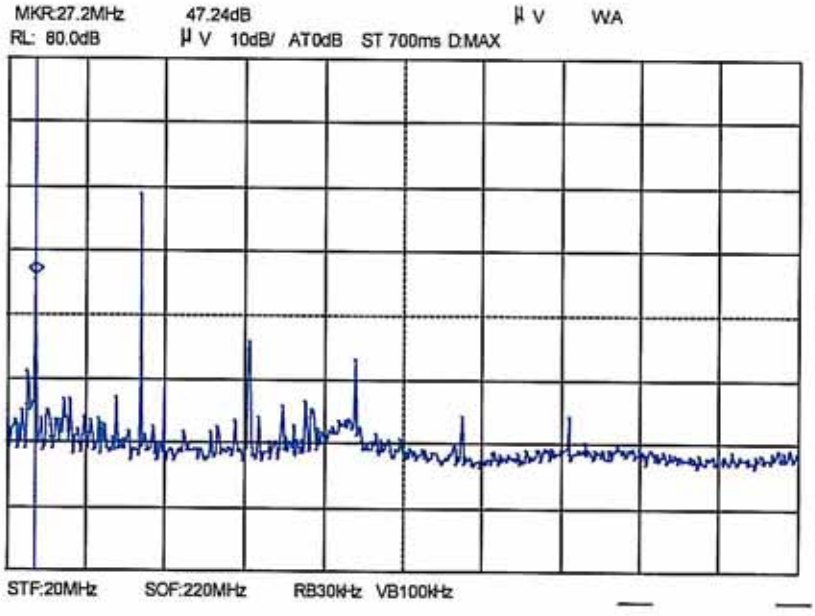
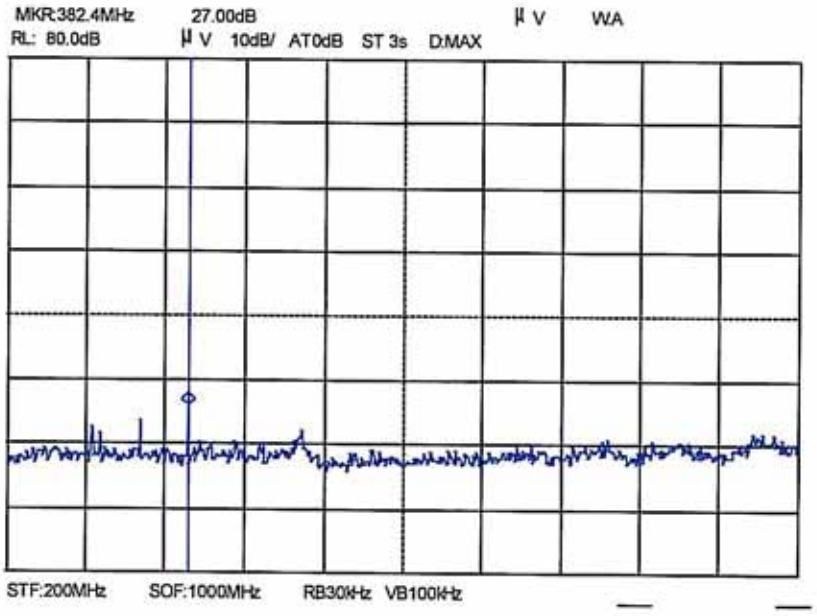
10.3. Figure 3-Radiated Emissions- Transmitter On Spurious

(Un-corrected Screened Enclosure Emission Measurements with PA2)



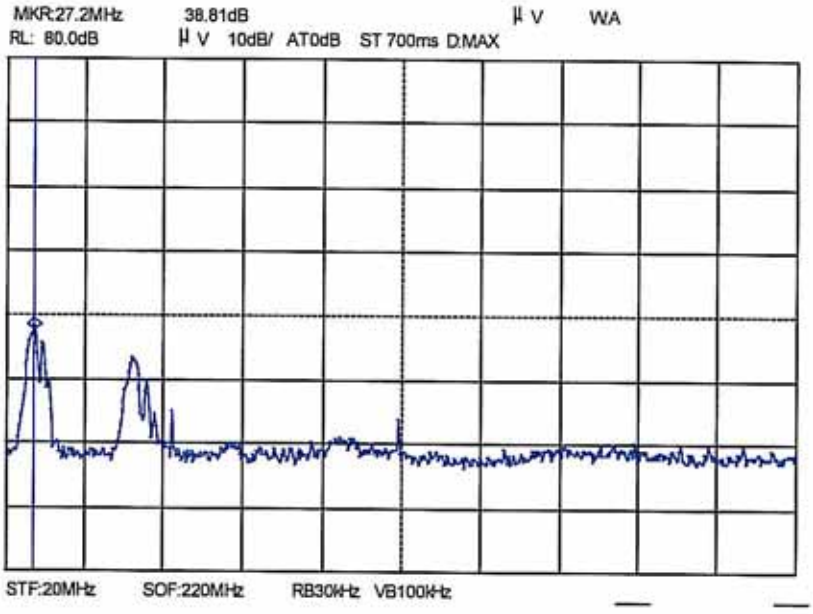
Frequency 20-200 MHz using Peak Detector



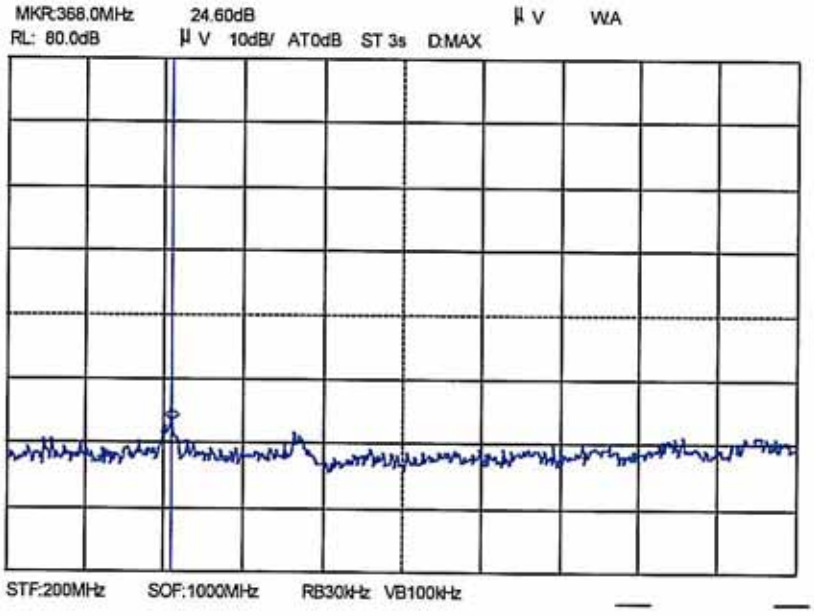
Frequency 200-1000 MHz using Peak Detector

