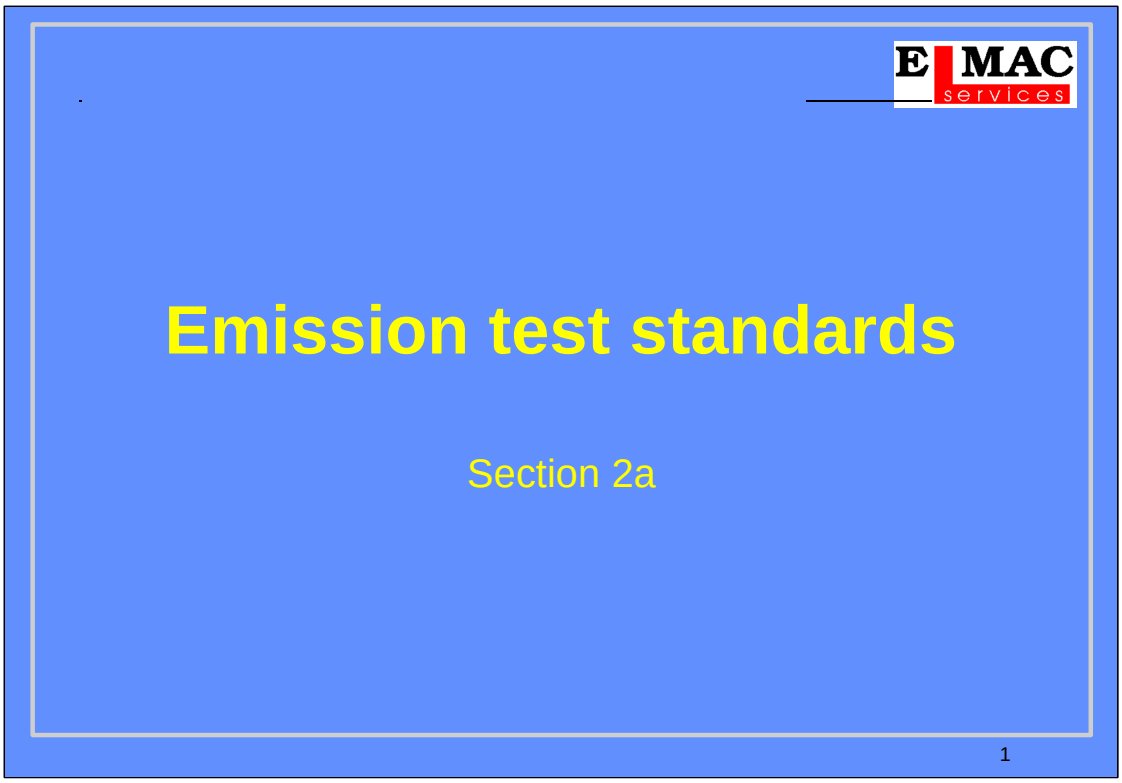
E MAC
services
Emission test standards
Section 2a
1

Outline

- Content of an emission standard
- CISPR22/EN 55022 for RF emissions tests
- Conducted test set up and limits
- Radiated test set up and limits

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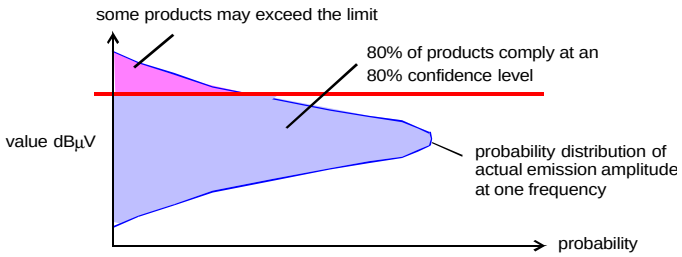
Content of a CISPR emission standard

- Scope
- Requirements (limits for each test method)
- Instructions for test:
  - equipment, method, layout
- Conformity assessment (80/80 rule)



