

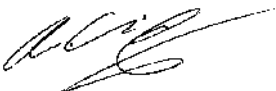
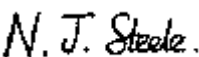
TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Maynetronics Ltd
NOMAD W4-2

To: FCC Part 15 Subpart C: 2000
(Intentional Radiators)
Section 15.249 and 15.209

Test Report Serial No:
RFI/EMCB2/RP42685JD06

Supersedes Test Report Serial No:
RFI/EMCB1/RP42685JD06

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	Checked By: 
Tested By:  pp	Release Version No: PDF01
Issue Date: 12 February 2002	Test Date: 8th January 2001 to 10th January 2001

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EMC Department

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1. Client Information

Company Name:	Maynetronics Ltd
Address:	9 Pavilion Rise Ryde Isle of Wight PO33 1PA
Contact Name:	Mr G Mayne

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2. Equipment Under Test (EUT)

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

2.1. Identification Of Equipment Under Test (EUT)

Brand Name:	NOMAD
Model Name or Number:	W4-2
Unique Type Identification:	W4-2-T-4
Serial Number:	None Stated by the Client
Country of Manufacture:	U.K.
FCC ID Number:	Not Applicable
Date of Receipt:	08 January 2002

Brand Name:	NOMAD
Model Name or Number:	W4-2
Unique Type Identification:	TA2
Serial Number:	None Stated by the Client
Country of Manufacture:	U.K.
FCC ID Number:	Not Applicable
Date of Receipt:	08 January 2002

2.2. Description Of EUT

Load cell indicator with graphic LCD display, keypad, smart card reader and RF link (916.5 MHz) to host PC. Up to 4 load cells may be connected to the indicator and a reading is taken when an external contact is closed. The serial number of the last smart card to pass the reader is added stored along with the reading in memory and sent to a host PC via the RF link when requested via that link. The keyboard and display is used for setting up, calibration and general status.

The Unit is dc powered via the ac mains network with internal batteries powering the system in the event of mains failure.

The card reader is contained in a separate housing connected to the main unit via a screened cable and interfaces with 125 kHz contactless HITAG2 cards.

2.3. Modifications Incorporated In EUT

The EUT has not been modified from the Model Name or Unique Type Identification number stated above.

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2.4. Support Equipment

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

Description:	Power Supply
Brand Name:	EMS POWER
Model Name or Number:	9090
Serial Number:	986723
FCC ID Number:	Not Applicable
Cable Length And Type:	4.1M of twin core 6 Amps/1.9M of triple core 15 Amps
Connected to Port:	DC IN

Description:	Load Cell Simulator
Brand Name:	None Stated by the client
Model Name or Number:	None Stated by the client
Serial Number:	None Stated by the client
FCC ID Number:	Not Applicable
Cable Length And Type:	4m Screened
Connected to Port:	Load Cell #1

Description:	Load Cell Simulator
Brand Name:	None Stated by the client
Model Name or Number:	None Stated by the client
Serial Number:	None Stated by the client
FCC ID Number:	Not Applicable
Cable Length And Type:	4m Screened
Connected to Port:	Load Cell #2

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Support Equipment Continued

Description:	Load Cell Simulator
Brand Name:	None Stated by the client
Model Name or Number:	None Stated by the client
Serial Number:	None Stated by the client
FCC ID Number:	Not Applicable
Cable Length And Type:	4m Screened
Connected to Port:	Load Cell #3

Description:	Load Cell Simulator
Brand Name:	None Stated by the client
Model Name or Number:	None Stated by the client
Serial Number:	None Stated by the client
FCC ID Number:	Not Applicable
Cable Length And Type:	4m Screened
Connected to Port:	Load Cell #4

Description:	Reading Activation Contact
Brand Name:	None Stated by the client
Model Name or Number:	None Stated by the client
Serial Number:	None Stated by the client
FCC ID Number:	Not Applicable
Cable Length And Type:	4m Screened
Connected to Port:	Strobe

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3. Test Specification, Methods And Procedures

3.1. Test Specification

Reference:	FCC Part 15 Subpart C: 2000 (Intentional Radiators). Section 15.249. (Operation within the Bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz and 24.0-24.25 GHz). Section 15.209. (Radiated emissions limits, general requirements)
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 (1996)

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

ANSI C63.4 (2001)

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 (1998)

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 (1999)

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.