10.4. Figure 4-Radiated Emissions –Transmitter & Ancillary Equipment Standby

(Un-corrected Screened Enclosure Emission Measurements with PA2)



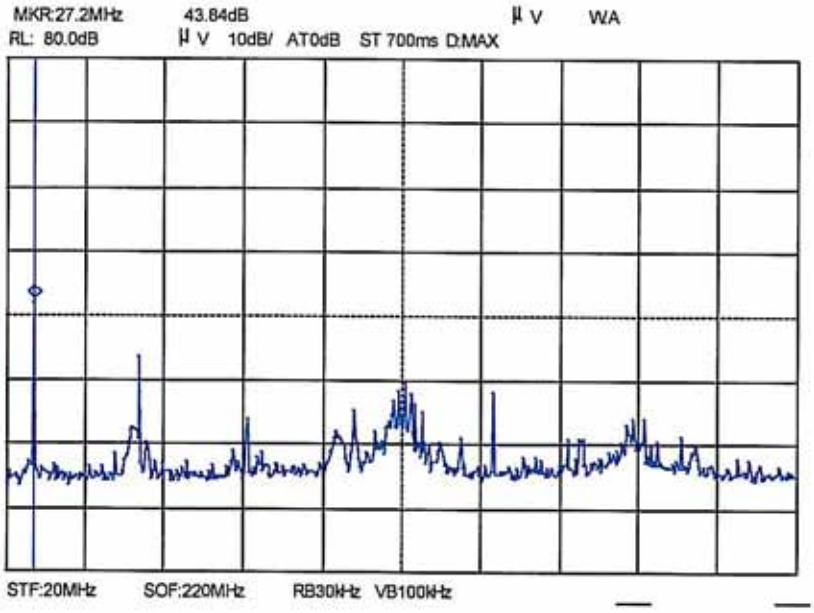
Frequency 20-200 MHz using Peak Detector

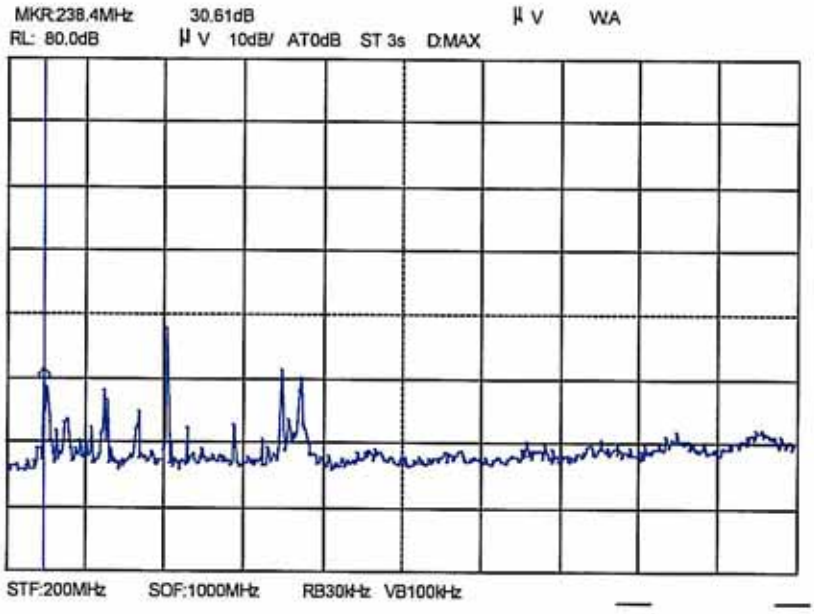


Frequency 20-200 MHz using Peak Detector

10.5. Figure 5-Radiated Emissions –Transmitter & Ancillary Equipment Operating

(Un-corrected Screened Enclosure Emission Measurements with PA2)





TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

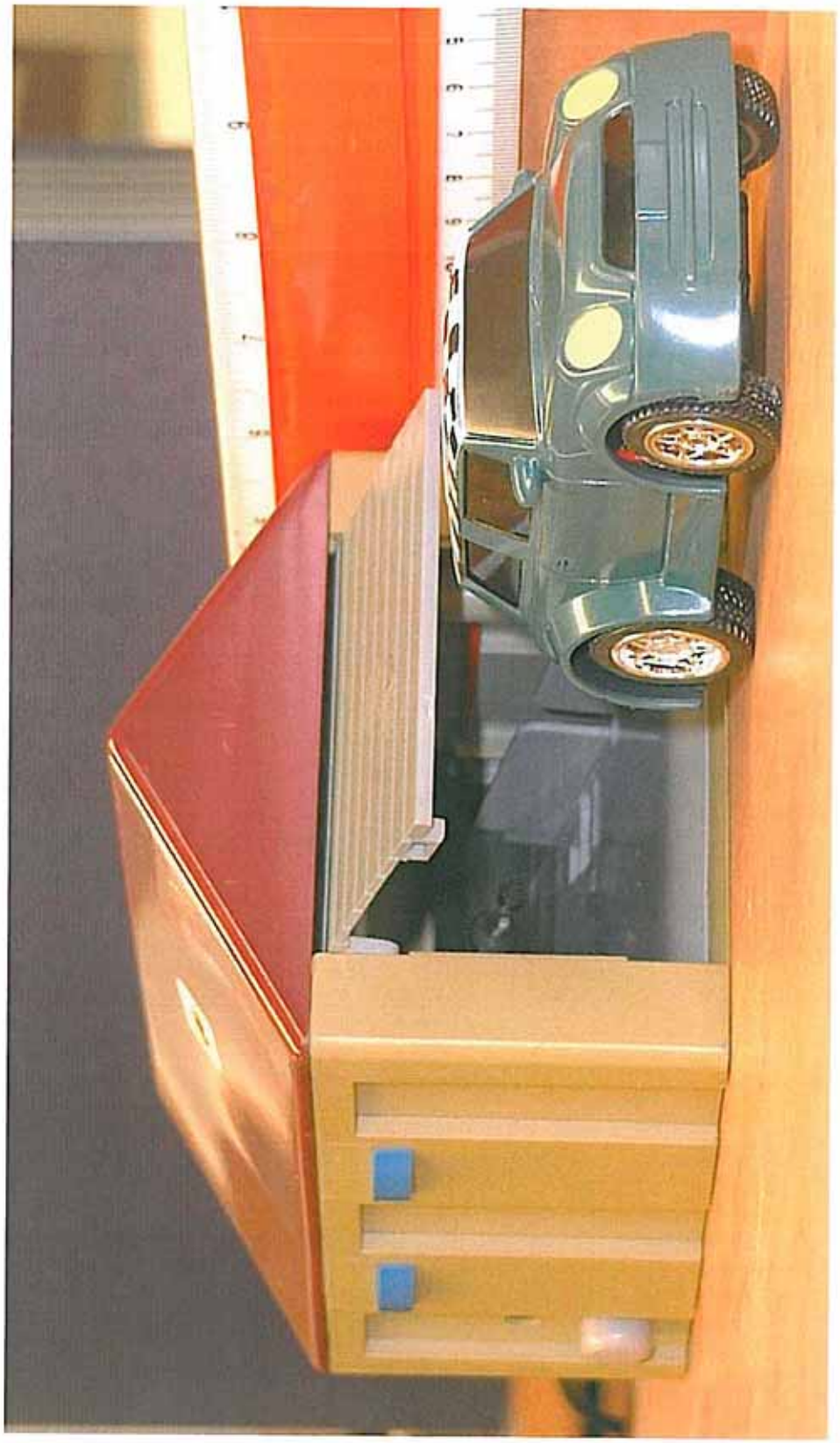
All test equipment used for the tests was calibrated and its operation verified prior to being used:-

