BS EN 55032:2015+A1:2020

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Polarization		Horizontal	Vertical			
<i>D</i> (m)	5	5	5	5		
<i>H</i> ₁ (m)	1 – 4	1 – 4	1 – 4	1 – 4		
<i>H</i> ₂ (m)	1	2	1	1,5		
Frequency (MHz)	NSA (dB)					
30,00	20,7	15,6	11,4	12,0		
35,00	18,2	13,3	10,1	10,7		
40,00	16,0	11,4	8,9	9,6		
45,00	14,1	9,8	7,9	8,6		
50,00	12,4	8,5	7,1	7,8		
60,00	9,5	6,3	5,6	6,3		
70,00	7,2	4,6	4,3	5,2		
80,00	5,3	3,2	3,3	4,3		
90,00	3,7	2,0	2,4	3,5		
100,00	2,3	1,0	1,6	2,9		
120,00	0,1	-0,7	0,3	2,1		
140,00	-1,7	-2,1	-0,6	1,7		
160,00	-3,1	-3,3	-1,3	1,0		
180,00	-4,3	-4,4	-1,8	-1,0		
200,00	-5,3	-5,3	-2,0	-2,6		
250,00	-7,5	-6,7	-3,2	-5,5		
300,00	-9,2	-8,5	-6,2	-7,5		
400,00	-11,8	-11,2	-10,0	-10,5		
500,00	-13,0	-13,3	-12,5	-12,6		
600,00	-14,9	-14,9	-14,4	-13,5		
700,00	-16,4	-16,1	-15,9	-15,1		
800,00	-17,6	-17,3	-17,2	-16,5		
900,00	-18,7	-18,4	-17,4	-17,6		
1 000,00	-19,7	-19,3	-18,5	-18,6		
These data apply to antennas that have at least 250 mm of RGP clearance when the centre of the antenna is 1 m above the RGP in vertical polarization. <i>D</i> measurement distance <i>H</i> beight of the receiving antenna						

Table C.3 – 5 m OATS/SAC NSA values

 H_2^1 height of the transmitting antenna

Annex D

(normative)

Arrangement of EUT, local AE and associated cabling

D.1 Overview

D.1.1 General

The intention of this publication is to measure the emissions from the EUT in a manner that is consistent with its typical arrangement and use. The measurement arrangement of the EUT, local AE and associated cabling shall be representative of normal practice.

A) This annex defines the arrangement of the EUT, local AE and associated cabling. This standard does not define the use of CMADs for radiated emission measurements and so they shall not be placed on cables leaving the test site. A:

The EUT shall be arranged in accordance with the requirements of Table D.1

Intended operational arrangement(s) of MME	Measurement arrangement	Remarks
Table-top only	Table-top	
Floor-standing only	Floor-standing	
Can be floor-standing or table- top	Table-top	
Rack mounted	In a rack or table-top	
Other, for example wall mounted, ceiling mounted, handheld, body worn	Table-top	With normal orientation If the equipment is designed to be mounted on a ceiling, the downward- facing portion of the EUT may be oriented facing upward.

Table D.1 – Measurement arrangements of EUT

If a physical hazard would be caused by testing the device on a table top, then it can be arranged as floor standing and the test report shall document the decision and justification.

All cables that are considered part of the EUT shall be arranged as for normal use subject to length restrictions given in Table D.2 and subject to the requirement to minimise the size of the arrangement. For example, the keyboard and mouse of a personal computer set-up shall be placed in front of the monitor.

The following arrangements may be used to limit the effects of adverse AE emissions or to reduce measurement time, as long as the arrangement can be shown not to reduce the emissions measured from the EUT:

- placing AE below the RGP;
- placing AE below the test volume of a FAR; or,
- placing AE outside the measurement area when it is normally located distant from the EUT.

An EUT intended for rack mounting may be arranged in a rack or as table-top equipment. An EUT that can be used in both floor standing and table-top configurations, or both floor standing and wall mounted configurations, shall be assessed in a table-top arrangement. However, if the usual installation is floor standing, then that arrangement shall be used.

The type and construction of cables used in the measurement set-up shall be consistent with normal or typical use. Cables with mitigation features (for example, screening, tighter/more twists per length, ferrite beads) shall only be used if it is the intention that all deployments will use these features. If the cable(s) have mitigation features, this detail shall be specified in the test report. Manufacturer-supplied or commercially available cabling shall be used, as specified in the installation manual or user manual.

