TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test Of: Adaptive Broadband Ltd.
AB Access EXTENDER

To: FCC Part 15: Subpart E: 2000
(Unlicensed National Information
Infrastructure Devices)

Test Report Serial No:
RFI/MICB1/RP42151A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	**Checked By:** 
Tested By: 	**Release Version No:** **PDF01**
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1. Client Information

Company Name:	Adaptive Broadband Ltd.
Address:	The Westbrook Centre Block 5 Milton Road Cambridge SB41 1YG.
Contact Name:	Mr A Crisp.

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:	AB-Access ™ EXTENDER
Model Name or Number:	Subscriber Unit
Unique Type Identification:	None stated by client
Serial Number:	None
Country of Manufacture:	USA
FCC ID Number:	Awaiting certification from FCC
Date of Receipt:	10 April 2001

Brand Name:	AB-Access ™ EXTENDER
Model Name or Number:	Power Supply
Unique Type Identification:	SSL40-3360
Serial Number:	None stated by client
Country of Manufacture:	China
FCC ID Number:	Awaiting certification from FCC
Date of Receipt:	10 April 2001

Brand Name:	AB-Access ™ EXTENDER
Model Name or Number:	AB-Access Extender Wall Box
Unique Type Identification:	10000008
Serial Number:	None stated by client
Country of Manufacture:	EU
FCC ID Number:	Awaiting certification from FCC
Date of Receipt:	10 April 2001

2.2. Description Of EUT

AB-Access ™ EXTENDER is targeted at providing high-speed wireless internet/video/data/voice access in the FCC UNII bands between 5.725 GHz and 5.825 GHz.

AB-Access ™ EXTENDER adopts a point to point configuration, consisting of two AB-Access extender units. It is a fixed access, point to point infrastructure. The product is targeted for the US market only.

The Subscriber Unit (SU) is routed via a wall box to the network service provider's truncated infrastructure. The SU has an integral antenna with a 10 degree by 10 degree, 3dB beam width to receive/transmit the desired area of coverage. SU units can be installed around the periphery of a tall building or on a tower for optimum line of sight range. Power and data (bi-directional) are routed via braid and foil screened, quad twisted pair, CAT 5 data cable from the internally mounted wall box (similar in construction to a standard BT telephone outlet) up to the SU transceiver/antenna unit. Power and data status is also routed via this cable. Power is provided to the wall box via a standard FCC approved 48V DC power supply. The wall box provides either Ethernet or ATM connectivity via the industry standard RJ45 socket, to the service providers network and end customer systems.

2.3. Modifications Incorporated In EUT

The EUT incorporates the following modifications:

The AB-Access ™ EXTENDER unit has been modified so that it can be driven from a PC test script, enabling the worst case conditions for FCC requirements, to be evaluated and tested for compliance. There are no hardware modifications, as the modification is purely in the software driver. AB Access employs a rapid Time Division Duplex (TDD) air interface, based on Asynchronous Transfer Mode (ATM) networking protocols. Data is transmitted asynchronously on demand, so there is no discernible duty cycle from which averaged measurements can be taken.

The following test modes have been implemented:

- Continuous Transmit Mode (CTM) – this configures the unit for its worst case mode, for EIRP measurements. The unit is set for maximum transmit power, to give the worst case for switching transients, which can cause spurious emissions whilst performing radiated and conducted emissions.

- Continuous Bursted Receive Mode (CBRM) – this exercises the unit if there may be some fundamental frequency components that exceed the receive switch test mode. In this configuration the unit is set to maximum receive gain.

In either of these modes it is possible to change the operating channel and antenna polarisation as required, by means of the PC controller.

2.4. Additional Information Related To Equipment Under Test

Power Supply Requirement:	Nominal 115 V, 60 Hz AC Mains Supply 13 Amp (max) 48 V DC from PSU to EUT
Current Rating:	0.6 Amps
Highest Frequency used or generated within the EUT	5.805 GHz
Type of Device:	Point to multipoint wireless data system
Antenna Details:	Permanently attached. (Horizontal or Vertical)
Transmitter Duty:	Continuous
Occupied Bandwidth:	17 MHz
Transmit Frequency:	5.745 GHz to 5.805 GHz
Type of Modulation:	QPSK at 25 Mbits/sec, raised cosine filter (α = 0.35)
Number of Channels:	5 Channels of 15 MHz
Receiver Category:	Superhetrodyne Highest local oscillator frequency 4.9025 GHz
Antenna	Permanently attached. (Horizontal or Vertical)
Tuning Frequency:	5.745 GHz to 5.805 GHz
Method of frequency Generation:	Synthesizer
Intended Operating Environment:	AB-Access ™ EXTENDER unit transceivers/antennas are mounted outside with an operating range of -20°C to +50°C. The wall box and power supply are intended to be mounted internally in users building/office/or home.
Weight:	Master Unit = 6.25 Kg PSU = 0.2 Kg Wall Box = 0.05 Kg
Dimensions:	Master Unit = 0.37 x 0.40 x 0.10 metres PSU = 0.11 x 0.045 x 0.03 metres Wall Box = 0.085 x 0.085 x 0.040 metres
Interface Ports:	Wall Box RJ45 Socket - Ethernet or ATM
Cycle Time:	Not applicable

