2) Number of turns: 51

3) Wire: 7-41 Litz wire (7 Strand, No. 41 AWG)

4) Shielding: electrostatic

5) Correction factor: See manufacturer's data for factors to convert measurement receiver readings to dBpT.

d) Measurement receiver or narrowband voltmeter

e) Current probe

f) LISNs

5.15.3.3 RS101M test setup

The test setup shall be as follows:

a) Maintain a basic test setup for the REM as shown and described in Figure 1, Figure 3, Figure 4, and 4.4.

b) Calibration: Configure the measurement equipment, radiating loop, and loop sensor as shown in Figure 41 (RE102MC-1).

c) REM testing: Configure the test as shown in Figure 3, Figure 4, and 4.4.

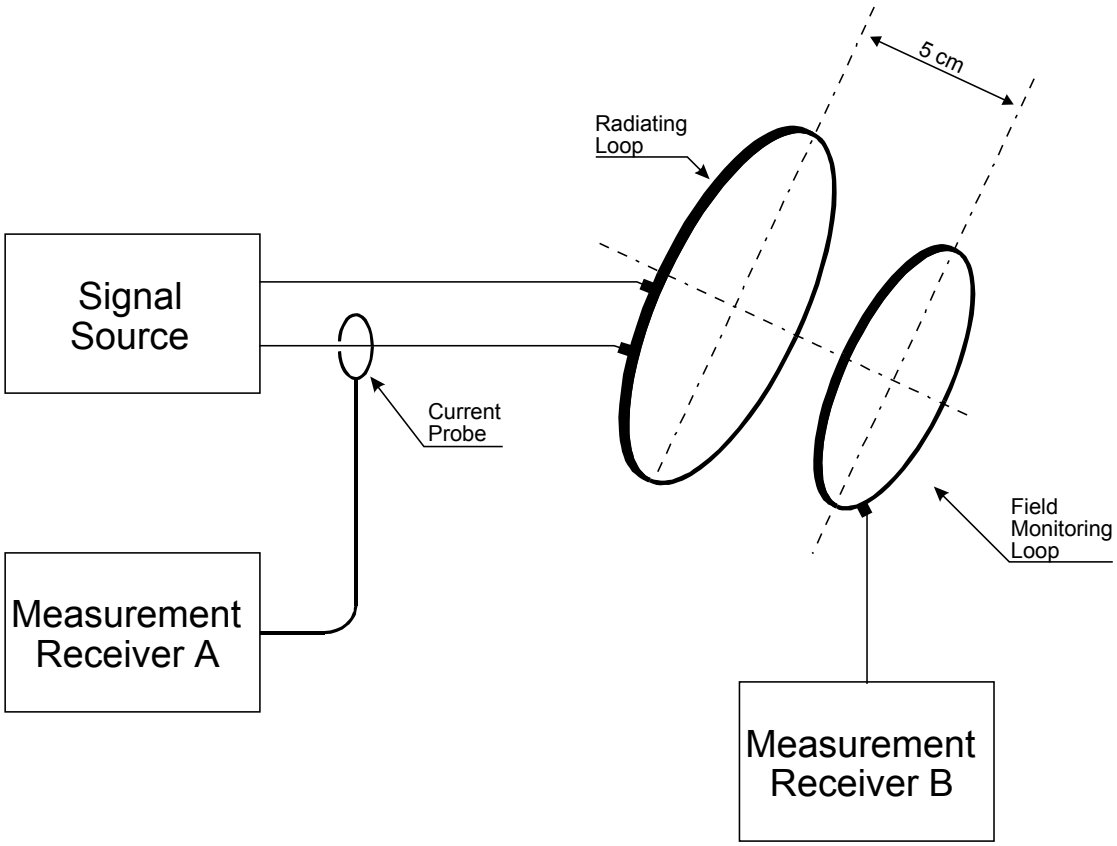


Figure 44 —RS101M-3 calibration of the radiating system

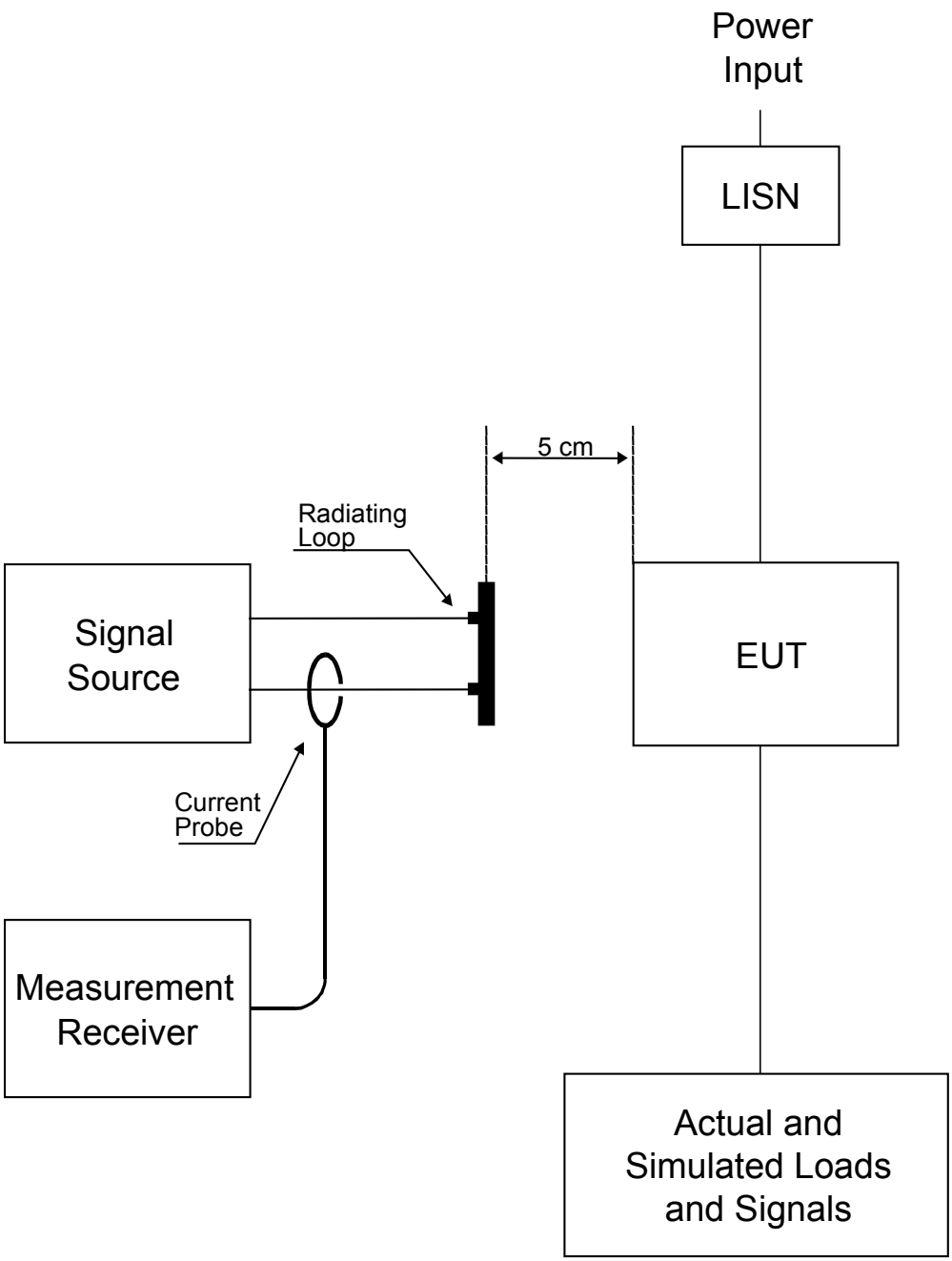


Figure 45 —RS101M-4 basic test setup

5.15.3.4 RS101M test procedures

The test procedures shall be as follows:

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

b) Calibration:

1) Set the signal source to a frequency of 1 kHz and adjust the output to provide a magnetic flux density of 110 dB above one picotesla as determined by the reading obtained on measurement receiver A and the relationship given in 5.15.3.3(b).

