3.30 NRE02 RADIATED EMISSIONS, ELECTRIC FIELD, 10 kHz to 18 GHz

3.30.1 NRE02 Applicability

This requirement is applicable for radiated emissions from equipment and subsystem enclosures, all interconnecting cables, and antennas designed to be permanently mounted to EUTs (receivers and transmitters in standby mode). The requirement does not apply at the transmitter fundamental frequencies and the necessay occupied bandwidth of the signal.

The requirement is for testing from 10 kHz to 18 GHz for all applications.

Reference should also be made to **Clause 3.9.20**.

3.30.2 NRE02 Limits

Electric field emissions shall not be radiated in excess of those shown in Figures NRE02-1 through to NRE02-4. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized fields.

3.30.3 NRE02 Test Procedures

3.30.3.1 Purpose

This test procedure is used to verify that electric field emissions from the EUT and its associated cabling do not exceed specified requirements.

3.30.3.2 Test Equipment

The test equipment shall be as follows:

a. Measurement Receivers

b. Data Recording Device

c. Antennas

(1) 10 kHz to 30 MHz, 104 cm rod with impedance matching network. The signal output connector shall be bonded to the antenna matching network case.

(a) When the impedance matching network includes a preamplifier (Active Rod), observe the overload precautions in **Clause 3.6.7.3**.

Gegengewicht.

(b) Use a square counterpoise measuring at least 60 cm on a side.

In radio systems, a biconical antenna is a broad-bandwidth antenna made of two roughly conical conductive objects, nearly touching at their points

(2) 30 MHz to 200 MHz, Biconical, 137 cm tip to tip

(3) 200 MHz to 1 GHz, Double Ridge Horn, 69.0 by 94.5 cm opening

(4) 1 GHz to 18 GHz, Double Ridge Horn, 24.2 by 13.6 cm opening

d. Signal Generators

e. Stub Radiator Used to check emissions.

f. Capacitor, 10 pF

g. 50 µH LISNs

3.30.3.3 Set-Up

The test setup shall be as follows:

a. Maintain a basic test set-up for the EUT as shown and described in Category 501 Figures 501- 2 through to 501-6 and **Clause 3.6.8**. Ensure that the EUT is oriented such that the surface that produces the maximum radiated emissions is toward the front edge of the test set-up boundary.

b. Calibration. Configure the test equipment as shown in Figure NRE02-5.

c. EUT Testing

1. For rod antenna measurements, electrical bonding of the counterpoise is prohibited. The required configuration is shown in Figure NRE02-6. The shield of the coaxial cable from the rod antenna matching network shall be electrically bonded to the floor in a length as short as possible (not to exceed 10 cm excess length). A ferrite sleeve with 20 to 30 ohms impedance at 20 MHz shall be placed near the center of the coaxial cable length between the antenna matching network and the floor.

2. Antenna Positioning

a. Determine the test set-up boundary of the EUT and associated cabling for use in positioning of antennas.

b. Use the physical reference points on the antennas shown in Figure NRE02-6 for measuring heights of the antennas and distances of the antennas from the test set-up boundary.

i. Position antennas 1 metre from the front edge of the test set-up boundary for all set-ups

ii. Position antennas 120 cm above the floor ground plane.

iii. Ensure that no part of any antenna is closer than 1 metre from the walls and 0.5 metres from the ceiling of the shielded enclosure

(c) The number of required antenna positions depends on the size of the test set-up boundary and the number of enclosures included in the set-up.

i. For testing below 200 MHz, use the following criteria to determine the individual antenna positions:

a. For set-ups with the side edges of the boundary 3 m or less, only one position is required and the antenna shall be centred with respect to the side edges of the boundary

b. Set-ups with the side edges of the boundary greater than 3 m use multiple antenna positions at spacings as shown in Figure NRE02-7. Determine the number of antenna positions (N) by dividing the edge-to-edge boundary distance (in metres) by 3 and rounding up to an integer. For large equipment the test distance can be increased from for instance 1 m to 3 m. Then the number of antenna positions will decrease by a factor 9, and thus test time will reduce by a factor 9. To do this, a correction factor has to be applied (3->1 m = 10 dB), or. In other words, the antenna factor shall be 10dB higher. In case the limit is reached within 6 dB, a final measurement at 1 m shall be performed.

ii. For testing from 200 MHz up to 1 GHz: Place the antenna in a sufficient number of positions such that the entire width of each EUT enclosure and the first 35 cm of cables and leads interfacing with the EUT enclosure are within the 3 dB beamwidth of the antenna.

iii. For testing at 1 GHz and above: Place the antenna in a sufficient number of positions such that the entire width of each EUT enclosure and the first 7 cm of cables and leads interfacing with the EUT enclosure are within the 3 dB beamwidth of the antenna.