2.5. Support Equipment

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

Description:	Personal Computer
Model Name:	Dell
Model Number:	PPX
Serial Number:	4898T
Cable Length And Type:	10.0 metres Ethernet cable
Connected to Port:	Local Area Line (LAN) to port 4 on fast Ethernet switch

Description	Fast Ethernet Switch
Brand Name	Netgear
Model Name or Number	FS308
Serial Number	FS38G05015393
F.C.C. ID Number	None stated
Cable Length And Type	9 m Ethernet Crossover Cable
Connected to Port	Port 5 to RJ45 Port on the Wall Box of the EUT

3. Test Specification, Methods And Procedures

3.1. Test Specification

Reference:	FCC Part 15 Subpart E: 2000
Title:	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices: Digital Devices. Subpart E: Unlicensed National Information Infrastructure 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:

FCC Code of Federal Regulations 47.
Telecommunication. Parts 0 to 19, October 2000.

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.

3.3. 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

None.

5. Operation Of The EUT During Testing

5.1. Operating Conditions

The EUT was tested in a normal laboratory environment.

During the testing the EUT was powered by a 48 V DC supply from the PSU. The PSU was powered from a 115 V AC, 60 Hz mains supply.

5.2. Operating Modes

The EUT was tested in the following operating modes:

Continuous Transmit Mode at maximum power for transmitter tests.

Continuous Bursted Receive Mode for receiver tests.

For both receive and transmit modes, tests were performed with the EUT set to the bottom (10), middle (12) and top (14) channels, which are shown in the table below.

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.

Channel	Frequency/GHz
10	5.745
12	5.775
14	5.805

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

The AB-Access ^{TM} EXTENDER unit was connected via the S-FTP, CAT 5 cable to the wall box. The power was supplied from the PSU to the wall box. Data was controlled from the support PC to the wall box via S-UTP-CAT 5 Ethernet cables.

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 and typical of an installation of a users home or office.

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. Transmitter Tests

Range Of Measurements	Specification Reference	Compliancy Status
AC Powerline Conducted Emissions 450 kHz to 30 MHz	Section 15.407 (b)(5) of C.F.R. 47: 2000. (Section 15.207)	Complied
Effective Isotropic Radiated Tx Power Levels 5 GHz to 6 GHz	Section 15.407 (a) of C.F.R. 47: 2000.	Complied
Electric Field Strength Spurious Emissions, 30 MHz to 1000 MHz	Section 15.407 (b)(5) of C.F.R. 47: 2000 (Section 15.209)	Complied
Effective Isotropic Radiated Spurious Emissions 1 GHz to 40 GHz	Section 15.407 (b)(3) of C.F.R. 47: 2000. (Section 15.209)	Complied

6.2. Receiver Tests

Range Of Measurements	Specification Reference	Compliancy Status
AC Powerline Conducted Emissions, 450 kHz to 30 MHz	Section 15.107 Class B of C.F.R. 47: 2000.	Complied
Electric Field Strength Spurious Emissions, 30 MHz to 40 GHz	Section 15.109 Class B of C.F.R. 47: 2000	Complied

6.3. 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. 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: Transmit Mode

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

7.2.1.1. Measurements were performed to FCC Part 15.407 (b)(5) to the limits specified by FCC Parts 15.107 and 15.207.

7.2.1.2. Initial conducted emission scans were performed in both Transmit and Receive modes, on all 3 operating channels as specified in section 5.2. These scans showed levels of similar amplitude for each mode and channel, therefore final conducted emission measurements were performed in Transmit mode on channel 12 only.

7.2.1.3. Plots of the initial scans can be found in Graphical Test Results documentation issued separately.

7.2.1.4. 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
0.579	Live	38.6	48.0	9.4	Complied
0.610	Live	39.5	48.0	8.5	Complied
0.664	Live	44.2	48.0	3.8	Complied
0.666	Neutral	44.3	48.0	3.7	Complied
0.771	Live	38.6	48.0	9.4	Complied
1.520	Neutral	37.1	48.0	10.9	Complied
2.091	Neutral	33.9	48.0	14.1	Complied
2.705	Neutral	34.2	48.0	13.8	Complied
2.740	Live	40.1	48.0	7.9	Complied
3.089	Neutral	39.3	48.0	8.7	Complied
8.727	Live	43.0	48.0	5.0	Complied
8.740	Neutral	42.3	48.0	5.7	Complied
29.903	Neutral	41.7	48.0	6.3	Complied
29.927	Live	36.6	48.0	11.4	Complied

7.3. Test Results For Radiated Emissions: Transmit Mode

7.3.1. Electric Field Strength Measurements: 30 MHz to 1000 MHz

7.3.1.1. Measurements were performed to FCC Part 15.407 (b)(5) to the limits specified by FCC Parts 15.209.

7.3.1.2. The client has stated that the highest clock frequency for the EUT was 5.805 GHz. Therefore tests contained within this section were performed up to 40 GHz.