2) Measure the voltage output from the loop sensor using measurement receiver B.

3) Verify that the output on measurement receiver B is within ± 3 dB of the expected value based on the antenna factor, and record this value.

c) REM testing:

1) Turn on the REM and allow sufficient time for stabilization.

2) Select test frequencies as follows:

i) Locate the loop sensor 5 cm from the REM face or electrical interface connector being probed. Orient the plane of the loop sensor parallel to the REM faces and parallel to the axis of connectors.

ii) Supply the loop with sufficient current to produce magnetic field strengths at least 10 dB greater than the applicable limit but not to exceed 15 A (183 dBpT).

iii) Scan the applicable frequency range. Scan rates up to 3 times faster than the rates specified in Table 3 are acceptable.

iv) If susceptibility is noted, select no less than three test frequencies per octave at those frequencies where the maximum indications of susceptibility are present.

v) Reposition the loop successively to a location in each 30 cm-by-30 cm area on each face of the REM and at each electrical interface connector, and repeat 5.15.3.4(c)(2)(iii) and 5.15.3.4(c)(2)(iv) to determine locations and frequencies of susceptibility.

vi) From the total frequency data where susceptibility was noted in 5.15.3.4(c)(2)(iii) through 5.15.3.4(c)(2)(v), select three frequencies per octave over the applicable frequency range.

3) At each frequency determined in 5.15.3.4(c)(2)(vi), apply a current to the radiating loop that corresponds to the applicable limit. Move the loop to search for possible locations of susceptibility, with particular attention given to the locations determined in 5.15.3.4(c)(2)(v) while maintaining the loop 5 cm from the REM surface or connector. Verify that susceptibility is not present.

5.15.3.5 RS101M test data presentation

Data presentation shall be as follows:

a) Provide tabular data showing verification of the calibration of the radiating loop in 5.15.3.4(b)(2).

b) Provide tabular data, diagrams, or photographs showing the applicable test frequencies and locations determined in 5.15.3.4(c)(2)(v) and 5.15.3.4(c)(2)(vi).

c) Provide graphical or tabular data showing frequencies and threshold levels of susceptibility.

5.15.4 RS101M alternative—ac Helmholtz coil verification

This test procedure may be substituted for the 5.15.3.4 procedures, provided that the REM size versus coil size constraints of 5.15.3.2(c) can be satisfied.

5.15.4.1 RS101M alternative—ac Helmholtz coil verification purpose

This test procedure is an alternative technique used to verify the ability of the REM to withstand radiated magnetic fields.

5.15.4.2 RS101M alternative—ac Helmholtz coil test equipment

The test equipment shall be as follows:

a) Signal source

b) Series-wound ac Helmholtz coil

c) Loop sensor having the following specifications (same as the RE101M loop):

   1) Diameter: 13.3 cm

   2) Number of turns: 36

   3) Wire: 7-41 Litz wire (7 strand, No. 41 AWG)

   4) Shielding: electrostatic

   5) Correction factor: See the manufacturer's data for factors to convert measurement receiver readings to dBpT.

d) Measurement receiver or narrowband voltmeter

e) Current probe

f) LISNs

5.15.4.3 RS101M alternative—ac Helmholtz coil setup

The test setup shall be as follows:

a) Maintain a basic test setup for the REM as shown and described in Figure 1, Figure 3, Figure 4, and 4.4.

b) Calibration:

   1) Configure the radiating system as shown in Figure 46 (RS101M-5). Select coil spacing based on the physical dimensions of the REM enclosure.