3.30.3.4 Procedures

The test procedures shall be as follows:

a. Verify that the ambient requirements specified in **Clause 3.6.4** of are met. Take plots of the ambient when required by the referenced paragraph.

b. Turn on the measurement equipment and allow a sufficient time for stabilization.

c. Using the system check path of Figure NRE02-5, perform the following evaluation of the overall measurement system from each antenna to the data output device at the highest measurement frequency of the antenna. For rod antennas that use passive matching networks, the evaluation shall be performed at the centre frequency of each band. For active rod antennas, the evaluation shall be performed at the lowest frequency of test, at a mid-band frequency, and at the highest frequency of test.

1. Apply a calibrated signal level, which is at least 6 dB below the limit (limit minus antenna factor), to the coaxial cable at the antenna connection point.

2. Scan the measurement receiver in the same manner as a normal data scan. Verify that the data recording device indicates a level within ±3 dB of the injected signal level.

3. For the 104 cm rod antenna, remove the rod element and apply the signal to the antenna matching network through a 10 pF capacitor connected to the rod mount as shown in Figure NRE02-8. Commercial calibration jigs or injection networks shall not be used.

4. If readings are obtained which deviate by more than ±3 dB, locate the source of the error and correct the deficiency prior to proceeding with the testing.

d. Using the measurement path of Figure NRE02-5, perform the following evaluation for each antenna to demonstrate that there is electrical continuity through the antenna.

1. Radiate a signal using an antenna or stub radiator at the highest measurement frequency of each antenna.

2. Tune the measurement receiver to the frequency of the applied signal and verify that a received signal of appropriate amplitude is present. Note: This evaluation is intended to provide a coarse indication that the antenna is functioning properly. There is no requirement to accurately measure the signal level.

e. Turn on the EUT and allow sufficient time for stabilization.

f. Using the measurement path of Figure NRE02-5, determine the radiated emissions from the EUT and its associated cabling.

1. Scan the measurement receiver for each applicable frequency range, using the bandwidths and minimum measurement times in Table 501-4.

2. Above 30 MHz, orient the antennas for both horizontally and vertically polarized fields.

3. Take measurements for each antenna position determined under **Clause 3.30.3.3d (3)** above.

3.30.3.5 Data Presentation

Data presentation shall be as follows:

a. Continuously and automatically plot amplitude versus frequency profiles. Manually gathered data is not acceptable except for plot verification. Vertical and horizontal data for a particular frequency range shall be presented on separate plots or shall be clearly distinguishable for a common plot.

b. Display the applicable limit on each plot.

c. Provide a minimum frequency resolution of 1% or twice the measurement receiver bandwidth, whichever is less stringent, and a minimum amplitude resolution of 1 dB for each plot.

d. Provide plots for both the measurement and system check portions of the procedure.

e. Provide a statement verifying the electrical continuity of the measurement antennas as determined in **Clause 3.30.3.4d**.