7.3.1.3. Initial radiated emission scans were performed on all 3 operating channels as specified in section 5.2. These scans showed levels of similar amplitude for each channel, and therefore final radiated emission measurements were performed on channel 12 only. As the emission at 280.026 MHz was found to be within 6dB of the specification limit, it was measured on all three channels and both EUT antenna polarisation's. The resultant emission level was unaffected, regardless of the EUT antenna polarisation, operating mode or channel.

7.3.1.4. Plots of the initial scans can be found in Graphical Test Results documentation issued separately.

7.3.1.5. 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)	Antenna Polarity	Q-P Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
43.900	Vertical	26.5	40.0	13.5	Complied
120.101	Horizontal	28.8	43.5	14.7	Complied
149.996	Vertical	21.6	43.5	21.9	Complied
200.033	Horizontal	21.0	43.5	22.5	Complied
204.014	Horizontal	20.6	43.5	22.8	Complied
274.980	Vertical	35.1	46.0	10.9	Complied
276.027	Vertical	25.4	46.0	20.6	Complied
280.026	Vertical	42.4	46.0	3.6	Complied

7.4. Test Results For Radiated Emissions: Receive Mode

7.4.1. Electric Field Strength Measurements: 30 MHz to 1000 MHz

7.4.1.1. Measurements were performed to FCC Part 15.109.

7.4.1.2. The client has stated that the highest clock frequency for the EUT was 5.805 GHz. Therefore tests contained within this section were performed up to 40 GHz.

7.4.1.3. 7.4.1.3. Initial radiated emission scans were performed on all 3 operating channels as specified in section 5.2. These scans showed levels of similar amplitude for each channel, and therefore final radiated emission measurements were performed on channel 12 only. As the emission at 280.026 MHz was found to be within 6dB of the specification limit, it was measured on all three channels and both EUT antenna polarisation's. The resultant emission level was unaffected, regardless of the EUT antenna polarisation, operating mode or channel.

7.4.1.4. Plots of the initial scans can be found in Graphical Test Results documentation issued separately.

7.4.1.5. 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 (dBmV/m)	Limit (dBmV/m)	Margin (dB)	Result
43.900	Vertical	26.5	40.0	13.5	Complied
120.101	Horizontal	28.8	43.5	14.7	Complied
149.996	Vertical	21.6	43.5	21.9	Complied
200.033	Horizontal	21.0	43.5	22.5	Complied
204.014	Horizontal	20.6	43.5	22.8	Complied
274.980	Vertical	35.1	46.0	10.9	Complied
276.027	Vertical	25.4	46.0	20.6	Complied
280.026	Vertical	42.4	46.0	3.6	Complied

7.5. Test Results For Radiated Emissions: Receive Mode

7.5.1. Electric Field Strength Measurements: 1.0 GHz to 40.0 GHz

7.5.1.1. Measurements were performed to FCC Part 15.109.

7.5.1.2. The client has stated that the highest clock frequency for the EUT was 5.805 GHz. Therefore tests contained within this section were performed up to 40.0 GHz.

7.5.1.3. Plots of the initial scans can be found in Graphical Test Results documentation issued separately.

7.5.1.4. It should be noted that the emission shown on the initial scans at approximately 9.3 GHz was verified as an ambient signal.

7.5.1.5. It should be noted that all of the emissions shown on plots GPH\42151JD01\021 to GPH\42151JD01\024 are ambient signals.

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

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
7.313	Horiz.	20.2	27.0	2.7	49.9	54.0	4.1	Complied

7.6. Test Results For Radiated Emissions: Transmit Mode

7.6.1. Effective Isotropic Radiated Power Measurements

7.6.1.1. Measurements were performed in accordance with Section 15.407 (b(1/2/3)) of C.F.R. 47: 2000. (Section 15.207), on the bottom, middle and top channels.

7.6.1.2. It was possible to polarise the antenna incorporated within the EUT for both vertical and horizontal polarisation's. Therefore EIRP measurements were performed with the antenna polarised in both planes.

7.6.1.3. Results are shown for the EUT operating on each of the 3 channels and both the EUT antenna polarisation's stated in section 5.2. Measurements are shown for both transmit power and peak power spectral density. Plots showing the characteristics of the transmitter output can be found in the Graphical Test Results documentation issued separately.

7.6.1.4. The ratio of the peak excursion of the modulation envelope was calculated as stated in Part 15.407 (a6)).

7.6.1.5. As specified by 15.407(a)(5), the Peak Power Spectral Density was measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. Similarly, the Peak Power was also measured by direct connection.