A) Cables connecting to AE located outside the measurement area shall drop directly to, but be insulated from, the RGP (or turntable where applicable), and then be routed directly to the place where they leave the test site. The thickness of the insulation is specified in Table Clause D2.14 and is separate from any insulation that is part of the cable construction. However, cables which would normally be bonded to ground should be bonded to the RGP in accordance with normal practice or the manufacturer's recommendation. (A)

During conducted emission measurements on analogue/digital data ports, the cable between the EUT and the measurement device or probe shall be as short as possible and satisfy the requirements given in Table D.2.

For conducted emission measurements, where practical, any excessive length in AC mains cables shall be bundled non-inductively, at the midpoint between the EUT and the AMN. The bundle length shall be less than 0,4 m to satisfy the distances given in Table D.2. Cables between the EUT and AAN shall be kept as short as possible, and shall take the most direct path between the EUT port and the corresponding AAN port, and should not be bundled in order to meet the arrangement spacing defined in Table D.2.

If a cable requires bundling care should be taken to ensure that the bundle is formed noninductively and the cable characteristics are maintained.

For radiated emission measurement, mains cables shall drape vertically to (but be insulated from) the horizontal ground plane. Where practical, any excessive cable length shall be arranged non-inductively on the insulation.

Non-inductive bundling means that the cable is shortened by overlapping loops arranged with alternate end loops wound in opposite directions using the minimum practicable bend radius. Where bundling cannot be achieved, coiling of the cables shall be avoided.

The effective length of all loop-back cables not routed overhead shall be longer than 2 m. Where possible, loop-back cables shall be arranged so that outgoing line is not closely coupled to the return.

A) For conducted measurements, where possible, the effective length of the EUT mains cables shall be 1 m \pm 0,1 m. (A)

Cable length is the distance between cable connector ends, excluding any protruding pins, when the cable is laid straight. The effective cable length, is the distance between cable connector ends, excluding any protruding pins, when the cable includes one or more bundles. The effective cable length will be shorter than the actual length if the cable has been bundled.

Loads and/or devices simulating typical operating conditions shall be connected to at least one of each type of interface port of the EUT. If loading (or terminating) with a device of actual usage is not feasible, the port should preferably be loaded with a simulator. Where these options are not practical the port shall be loaded by the application of a typical impedance considering both the common and differential modes. These loads and/or devices shall be connected via a cable if this represents normal usage.

Where there are multiple ports of the same type the manufacturer shall determine whether to load these additional ports, considering:

- maximisation of the emission levels, for example, when adding additional cables does not significantly affect the emission level (for example varies less than 2 dB), it can be assumed a maximum has occurred;
- reproducibility;
- achievement of a representative configuration having regard to other requirements in this clause.

For example, additional cables with or without terminations may be connected to the EUT ports. This process may also be applied to establishing the number of similar elements (plug-in modules, internal memory, and so forth) within the EUT.

Where the EUT has more than one analogue/digital data port, ports shall be included in the measurement arrangement as follows:

- if there are multiple similar ports on the same card or module type, then it is acceptable to assess one typical port,
- where there are ports of the same type on different card or module types, then it is acceptable to assess one typical port on each card or module types.

The test report shall identify the ports assessed.

An EUT which requires a dedicated ground connection shall be bonded to the RGP or to the chamber wall or chamber floor in case of a FAR, with a grounding connection that is similar to that used in practice.

When making measurements in a FAR, any measurements of height are referenced to the bottom of the test volume.

NOTE When testing in a FAR, measurements of height are made to the top surface of the turntable or the top of the floor absorber when the floor absorber extends above the turntable.

Any antenna masts and supporting floors shall be in place during site validation. All other relevant conditions of Table D.1 and Table D.2 apply. For example, unpainted expanded polystyrene may be used as a supporting platform above the turntable.

A See Figure D.1 through Figure D.12 for examples of arrangements. A

Requirements for EUT spacing and distances are given in Table D.2.

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Table D.2 – Arrangement spacing, distances and tolerances