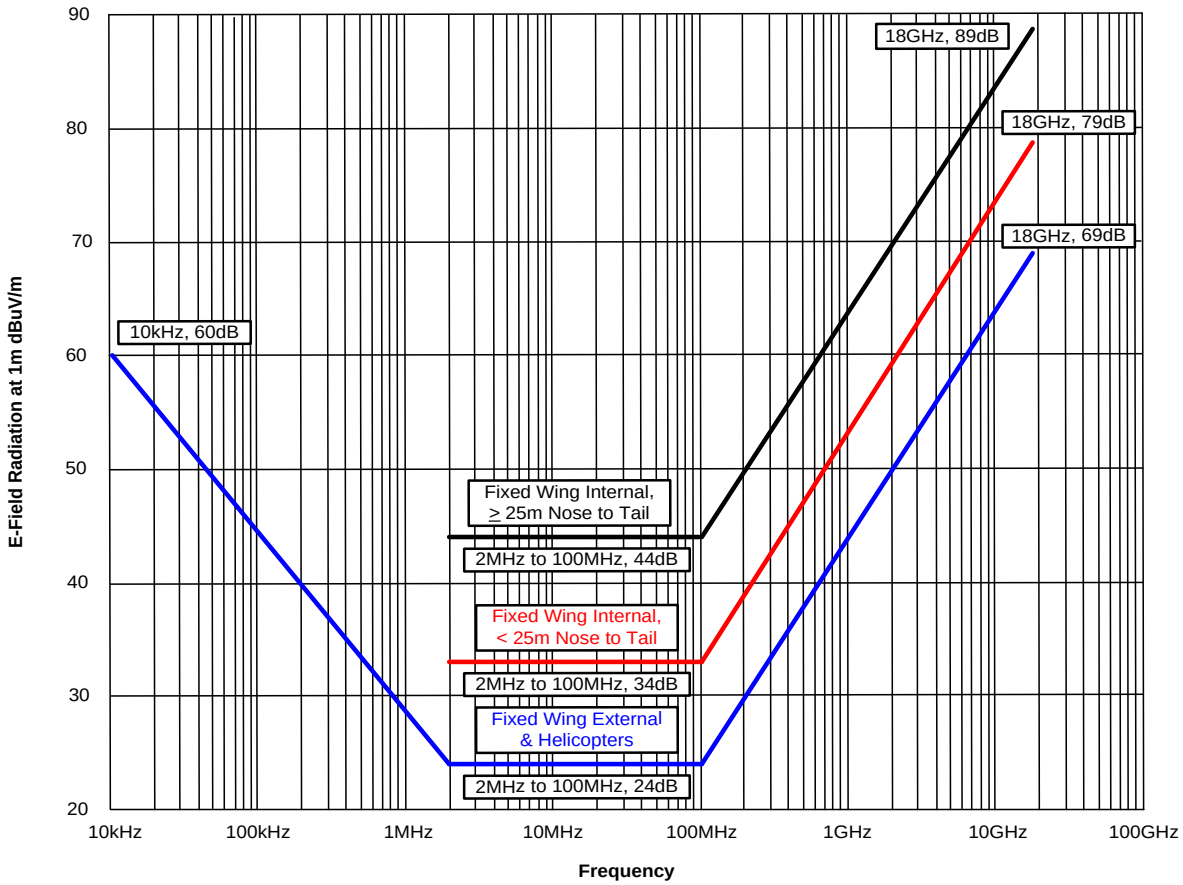


Figure NRE02-1 Limits for Applications in the Air and Space Environments

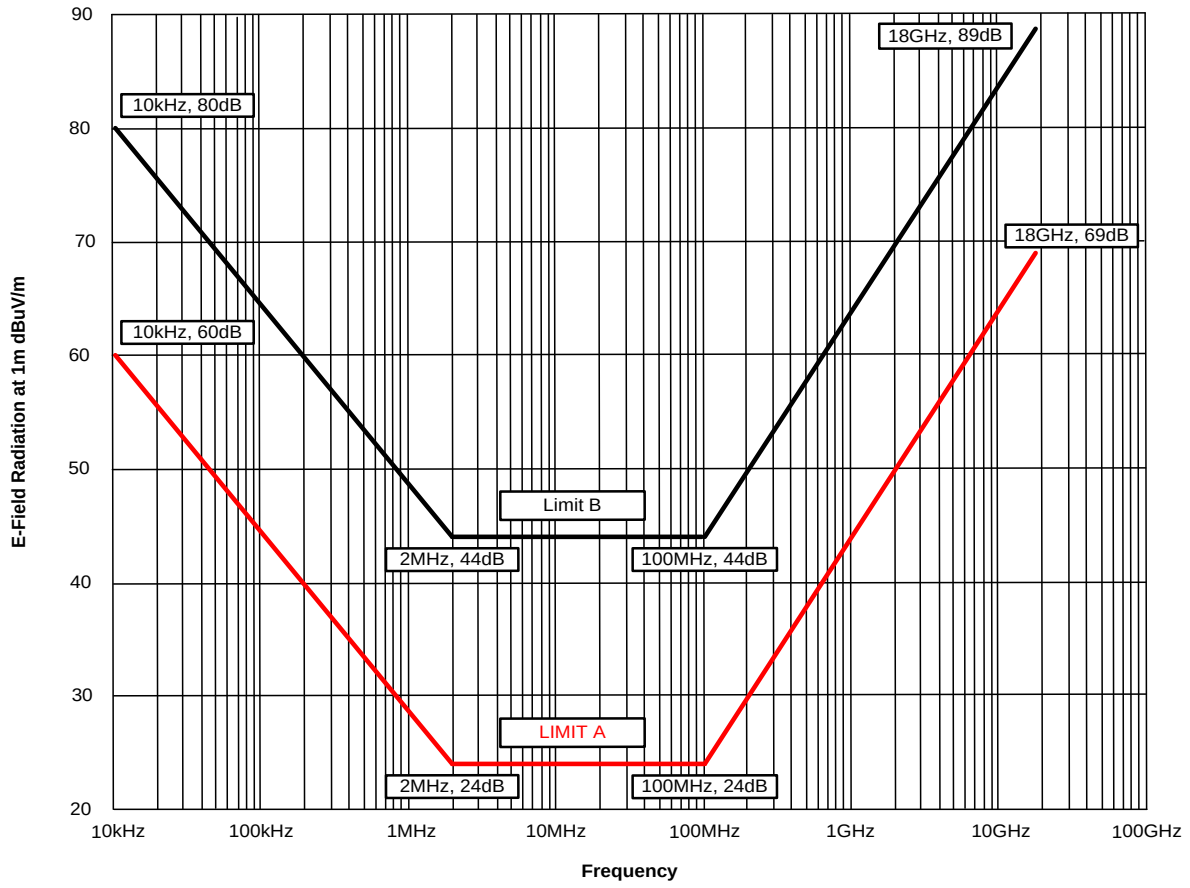


Figure NRE02-2 Limits for Applications in the Land Environment

Note 1: The use of limit A above is reserved for all land based EUTs procured for Army use and Mobile Sea Systems, deployed in a land based role.

Note 2: Limit B is utilised for fixed Sea System Installations such as those associated with Port and RADAR emplacements,