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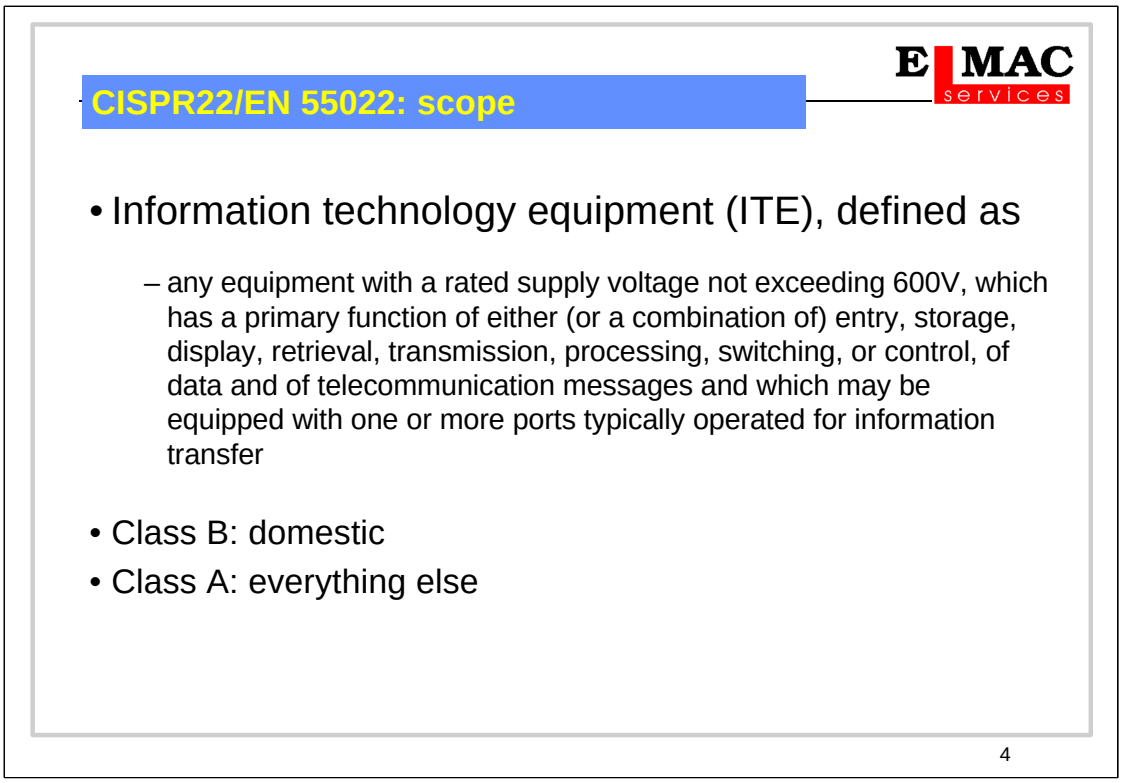
EMC emissions standards give recipes for testing along with limits to apply to the test results. The scope is a critical part of a standard as it defines as clearly as possible to what type of equipment the standard should apply. However, the three most significant standard test methods (in CISPR11, 14 and 22) are applied, through references in other product and generic standards, much more widely than their scope allows.

The test specification will prescribe the frequency ranges and methods of testing, including test layout and instrumentation. There is usually a catch-all requirement that the equipment under test should be operated and configured in a manner which maximizes the disturbance, consistent with typical applications. The implementation of this requirement is left up to the expertise of the test engineer.

