

Test Procedure for Radiated Emission Measurement on the OATS between 30MHz and 1GHz for Digital and Computing Devices	Doc. No.: EMC/EMI/004/A Issue: 1 Revision: C Date: 2000-11-19 Page: 2 of 10
Standard: FCC Part 15:2000	

1. OBJECTIVE

The objective of this test is to measure radiated E-field emissions in the frequency range 30MHz to 1GHz. The main procedure is outlined in ANSI C63.4, which details the procedure for measuring RF emissions from computing devices. ANSI C63.4 must be used in conjunction with this procedure.

This procedure is aimed at digital and computing devices. Other procedures are available for measurement of radiated emissions from intentional radiators and broadcast receivers.

2. REFERENCES

- | | | |
|------------|-----------------|--|
| 2.1 | FCC Part 15 | Code of Federal Regulations, title 47, part 15:2000 |
| 2.2 | ANSI C63.4:2000 | Methods of measurement of radio-noise emissions from low voltage electrical and electronic equipment in the range 9kHz to 40GHz. |
| 2.3 | CISPR 16-1:1993 | Radio disturbance and immunity measurement apparatus |
| 2.4 | EMC/UNC/001 | Uncertainty budgets for EMC department |
| 2.5 | EMC/MNT/001 | EMC department equipment maintenance and operation check procedures |

3. DEFINITIONS

B/W Bandwidth
EMC Electro-Magnetic Compatibility
EUT Equipment Under Test
IF Intermediate Frequency
OATS Open Area Test Site
rf Radio-Frequency

4. APPARATUS

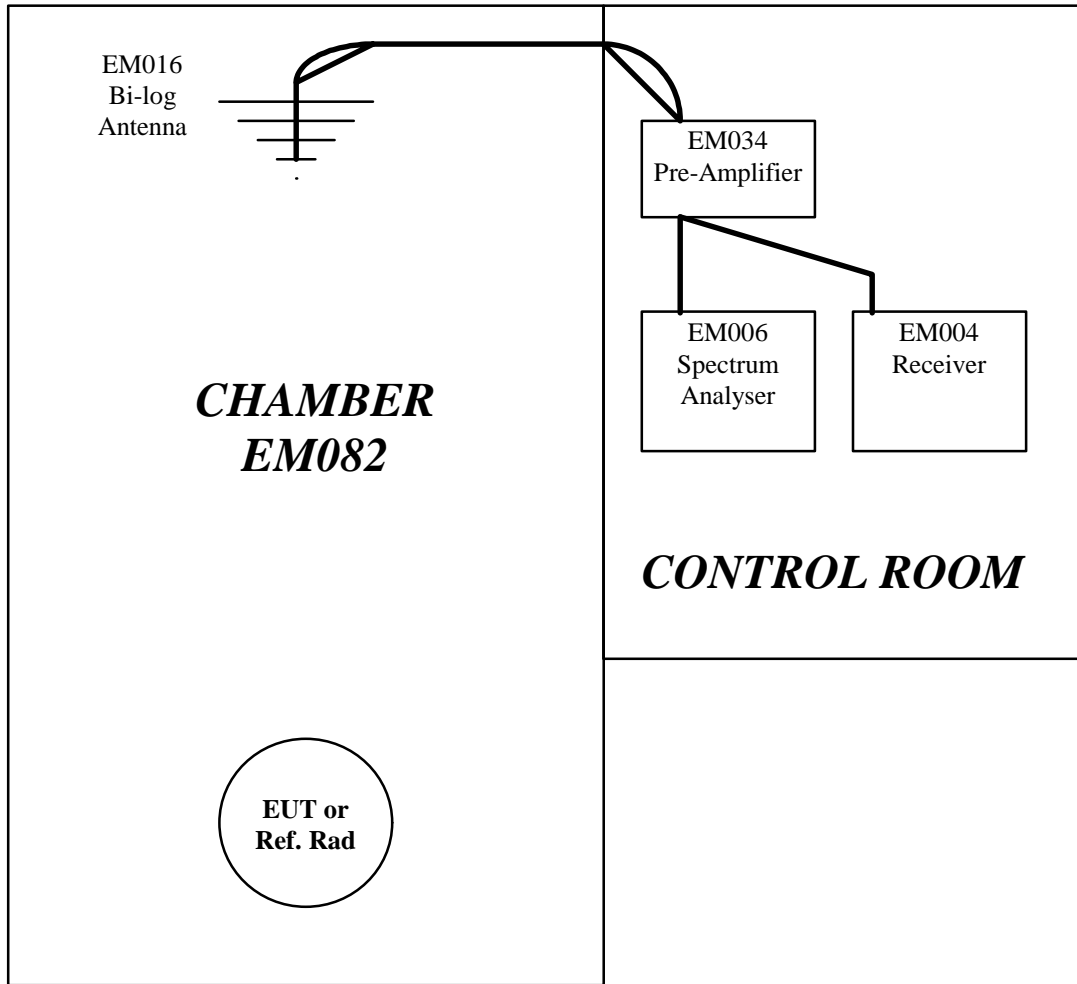
Item	Equip. No.	Description
1	EM007	Spectrum Analyser
2	EM008	Spectrum Analyser
3	EM009	Quasi-Peak Adapter
4	EM010	Pre-selector
5	EM011	Attenuator / Driver
6	EM012	Pre-Amplifier
7	EM017	Antenna
8	EM006	Spectrum Analyser
9	EM034	Pre-Amplifier
10	EM004	Receiver
11	EM016	Antenna
12	EM125	Reference Radiator
13	EM082	3m Semi-Anechoic Chamber
14	EM083	Open Area Test Site