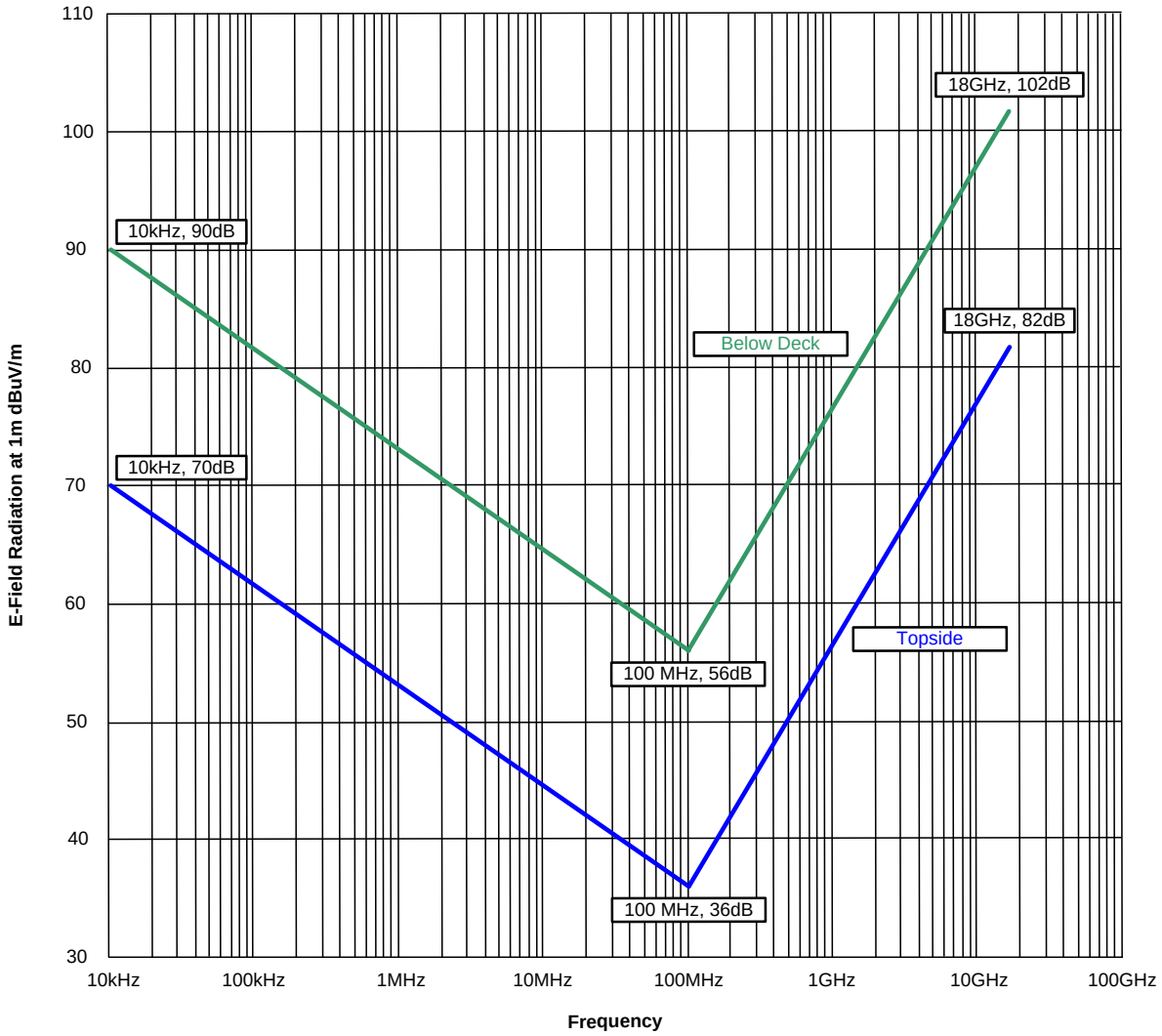


Figure NRE02-3 Limits for Sea Environment Above Deck

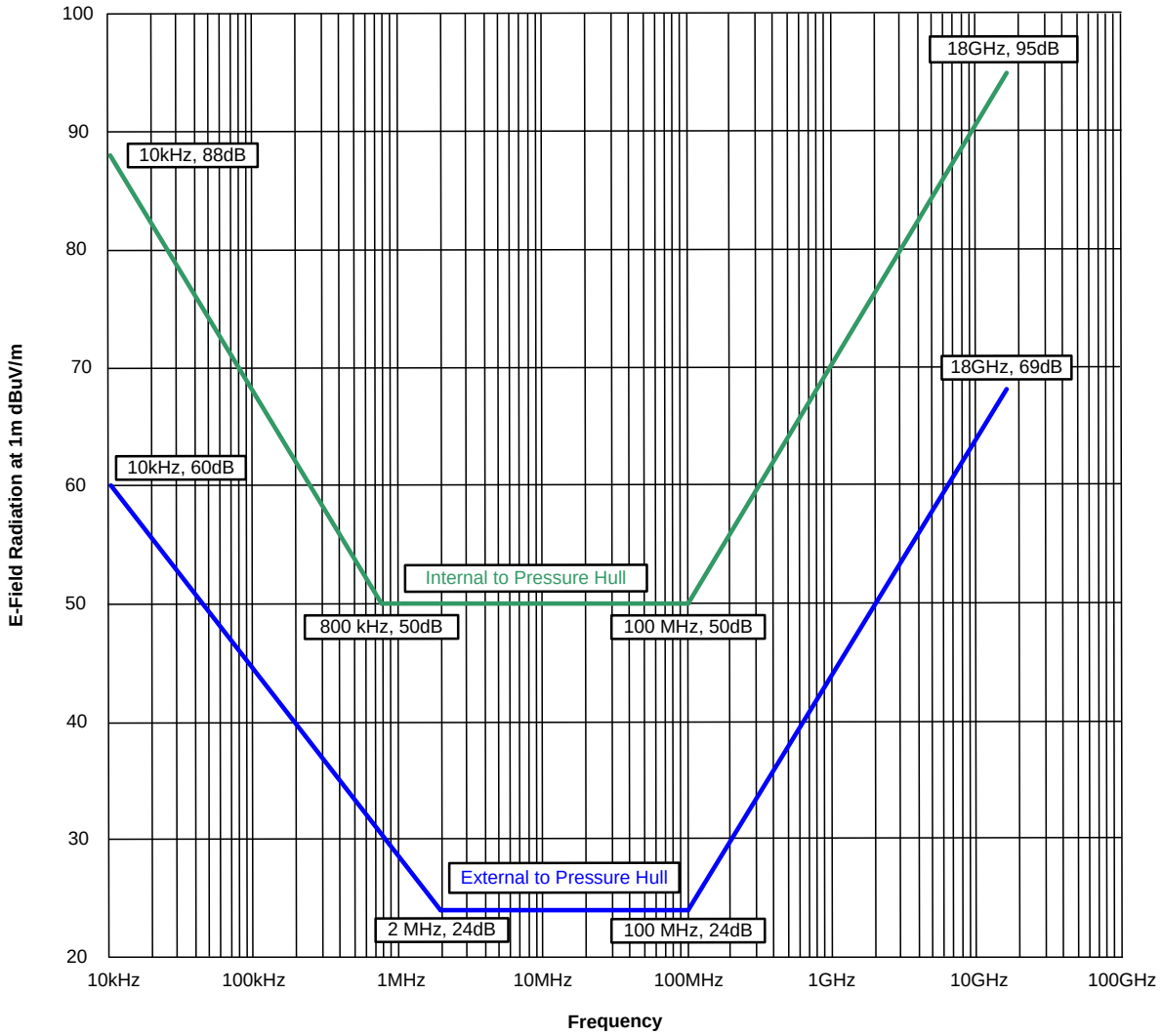


Figure NRE02-4 Limits for Submarine Application

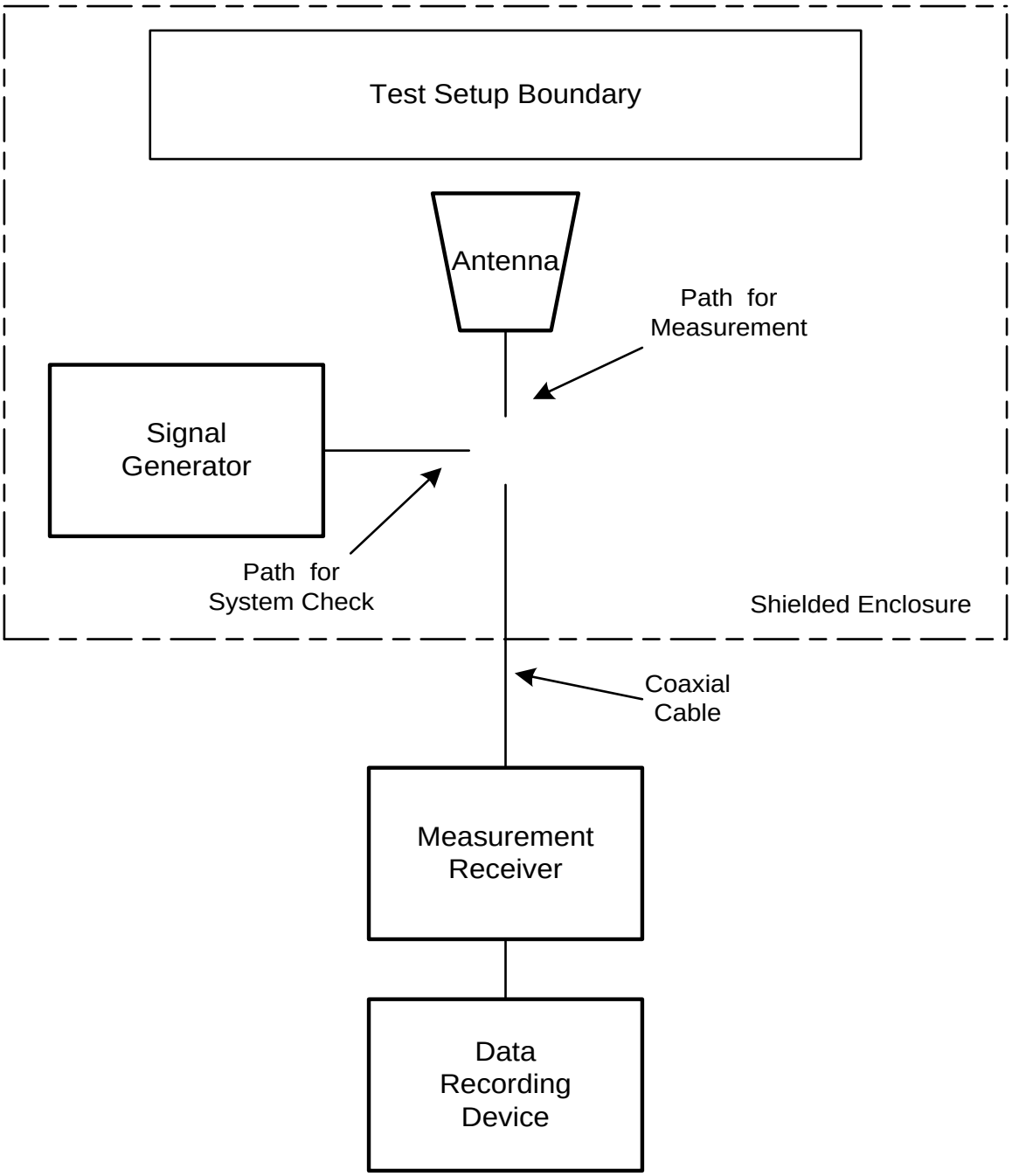


Figure NRE02-5 Basic Set-up

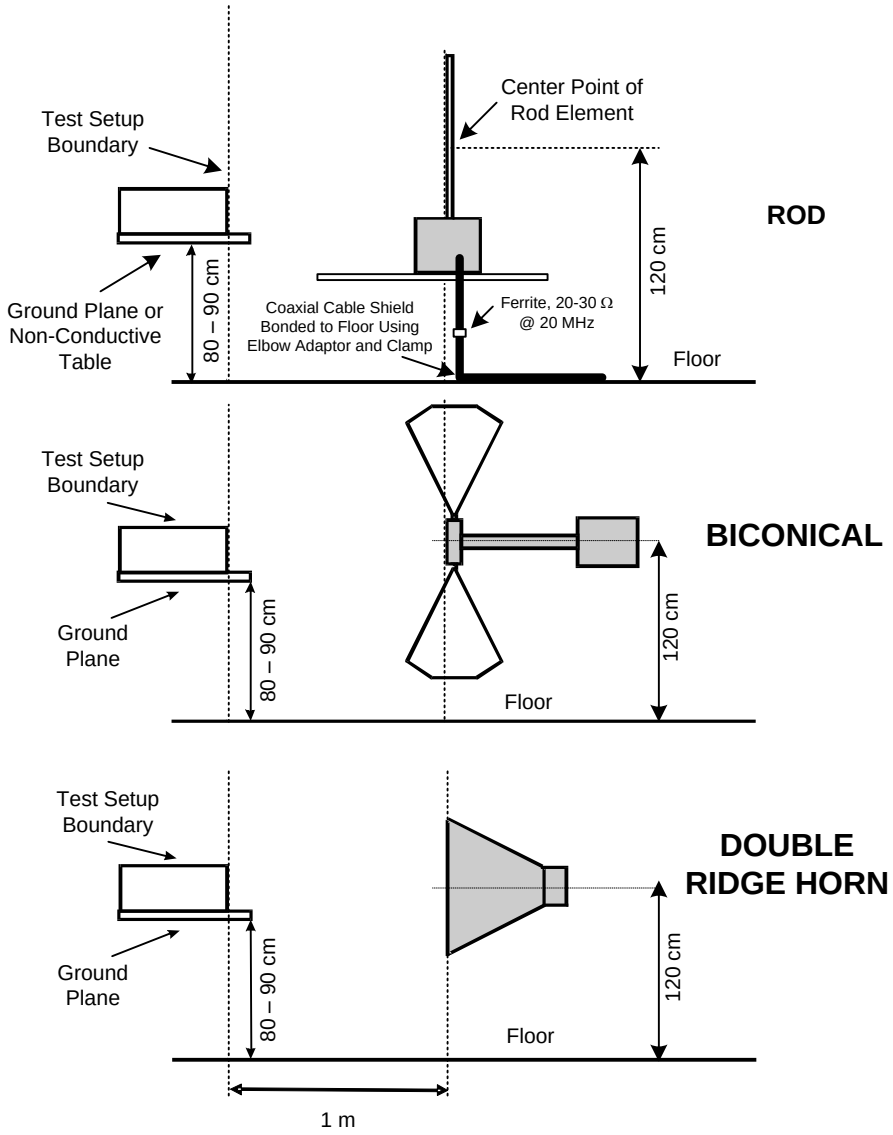


Figure NRE02-6 Antenna Positioning

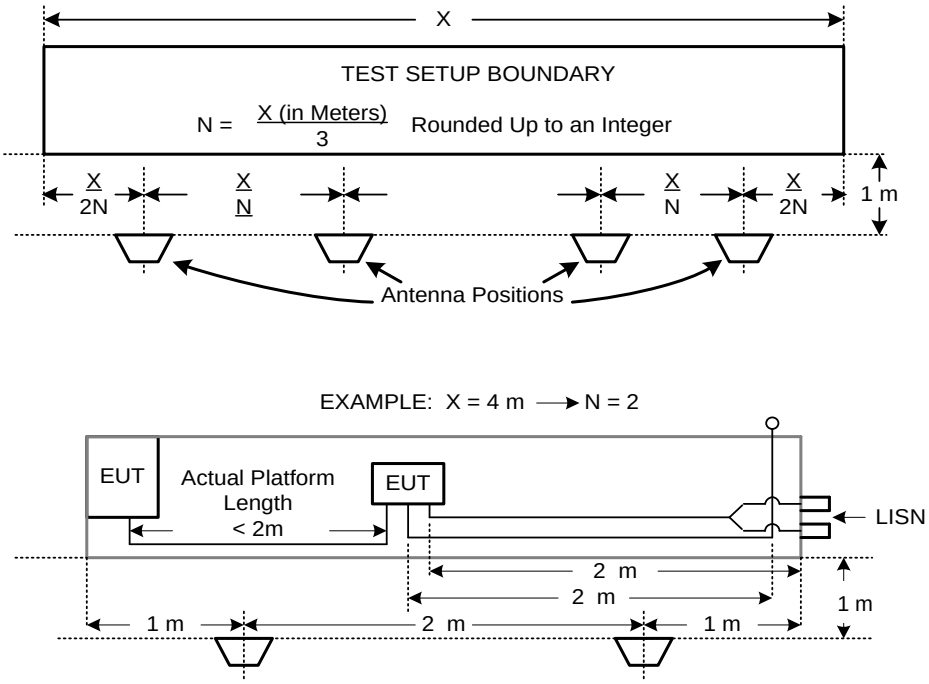
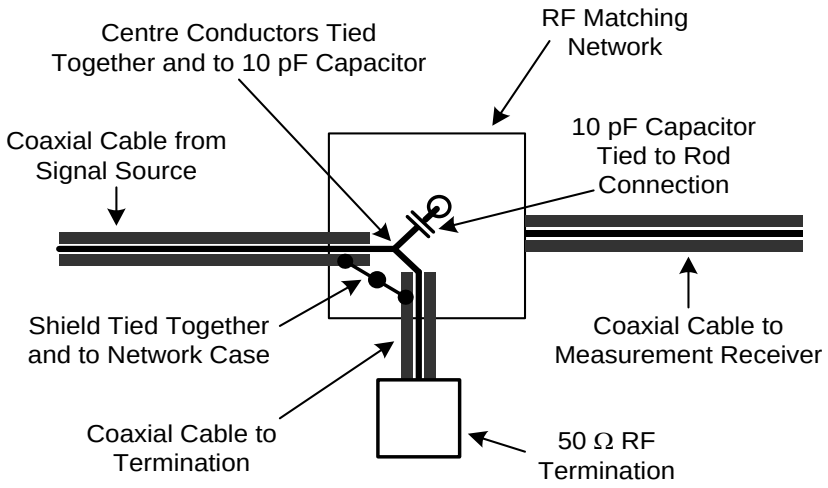


Figure NRE02-7 Multiple Antenna Positions