Compliance of mass-produced items with an emissions standard does not imply that *all* products must emit less than the limit. The actual requirement for series production is that 80% of units will comply with the limit at an 80% confidence level. Although standards allow “for simplicity’s sake” just one product to be tested, this statistical statement can only be *proved* by testing several samples of a product. The following equation is provided to determine compliance of a group of samples, where k is a constant determined by the number of samples, x is the arithmetic mean of the measured value and S_n is the standard deviation:

$$x + kS_n \leq \text{limit value}$$

The recommended minimum number of samples is five but in exceptional circumstances a sample of three or four is acceptable. One implication of this rule is that non-compliance of *individual* products cannot be proved. CISPR standards carry the rider that *“the banning of sales... shall be considered only after tests have been carried out using the statistical method of evaluation”.*



CISPR 22 and its European equivalent EN 55022 apply directly to all equipment that falls within the definition above. Equipment for which all disturbance requirements in the frequency range are explicitly formulated in other standards are excluded; but there is a move to define the requirements for multi-function equipment (household appliances, for instance, that are microprocessor controlled with a data port) in terms of the published requirements in *each* applicable standard. The measurement methods specified in CISPR 22 are widely referenced in many product standards, including the ETSI radio standards, with the product standard referring to particular EUT configurations and operating modes, and applying either class A or class B limits.

The equipment categorization applicable directly under CISPR 22 are defined as follows:

Class B: equipment which satisfies the Class B limits, is intended primarily for the domestic environment, and may include equipment with no fixed place of use (portable equipment), telecomms terminal equipment powered by the network, personal computers and auxiliary connected equipment.

Class A: equipment which satisfies Class A limits but not Class B limits. CISPR 22 says that such equipment should not be restricted in its sale but should include a warning that in a domestic environment it may cause radio interference. However, under the EMC Directive it would not be allowable merely to include this warning in a product intended for domestic use that only met the Class A limits; products should meet all applicable standard requirements *for the environment for which they were intended*.

If the product falls under another product standard or the generic standards, and not directly under CISPR 22/EN 55022, then that standard defines the applicable limit, which will be either the Class A or Class B levels.

CISPR22/EN 55022: tests

- Conducted emissions 150kHz to 30MHz on the mains port
  - established test on L-E and N-E using mains LISN
- Conducted emissions 150kHz to 30MHz on telecommunications ports
  - new requirement, not yet well established
- Radiated emissions 30MHz to 1GHz at 3m or 10m distance on an open area test site
  - soon to be increased to 2.7GHz

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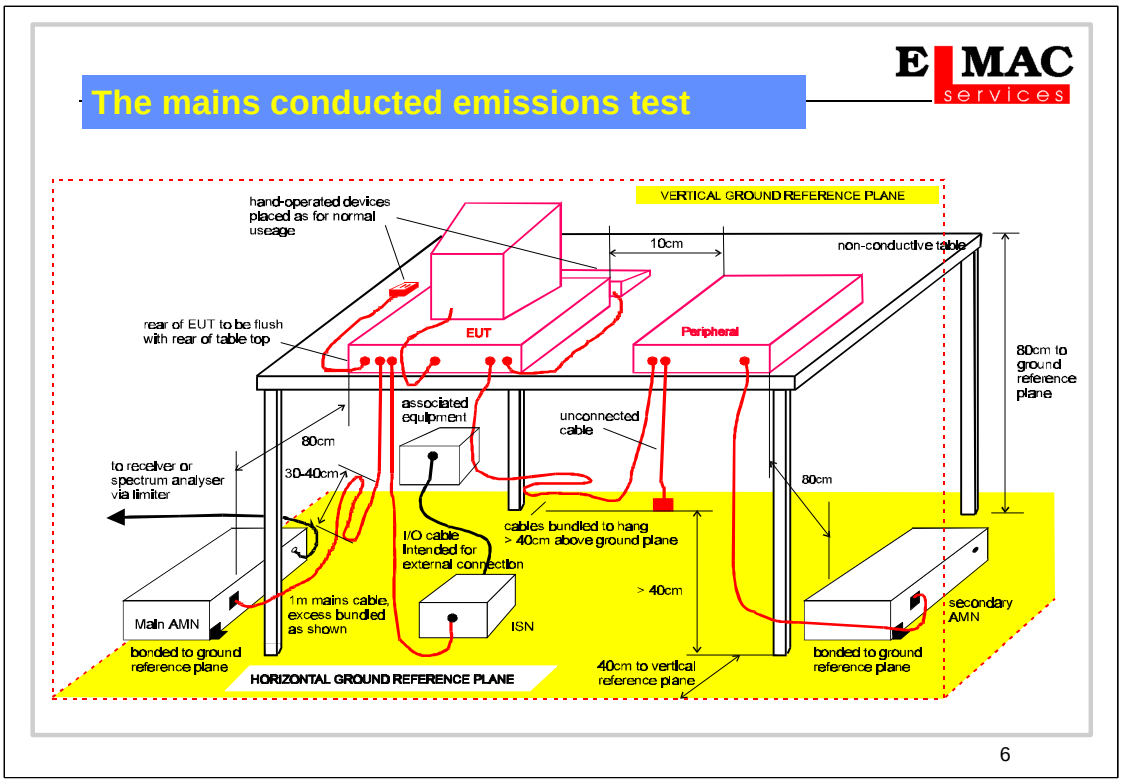
The two principal tests of mains conducted emissions and radiated emissions have now been joined by a third, that of telecom port conducted emissions. A telecom port is defined as a port which is intended to be connected to telecommunication networks (eg PSTN, ISDN), local area networks (eg Ethernet, Token Ring) and similar networks. A revision is in hand to make it clear that ports for connection to local components (e.g. serial and parallel ports, and video ports of PCs) are not meant to be included. The telecom port test method is a new arrival (in the 1997 third edition of the standard) and has many anomalies and difficulties.