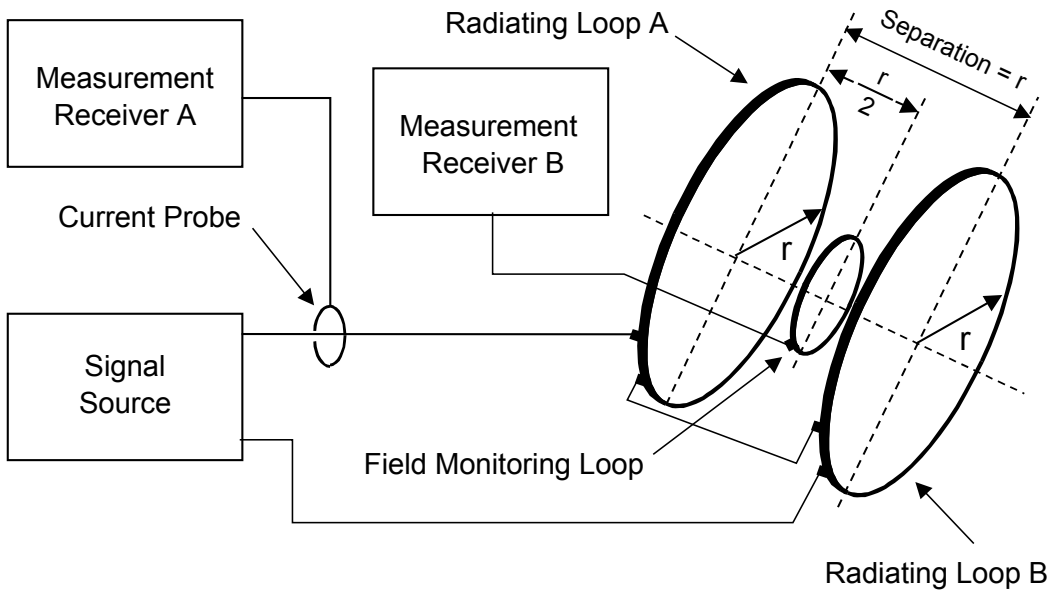
   2) For a REM with dimensions less than one coil radius, use a standard Helmholtz configuration (coils separated by one coil radius). Place the field monitoring loop in the center of the test volume.

   3) For a REM with dimensions greater than one coil radius, use the optional configuration. Select a coil separation such that the plane of the REM face is at least 5 cm from the plane of the coils and such that the separation between the coils does not exceed 1.5 radii. Place the field monitoring probe in the plane of either coil at its center.

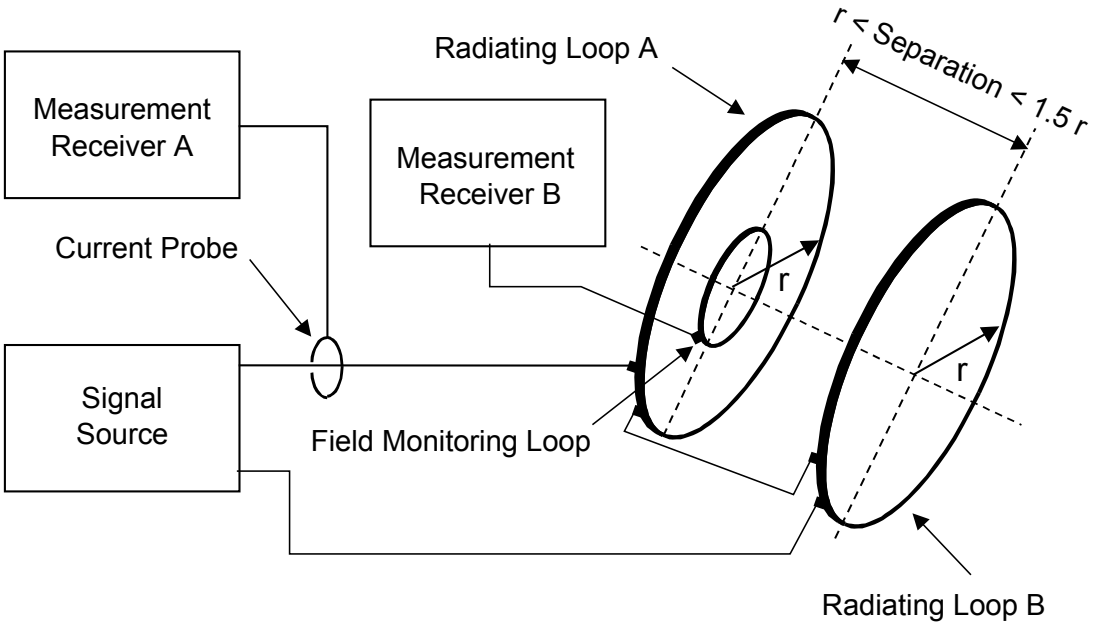
c) REM testing:

   1) Configure the test as shown in Figure 47 (RS101M-6), using the same coil spacing arrangement as determined for calibration under 5.15.4.3(b).

   2) Position the coils such that the plane of the REM face is in parallel with the plane of the coils.

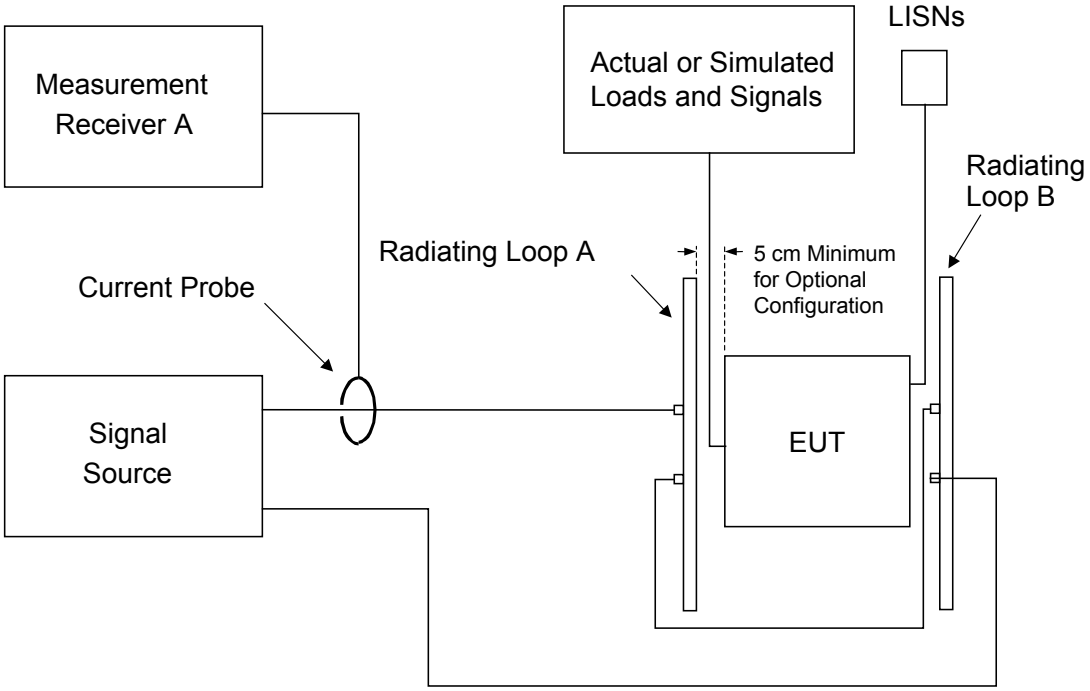


Standard Configuration



Optional Configuration

Figure 46 —RS101M-5 calibration of Helmholtz coils



Note: One axis position of three required is shown

Figure 47 —RS101M-6 test setup for Helmholtz coils

5.15.4.4 RS101M alternative—ac Helmholtz coil procedures

The test procedures shall be as follows:

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

b) Calibration:

1) Set the signal source to a frequency of 1 kHz and adjust the output current to generate a magnetic flux density of 110 dB above one picotesla as determined by the reading obtained on measurement receiver A.