Table Clause	Element	Spacing/ Distances	Tolerance (±)	Measurement
D2.1	Spacing between any two elements on the measurement table (See ^c)	≥0,1 m	n/a	Both
D2.2	Spacing between any two elements where one or more of the elements are not on a table-top	Typical	n/a	Both
D2.3	Distance between the rack (or cabinet) containing the EUT and the vertically rising cabling which would normally leave the measurement facility	≥0,2 m	n/a	Both
D2.4	Spacing between AMN and EUT	0,8 m	0,08 m	Conducted
D2.5	Spacing between AMN and local AE	≥0,8 m	n/a	Both
D2.6	Spacing between AAN and EUT	0,8 m	0,08 m	Conducted
D2.7	Horizontal spacing between EUT and current probe (or 150 Ω resistor) (See ^b) Spacing between current probe and 150 Ω resistor Spacing between 150 Ω resistor and optional ferrites (CMAD)	0,3 m to 0,8 m 0,1 m 0,1 m	0,03 m 0.01 m 0,01 m	C.4.1.6.3.
D2.8	Horizontal spacing between EUT and current probe (See ^b) Spacing between current probe and CVP Spacing between 150 Ω resistor and optional ferrites (CMAD)	0,3 m 0,1 m 0,1 m	0,03 m 0.01 m 0,01 m	C.4.1.6.4.
	Space between the cable under test and the RGP.	0,04 m	0,01 m	
D2.9	Spacing between AAN and local AE	≥0,8 m	n/a	Conducted
D2.10	Measurement distance when testing frequencies up to 1 GHz. See Table A.2, Table A.4, Table A.6 and Table A.7	3 m to 10 m	0,1 m	Radiated
D2.11	Measurement distance when testing frequencies above 1 GHz. See Table A.3, Table A.5 and Table A.7	1 m to 10 m	0,1 m	Radiated
D2.12	Spacing between: EUT, local AE and associated cabling; and metal surfaces and objects other than the RGP This spacing does not apply when a combination of table- top and floor-standing equipment is measured. In this case the table-top EUT may be 0,4 m from the vertical RGP as shown in Figure D.7	≥0,8 m	n/a	Conducted
D2.13	Thickness of insulation between floor standing EUT and local AE and the RGP	≤0,15 m	n/a	Both
D2.14	Thickness of insulation between cabling to AE (whether local or located outside the test area, including power cabling) and the Horizontal RGP. This only covers the portion of this cabling that is routed directly above the Horizontal PGP.	10 mm to 150 mm	n/a	Both
D2 15	Height to the top of table for radiated measurements	0.8 m	0.01 m	Radiated
D2.16	Height to the top of table for conducted measurements (with Vertical RGP)	0,8 m	0,01 m	Conducted
	Height to the top of table for conducted measurements (with Horizontal RGP)	0,4 m		
D2.17	Spacing between table-top EUT, local AE and associated cabling and the RGP	0,4 m	0,04 m	Conducted
	For measuring analogue/digital data ports, the line under test shall be kept 0,4 m distant from the RGP for as long as possible before being run to the termination point. For testing using C.4.1.6.3 this also includes the cable from the measurement device to the AE.			
	The section of cable running to and from the termination point shall be exempt from this RGP spacing requirement.			
D2.18	Spacing between: table-top EUT/AE cables or bundled EUT/AE cables draped over the back of the table; and the RGP	0,4 m above the RGP	0,04 m	Both

Table Clause	Element	Spacing/ Distances	Tolerance (±)	Measurement
	This may be achieved by a non-conductive support.			
D2.19	Minimum height of the cables connecting table-top and floor standing parts	(See ^a)	n/a	Both
^a Lowest of: 0,4 m; or connector height.				
^b Where the test arrangement is 0,4 m from a vertical RGP the horizontal spacing is from the projection of the EUT onto the vertical RGP, to the current probe. See Figure D.4.				

^c Except where MME ports use technologies that require a specific physical alignment and spacing of less than 0,1 m to operate as intended.

Measurement types have the following meaning:

- Conducted = All types of conducted measurements

- Radiated = All types of radiated measurements

- Both = All types of conducted measurements and all types of radiated measurements

Where manufacturer-provided cables have to be used and are too short to meet the requirements of this table, the equipment shall be arranged to be as close to the requirements of this table as is reasonably practical and the actual arrangement shall be described in the test report.

The EUT, local AE and associated cabling shall be arranged in the most compact practical arrangement while respecting typical spacing and the requirements of this table.

Where the EUT is a module as defined in Figure 2, the distances specified relative to the EUT are measured to the surface of the host.

Where the EUT is rack mounted, the distances specified relative to the EUT are measured to the surface of the rack.

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D.1.2 Table-top arrangement

The following specific arrangements apply.

Equipment, including the power supply, intended for table-top use shall be placed on a nonconductive table of sufficient size to hold the EUT, local AE and associated cabling. Where practical, the rear of the EUT should be flush with the rear of the table.

For radiated measurements the table shall be made of a material with a dielectric constant which minimises the impact on the results, for example, by the use of unpainted expanded polystyrene. Subclause 5.5.2 of A CISPR 16-1-4:2010/ AMD1:2012 (A) describes a measurement to help ensure that the dielectric qualities of the material used for construction of the table are appropriate.