Results: Peak Transmit Power Levels

Tx Band (GHz)	Channel	Tx Antenna Polarisation	Measured Peak Power (EIRP) (dBm)	Limit (dBm)	Bandwidth (MHz)	Plot No.	Result
5.725 to 5.825	10	Horizontal	26.1	29.1	16.1	101	Complied
5.725 to 5.825	10	Vertical	25.6	29.1	16.2	102	Complied
5.725 to 5.825	12	Horizontal	27.1	29.0	15.9	103	Complied
5.725 to 5.825	12	Vertical	26.5	29.0	15.8	104	Complied
5.725 to 5.825	14	Vertical	26.6	29.0	15.9	105	Complied
5.725 to 5.825	14	Horizontal	27.5	29.0	16.0	106	Complied

Results: Peak Power Spectral Density (PPSD)

Tx Band (GHz)	Channel	Tx Antenna	Measured PPSD (dBm/MHz)	Limit (dBm/MHz)	Result
5.725 to 5.825	12	Horizontal	15.6	17.0	Complied
5.725 to 5.825	12	Vertical	15.5	17.0	Complied
5.725 to 5.825	10	Horizontal	14.5	17.0	Complied
5.725 to 5.825	10	Vertical	14.3	17.0	Complied
5.725 to 5.825	14	Horizontal	14.7	17.0	Complied
5.725 to 5.825	14	Vertical	15.0	17.0	Complied

Results: Ratio of Peak Excursion of the Modulation Envelope

Tx Band (GHz)	Channel	Tx Ant	Measured Output Power (dBm)	Measured PPSD (dBm/ MHz)	Ratio: Peak Excursion	Limit (dB)	Result
5.725 to 5.825	12	Horizontal	5.1	15.6	10.5	13.0	Complied
5.725 to 5.825	12	Vertical	5.3	15.5	10.2	13.0	Complied
5.725 to 5.825	10	Horizontal	4.3	14.5	10.2	13.0	Complied
5.725 to 5.825	10	Vertical	3.9	14.3	10.4	13.0	Complied
5.725 to 5.825	14	Horizontal	4.9	14.7	9.8	13.0	Complied
5.725 to 5.825	14	Vertical	4.1	15.0	10.9	13.0	Complied

7.7. Test Results for Radiated Emissions: Transmit Mode: 1.0 to 40.0 GHz

7.7.1. Effective Isotropic Radiated Power Spurious Emissions Measurements:

7.7.1.1. Measurements were performed in accordance with FCC Part 15.407(b).

7.7.1.2. The client has stated that the highest frequency generated within the device is 5.825 GHz. Therefore tests were performed up to 40 GHz.

7.7.1.3. EIRP preliminary scans were performed with the EUT operating on each of the 6 channels as specified in section 5.2. Plots showing the spurious (undesirable) emission levels can be found in the Graphical Test Results documentation issued separately.

7.7.1.4. The EUT was configured with a permanently attached antenna.

7.7.1.5. Preliminary scans were performed with the EUT operating on each of the channels, as specified in section 5.2. It can be shown from the plots that all emissions outside of the transmitter band edges are of at least 6dB from the reference limit line, therefore no final measurements were required.

7.7.1.6. All preliminary scans can be found in Graphical Test Results documentation issued separately.

8. Measurement Uncertainty

8.1. Company Policy, as based on the NAMAS 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 NAMAS NIS 81 (Edition 1, May 1994) as follows:

Measurement Type	Range	Confidence Level	Calculated Uncertainty
Conducted Emissions	0.15 MHz to 30 MHz	95%	+/- 3.25 dB
Radiated Field Strength Emissions	30 to 1000 MHz @ 3m	95%	+/- 5.26 dB
Radiated Field Strength Emissions	1.0 to 18.0 GHz	95%	+/- 4.18 dB
Effective Isotropic Radiated Power	1.0 to 40.0 GHz	95%	+/- 1.78 dB

8.3. Measurement uncertainties have been applied in accordance with NAMAS 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 NAMAS 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).

Appendix 1. Test Equipment Used

Instrument	Manufacturer	Model	RFI No.
Chase Bilog Antenna	Chase EMC Ltd	CBL6112B	A1037
Bilog Antenna	Chase	CBL6111	A259
OATS Positioning Controller	Rohde & Schwarz	HCC	A276
WG 22 Attenuator	Flann	22081-10	A332
Absorbing Clamp	Rohde & Schwarz	MDS 21	A504
Cables	Rosenberger	UFA210A-1-1181-70x70	C160
Cable	Andrews	None	C340
Cable	Rosenberger	UFA210A-1-1182-704704	C459
C564-N-2	Rosenberger	UFA 210A-1-0787-70x70	C564
Spectrum Monitor	Rohde & Schwarz	EZM	M003
ESVP Receiver	Rohde & Schwarz	ESVP	M023
Temperature/Humidity/Pressure Meter	RS Components	None	M136
Turntable Controller	R.H.Electrical Services	RH351	M173
OATS Turntable	British Turntable Ltd	S36069	M174
Thermo/hygro meter	RS Components Ltd	RS212-124	M210
Analyser Display Unit	Rohde & Schwarz	ESAI-D	M505
RF unit	Rohde & Schwarz	ESBI-RF	M506
Site 1	RFI	1	S201

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

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 115 V 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.

A2.2. Radiated Field Strength Emissions

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 (for frequencies below 2 GHz) or on an open area test site (for frequencies above 2 GHz) 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. Where (at higher frequencies) the noise floor was found to be of a higher level, a test distance of 1m was used. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. Emissions that were found to be within 6dB of the specification limit 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.