Plant No	Cal Due	Equipment	Manufacturer	Description	Serial No	Cal Period
BA3	04-Oct-08	Antenna	Chase	Bilog Antenna,CBL6111A	1733	24 Months
CT1	16-Mar-08	Receiver	Rhode & Schwarz	Radio Communication Service Monitor, CMS52	825384/001	12 Months
EMC70	29-Aug-08	Antenna	EMC Projects Ltd.	Magnetic loop HF		24 Months
GS1	21-Dec-07	G-Strip Enclosure	Comtest	G Strip Enclosure	CC107-0050	12 Months
LHR1	03-Apr-08	Receiver	Chase	Receiver LHR 7000	1028	12 Months
OTS2	29-May-08	Open Area Test Site	EMC Projects Ltd.	Open test site 2		12 Months
PA1	04-Jul-08	Pre Amplifier	EMC Projects Ltd.	LF Pre-amp	001	12 Months
PA2	04-Jul-08	Pre Amplifier	EMC Projects Ltd.	HF Pre-amp	001	12 Months
ROOM2	23-Apr-08	Screened Room	Ray Proof	Screen room 3.7m x 5m x3m		12 Months
RX11	13-Aug-08	Receiver	Chase	Receiver UHR 4000	6114	18 Months
RX20	07-Aug-08	Receiver	Rhode & Schwarz	ESIB7 Test Receiver	100108	12 Months
SA8	06-Mar-08	Spectrum Analyser	Anritsu	Spectrum Analyser MS2601B	MW39953	12 Months

