TEST REPORT No: P3133/2

Customer/Applicant:	Merrychef Limited
Address:	Station Road West Ash Vale Aldershot Hampshire GU12 5XA
Subject:	**ELECTROMAGNETIC COMPATIBILITY**
Customer Ref:	21398
Manufacturer:	Merrychef Limited
Product:	Micro Combination Oven
Model/Trade Name:	Menuflex
Model No/Type:	208V 60Hz System
Serial No/Lot No:	MF00171001
Tests Carried Out:	CFR 47 Part 18 Sections 18.305 & 18.307

Tests marked "NUA" in this report are not included in the UKAS accreditation schedule for our laboratory. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Report Author:	F Barkas	**Checked By:**	O.W.Cockram
Title:	(EMC Engineer)	**Title:**	(General Manager)
Signature	_____	**Signature**	_____

Issue Date: 23rd Oct 2001

Report Summary

Report No:	P3133/2
Test Standard:	CFR 47 Part 18 Sections 18.305 & 18.307
Carried Out At:	EMC Projects Ltd., Ringwood, Hants, BH24 2DB
Equipment Tested:	Menuflex
Model No:	208V-60Hz
Serial No:	MF00171001
Software Version:	Fast Control
Carried Out On:	3-8th Oct 2001
Test Engineer:	F Barkas & J Crossley
In Attendance:	Gordon Hind

SUMMARY of RESULTS

The Table below depicts a summary of the tests and test results detailed in this report.

Test	Test Type	Specification & Issue	Result	Page	Levels/Comments
1	Power Output & Frequency	MPT-5	Pass	8	2.45GHz.+/- 50MHz @1322.5Watts
1	Conducted Emissions	CFR 47 Part 18 Section 18.305 Non Consumer Equipment Limits	Pass	8	208V-60Hz Supply
2	Radiated Emissions	CFR 47 Part 18 Section 18.307 ISM greater than 500W Limits	Pass	13	10m & 3m Open Area Test Site

CONTENTS PAGE

1. INTRODUCTION

This report details the results of the Electromagnetic Compatibility (EMC) tests carried out on a Microwave Combination Oven with a rated power output of 1.5kW. The Menuflex is a Microwave Combination Oven, (EUT) manufactured by Merrychef Limited. Testing was carried out to the requirements of CFR 47 Part 18, subpart C, Sections 18.305 Radiated Emissions, and 18.307 Conducted Emissions in accordance with the requirements of FCC/OST MP-5 (1986) and ANSI 63.4 (1992).

EMC Projects Ltd. is an UKAS accredited EMC Test House; a CAB recognised by the EU-US MRA Joint Committee and is registered with the FCC, registration No 90573.

2. MODES OF OPERATION

For the duration of the testing, the EUT was powered from a 208V-60Hz.supply, operating modes were heater on, microwave on 100% and 50% of full power. The EUT load, when tested on microwave, consisted of various quantities of tap water contained in polypropylene containers as required in MP-5.

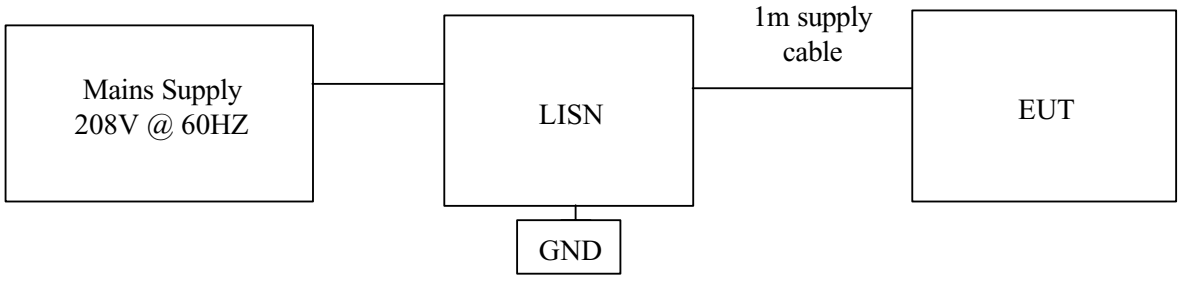
3. GENERAL TEST SETUP

The EUT was set-up for testing as described below and shown in the set-up diagrams and photographs.

A block diagram of the EUT set-up is shown in figure 1 detailing cable connections. A dummy load of tap water was placed in the oven. Worse test conditions, were assessed for each test required. The only cable connected to the EUT was the mains cable and this was connected continuously during testing.

The method used to calculate the amount of tap water to be used as a dummy load and the type of container, was as detailed in MP-5 Para 4.1.

3.1 Figure 1 - Block Diagram of EUT Set-up



3.2 Conducted Emissions

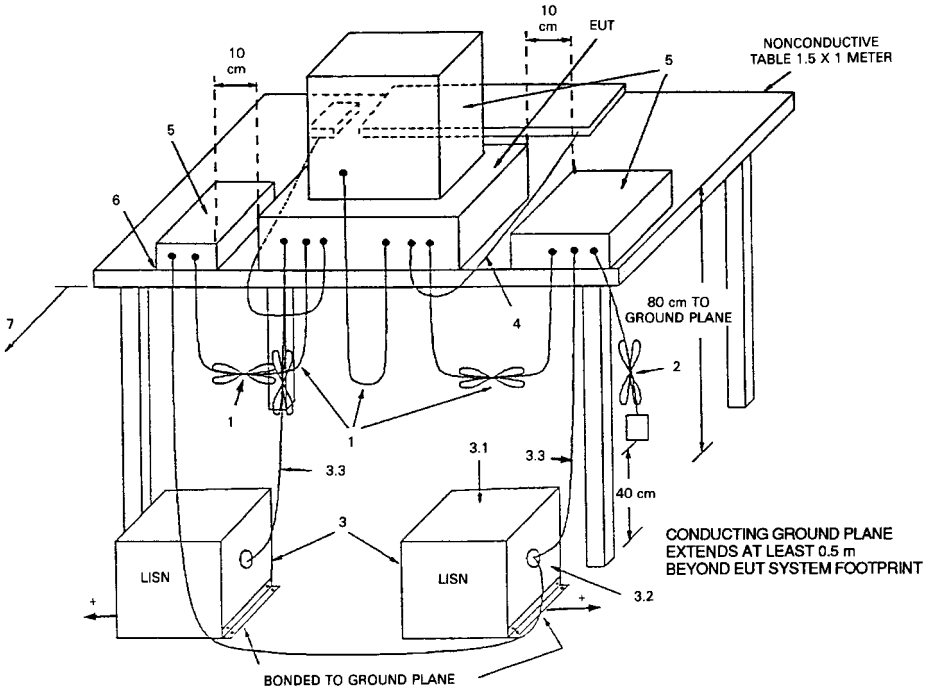
The EUT being Table Top Equipment was set-up upon a non-metallic tables measuring 1.5 x 1.0m x 800mm above the conducting ground plane and 400mm from the vertical conducting surface in Screened Room No 1, as indicated in the test set-up and set-up photographs.