Notes:

1 Each Individual Wire Connection Limited to 5 cm length maximum

2 50 Ω Termination may be replaced with 50 Ω Measurement Receiver to verify Level of Injected Signal

3 The 10 pF Capacitor may be built into some Antenna Matching Networks

Figure NRE02-8 Rod Antenna System Check

3.31 NRE03 RADIATED EMISSIONS, ANTENNA SPURIOUS and HARMONIC OUTPUTS 10 kHz to 40 GHz

3.31.1 NRE03 Applicability

This requirement may be used as an alternative for NCE03 when testing transmitters with their intended antennas. NCE03 is the preferred requirement unless the equipment or subsystem design characteristics preclude its use. The requirement is not applicable within the EUT necessary bandwidth and within ±5 % of the fundamental frequency. Depending on the operating frequency range of the EUT, the start frequency of the test is shown in Table NRE03-1:

Operating Frequency Range (EUT)	Start Frequency of Test
10 kHz to 3 MHz	10 kHz
3 MHz to 300 MHz	100 kHz
300 MHz to 3 GHz	1 MHz
3 GHz to 40 GHz	10 MHz

Table NRE03-1 Operating Frequency Range of EUT

The end frequency of the test is 40 GHz or twenty times the highest generated frequency within the EUT, whichever is less. For equipment using waveguide, the requirement does not apply below eight-tenths of the waveguide's cut-off frequency. Reference should also be made to **Clause 3.9.21**.

3.31.2 NRE03 Limits

Harmonics, except the second and third, and all other spurious emissions shall be at least 80 dB down from the level at the fundamental. The second and third harmonics shall be suppressed to a level of – 20 dBm or 80 dB, whichever requires less suppression.

3.31.3 NRE03 Test Procedures

3.31.3.1 Purpose

This test procedure is used to verify that radiated spurious and harmonic emissions from transmitters do not exceed the specified requirements.