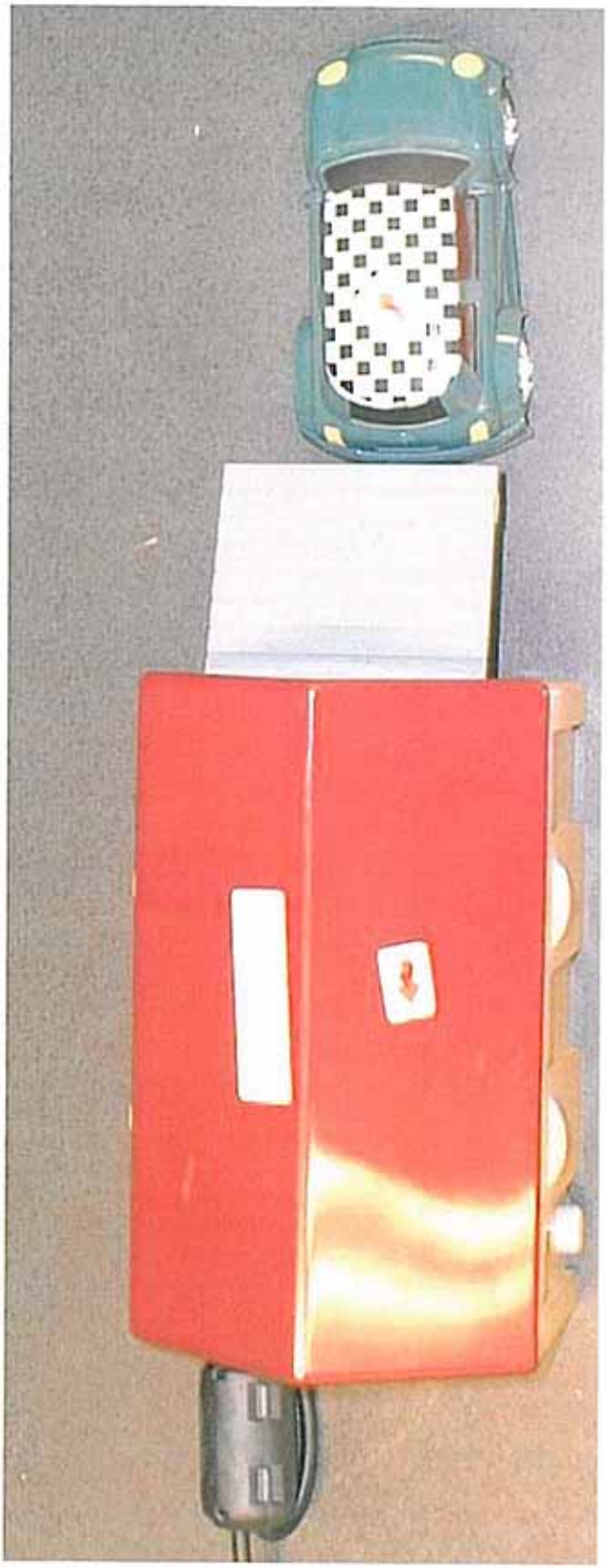
11. Photographs

11.1. Figure 6 Test Set Up

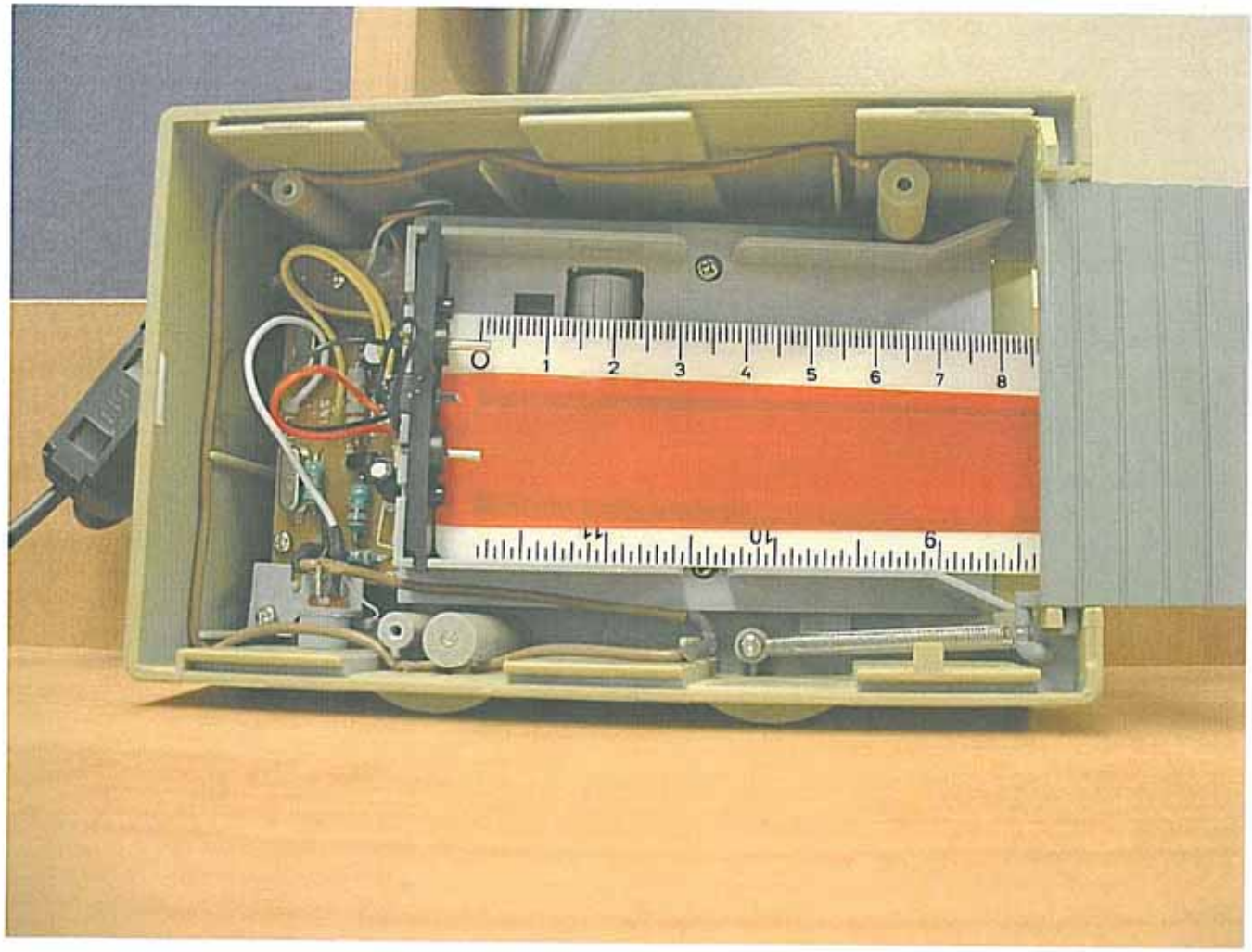
11.2. Figure 7 Transmitter and Ancillary as Supplied View 1



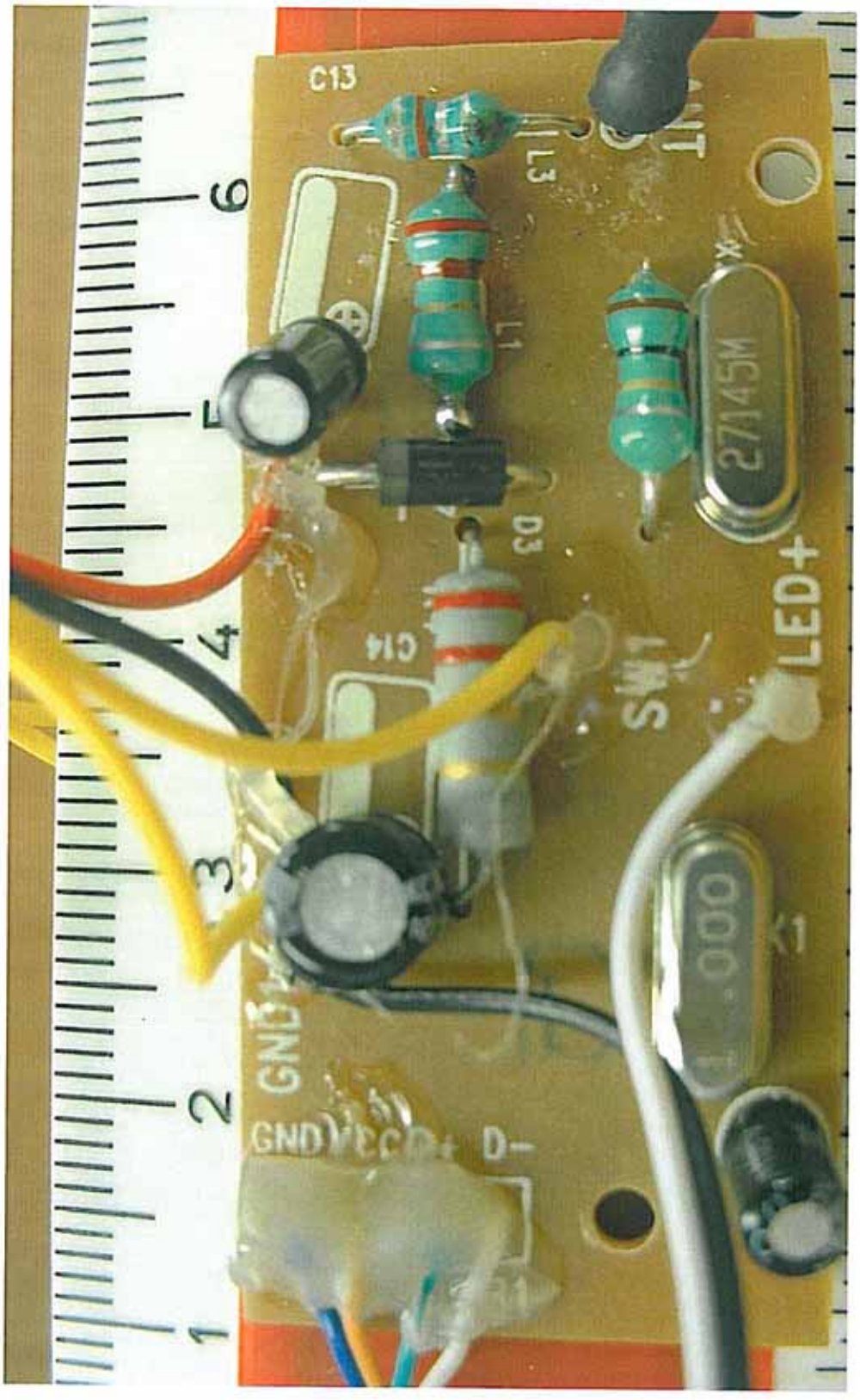
11.3. Figure 8 Transmitter and Ancillary as supplied View 2