The EUT was powered from a filtered 208V-60Hz supply via Line Impedance Stabilizing Networks (LISN's). The LISN was mounted and bonded to the conducting ground plane 800mm from the EUT. All unused 50-Ohm connectors of the LISN were terminated with resistive 50-Ohm terminations.

Any excess length of the EUT supply and interconnecting cables were folded back and forth at the centre of the cable to produce a bundle 40cm in length to ensure the overall length did not exceed 1m.

The EUT ground (safety) connection was connected to the ground at the LISN, through the conductor provided in the supply lead.

3.2.1 Figure 1 - General Test Set-up - Table Top Equipment



†LISNs may have to be moved to the side to meet 3.3 below.

LEGEND:

1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 to 40 cm long, hanging approximately in the middle between ground plane and table.
2. I/O cables that are connected to a peripheral shall be bundled in center. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.
3. EUT connected to one LISN. Unused LISN connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, ground plane.
   - 3.1 All other equipment powered from second LISN.
   - 3.2 Multiple outlet strip can be used for multiple power cords of non-EUT equipment.
   - 3.3 LISN at least 80 cm from nearest part of EUT chassis.
4. Cables of hand-operated devices, such as keyboards, mouses, etc., have to be placed as close as possible to the host.
5. Non-EUT components being tested.
6. Rear of EUT, including peripherals, shall be all aligned and flush with rear of tabletop.
7. Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the floor ground plane (see 5.2).

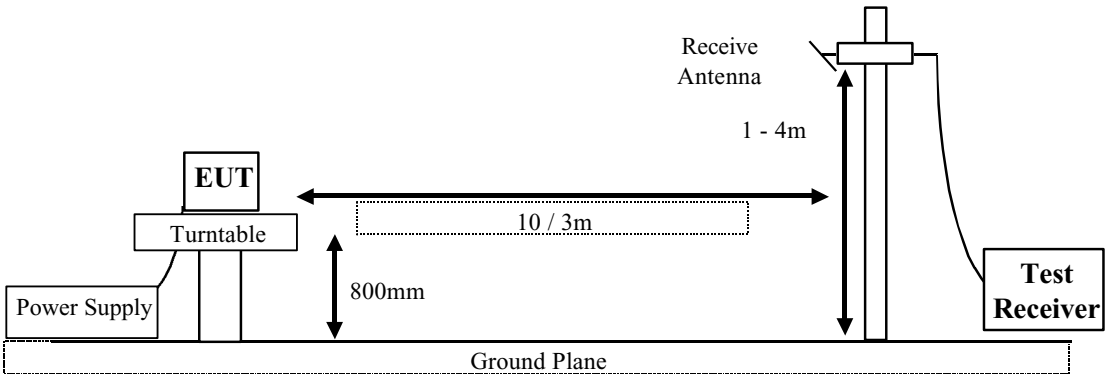
3.3 Radiated Emissions

Measurements for radiated emissions were carried out on a 10m and 3m Open Area Test Site (OATS) meeting the requirements of 5.3 of ANSI 63.4:1992.

For preliminary testing radiated emissions were first recorded in an unlined screened room to determine the mode of operation, cable, sub-assembly position, and layout that produced the maximum levels and frequencies of any emissions.

The EUT was then moved to the OATS and placed on a Turntable 800mm above the conducting ground plane; the lay out was that, previously assessed in the screened room as producing the maximum emissions. This is indicated in the test set-up and set-up photographs.

3.3.1 Figure 1 - OATS General Test Set-up



4. TEST EQUIPMENT

All test equipment used for the tests was calibrated and its operation verified prior to being used, a full list of which is shown in Annex A.

Test cable measured attenuation figures and calibrated antenna factors not detailed in other areas of the report are listed in Annex B.

5. AMBIENT CONDITION

For the duration of the tests the ambient conditions were recorded and found to fall in the following ranges:

Temperature Recorded:	15-22°C
Humidity Recorded:	50-65%
Atmospheric Pressure:	1005-1015mb

6. TEST PROCEDURES

Procedures and methods of test employed were in accordance with the requirements of the specifications applied, using accredited in-house test procedures in accordance with ANSI 63.4:1992 as described below:

6.1 Power Measurement

The EUT shall be set to 100% of full power. A dummy load of tap water, in the style of container and positioned, as required by MP-5 Para 4.1.shall be placed in the microwave oven. The temperature rise of the water over a period of 0.6 minutes shall be recorded. This temperature rise shall be used to calculate the power output of the microwave. The calculated power will then be used to determine the radiated limits to be applied.

6.2 Conducted Emissions

The EUT shall be set-up in the screened room as detailed in Para 3, conducted emissions will be recorded on each supply line over the frequency range 450kHz to 30MHz with a receiver bandwidth of 10kHz. The receiver shall be in Peak, Quasi-Peak and Average detector modes as required to ensure compliance with the specification, whilst operating the EUT in the worse state condition.

The EUT dummy load shall be maintained at the level of tap water, using the style of container and positioned in the oven, as required by MP-5 Para 4.1.

The recorded emissions shall be compared against the limits for CFR 47 Part 18.305 non-consumer equipment.

6.3 Radiated Emissions

With the EUT set-up in the screened room as for conducted emissions and operated at maximum power output and differing loads of tap water, frequencies of radiated emissions shall be recorded from the EUT at a distance of 1m in both polarities.

The EUT dummy load's shall be maintained during all testing, at the level of tap water, using the style of container and positioned in the oven, as required by MP-5 Para 4.1.

The EUT will then be taken onto the OATS and the maximum levels of the radiated emissions recorded in preliminary tests will be measured at distances of ether 10 or 3m, with the receive antenna varied between 1 and 4m in height, the antenna in both vertical and horizontal polarisation and the EUT rotated through 360deg.