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5. APPARATUS CONFIGURATION

5.1 Pre-Scan

The pre-scan test equipment should be connected up as follows:-

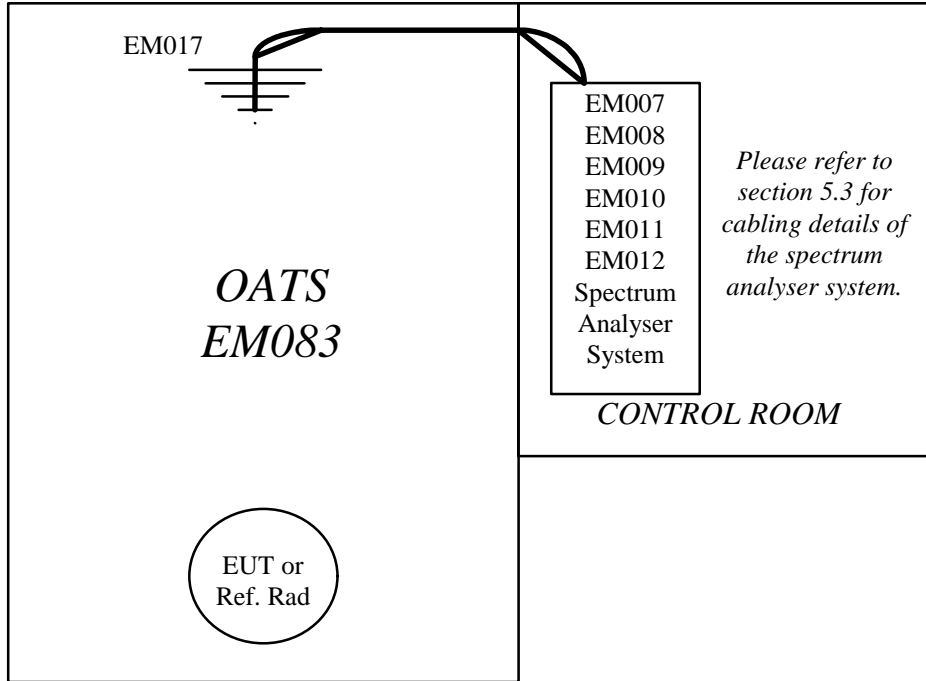


PLAN VIEW OF EMC CHAMBER & CONTROL ROOM

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5.2 Final (OATS) Measurement