11.4. Figure 9 Transmitter Circuit Board View 1

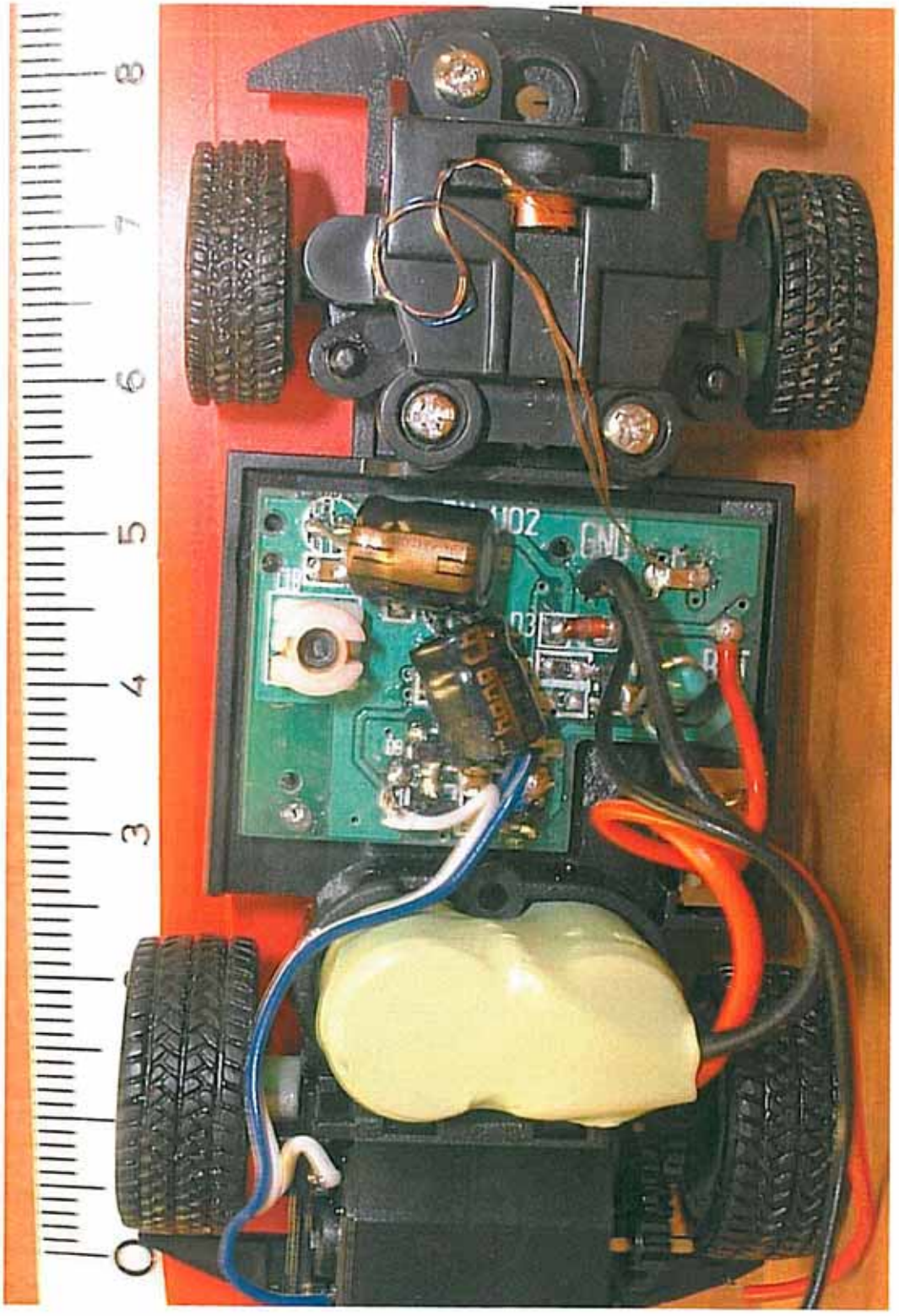


11.5. Figure 10 Transmitter Circuit Board View 2

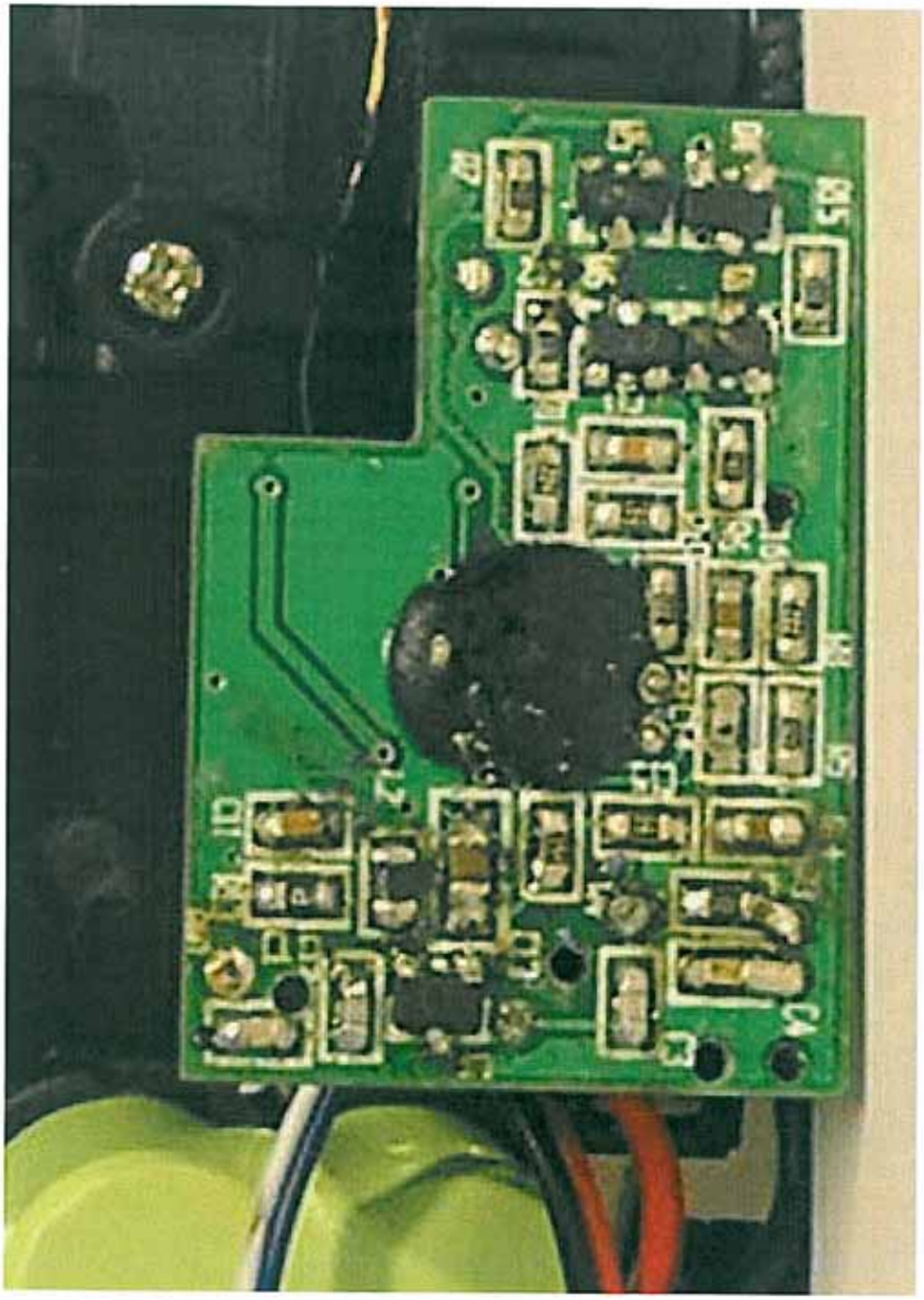


11.6. Figure 11 Transmitter Circuit Board View 3

11.7. Figure 12 Receiver Circuit Board View 1



11.8. Figure 13 Receiver Circuit Board View 2



Last page
Intentionally left blank

EMC PROJECTS LTD - TEST PROCEDURES HANDBOOK - ANNEX M

TEST PROCEDURE – Mil Std 461E

Issue 2

RADIATED EMISSIONS ELECTRIC FIELD (10 kHz - 18 GHz) RE102

Contents **Page**

© 2005 EMC Projects Ltd

EMC PROJECTS LTD - TEST PROCEDURES HANDBOOK - ANNEX M

Document History

Date	Issue	Comments
June 2005	1	Issued For Comment – Initial Accreditation
December 2005	2	Correct Bandwidth change to 150 kHz following visit by UKAS

© 2005 EMC Projects Ltd

EMC PROJECTS LTD - TEST PROCEDURES HANDBOOK - ANNEX M

1. INTRODUCTION

This test procedure outlines the steps to be followed in carrying out the above tests to, but not limited to, the following test specifications:-

a) Mil Std 461E - RE102

The object of this test procedure is not to repeat the detailed procedures in the appropriate test plan/specification, but is intended as an aid, ensuring all personnel carryout the testing in a controlled manner and that adequate records are kept.

This procedure shall be read in conjunction with the standard.

2. CLIMATIC CONDITIONS

The climatic conditions shall be within the following ranges, unless otherwise stated in the Test Plan/EUT requirement specification.

Ambient Temperature 15 to 35ºC Relative Humidity 45% to 75%

Record the climatic conditions in the test records.

3. TEST EQUIPMENT

3.1.1 Major Items

1.	EMC Receivers or Spectrum Analyser.	7	Attenuator
2.	Line Impedance Stabilisation Networks (LISN's)	8	Calibrated Coaxial Cables
3.	50 Ohm Terminations	9	41" Rod Antenna & Counterpoise
4.	Bi-conical Antenna (30 to 200 MHz)	10	Double Ridge Horns (200 MHz to 18 GHz)
5.	Signal Generators	11	Stub Radiator
6.	Capacitor 10 pF	12	Lined Screened Room

3.1.2 General

a) Ensure that all test equipment is in calibration and is operational.

b) Record the test equipment used in the project file.