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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 the test the EUT was operated by a 115v AC mains adapter supplying a 12v DC supply to the EUT.

5.2. Operating Modes

The EUT was tested in the following operating modes:

1. Load Cell Indicator configured with the Transmitter Active. The Card Reader was active with a TAG present.
2. Load Cell Indicator configured with the Transmitter in Standby. The Card Reader was active with a TAG present.
3. Load Cell Indicator configured with the Transmitter Active. The Card Reader was active with no TAG present.

The reason for choosing these operating modes was that it was defined by the client as being the general operating modes.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

The EUT was configured as for normal operation with all ports connected to external devices or dummy loads.

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.

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6. Summary Of Test Results

6.1. Radiated Emissions

Range Of Measurements	Specification Reference	Compliance Status
Conducted AC Mains Emissions 0.45 to 30 MHz	C.F.R. 47 FCC Part 15.207: 2000	Complied
Radiated Field Strength Emissions 9 kHz 30 MHz	C.F.R. 47 FCC Part 15.209: 2000	Complied
Electric Radiated Field Strength Emissions Fundamental and Harmonics	C.F.R. 47 FCC Part 15.249(a): 2000	Complied
Electric Radiated Field Strength Emissions 30 MHz to 10000 MHz	C.F.R. 47 FCC Part 15.249(c): 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.

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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. 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.

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7.2. 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
7.823	Neutral	43.2	48.0	4.8	Complied
28.494	Live	51.2	48.0	-3.2	Note 1

Note 1: A level of 51.2 was measured against a limit of 48.0. As specified in section 15.207 (b), if an emission exceeds the limit specified in section 15.207 (a) then the measurement procedure specified in part (b) may be applied. Using this method, this emission was re-measured with an Average detector and noted to be lower in amplitude by a minimum of 6 dB, thus resulting in the emission being wide band. Therefore the relevant Q-P measurement was reduced by 13 dB as specified in FCC part 15.207 (b).

7.2.1.3. The following table shows the corrected Q-P level after subtracting 13 dB from the initial measured value. The levels measured can now be seen to show compliance.

Frequency (MHz)	Line	Q-P Level (dBmV)	Q-P Limit (dBmV)	Margin (dB)	Result
28.494	Live	38.2	48.0	9.8	Complied

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7.3. Radiated Emissions

7.3.1. Field Strength Measurements: Fundamental Emissions:

7.3.1.1. The client has stated that the two transmitter frequencies for the EUT were 125 kHz and 916.5 MHz.

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

7.3.1.3. The test was performed against the limits specified in section 15.209 for the TAG reader and section 15.249 (a) for the Load Cell Indicator.

Tag Reader

7.3.1.4. Preliminary radiated emission scans and final measurements were performed with the EUT operating with and without a TAG. These scans showed similar levels between each mode with the highest being with the TAG present. Therefore final measurements were performed with the TAG present only.

7.3.1.5. The following table lists the measurement of the fundamental emission in the worse case antenna polarisation, using an average detector function (results incorporate antenna factors and cable losses):

10 Meter Measurements: Limit Specified at 300 Meters

Frequency (MHz)	Ant. Pol.	Av. Level (dBmV/m) at 10 meters	Corrected Av. Level (dBmV/m)	Av. Limit (dBmV/m)	Margin (dB)	Result
0.125	0 deg	74.4	15.3	25.7	10.4	Complied

30 Meter Measurements: Limit Specified at 300 Meters

Frequency (MHz)	Ant. Pol.	Av. Level (dBmV/m) at 30 meters	Corrected Av. Level (dBmV/m)	Av. Limit (dBmV/m)	Margin (dB)	Result
0.125	0 deg	42.6	2.6	25.7	13.1	Complied

Note: The limit at 125 kHz is specified at a test distance of 300m. However as specified by section 15.31 (f(2)), measurements may be performed at a closer distance than specified, and the measured level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor (40dB/decade).