The recorded emissions shall be compared against the limits for CFR 47 Part 18.307 non-consumer equipment.

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7. TESTS CARRIED OUT

The following tests were deemed to be applicable to the EUT and were carried out as detailed in the test results section.

Test	Test Type	Specification & Issue	Levels Comments
1	Power Output & Frequency	MPT-5: 1986	In line with the declared power output & a fundamental frequency of 2.45GHz +/- 50MHz
2	Conducted Emissions	CFR 47 Part 18 Section 18.307	208V-60 Hz Supply - Live Line
3	Conducted Emissions	CFR 47 Part 18 Section 18.307	208V-60 Hz Supply - Neutral Line
4	Radiated Emissions	CFR 47 Part 18 Section 18.305	10m & 3m Open Area Test Site (OATS)

8. TEST RESULTS

8.1 Test 1a Power Output & Fundamental Frequency

8.1.1 Test 1a Power Output

The EUT was set-up as shown in figure 1, the microwave set to 100% of full power and a dummy load consisting of 1000milli-litres of tap water contained in a polypropylene beaker was positioned in the centre of the microwave oven; the temperature rise of the water over a period of 0.6 minutes was be recorded. This temperature rise was used to calculate the power output of the microwave.

The ac-measured current during this test was found to be inline with the manufactures declared level for the microwave operating at 100% of full power.

In order to calculate the power output the following formulas were used:

$$P = \frac{q \times \tilde{}t}{14.4 \times T} \text{ watts}$$

P = watts	˜t = temperature rise in water(Deg C)11.3
q = quantity of water(cm^3) 1000milli-litres	T = heating time (min)0.6

P = 1.3kWatts without an allowance for the container

8.1.2 Test 1b Fundamental Frequency

The EUT was set-up as shown in figure 1, the microwave was set to 100% of full power and a dummy load consisting of 1500, 1050 and 450milli-litres of tap water contained in a polypropylene beaker was positioned in the centre and front right of the microwave oven. The fundamental frequency was recorded and found to remain within the ISM band of 2.45GHz +/- 50MHz.

8.1.3 Test 1 - Test Equipment Used

The following major items of test equipment were used for the power output & fundamental frequency tests:

DRG2	SA10	PA5	YI5	Room 1

8.1.4 Test 1 - Figure 1 - Set-up Photographs

8.2 Test 2 - Conducted Emissions 208V-60Hz Supply

The EUT was set-up inside a screened room as detailed below and powered from a filtered 208V-60Hz supply via Line Impedance Stabilization Units (LISN's). The format for the layout was as detailed in Para. 3, set-up diagrams with the actual layout as the photograph in figure 1.

The Test Equipment was verified for calibration and operation before being used.

Prior to carrying out the tests ambient levels were recorded and found to be greater than 6 dB below the required limits.

During the test, the EUT was powered up and operated in the following modes with heaters on & off , 100% and 50% of microwave output power. A dummy load of 1050milli-litres of tap water in a polypropylene container was placed in the centre of the EUT

Conducted emissions were recorded on both Live and Neutral supply lines over the frequency range 450kHz to 30MHz in accordance with the specification requirements. Emissions were recorded with the EUT operating at 100% and 50% of full power. Heater on or off did not change the emission levels. The results depicted in figures 2 & 3 are representative worse case graphs of 100% and 50% emissions on the live and neutral lines.

Figure 2, is a graph using a quasi peak detector function with emissions above the limit line, figure 3 shows the worse case recorded emissions with an average detector. These showed that the use of an average detector produced levels of emissions greater than 6dB below the quasi-peak levels. MP5 Para 4.22 Note 2 allows for a relaxation of 13dB in the quasi-peak limit, as a quasi-peak emission exceeds the limit, it has been required to exercise this option. It can be seen that the maximum-recorded emissions in the normal mode of operation were within the required limits. Test on the live line and other modes of operation were all found to be within the limits.