c) Verify operation of the test equipment prior to commencement of the tests.

© 2005 EMC Projects Ltd

4. TYPICAL TEST SET UP

a) Typical EUT test set-ups are shown in Figures 2, 3 & 4 of Mil Std 461E.
b) Antenna positions are indicated in Figures 102-6 and reproduced here in Figure 1.
c) Measurement tolerances are ± 5 %.
d) The set up may include a metallic ground plane or a non-conductive table as required by the EUT installation requirements (4.3.5).
e) The metallic ground plane shall be a minimum of 2.25 sq meters electrically bonded to the screened room at least every 1 m, with a dc bonding resistance **of less than 2.5 mOhms** (4.3.5.1).
f) Radio frequency absorber material shall be used when performing radiated emissions testing inside the screened room (4.3.2.1).
g) Only the provisions included in the design of the EUT shall be used to bond units to the ground plane and should be identical to those specified in the installation drawings (4.3.8.2) & (4.3.8.4).
h) Where no instructions are given for the bonding of an EUT the configuration used shall be recorded by photograph/detailed sketch in the test log for inclusion in the Test Report.
i) EUT's shall be orientated such that the surfaces that produce the maximum radiated emissions face the measuremnt antennas (4.3.8.5) and located 10 cm from the front of the ground plane (4.3.8.5).
j) Cable assemblies shall simulate actual installation and usage. If cables are longer than 10 m, 10 m shall be included. At least 2 m, if sufficiently long in the actual installation, of each interconnecting cable shall be run along the front of the ground plane (4.3.8.6).
k) The cables closest to the front of the ground plane shall be placed at a distance of 10 cm from the front edge. All cables shall be supported 5 cm above the ground plane (4.3.8.6).
l) Input power leads shall be 2 m in length and be routed parallel to the front edge and 5 cm above the ground plane. The total length of the ground plane should not exceed 2.5 m (4.3.8.6.2).
m) The set up used shall be recorded by detailed sketch and photograph, giving cable lengths used and placed in the test log, for subsequent use in the Test Report.

