998
Tests performed in a screened enclosure

Test Of: **Madge Networks Ltd.**
PCI-HS Interface Card
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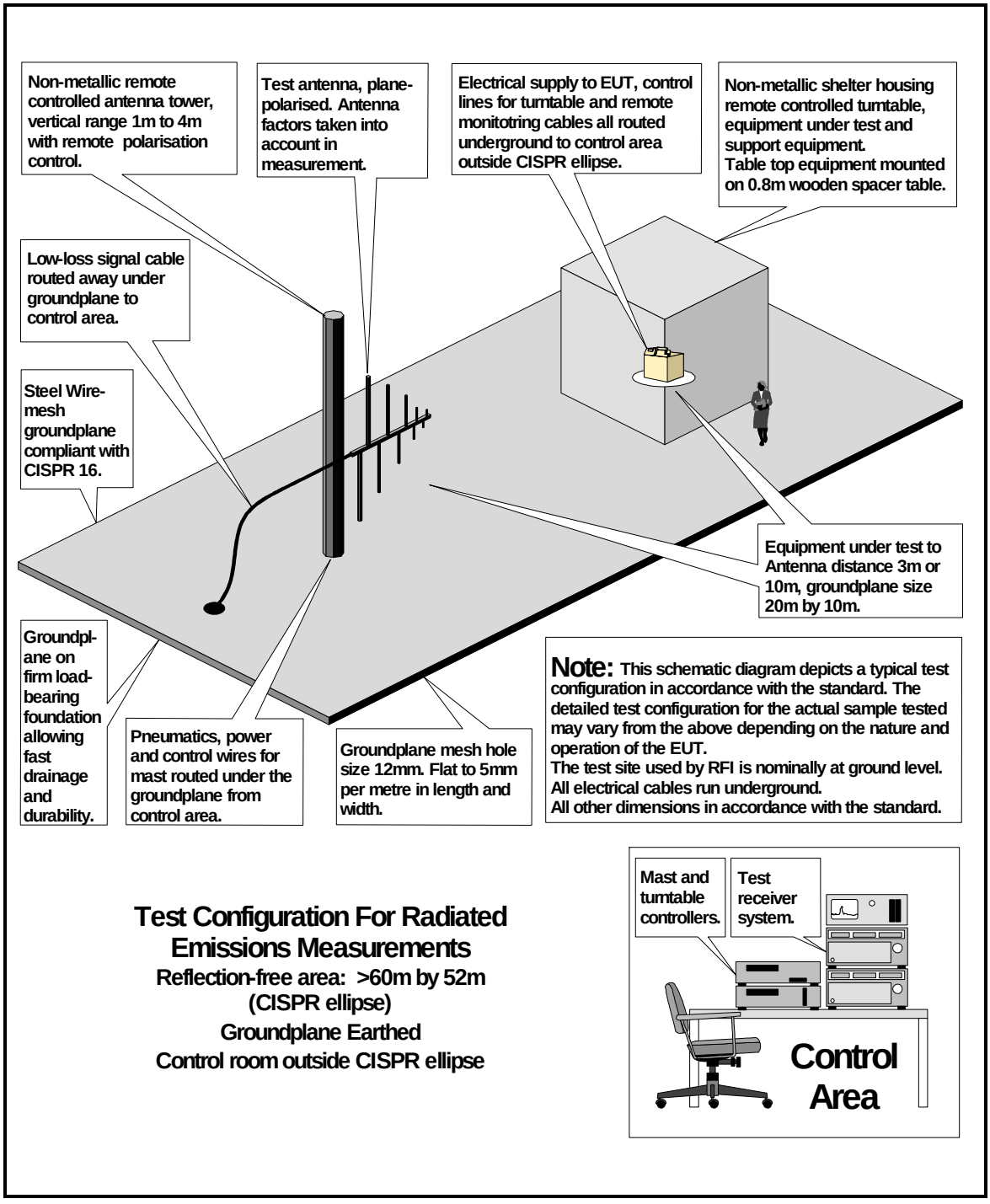
DRG\39307ETF01\EMIRAD