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Load Cell Indicator

7.3.1.6. The following table lists the measurement of the fundamental emission in the worse case antenna polarisation, using a Quasi-Peak detector function at a test distance of 3m (results incorporate antenna factors and cable losses):

Frequency (MHz)	Ant. Pol.	Q-P Level (dB _m V/m)	Q-P Limit (dB _m V/m)	Margin (dB)	Result
916.533	Vert	86.2	94.0	7.8	Complied

7.3.2. Field Strength Measurements: 9 kHz to 30 MHz

7.3.2.1. The client has stated that the two transmitter frequencies for the EUT were 125 kHz and 916.5 MHz.

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

7.3.2.3. The test was performed against the limits specified in section 15.209.

7.3.2.4. Preliminary radiated emission scans and final measurements were performed with the EUT operating with and without a TAG present. Emissions recorded by these scans indicated all emissions (except the fundamental) to be at least 20 dB from the reference limit line. Therefore no final measurements were performed.

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7.3.3. Electric Field Strength Measurements: 30 to 1000 MHz

7.3.3.1. The client has stated that the highest clock frequency for the EUT was 916.5 MHz. Therefore tests were performed up to 10 GHz.

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

7.3.3.3. Preliminary radiated emission scans and final measurements were performed with the EUT set to operate with the Load Cell Indicator Transmitter in transmit mode and standby mode. With the exception of the transmitter frequency, both modes showed similar levels. Therefore final measurements were performed in transmit mode only. At all times a TAG was also present.

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

Frequency (MHz)	Ant. Pol.	Q-P Level (dB _m V/m)	Q-P Limit (dB _m V/m)	Margin (dB)	Result
44.004	Vert	31.0	40.0	9.0	Complied
45.754	Vert	24.0	40.0	16.0	Complied
62.003	Vert	29.3	40.0	10.7	Complied
70.737	Vert	19.6	40.0	20.4	Complied
84.007	Vert	25.0	40.0	15.0	Complied
151.175	Vert	29.4	43.5	14.1	Complied
192.391	Vert	41.4	43.5	2.1	Complied
201.928	Vert	35.0	43.5	8.5	Complied

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7.3.4. Electric Field Strength Measurements (1 to 10 GHz)

7.3.4.1. The client has stated that the highest clock frequency for the EUT was 916.5 MHz. Therefore tests were performed up to 10 GHz.

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

7.3.4.3. Preliminary radiated emission scans and final measurements were performed with the EUT set to operate with the Load Cell Indicator Transmitter in transmit mode and standby mode. Both modes showed similar levels. Therefore final measurements were performed in transmit mode only. At all times a TAG was also present.

7.3.4.4. The following table lists frequencies at which emissions were measured using an Average and Peak detector function at a distance of 1m.

Average Levels

Frequency (GHz)	Antenna Polarity (H/V)	Average Level (dBmV) Note 1	Av. Level (dBmV/m) at 1 meter	Corrected Av. Level (dBmV/m)	Average Limit (dBmV/m)	Average Margin (dB)	Result
1.832854	Horiz	24.2	47.1	37.6	54.0	16.4	Complied
2.416527	Horiz	24.3	45.9	36.4	54.0	17.6	Complied
3.333054	Horiz	24.7	46.3	36.8	54.0	17.2	Complied
4.963333	Horiz	18.6	44.0	34.5	54.0	19.5	Complied
5.475554	Horiz	12.8	38.8	29.3	54.0	24.7	Complied
6.921672	Horiz	11.7	40.1	30.6	54.0	23.4	Complied
9.467239	Horiz	11.5	43.9	34.4	54.0	19.6	Complied

Note 1: Antenna Factor and Cable Loss Not Included.

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Peak Levels

Frequency (GHz)	Antenna Polarity (H/V)	Peak Level (dBmV) Note 1	Peak Level (dBmV/m) at 1 meter	Corrected Peak Level (dBmV/m)	Peak Limit (dBmV/m)	Peak Margin (dB)	Result
1.832854	Horiz	32.0	54.9	45.4	74.0	28.6	Complied
2.416527	Horiz	34.8	56.4	46.9	74.0	27.1	Complied
3.333054	Horiz	35.0	56.6	47.1	74.0	29.9	Complied
4.963333	Horiz	29.0	54.8	45.3	74.0	29.1	Complied
5.475554	Horiz	23.4	49.4	39.9	74.0	34.1	Complied
6.921672	Horiz	22.5	50.9	41.4	74.0	32.6	Complied
9.467239	Horiz	22.8	55.2	45.7	74.0	38.3	Complied

Note 1: Antenna Factor and Cable Loss Not Included.