© 2005 EMC Projects Ltd

5. DETECTOR,BANDWIDTHS & DWELL TIME

Measuremnts shall be carried out with a peak detector in the following bandwidths and minimum dwell times. Larger bandwidths may be used, but no bandwidth correction factors shall be applied.

Frequency Range	Bandwidth	Frequency Steps	Dwell Time
30 Hz to 1 kHz	10 Hz	5 Hz	0.15 sec
1 kHz to 10 kHz	100 Hz	50 Hz	0.015 sec
10 kHz to 150 kHz	1 kHz	500 kHz	0.015 sec
150 kHz to 30 MHz	10 kHz	5 kHz	0.015 sec
30 MHz to 1 GHz	100 kHz	50 kHz	0.015 sec
Above 1 GHz	1 MHz	500 kHz	0.015 sec

Ambient measurements are not needed where the EUT is compliant with the limits (See Para 4.3.4 of the standard).

© 2005 EMC Projects Ltd

6. ANTENNA POSITIONS

a) Determine the test setup bounfary of the EUT and assocuiated cables.

b) Use the physical reference points on the antenna, shown in Figure RE102-6 and Figure 1 of this document for measuring heights and distances from the test setup boundary.

c) Position antennas 1 m from the test setup boundary

d) Position antennas other than the rod antenna 120 cm above the ground floor plane.

e) Ensure no part of any antenna is closer than 1 m from the walls and 0.5 m from the ceiling of the shielded enclosure.

f) Test setups using bench tops, additional antenna positioning reqirements for the rod antenna and distance above the bench ground plane are shown in Figure RE102-6 of the standard and Figure 1 of this procedure.

g) Fior free standing setups, electrically bond and mount the 104 cm rod antenna matching network to the floor ground plane without a separate counterpoise.

h) The number of antenna positions depends on the size of the test setup boundary and number of enclosures included in the setup.

i) Below 200 MHz, use the following criteria to determine antenna positions.

j) A) For setups with the side edges of 3 m or less, one position is required in the centre od the side edges of the boundary.

k) B) For side edges of the boundary greater than 3 m, use multiple positions at spacings shown in Figure RE102-7 of the standard and Figure 2 of this procedure.

l) For testing from 200 MHz to 1 GHz, place the antenna in a sufficient number of positions such that the entire width of each EUT and the first 35 cm of cables interfacing with the EUT are within the 3 dB beamwidth.

m) Above 1GHz place the antenna in a sufficient number of positions such that the entire width of each EUT and the first 7 cm of cables interfacing with the EUT are within the 3 dB beamwidth.

© 2005 EMC Projects Ltd

7. CALIBRATION/VERIFICATION TESTS.

1. Check all test equipment to be used is functional and in current calibration.
2. Carryout a calibration check on the Receivers to be used as well as a general verification check. This can be achieved with a two port measurement over the frequency range of the test to be carried out.
2. Configure the test equipment as shown in Figure RE102-5 of the standard and Figure 3 of this Test Procedure.
3. Bond the rod antenna counterpoise to the ground plane using a solid metal sheet that is greater or equal to the width of the counterpoise. Bonding shall be checked to be 2.5 mOhms or less. Where a metallic ground plane is not used bond the counterpoise to the floor ground plane.

4. ***Carryout an attenuation measurement of the receive cables including the screened room bulk head connector, over the frequency range to be recorded. Record the attenuation and use the attenuation figures obtained in the correction factors.***

5. ***The specification requires that for rod antennas, remove the rod element and apply a signal to the antenna matching network through a 10 pF capacitor connected to the rod mount. Readings should be within ± 3 dB of those expected.***
6. ***In order to carry out 5 above, replace the rod element with a 50 Ohm matching network and carryout a two port test over the frequency range required and check the levels is within ±3 dB of that expected.***

7. ***For each antenna radiate a signal using a stub radiator to check the continuity of each antenna. There is no requirement to accurately measure the signal level this is purely a coarse indication that each antenna is functioning properly.***

© 2005 EMC Projects Ltd

8. TEST PROCEDURES

a) Check that the EUT mains supply is correct.
b) Power the EUT and ensure correct operation.
c) Ensure the layout is correct to the specification and test plan requirements.
d) Ensure that all test equipment is correctly positioned with regards to the ground reference plane and EUT as required by the standard.
e) Ensure that the walls and ceiling of the screened room shall not be closer than 1 m to any part of the antenna element.
f) A vertical 1 m rod antenna shall be used over the frequency range 10 kHz to 30 MHz, mounted on a counterpoise a minimum of 600 mm wide for screened room use. The counterpoise shall be bonded to the ground plane.
g) A bi-conical antenna shall be used over the frequency range 30 to 200 MHz.
h) A DRG antenna shall be used over the frequency range 200 to 18 GHz.
i) Set-up the test criteria on the receiver including correction factors, bandwidth's, frequency span, and dwell times in accordance with the specification/test plan requirements.
j) Carryout the verification checks detailed in 7 above and record the results.
k) Check that the dwell time is adequate for the tests by measuring in a higher dwell time to that required and check for increases in recored levels.
l) Carryout the tests for each defined mode of operation, each antenna position and antenna for both horizontal and vertical polarisation where required.
m) Record the results for each test and assess against the EUT's performance criteria.

© 2005 EMC Projects Ltd

9. RECORDS AND TEST RESULTS.

1) Record all details and test results in the test log and ensure that it is placed in the project file.
2) If appropriate notes are recorded in an engineers note book, they should be photocopied and inserted in the project file.

The test records should include the following information as a minimum:

a) EUT details including cables connected and mode of operation.
b) EUT test set up.
c) EUT performance criteria, and operating conditions.
d) Mains voltage and climatic conditions.
e) Test equipment used.
f) Details of test applied.
g) Test results as continuous plots of amplitude against frequency. Horizontal and vertical data shall be presented on different plots.