A2.2.4. 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°. In addition, for frequencies below 1000 MHz, the antenna height was varied between 1 and 4 m. For frequencies above 1000 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.

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

Receiver Function	**Initial Scan Below 1GHz**	**Final Measurements Below 1GHz**
Detector Type:	Peak	Quasi-Peak (CISPR)
Mode:	Max Hold	Not applicable
Bandwidth:	120 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 Above 1GHz**	**Final Measurements Above 1 GHz**
Detector Type:	Peak	Peak/Average
Mode:	Max Hold	Not applicable
Bandwidth:	1 MHz	1 MHz
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

A.2.3.Effective Isotropic Radiated Power Measurements

A.2.3.1. Effective Isotropic Radiated Power measurements were performed in accordance with the standard, against the appropriate limits on an open area test site.

A.2.3.2. The EUT was set to transmit on the required channel at maximum transmit power. The channels stated in section 5.2 were tested. The EUT was configured with a permanently attached antenna. Therefore radiated power measurements were performed.

A.2.3.3. The EUT was mounted on a non-metallic table at a 1.5m test height. The receive (test) antenna was placed at a test distance of 2m. The EUT was set to operate at the required channel and the exact frequency recorded. A substitution measurement was then performed to determine the loss of the test set-up. (Details of the substitution method can be seen in Appendix A.2.6.).

A.2.3.4. The level recorded for the substitution method was entered as a level offset in the measuring receiver. Initial measurements covering the entire measurement band were performed in the form of a swept scan. 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 (1MHz). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT. The EUT was rotated through 360° to maximise all emissions. The test was performed with the EUT integral antenna set for both horizontal and vertical polarisations. The test antenna was also set for both polarities.

A.2.3.5. The measured Peak Transmit Power could then be determined.

A.2.3.6. The EUT was set to the next channel and sections A.2.3.2. to A.2.3.5. were repeated.

A.2.4. Effective Isotropic Radiated Power Spurious Measurements: 1.0 GHz to 40.0 GHz.

A.2.4.1. Effective Isotropic Radiated Power Spurious measurements were performed in accordance with the standard, against the appropriate limits on an open area test site.

A.2.4.2. The EUT was set to transmit on the required transmit channel at maximum transmit power. The channels stated in section 5.2 were tested. The EUT was configured with a permanently attached antenna. Therefore radiated power measurements were performed.

A.2.4.3. The EUT was mounted on a non-metallic table at a 1.5m test height. The receive (test) antenna was placed at a test distance of 2m. For each of the frequency ranges performed, a substitution method was performed to determine the worst case loss of the test set-up. (Details of the substitution method can be seen in Appendix A.2.6.)

A.2.4.4. The level recorded for the substitution method was entered as a level offset in the measuring receiver. Initial measurements covering the entire measurement band were performed in the form of a swept scan (For frequencies below 2 GHz, initial scans were performed in a shielded enclosure). 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 (1MHz). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT. The EUT was rotated through 360° to maximise all emissions. The test antenna was set for both polarities.

A.2.4.5. The maximum emission level obtained in dBm/MHz could then be determined. Any levels which were found to be within 6dB of the reference limit line were re-measured with a substitution measurement being performed.

A.2.4.6. The EUT was set to the next channel and sections A.2.4.2. to A.2.4.5. were repeated.

A.2.5. Substitution Methods

A.2.5.1. The equipment is configured as illustrated in Appendix 4.

A.2.5.2. The EUT is replaced by an in-band antenna connected to a signal generator tuned to the frequency of interest. A 10dB attenuator was connected to improve matching.

A.2.5.3. The transmit and receive antennas were vertically polarised at a fixed height of 1.5 metres.

A.2.5.4. The signal generator level is then adjusted to give a level equal to that obtained from the EUT.

A.2.5.5. The radiated power is given by the formula below.

$$\text{True Signal level} = \text{Signal Generator Level} - \sum L + \text{Ag}$$

where:

$\sum L$ is the sum of the losses, i.e. cable loss.
Ag is the isotropic gain of the antenna.

A.2.5.6. The measurement shall be repeated for horizontal polarisation.

A.2.6. Peak Power Spectral Density

A.2.6.1. As specified by 15.407(a)(5), the Peak Power Spectral Density was measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test.

A.2.6.2. The EUT was set to transmit on the required channel at maximum transmit power. The channels stated in section 5.2 were tested.

A.2.6.3. The measurement was performed on both polarities of the EUT's antenna.

A.2.6.4. A spectrum analyser was connected to the antenna port. The centre frequency was set the nominal transmit frequency of the EUT. A suitable span was selected and the units were set to dBm/Hz.

A.2.6.5. The Peak Power Spectral Density could then be measured. A factor of 60dB was used to convert from dBm/Hz to dBm/MHz.