By contrast the radiated and mains conducted test methods have been around since the inception of the standard in the early 1980s and are well understood. They have, though, been subject to some development and elaboration over the years, particularly in terms of:

- the test layout, configuration and operation of the EUT, four full pages and ten figures are devoted to these aspects;
- development of alternative test sites to the classic open area site.

There is also some concern to increase the upper limit of the frequency of testing to 2.7GHz for certain types of equipment, and to specify methods for testing of installations (in-situ tests).

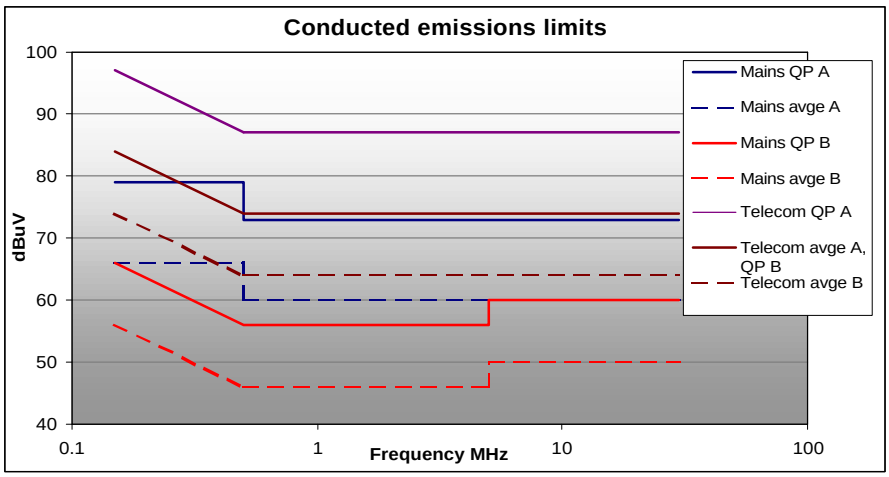


For table-top apparatus different standards allow the ground reference plane (GRP) to be either vertical or horizontal, but all require the EUT's closest face to be maintained at a distance of 40cm from the GRP, and at least 80cm from all other conductive surfaces. This is typically achieved with a wooden table either 40cm high off a conducting floor used as the GRP, or 80cm high and 40cm away from a conducting wall used as the GRP. Floor-standing EUTs should be placed on a conducting floor used as the GRP but not in electrical contact with it.