2) Measure the voltage output from the loop sensor using measurement receiver B.

3) Verify that the output on measurement receiver B is within ± 3 dB of the expected value based on the antenna factor, and record this value.

c) REM testing:

1) Turn on the REM and allow sufficient time for stabilization.

2) Select test frequencies as follows:

i) Supply the Helmholtz coil with sufficient current to produce magnetic field strengths at least 6 dB greater than the applicable limit.

ii) Scan the applicable frequency range. Scan rates up to three times faster than the rates specified in Table 3 are acceptable.

iii) If susceptibility is noted, select no less than three test frequencies per octave at those frequencies where the maximum indications of susceptibility are present.

iv) Reposition the Helmholtz coils successively over all areas on each face of the REM (in all three axes), including exposure of any electrical interface connectors, and repeat 5.15.4.4(c)(2)(ii) and 5.15.4.4(c)(2)(iii) to determine locations and frequencies of susceptibility.

v) From the total frequency data where susceptibility was noted in 5.15.4.4(c)(2)(ii) through 5.15.4.4(c)(2)(iv), select three frequencies per octave over the applicable frequency range.

3) At each frequency determined in 5.15.4.4(c)(2)(v), apply a current to the Helmholtz coil that corresponds to the applicable RS101 limit. Move the coils to search for possible locations of susceptibility, with particular attention given to the locations determined in 5.15.4.4(c)(2)(iv). Ensure the REM remains centered between the coils or the coils remain 5 cm from the REM surface, as applicable. Verify that susceptibility is not present.

5.15.4.5 RS101M alternative—ac Helmholtz coil data presentation

Data presentation shall be as follows:

a) Provide tabular data showing verification of the calibration of the Helmholtz coils in 5.15.4.4(b).

b) Provide tabular data, diagrams, or photographs showing the applicable test frequencies and locations determined in 5.15.4.4(c)(2)(iv) and 5.15.4.4(c)(2)(v).

c) Provide graphical or tabular data showing frequencies and threshold levels of susceptibility.

5.16 RS103M, radiated susceptibility, electric field, 30 mHz to 18 GHz

5.16.1 RS103M applicability

This requirement is applicable to REMs and exposed interconnecting cables not part of the backplane.

5.16.2 RS103M limit

The REM shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in its individual procurement specification, when subjected to the radiated electric fields listed in Table 9, or as tailored by the procuring agency per program requirements. Any interfaces that are not routed via the backplane shall be constructed as in the installed configuration and shall be subject to the requirements of MIL-STD-461E test RS103 unless otherwise specified by the procuring activity. If the REM is hosted in a rack with no attenuation features, the maximum level for the applicable application should be used. If the REM is hosted in a rack with some attenuation features, a minimum of 12 dB of reduction to the Table 7 measurements can be used for the applicable application. Host rack attenuation greater than 12 dB should be provided by the manufacturer of the host rack or characterized by measurement or analysis.

Table 9—RS103M limits

FREQ. RANGE / PLATFORM		LIMIT LEVEL (VOLTS/METER)							
		AIRCRAFT (EXTERNAL OR SAFETY CRITICAL)	AIRCRAFT INTERNAL	ALL SHIPS (ABOVE DECKS) AND SUBMARINES (EXTERNAL)*	SHIPS (METALLIC) (BELOW DECKS)	SHIPS (NON-METALLIC) (BELOW DECKS) **	SUBMARINES (INTERNAL)	GROUND	SPACE
2 MHz ↓ 30 MHz	A	200	200	200	10	50	5	50	20
	N	200	200	200	10	50	5	10	20
	AF	200	20	-	-	-	-	10	20
30 MHz ↓ 1 GHz	A	200	200	200	10	10	10	50	20
	N	200	200	200	10	10	10	10	20
	AF	200	20	-	-	-	-	10	20
1 GHz ↓ 18 GHz	A	200	200	200	10	10	10	50	20
	N	200	200	200	10	10	10	50	20
	AF	200	60	-	-	-	-	50	20

KEY: A = Army
N = Navy
AF = Air Force

* For equipment located external to the pressure hull of a submarine but within the superstructure, use SHIPS (METALLIC)(BELOW DECKS)

** Equipment located in the hanger deck of Aircraft Carriers

5.16.3 RS103M verification

5.16.3.1 RS103M verification purpose

This test procedure is used to verify the ability of the REM and associated cabling to withstand electric fields.