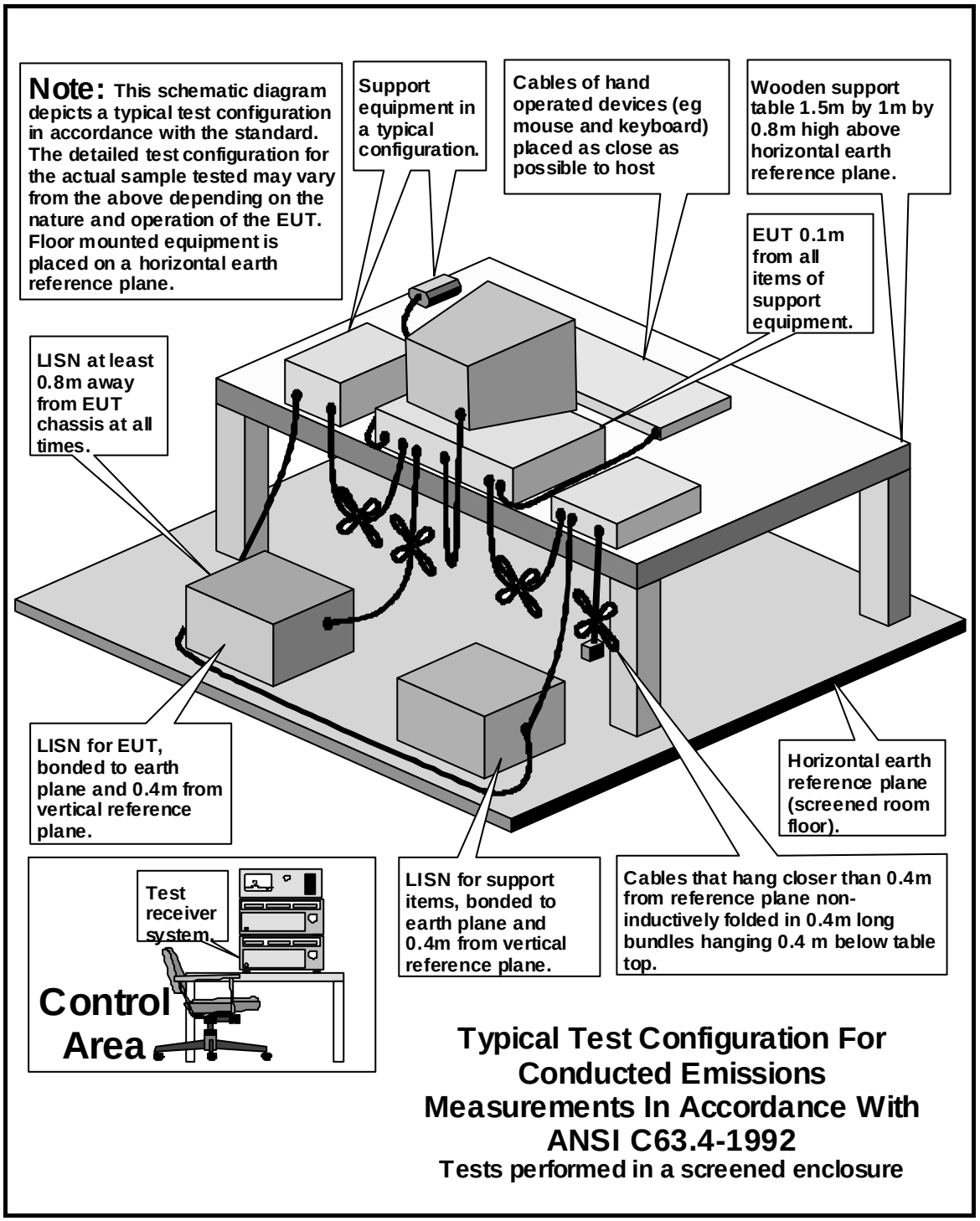
A.2.6.6. The EUT was set to the next channel and sections A.2.6.2. to A.2.6.5. were repeated.

Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\42151JD01\EMICON	Test configuration for measurement of conducted emissions
DRG\42151JD01\EMIRAD	Test configuration for measurement of radiated emissions
DRG\42151JD01\001	Schematic diagram of the EUT, support equipment and interconnecting cables used for the test
DRG\42151JD01\002	Substitution measurement test set-up