7.3.5. Antenna Factors and Cable Loss For Frequencies Above 1 GHz

Frequency (GHz)	Antenna Factor (dB)	Cable Loss (dB)	Total Loss (dB)
1.832854	22.0	0.9	22.9
2.416527	20.5	1.1	21.6
3.333054	20.5	1.1	21.6
4.963333	24.4	1.2	25.6
5.475554	24.4	1.6	26.0
6.921672	26.9	1.5	28.4
9.467239	30.7	1.7	32.4

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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 measured (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
Conducted Emissions	0.45 MHz to 30 MHz	95%	+/- 3.25 dB
Magnetic Field Radiated Emissions	9 kHz to 30 MHz	95%	+/- 3.53 dB
Electric Field Radiated Emissions	30 MHz to 1000 MHz	95%	+/- 5.26 dB
Radiated Electric Field Strength 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.

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Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A007	H Field Antenna	Rohde & Schwarz	HFH2-Z2	880 458/020
A028	Horn Antenna	Eaton	91888-2	304
A031	2 to 4 GHz Eaton Horn Antenna	Eaton	91889-2	557
A059	3146 Log Periodic Antenna	EMCO	3146	8902-2378
A197	Site 2 Controller SC144	Unknown	SC144	150720
A553	Bi-log Antenna	Chase	CBL6111A	1593
A253	WG 12 Microwave Horn	Flann Microwave	12240-20	128
A254	WG 14 Microwave Horn	Flann Microwave	14240-20	139
A255	WG 16 Microwave Horn	Flann Microwave	16240-20	519
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008
C563	C563-N-2	Rosenberger	UFA 210A-1-0787-70x70	96L0225
C565	C565-N-3	Rosenberger	UFA 210A-1-1181-70x70	96 L 0703
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M023	ESVP Receiver	Rohde & Schwarz	ESVP	872 991/027

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Test Equipment Used Continued

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
M069	ESMI Spectrum Analyser / Receiver	Rohde & Schwarz	ESMI	829 808/007 (DU) / 827 063/008 (RU)
M090	Receiver / Spectrum Analyser System	Rohde & Schwarz	ESBI	DU:838494/005 RU:836833/001
M115	Temperature/Humidity Meter	RS Components	212-146	None
M116	Temperature/Humidity Meter	RS Components	212-146	None
M173	Turntable Controller	R.H. Electrical Services	RH351	3510020
M174	OATS Turntable	British Turntable Ltd	S36069	None
S201	Site 1	RFI	1	-
S202	Site 2	RFI	2	-
S209	Site 9	RFI	9	-

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: FCC Part 15

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 and with the EUT powered via a 60 Hz AC mains supply.

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. 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.

A2.1.5. The test equipment settings for conducted emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements
Detector Type:	Peak	Quasi-Peak (CISPR)*
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

* In some instances an Average detector function may also have been used.

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A2.2. Radiated Emissions: FCC Part 15

A2.2.1. Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

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 receivers with a Quasi-Peak or Average detector (below 1000 MHz) where applicable, for measurements above 1000 MHz average and peak detectors were used.

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°. For frequencies below 1000 MHz, the antenna was varied in height between 1 m and 4 m. For frequencies below 30 MHz, the antenna was fixed at a height of 1.5m. 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.