The test equipment should be connected up as follows:-

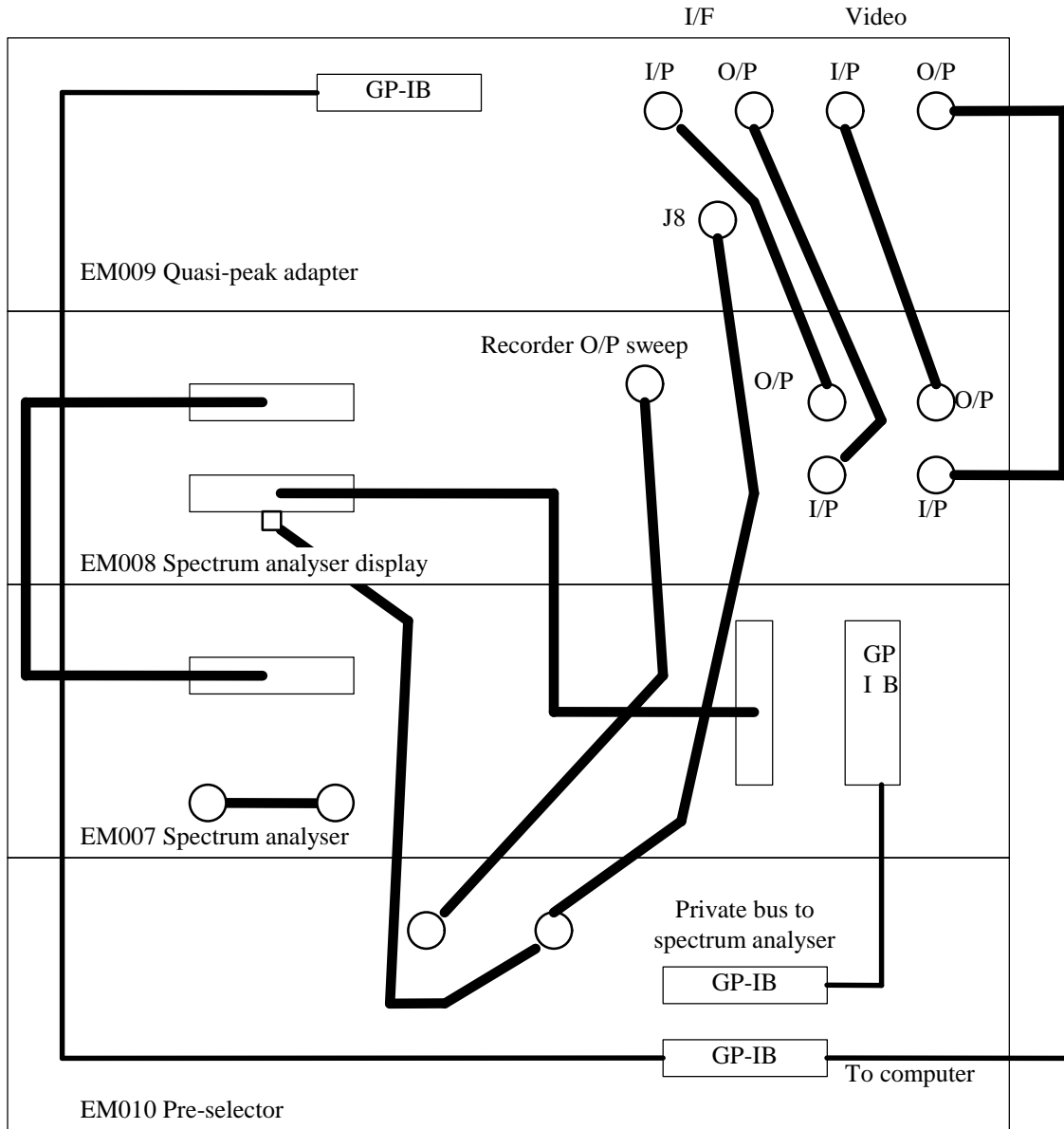


PLAN VIEW OF STC OATS & CONTROL ROOM

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5.3 Final (OATS) Measurement - Spectrum Analyser System Cabling