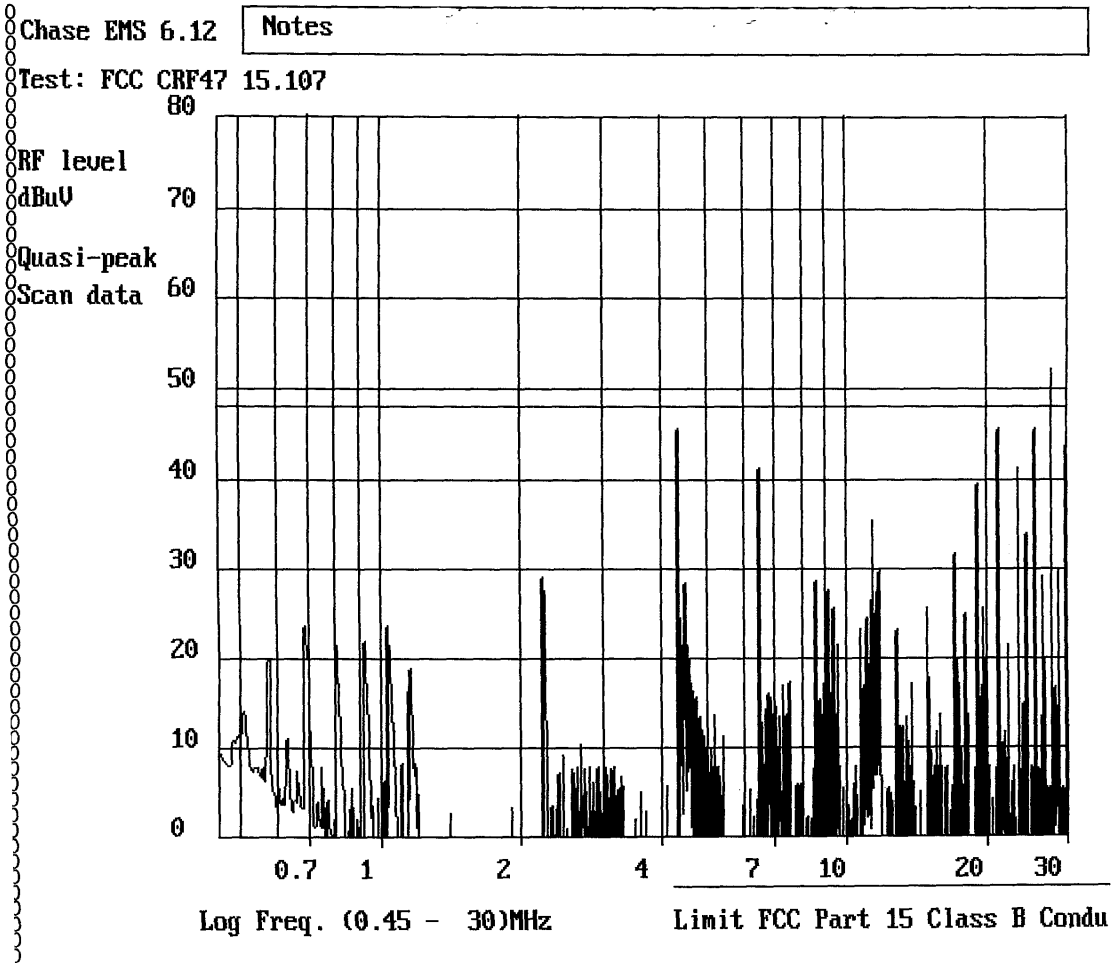
8.2.1 Test 2 - Test Equipment Used

The following major items of test equipment were used for the conducted emission tests:

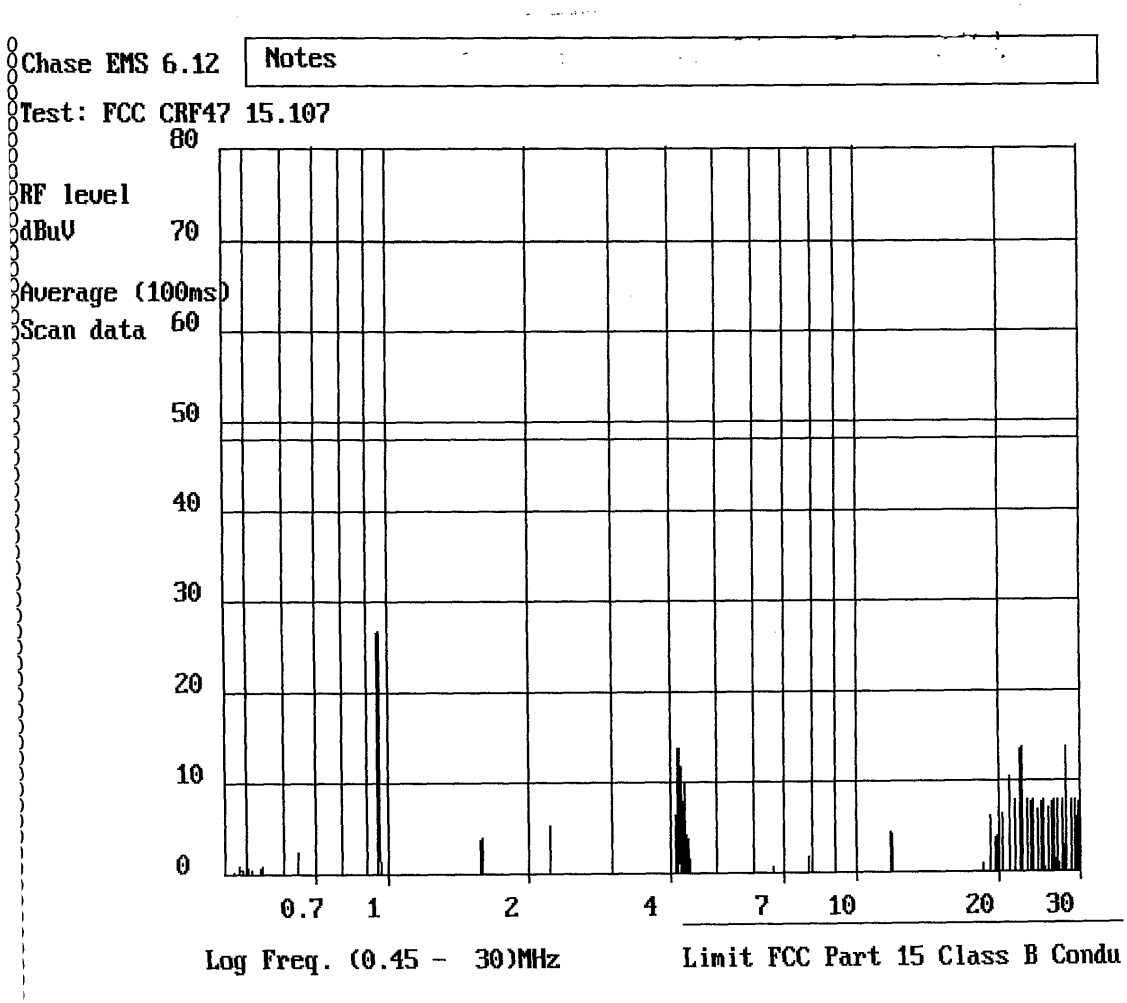
Rx10	L6/2	L6/3	DB76	DL50/3	Room 1

8.2.2 Test 2 - Figure 1 - Set-up Photographs

8.2.2.1 Test 2 – Figure 2 – 208V-60Hz supply – 208V Oven- Neutral Line
Quasi Peak detector



8.2.2.2 Test 2 - Figure 3 - 208V-60Hz – 208V Oven - Neutral Line
Average Detector



8.3 Test 3 - Radiated Emissions 30MHz to 25GHz

8.3.1 Test 3a - Radiated Emissions 30MHz to 1GHz

Radiated emissions over the frequency range 30MHz to 1GHz were recorded 1m from the EUT whilst set-up in a screened room. During this test, checks were carried out to determine the mode of operation and cable configuration most likely to produce the maximum emissions.

The Test Equipment was verified for calibration and operation prior to being used.

During testing the EUT was powered up and operated in the following modes with heaters on & off, 100% and 50% of microwave output power. The heaters being on or off was found to have no effect on the emission levels, testing on the OATS was carried out with heaters off. A dummy load of 1050milli-litres of tap water in a polypropylene container was placed in the centre of the EUT during testing of the microwave function.

The EUT was then set-up on a turn table on the 10m Open Area Test Site (OATS) powered up from a 208V-60Hz supply, allowed to stabilize in its worse case mode of operation, as detailed in Para.3, set-up diagrams and the photograph in figure1.

The tests were carried out with a 2m mains cables connected. No other cables were applicable.