The arrangement of external power supply units (including AC/DC power converters) shall meet the requirements of Table D.2. Where possible, cables that connect between modules or units shall hang over the back of the table. If a cable hangs closer than 0,4 m from the horizontal RGP (or floor), the excess shall be folded at the cable centre into a bundle no longer than 0,4 m, such that the bundle is 0,4 m above the horizontal RGP.

If the mains port input cable is less than 0,8 m long, (including power supplies integrated in the mains plug) an extension cable shall be used such that the external power supply unit is placed on the measurement table. The extension cable shall have similar characteristics to the mains cable (including the number of conductors and the presence of ground connection). The extension cable shall be treated as part of the mains cable.

Power supply output cables shall be treated as inter-unit cables.

Equipment may be stacked if this is a normal arrangement for this equipment.

 \bigcirc Example measurement arrangements are given in Figure D.1 to Figure D.5, Figure D.8, Figure D.11 and Figure D.12. \bigcirc

D.1.3 Floor standing arrangement

Where cable routing is specified by the manufacturer, this routing shall be used.

Where the inter-unit cabling is typically routed overhead, it shall be routed vertically to an overhead support. Overhead inter-unit cables shall rise from the first unit up to the support, run along the support, and drop down into the other unit. Overhead exit cables shall rise from the first unit up to the support, run along the support to a specified distance, drape down to the RGP, and route out of the facility to remote AE. Excess cable shall be bundled non-inductively on, but separated from, the RGP (respecting separation distances as defined in Table D.2).

Mains cabling shall drape vertically to (but be insulated from) the horizontal RGP.

The EUT shall be insulated (by insulation of maximum thickness of 150 mm) from the horizontal reference ground plane. If the equipment requires a dedicated ground connection, this shall be provided and bonded to the RGP.

Examples are given in Figure D.6 and Figure D.9.

D.1.4 Combinations of table-top and floor standing EUT arrangement

The following specific arrangements apply.

For the assessment of a combination of table-top and floor standing EUT, two RGPs may be required. The horizontal plane is always the RGP for the floor standing equipment while the RGP for the table-top equipment during conducted emission measurements may be either horizontal or vertical. The inter-unit cables between a table-top unit and a floor standing unit which are long enough to drape on the horizontal RGP shall be non-inductively bundled (or if too short or stiff for bundling, arranged but not-coiled) and placed on the table or supported at 0,4 m or at the height of the lowest cable entry point if this is below 0,4 m.

Examples of general arrangements are given in Figure D.7 and Figure D.10.

D.1.5 Arrangements for radiated measurement in a FAR

Where necessary, an access hole should be provided in the centre of the turntable to facilitate routing of cables.

Mains power outlets may be placed on the surface of the turntable (or supporting element), if the site validation requirements for the chamber can be met in this configuration.

The arrangement of the EUT and local AE shall be identical to those used for measurements using a OATS/SAC/FSOATS except for cables that leave the test area. These cables shall be routed horizontally with a minimum exposed length of 0,8 m, before being routed vertically with a minimum of exposed length of 0,8 m, to the bottom of the test volume (See Figure D.12). They shall then be routed to the centre of the turntable where, if possible the cables shall drape vertically downward. The cables shall then leave the chamber by the shortest possible route to minimise any impact. Where the cables are shorter than 1,6 m, as defined by the manufacturer, then the horizontal component shall be as close to 0,8 m as possible.

Example measurement arrangements are given in Figure D.11 and Figure D.12.

D.2 MME-related conditions for conducted emission measurement

D.2.1 General

During measurements of conducted emissions, any required dedicated ground connection of the EUT shall be made to the reference point of the AMN. Where not otherwise provided or specified by the manufacturer, this ground connection shall be of the same length as the mains port cable and run parallel to the mains port cable at a separation distance of not more than 0,1 m.

"Coaxial" broadcast receiver tuner ports shall be connected to an AAN (or a CDN as defined in IEC 61000-4-6) that provides a 150 Ω common mode termination to ground and is bonded to the RGP.

In addition to the general principles given above the following requirements apply.

The mains cable of the unit being assessed shall be connected to one AMN. All other units of the EUT and AE shall be connected to a second (or multiple) AMN(s). It is acceptable to connect these other equipments to an AMN via extension cables that include one or multiple socket outlets. Where additional socket outlets are needed, the extension shall be as short as practical. All AMNs shall be bonded to a RGP.

For AMNs mounted below the RGP an extension cable may be used. The AMN specification shall be met at the connection point for the EUT (the end of the extension cable or power strip) with at least 0.8 m spacing between the EUT and the connection point on the extension cable.