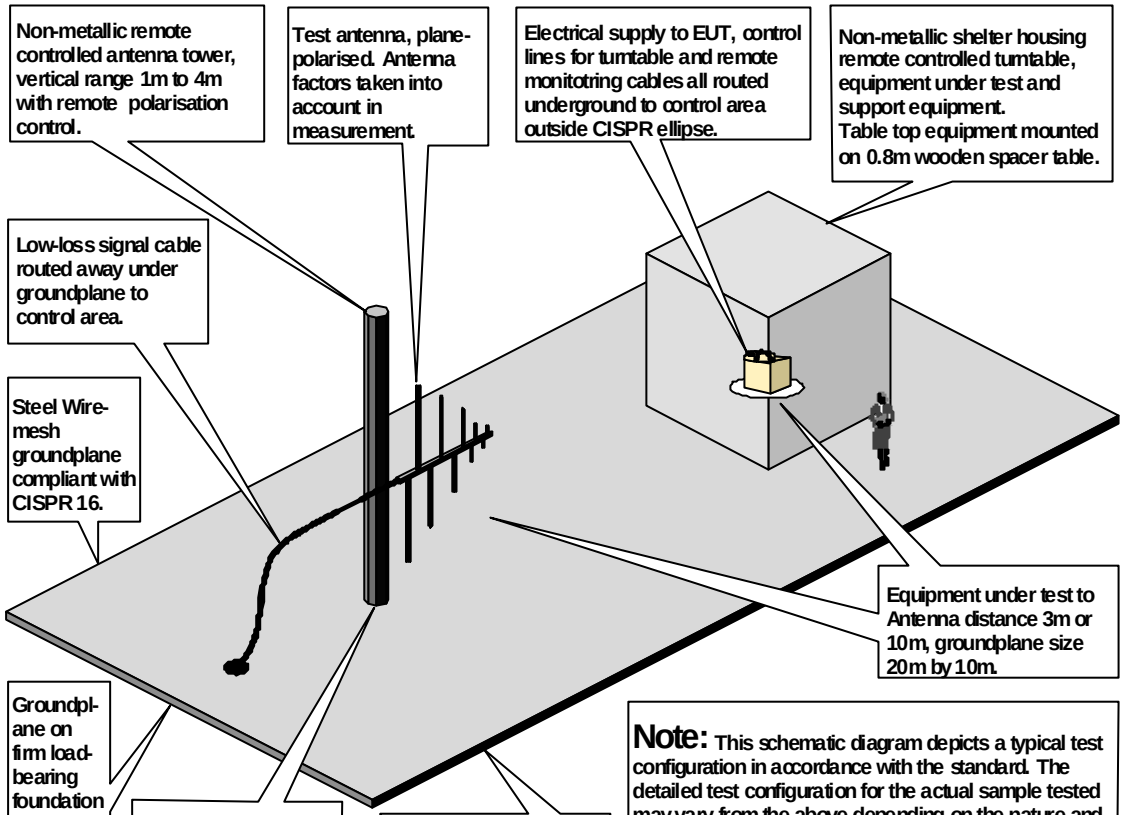
DRG\42151JD01\EMICON



Typical Test Configuration For Conducted Emissions Measurements In Accordance With ANSI C63.4-1992

Tests performed in a screened enclosure

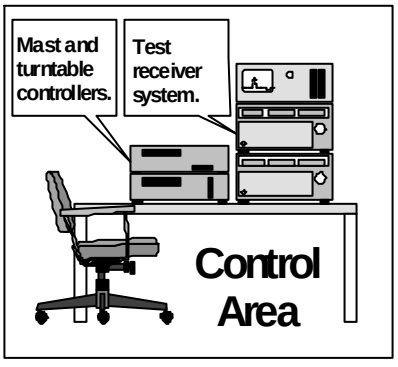
DRG\42151JD01\EMIRAD



Note: This schematic diagram depicts a typical test configuration in accordance with the standard. The detailed test configuration for the actual sample tested may vary from the above depending on the nature and operation of the EUT.
The test site used by RFI is nominally at ground level.
All electrical cables run underground.
All other dimensions in accordance with the standard.

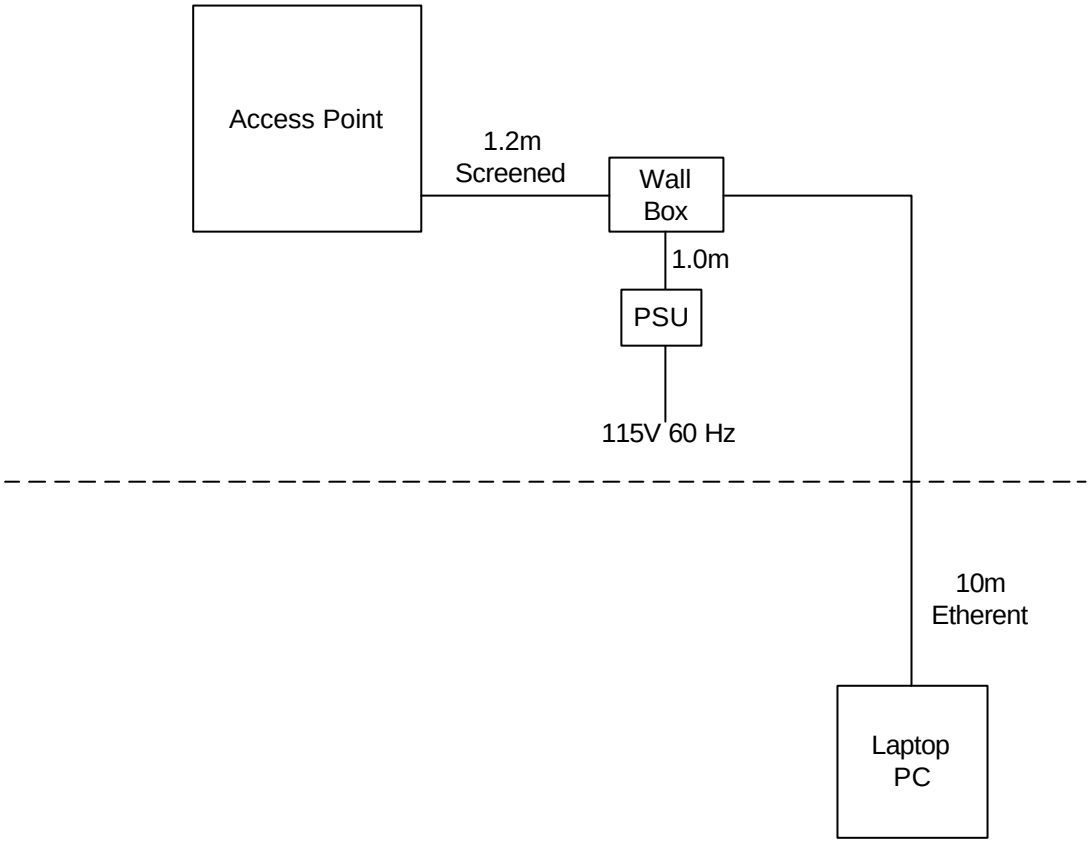
Test Configuration For Radiated Emissions Measurements