The rear of the spectrum analyser should be cabled up as follows:-



Spectrum Analyser System Cabling

Rear view, pre-amplifier(EM012) & attenuator driver (EM011) not shown for clarity

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6. SPECIAL PRECAUTIONS

Ensure:-

1. All test instruments are within calibration.
2. That the EUT falls within the scope of the standard being applied.
3. Investigate all operating modes of the EUT and rotated about all 3 axis to obtain worse results.
4. Select the correct test limit for the EUT (either Class A or B, see FCC part 15.109 & 15.209 for details).
5. Confirm that the correct settings have been entered on the antenna mast controller and the turntable controller. i.e. the correct height/angle and limits. This should be done at the start of each days testing.
6. Ensure that the height of the antenna is updated everytime the polarity is changed.
7. If the EUT emission is covered by background noise and the level is within 6dB of the limit line (or above), then the following may be used to overcome the problem.
 - a. Reduce the resolution bandwidth (for narrowband signal only) and attempt to resolve the background and EUT emission. For narrowband signals, the peak value will be similar to the quasi-peak.
 - b. If the procedure in a. above is not successful, then try and locate and measure (on the OATS) an EUT emission close to the one being masked by background noise. Measure this and the masked EUT emission in the chamber. Calculate the difference between the OATS and chamber measurement for the adjacent emission. Then, for the masked emission, apply the calculated difference. Only apply this if the difference in wavelength is 10% or less.
 - c. If no EUT emission is available as required in b. above, then attempt the following:-
Compare the masked EUT emission with a reference radiator emission and select an emission which is within 1/10 of the wavelength or one resolution bandwidth either side of the EUT emission.
Measure the reference radiator emission on the OATS and in the semi-anechoic chamber. Calculate the difference.
Measure the EUT in the semi-anechoic chamber. Apply the difference as a correction factor to give the equivalent OATS measurement.

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- d. If the above fail to give a satisfactory result, then book time in the HKPC 10m range EMC chamber (which fulfills site attenuation requirements) and re-measure the EUT.

WHENEVER ANY ONE OF THESE PROCEDURES ARE USED, ALWAYS ENSURE THAT THE SUPERVISOR/MANAGER ARE INFORMED DURING THE MEASUREMENT.

8. READ & FOLLOW the detailed test procedures outlined in ANSI C63.4.
9. Ensure that the last reference radiator measurement (full scan) is not greater than 1 week old. If it is, then perform a full scan measurement. The measured data should be within the measurement uncertainty. If the measurement is outside the measurement uncertainty, then check all the test equipment, cables, antenna, OATS, setup (hardware & software). Do not perform a measurement until a satisfactory conclusion been reached. Inform the supervisor / manager.
10. Ensure that all the equipment used for the test has had an operation / maintenance check performed. Please refer to procedure EMC/MNT/001 for further details.

7. TEST CONDITIONS

Configure the EUT in a typical working configuration, with the following caveats:-

If the EUT is table top, then it is placed on a non-conductive support, 0.8m above the groundplane. For a floor standing EUT, place it on the groundplane (but insulated from it).

Investigate the effect of EUT and cable configuration, bearing in mind 'typical working modes'.

For the final measurement on the OATS, take a note of the layout and configuration of the EUT. If necessary, take photographs. Photographs must be taken for computing products and intentional radiators.

Measurements at 10m test distance are preferred.

For further details, refer ANSI C63.4 and FCC part 15.

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8. PROCEDURE

8.1 Calibration

Perform the self calibration routine on all applicable test instruments. This can be performed under software control for the HP spectrum analyser.

8.2 Initial Pre-Scan

Using the pre-scan instruments, perform a full reference radiator measurement if the last one was performed more than 1 week ago. If the time for the reference radiator measurement is less than 1 week, then perform spot frequency checks on 5 frequencies at the start of each day (or measurement) in order to confirm the integrity of the measurement system.