Radiated emission tests were repeated over the full frequency range, paying particular attention at those frequencies detected in the screened room test. At each frequency detected, the height and polarization of the receive antenna was adjusted and the turntable rotated to record the maximum level on the receiver.

From figures 2 & 3, it can be seen that inside a screened room with the antenna 1m from the EUT emissions were recorded. When the EUT was taken to the OATS emissions above the specification limit was detected. The EUT was modified as figure 4 with 2 TDK clamp on ferrites. The EUT was reassessed on the OATS for compliance and found to meet the requirements. Particular attention was paid to the frequencies highlighted by the screen room investigations

No emissions were recorded above the limit line on the OATS. It can therefore be stated that the radiated emissions were found to be within the requirements of the specification.

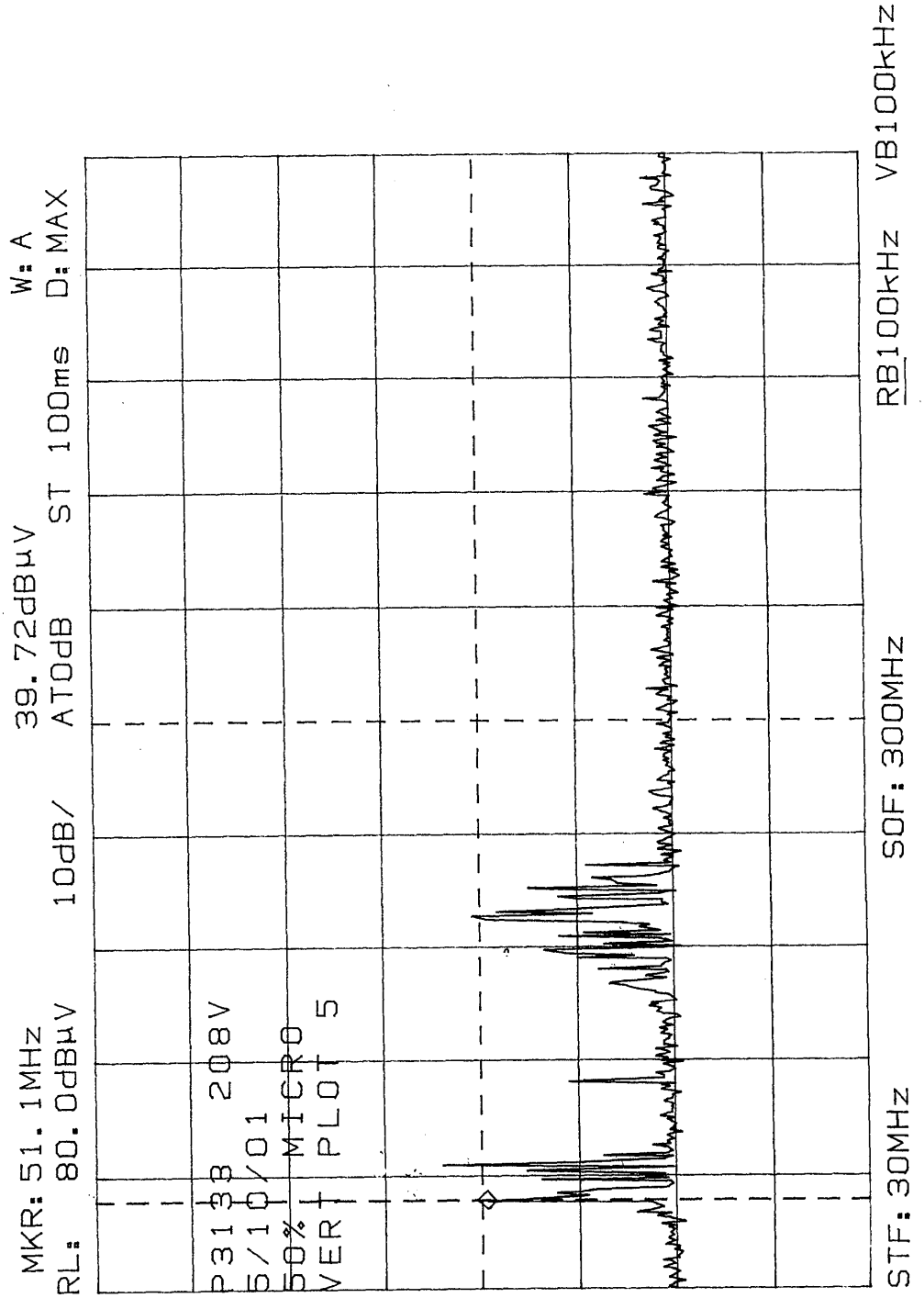
8.3.2 Test 3a - Test Equipment Used

The following major items of test equipment were used for the radiated emission tests:

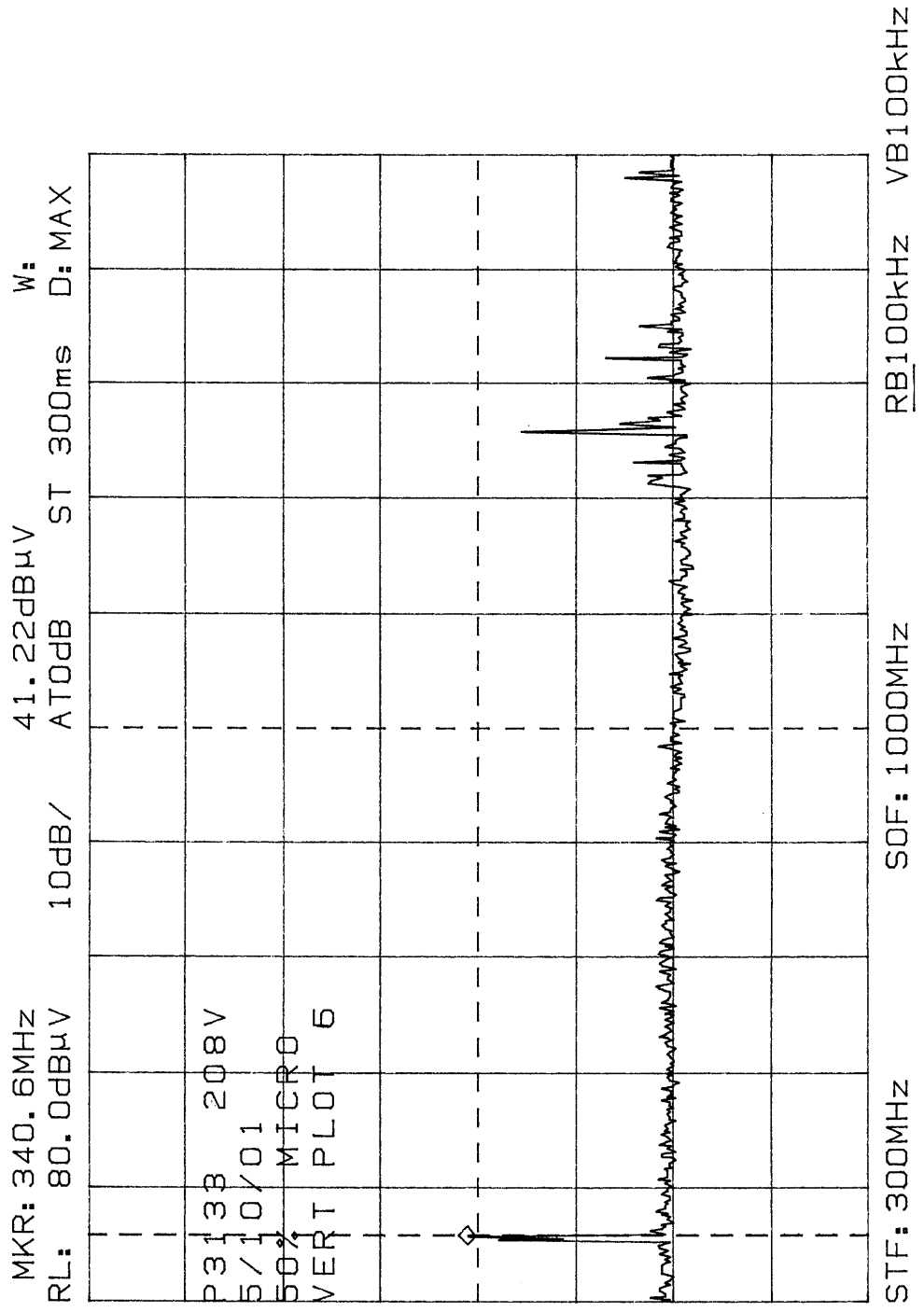
SA9	Rx11	BA1	BA4	OATS2	PA2

8.3.3 Test 3a - Figure 1 - Set-up Photographs

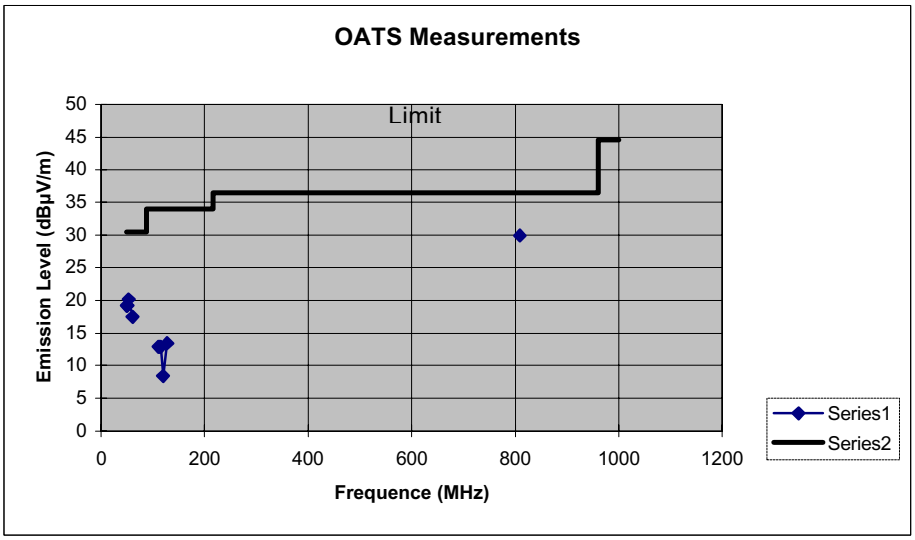
8.3.3.1 Test 3a - Figure 2 – 208V Oven – 30-300MHz Screened Room Emission Measurements Uncorrected



8.3.3.2 Test 3a - Figure 3 – 208V Oven – 300-1000MHz Screened Room Emission Measurements Uncorrected



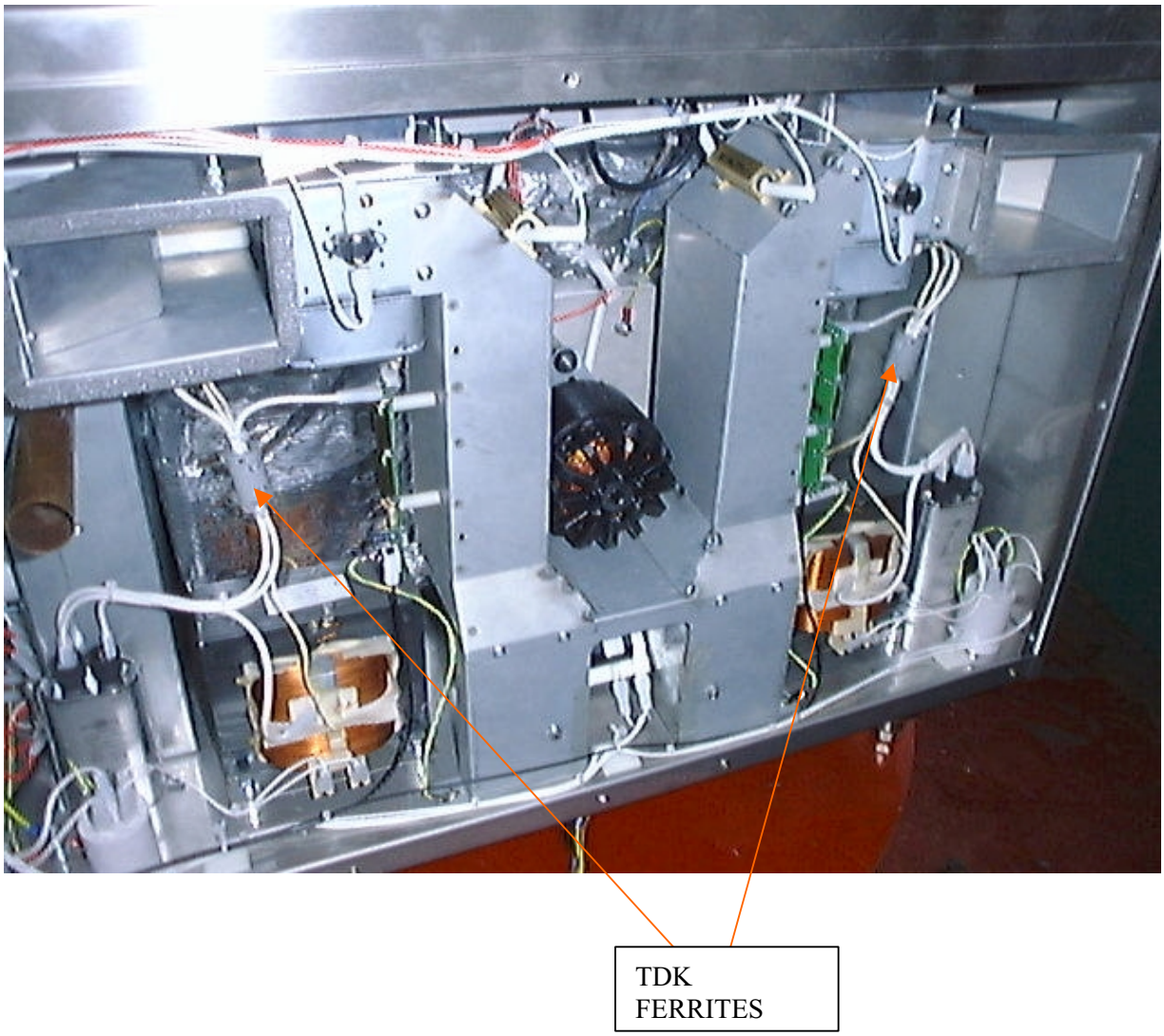
8.3.3.3 Test 3a - Figure 4 - Radiated Emissions 10m OATS