Reflection-free area: >60m by 52m (CISPR ellipse)
Groundplane Earthed
Control room outside CISPR ellipse



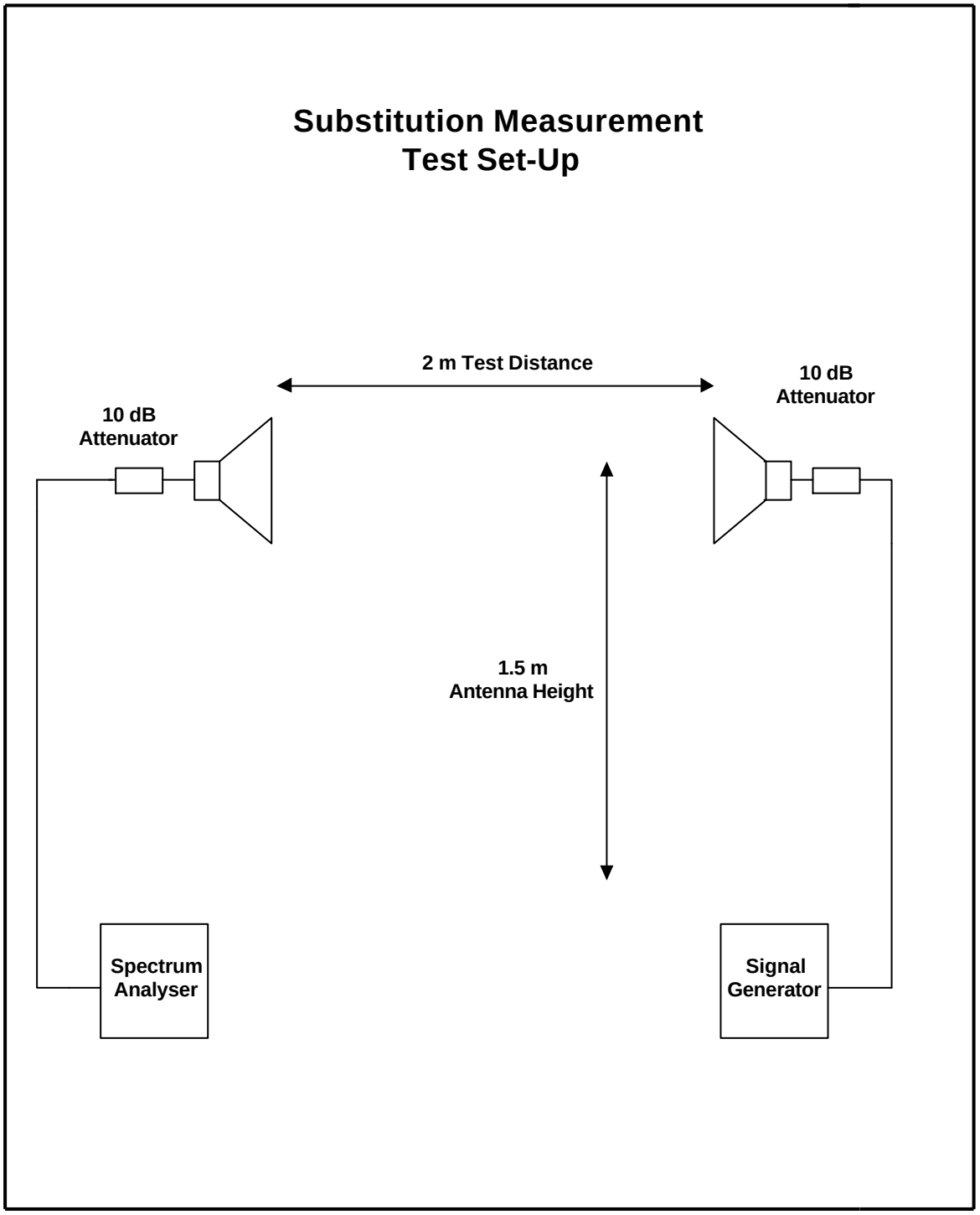
DRG\42151JD01\001

Configuration of EUT and Local Support Equipment



Configuration of Remote Support Equipment

DRG\42151JD01\002



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