Now place the EUT in the semi-anechoic chamber. Configure the EUT in a typical working mode.

Perform an initial scan for both vertical and horizontal antenna polarities with the EUT switched off. Ensure that no emissions are located. If emissions are recorded, then locate the source and rectify. Typical cases maybe the chamber door being left open or noise feeding into the chamber via the cables of associated equipment located in the control room.

Perform an initial maximisation exercise by investigating all the operating modes of the EUT, the typical cable and EUT layouts and by running software routines where applicable. For the worse case, scan and record all emissions for both vertical and horizontal antenna polarities between 30MHz and 1GHz. If no emissions are found, record the worse case noise floor with respect to the limit line in the log book.

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8.3 Compliance Measurement on OATS

- 8.3.1** After switching on all the test equipment, ensure that the antenna and turntable have the correct limits and current positions.
- 8.3.2** Load and run the HP 'REMS' software. To do this, you need to type **MSI 'EMI_TEST'**, then hit enter. Now type **LOAD 'REMS'**, then hit enter. Finally type **RUN**, then hit enter.
- 8.3.3** Load up the correct test library. Ensure that the correct limit lines, antenna factors, cable losses and frequency ranges are selected.
- 8.3.4** Perform the software calibration routine (under the **UTILITY** menu) of the spectrum analyser.
- 8.3.5** Perform a full reference radiator measurement if the last one was performed more than 1 week ago. If the time for the reference radiator measurement is less than 1 week, then perform spot frequency checks on 5 frequencies at the start of each day (or measurement) in order to confirm the integrity of the measurement system.
- 8.3.6** Configure the sample in a typical working mode on the OATS.
- 8.3.7** Select the manual measurement option (under the **SIGNAL IDENTIFICATION** menu), then locate and hit the **ADD SUSPECT** key for all pre-scan emissions which were recorded. Perform this for all relevant frequency bands (for horizontal and vertical antenna polarities).
- 8.3.8** Exit the **SIGNAL IDENTIFICATION** menu and select the **SUSPECT LIST** menu. Tune and maximise (i.e. scan the turntable and antenna) all the emissions in the suspect list. Confirm that these are EUT emissions by switching the EUT on and off. Perform this for all relevant frequency bands and for horizontal and vertical antenna polarities.
- 8.3.9** Exit the **SUSPECT LIST** menu and then transfer all the EUT emissions from the suspect list to the finals list.
- 8.3.10** Select the **FINAL LIST** menu. Perform quasi-peak measurements under software control on all maximised EUT emissions which are within 6dB of the limit line. If necessary, scan the turntable and antenna in order to re-maximise the signals. Hit the **ACCEPT** key when the turntable and antenna are at the maximised emission. This will ensure that the turntable and antenna positions are recorded in the results.
- 8.3.11** Print and plot out the final list of maximised peak emissions and quasi-peak measurements for all peak emissions within 6dB of the limit line.
- 8.3.12** Save the measurement data on the floppy disc. The disc is labelled on a

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month by month basis, e.g. July 96 disc will contain all the data for measurements performed in July 1996.

9. CALCULATIONS

From the final list printed out by the software, one can compare the EUT emissions with the limit line. The printed list will give the frequency, quasi-peak and peak levels, limit line and margin to the limit line.

10. RESULTS / REQUIREMENTS

From the calculations, inspect the margin between the limit lines and the measurements. Then with reference to the uncertainty budgets (document EMC/UNC/001), the following conclusion may be reached:-

For measurements which are below the limit line by a margin greater than the measurement uncertainty, the result is considered as a pass.

For measurements which are above the limit line by a margin greater than the measurement uncertainty, the result is considered as a failure.

For measurements below the limit line, but within the measurement uncertainty, the result is considered as a marginal pass.

For measurements above the limit line, but within the measurement uncertainty, the result is considered as a marginal fail.