The distance between the boundary of the EUT and the closest surface of the AMN/LISN must be 80cm. The mains lead from the EUT to the AMN/LISN should preferably be 1m long and raised at least 10cm from the GRP for the whole of its length. Longer mains leads may be bundled non-inductively, but this introduces considerable variations into the results, and it is preferable to shorten them to the standard length. Alternatively, provide a standard wooden jig such that the bundling can be done repeatably.

Mains-powered peripherals that are necessary for the EUT's operations but which are not themselves under test should be powered from a separate AMN/LISN. Other connected leads should be terminated in their normal loads but should not extend closer than 40cm from the GRP.

CISPR22/EN 55022: conducted limits



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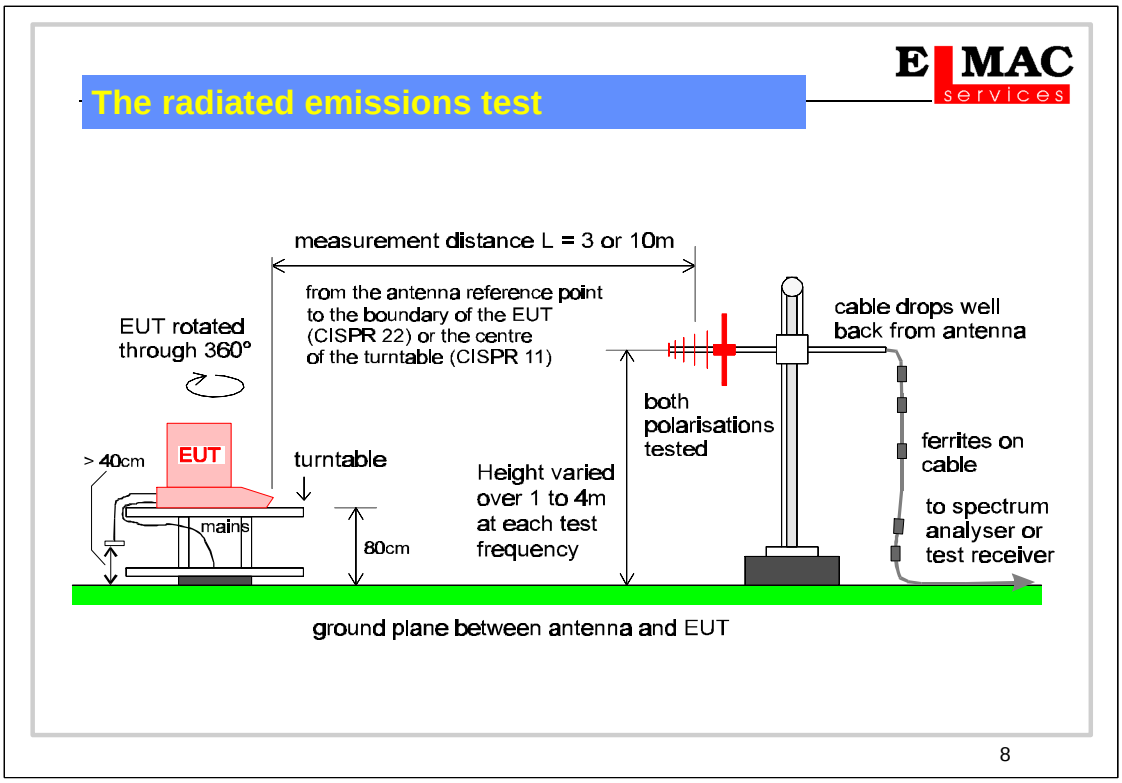
The conducted limits for mains ports are, as measured from live to earth and from neutral to earth with both a quasi peak (QP) and average detector in a 9kHz bandwidth:

	Class A		Class B	
Freq MHz	QP	Avge	QP	Avge
0.15	79	66	66	56
0.5	79	66	56	46
0.5	73	60	56	46
5	73	60	56	46
5	73	60	60	50
30	73	60	60	50

The limits for telecom ports are given as equivalent voltage or current limits, measured in common mode with a 150Ω load impedance. The voltage limits are

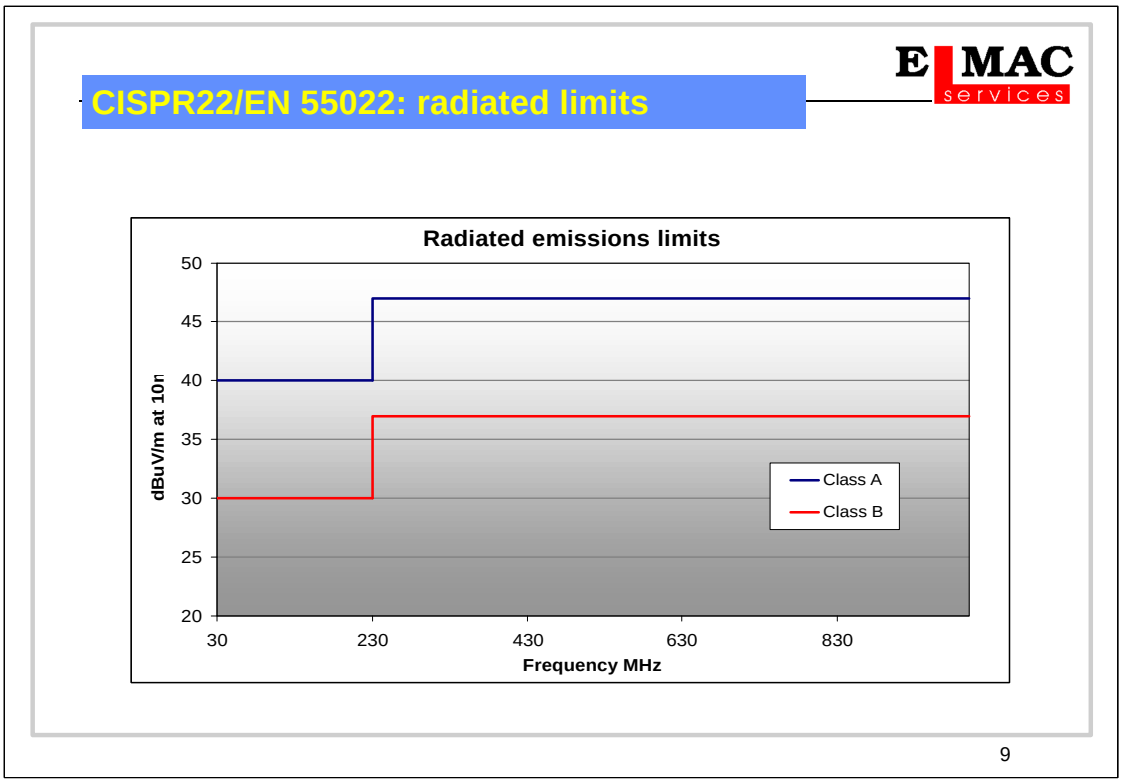
Frequency	QP A	Avg A	QP B	Avg B
0.15	97	84	84	74
0.5	87	74	74	64
30	87	74	74	64



CISPR 22 gives considerable detail for the test setup. Even so, much is left to the discretion of the test engineer, since no standard in general can dictate the layout for specific EUTs.

The measurement distance from the boundary of the EUT as it rotates to the antenna reference mark is defined as 10m, with 3m allowed as an alternative, with limits increased by a factor of 10/3 or 10.5dB. Most test labs take advantage of this allowance, although it worsens the measurement uncertainty. The EUT is positioned on the turntable at a height of 0.8m above the ground plane, with all cables that do not pass outside the chamber or off the site terminated more than 40cm above the ground plane. The turntable is usually wooden, although research has suggested that the dielectric effects of wood are significant in the UHF range, and a plastic table would be better. Cable layout is important - all cables should be arranged to give maximum radiated coupling, which typically means well spread out in a dipole fashion with respect to the EUT.