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

Receiver Function	Initial Scan 30 to 1000 MHz	Final Measurements 30 to 1000 MHz
Detector Type:	Peak	Quasi-Peak (CISPR) or Average
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

Receiver Function	Initial Scan Below 30 MHz	Final Measurements Below 30 MHz
Detector Type:	Peak	Quasi-Peak/Average
Mode:	Max Hold	Not applicable
Bandwidth:	9 kHz to 150 kHz: 200 Hz 150 kHz to 30 MHz: 9 kHz	9 kHz to 150 kHz: 200 Hz 150 kHz to 30 MHz: 9 kHz
Amplitude Range:	60 dB	20 dB (typical)
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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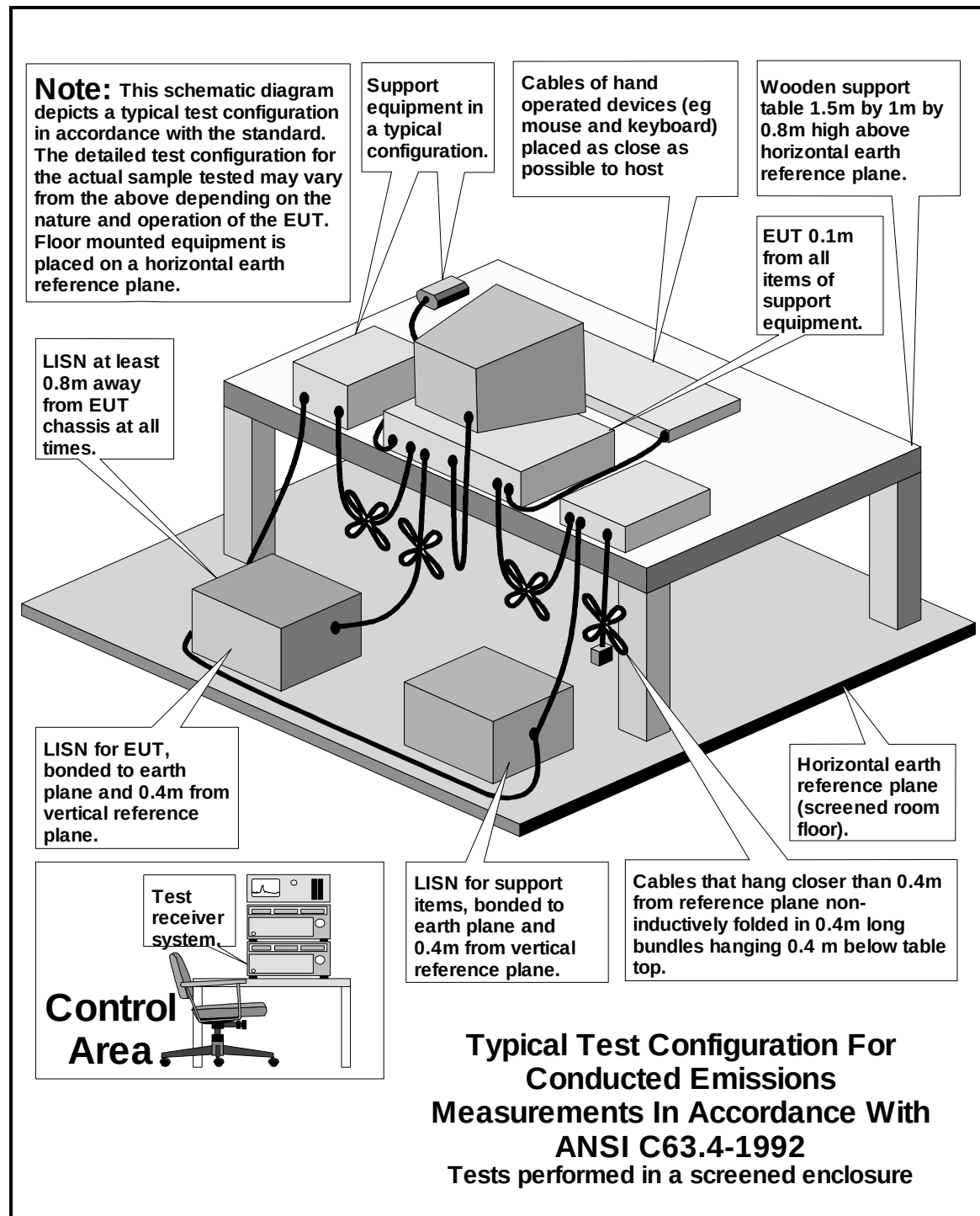
Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\42685JD06\EMICON	Test configuration for measurement of conducted emissions
DRG\42685JD06\EMIRAD	Test configuration for measurement of radiated emissions
DRG\42685JD06\001	Schematic diagram of the EUT, support equipment and interconnecting cables used for the test