5.16.3.2 RS103M test equipment

The test equipment shall be as follows:

a) Signal generators
b) Power amplifiers
c) Receive antennas
d) Transmit antennas
e) Electric field sensors (physically small, electrically short)
f) Measurement receiver
g) Power meter
h) Directional coupler
i) Attenuator
j) Data recording device
k) LISNs
l) MDN

5.16.3.3 RS103M test setup

The test setup shall be as follows:

a) Maintain a basic test setup for the REM as shown and described in Figure 1, Figure 3, Figure 4, and 4.4.

b) There are three methods for field calibration, which require different setup as follows:

1) Method 1:

i) Electric field sensors are required from 30 MHz to 18 GHz with the ability to measure the required field strength.

ii) Configure test equipment as shown in Figure 48 (RS103M-1), with the REM installed in the fixture.

iii) Position sensors 1 m from, and directly opposite to, the transmit antenna as shown in Figure 48 (RS103M-1) and Figure 49 (RS103M-2), 25 cm above the module fixture and in line with the face closest to the transmit antenna. The sensor and the REM must be in the main beam of the transmitting antenna.

iv) Perform the REM testing in 5.16.3.4.

2) Method 2:

i) Electric field sensors or antennas/measurement systems are required from 30 MHz to 18 GHz with the ability to measure the required field strength.

ii) Configure test equipment as shown in Figure 51 (RS103M-4). The REM is not installed in the fixture. A directional coupler is required between the amplifier and the transmit antenna.

iii) Position sensors/antenna 1 m from, and directly opposite to, the transmit antenna as shown in Figure 51 (RS103M-4) and Figure 49 (RS103M-2), and in the volume of the module and sensor/antenna surface in line where the module face would be closest to the transmit antenna.

iv) Perform the REM testing in 5.16.3.4.

3) Method 3:

i) Electric field sensors are required from 30 MHz to 18 GHz, but the required field is less than what the sensor can measure.

ii) Configure test equipment as shown in Figure 48 (RS103M-1). The REM is not installed in the fixture.

iii) Position sensors 1 m from, and directly opposite to, the transmit antenna as shown in Figure 49 (RS103M-2) and Figure 51 (RS103M-4), and in the volume of the module and sensor surface in line where the module face would be closest to the transmit antenna.

iv) Add 10 dB or 20 dB to the required field and use this value to establish a calibrated field. (Later in the test, the transmit power will be reduced by the 10 dB or 20 dB to test with the required field.)

v) Perform the REM testing in 5.16.3.4.

c) Placement of transmit antennas: Antennas shall be placed 1 m from the test setup boundary as follows:

1) 2 MHz to 200 MHz

i) Test setup boundaries $\leq$ 3 m. Center the antenna between the edges of the test setup boundary. The boundary includes all enclosures of the REM and the 2 m of exposed

interconnecting and power leads (see Figure 1, Figure 3, Figure 4, and 4.4). Interconnecting leads shorter than 2 m are acceptable when they represent the actual installation.

ii) Test setup boundaries > 3 meters: Use multiple antenna positions (N) at spacings as shown in Figure 50 (RS103M-3). The number of antenna positions (N) shall be determined by dividing the edge-to-edge boundary distance (in meters) by three and rounding up to an integer.

2) 200 MHz and above: Multiple antenna positions may be required as shown in Figure 49 (RS103M-2). Determine the number of antenna positions (N) as follows:

i) 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.

ii) 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.