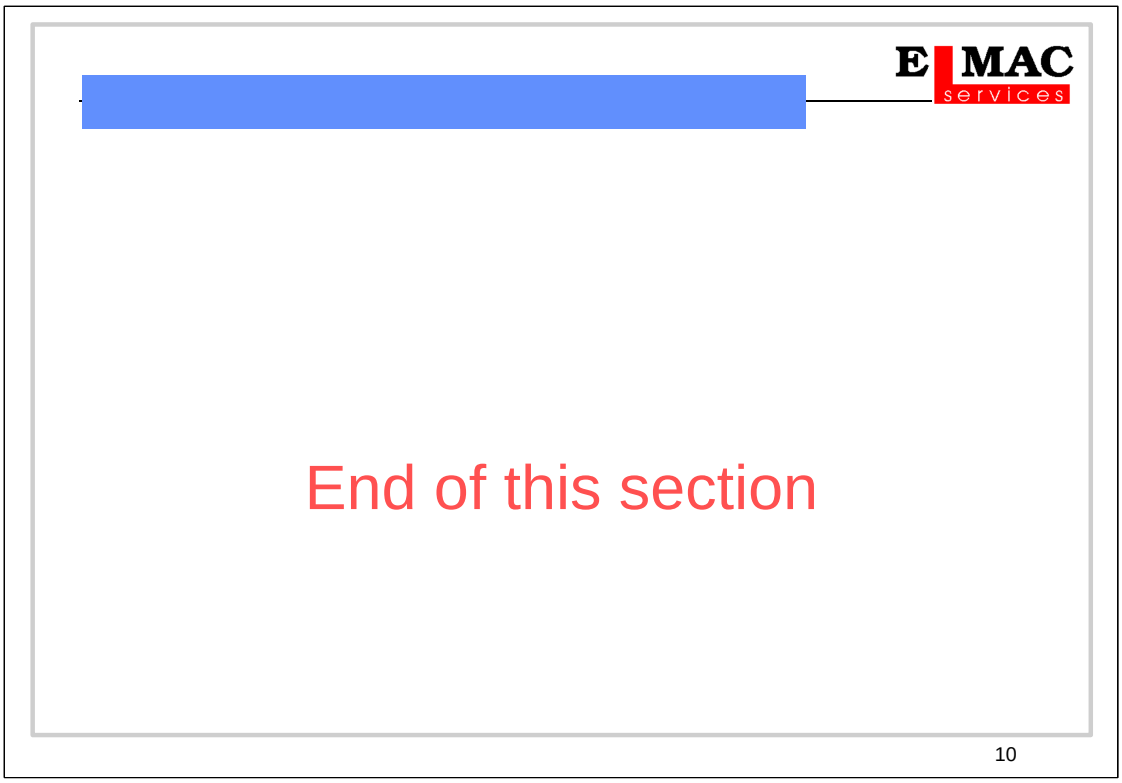
The antenna is mounted on a mast which allows the height scan from 1 to 4m. For minimum effect on the antenna, the cable feeding it should be carried horizontally some distance back from the antenna in line with its boom before dropping to the floor, or back to the rear wall of the chamber. This is to minimize its coupling with the antenna, especially in vertical polarization, which will reduce its effect on the antenna factor. Ferrite chokes on the cable, or a ferrite loaded cable, will also give an improvement.



The radiated limits are as follows:

Freq MHz	Class A	Class B	(dBµV/m at 10m distance)
30	40	30	
230	40	30	
230	47	37	
1000	47	37	

These are measured with the quasi-peak (QP) detector at 120kHz bandwidth.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