© 2005 EMC Projects Ltd

10. FIGURE 1 - ANTENNA POSITIONS

MIL-STD-461E

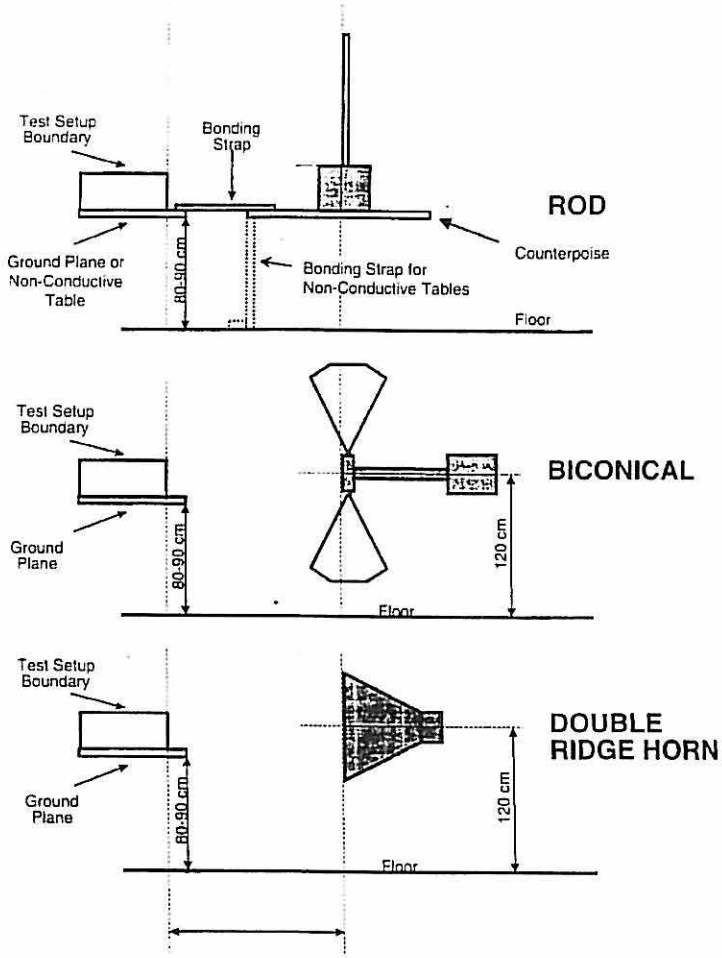


FIGURE RE102-6. Antenna positioning.

11. FIGURE 2 - ANTENNA BOUNDARIES

© 2005 EMC Projects Ltd

EMC PROJECTS LTD - TEST PROCEDURES HANDBOOK - ANNEX M

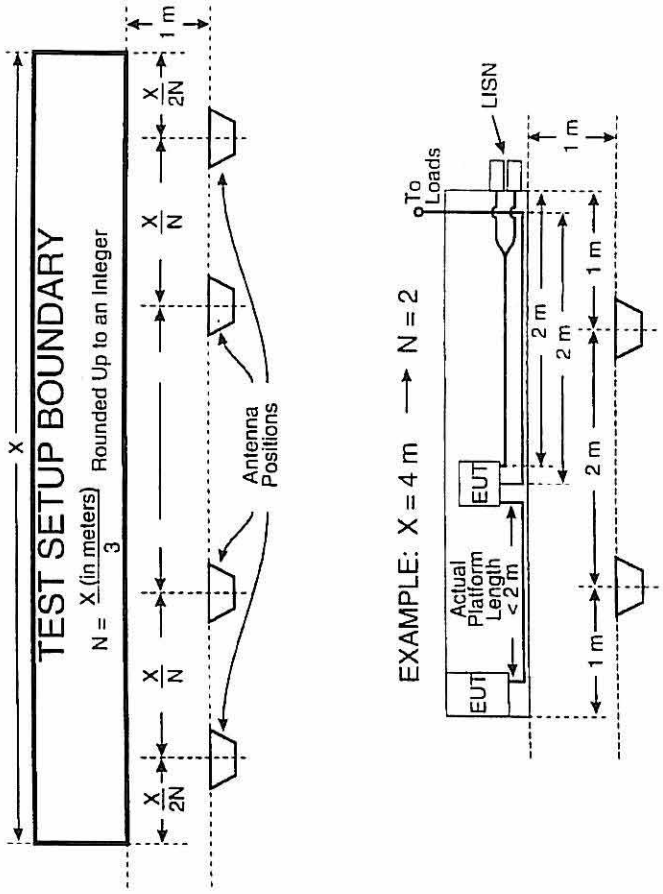


FIGURE RE102-7. Multiple antenna positions.

© 2005 EMC Projects Ltd

12. FIGURE 3 ANTENNA VERIFICATION

MIL-STD-461E

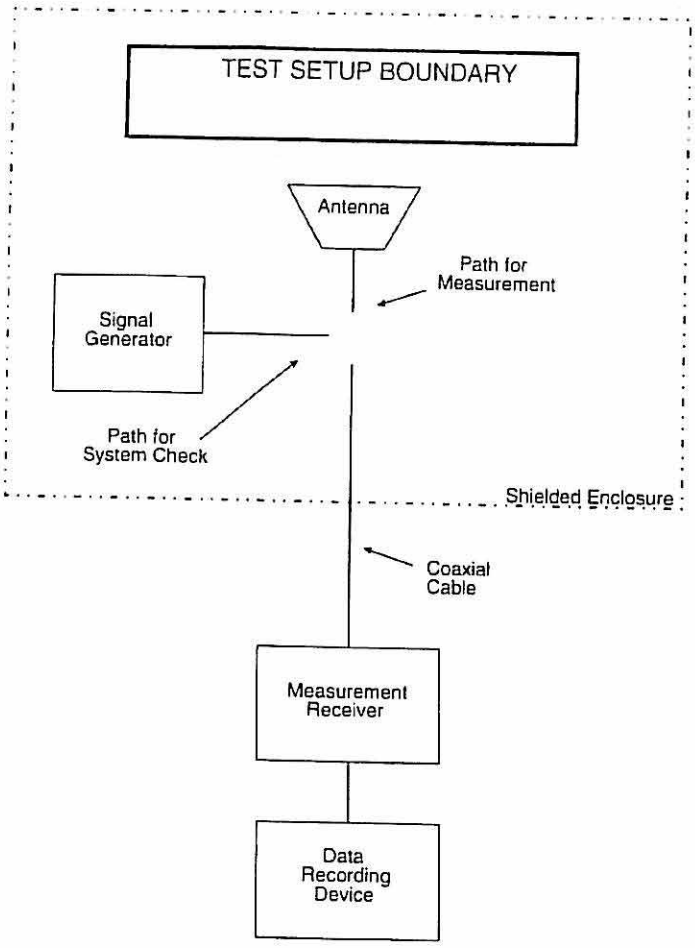


FIGURE RE102-5. Basic test setup.

© 2005 EMC Projects Ltd