Where the EUT is a collection of equipment with multiple units, each having its own power cable, the point of connection for the AMN is determined by the following rules:

- for an EUT that has several modules, each with its own power cable (however terminated) and for which the manufacturer provides a power strip (multi-socket mains splitter) with a single power cable for connection to the external power source, a single measurement shall be performed at the mains input to that power cable;
- power cables or terminals which are not specified by the manufacturer to be connected via a host unit shall be measured separately;
- power cables or field wiring terminals (mains input terminals) which are specified by the manufacturer to be connected via a host unit or other power-supplying equipment shall be connected as described by the manufacturer;
- where a special connection is specified, the necessary hardware to effect the connection shall be supplied by the manufacturer for the purpose of this measurement.

In all other cases the conducted emissions on each individual EUT with its own power cable that is terminated in a power supply plug of a standard design (IEC TR 60083 for example) shall be measured separately.

Any AAN used during conducted emission measurements shall be selected and configured to be representative of the network in which the EUT is intended to operate. All ports of the AAN shall be correctly terminated in accordance with D.1. Where the 1 m requirement cannot be achieved, because of the position of the power input port/wired network port, then the effective length shall be as short as possible. In the case of EUTs including floor standing equipment the cable connecting the analogue/digital data port to the AAN may be positioned perpendicular to the EUT for a distance between of 0,3 m and 0,8 m then drop vertically to (but be insulated from) the horizontal RGP before being extended to the AAN. In these cases any bundling may be located on (but be insulated from) the ground plane

D.2.2 Specific conditions for table-top equipment

The RGP shall have a minimum size of 2 m by 2 m and shall extend a minimum of 0,5 m beyond the EUT, local AE and associated cabling in all directions.

Alternative 1: The measurement shall be performed using a vertical RGP. The rear of the EUT, local AE and associated cabling shall be 0,4 m from the vertical RGP. All ground planes in use shall be bonded together. AMN(s) and AAN(s) in use shall be bonded to either the vertical RGP or other metal planes bonded to it.

The portions of signal cables that hang over the rear of the table shall be positioned at a distance of 0,4 m from the vertical RGP and no less than 0,4 m from any horizontal RGP bonded to the vertical RGP. If necessary, maintain the separations using a fixture made of non-conductive material with an appropriate dielectric constant.

An example of the measurement arrangement is given in Figure D.2.

Alternative 2: The measurement shall be performed with a horizontal RGP. The EUT, local AE and associated cabling shall nominally be spaced 0,4 m above the horizontal RGP.

Example measurement arrangements are given in Figure D.3 and Figure D.5.

D.2.3 Specific requirements for floor standing equipment

If conducted emission measurements are undertaken within a SAC, the EUT, local AE and associated cabling shall be configured as defined in D.2.1. whilst meeting the general principles given in D.1.1. The AE cable routing shall be overhead if the EUT is designed for this configuration. Example measurement arrangements are given in Figure D.6.

D.2.4 Specific requirements for combined table-top and floor standing equipment

The configuration for conducted emission measurements shall be as defined in D.2.1 whilst meeting the general principles given in D.1.1.

The table-top equipment shall be assessed using alternative 1 or alternative 2 in D.2.2. The floor standing equipment shall be assessed on a horizontal RGP. If a vertical RGP is used for the table-top equipment, care shall be taken that the floor standing equipment is at least 0,8 m from the vertical RGP. This may require that the spacing between the table-top equipment and floor standing equipment be set at a small and convenient distance.

Example measurement arrangements are given in Figure D.7.

D.3 MME-related requirements for radiated measurement

D.3.1 General

 \square Unless some other configuration is typical of normal use, or specified by the manufacturer, mains cables shall drop vertically before being routed horizontally to the mains power outlet, maintaining the separation distances defined in Table clause D2.14. (A) This outlet should not protrude above the RGP. If the outlet has a metal case, it shall be bonded to the RGP. If the mains outlet has a protective earth, it shall be bonded to the RGP. If used, the AMN shall be installed under the RGP.

D.3.2 Requirements for table-top equipment

Excess length of cables shall only be included in the arrangement to represent normal installation and shall be bundled in line with D.1.1. An example measurement arrangement is given in Figure D.8.



Vertical coupling plane (for conducted measurements - alternative 1)

Figure D.1 – Example measurement arrangement for table-top EUT (conducted and radiated emission) (top view)





The 0,8 m distance specified between EUT/AE/PSU and AMN/AAN, is applicable only to the EUT being measured. If the device is AE then it shall be \ge 0,8 m.

Figure D.2 – Example measurement arrangement for table-top EUT (conducted emission measurement – alternative 1)

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