8.3.3.4 Test 3a - Table 1- Radiated Emissions, Data

Freq MHz	Total dBµV/m	Limit dBµV/m @ 10m	Reading dBµV/m	Antenna & Cable Correction	Antenna
50.1	19.2	30.5	10	9.2	BA4
51.1	19.2	30.5	10	9.2	BA4
52.7	20.2	30.5	11	9.2	BA4
60.8	17.5	30.5	11	6.5	BA4
88		30.5			
88		34			
111	12.9	34	0	12.9	BA4
113	12.9	34	0	12.9	BA4
116	12.9	34	0	12.9	BA4
120	8.4	34	-5	13.4	BA4
127	13.4	34	0	13.4	BA4
216		34			
216		36.5			
809	29.9	36.5	0	29.9	BA4
960		36.5			
960		44.5			
1000		44.5			

8.3.4 Test 3a - Figure 5 – Photographs of EUT modification



8.3.5 Test 3b - Radiated Emissions 1GHz to 25GHz

Radiated emissions over the frequency range 1GHz to 25GHz were recorded 1m from the EUT whilst set-up in a screened room. During this test, checks were carried out to determine the mode of operation and cable configuration most likely to produce the maximum emissions.

The Test Equipment was verified for calibration and operation prior to being used.

During testing the EUT was powered up and operated in the following modes with heaters on & off, 100% and 50% of microwave output power. The operation of the heaters was found to have no effect on the emission levels, testing on the OATS was carried out with heaters off. A dummy load of 1050 and 450milli-litres of tap water in polypropylene containers was placed in the centre and right hand corner of the EUT during testing of the microwave function as required by MP-5.

The EUT was then set-up on a turn table on the 3m Open Area Test Site (OATS) powered up from a 208V-60Hz supply, allowed to stabilize in its worse case mode of operation, as detailed in Para.3, set-up diagrams and in the photograph in figure 1.

The tests were carried out with a 2m mains cable connected. No other cables were applicable.

Radiated emission tests were repeated over the full frequency range, paying particular attention at those frequencies detected in the screened room test. At each frequency detected, the height and polarization of the receive antenna was adjusted and the turntable rotated to record the maximum level on the receiver.

The maximum-recorded levels were corrected for antenna factor, cable losses and amplifier gain if required. The specification limits were then corrected, for distance of the antenna from the EUT and the power of the EUT. This was used to determine compliance with the standard as shown in figures 2-6 and table 1.

From the figures and table, it can be seen that the radiated emissions were found to be within the requirements of the calculated limits:

Limit = 25µV/m @ 300M for 500W
Limit = 72.2dBµV/m @ 3m for a calculated power of 1.3kW