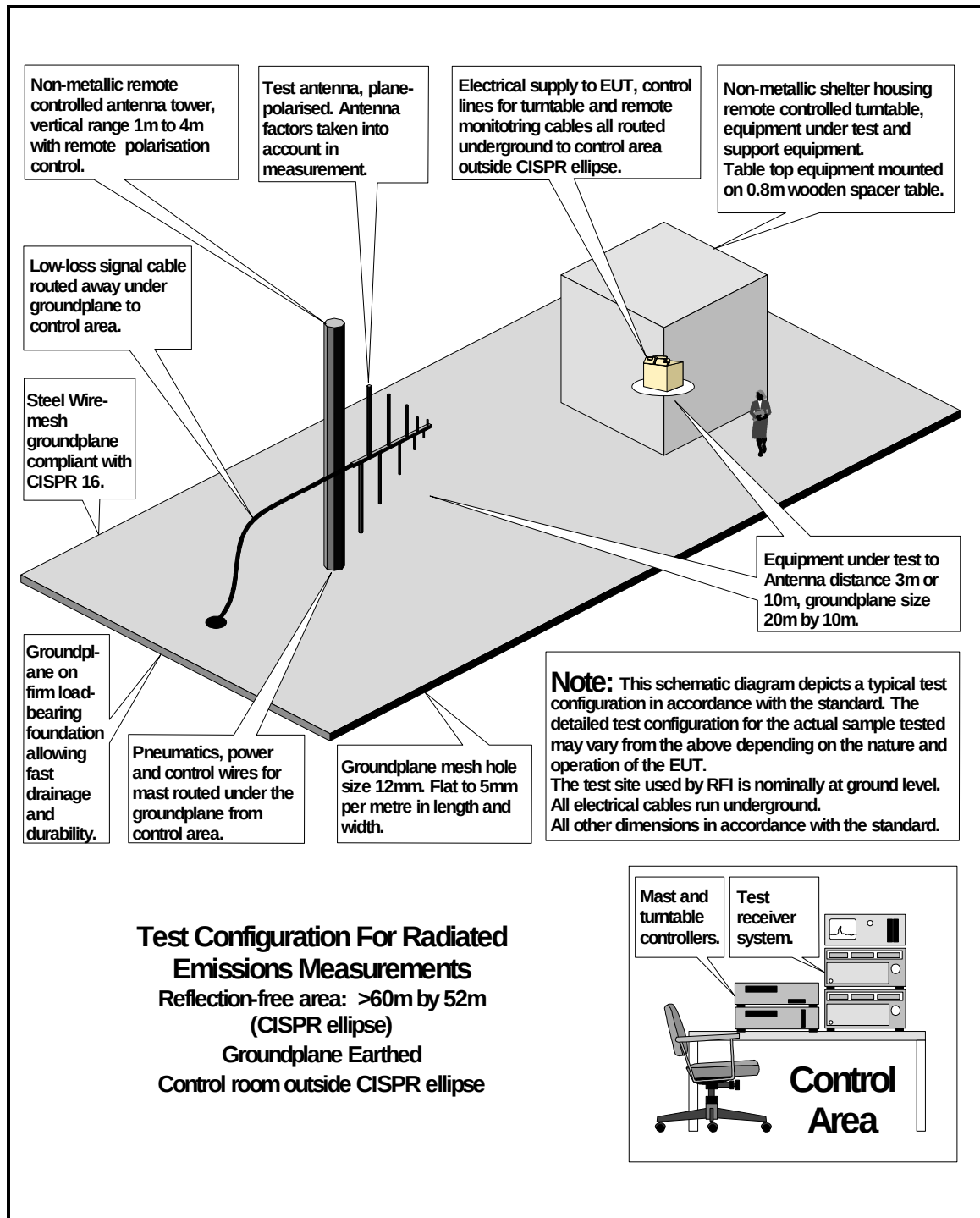
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Configuration of EUT and Local Support Equipment