Test Configuration For Radiated Emissions Measurements
Reflection-free area: >60m by 52m (CISPR ellipse)
Groundplane Earthed
Control room outside CISPR ellipse

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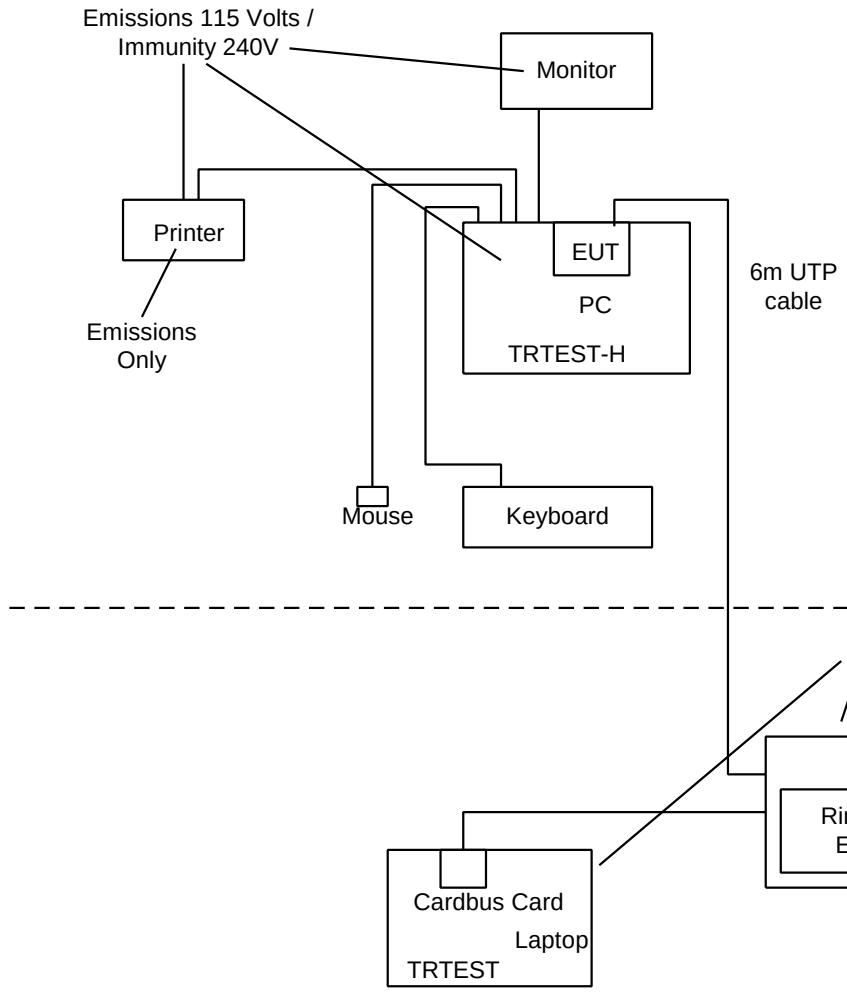
DRG\39307ETF01\001

Configuration of EUT and Local Support Equipment



Configuration of Remote Support Equipment

Appendix 4. Photographs of EUT

This appendix contains the following photographs

Photo Reference Number	Title
PHT\39307ETF01\001	Front view of conducted emissions
PHT\39307ETF01\002	Side view of conducted emissions
PHT\39307ETF01\003	Front side view of radiated emissions
PHT\39307ETF01\004	Rear view of radiated emissions

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PHT\39307ETF01\001 Front view of conducted emissions

Test Of: **Madge Networks Ltd.**
PCI-HS Interface Card
To: **FCC Part 15: 1998 Class B**

PHT\39307ETF01\002 Side view of conducted emissions

Test Of: **Madge Networks Ltd.**
PCI-HS Interface Card
To: **FCC Part 15: 1998 Class B**

PHT\39307ETF01\003 Front side view of radiated emissions

Test Of: **Madge Networks Ltd.**
PCI-HS Interface Card
To: **FCC Part 15: 1998 Class B**

PHT\39307ETF01\004 Rear view of radiated emissions