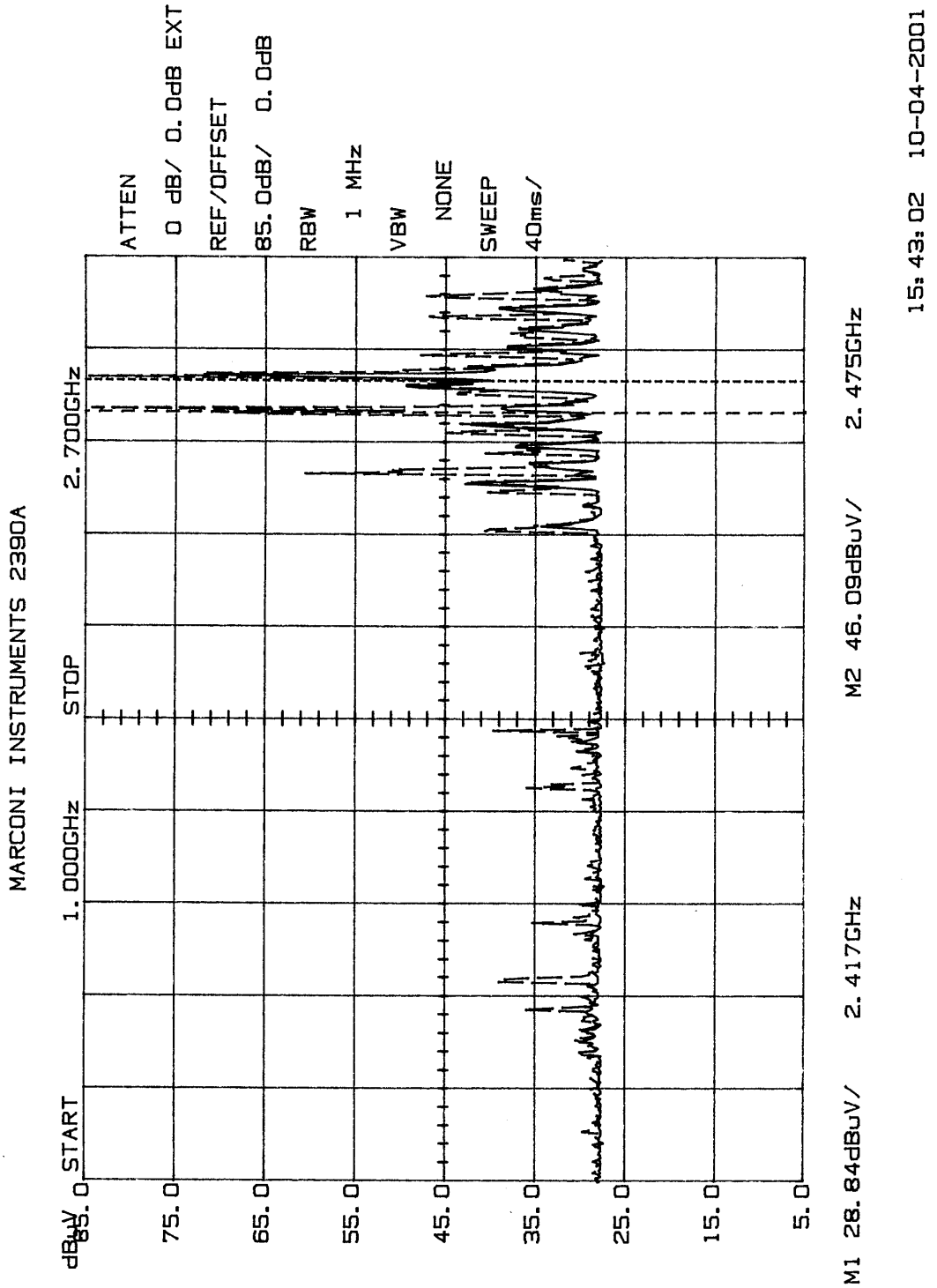
8.3.6 Test 3b- Test Equipment Used

The following major items of test equipment were used for the radiated emission tests:

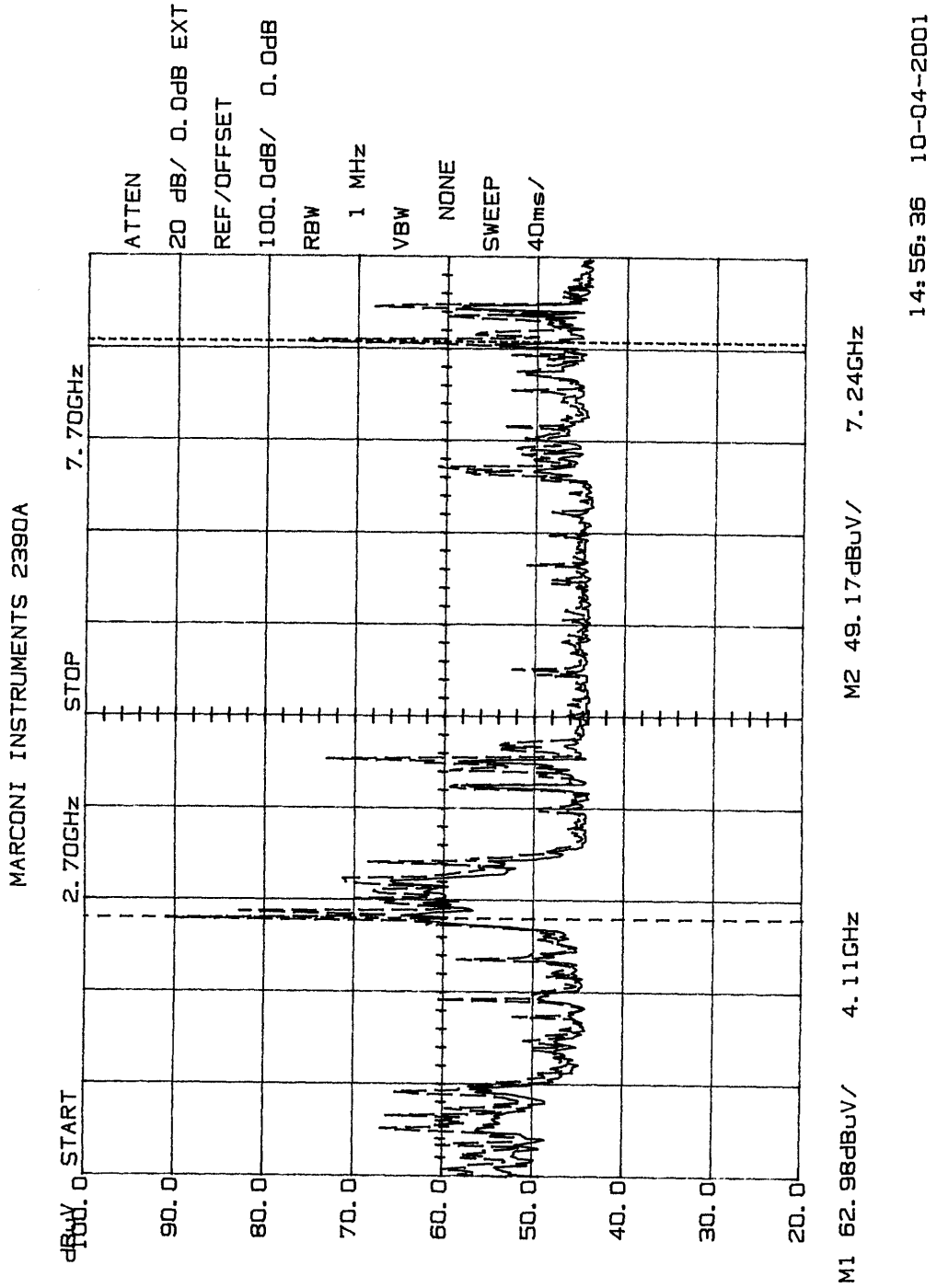
OATS 1	SA10	Loan 3116	DRG2	PA5	RX9	Loan R3271A	Room 1
TC1	TC2						

8.3.7 Test 3b - Figure 1 - Set-up Photographs

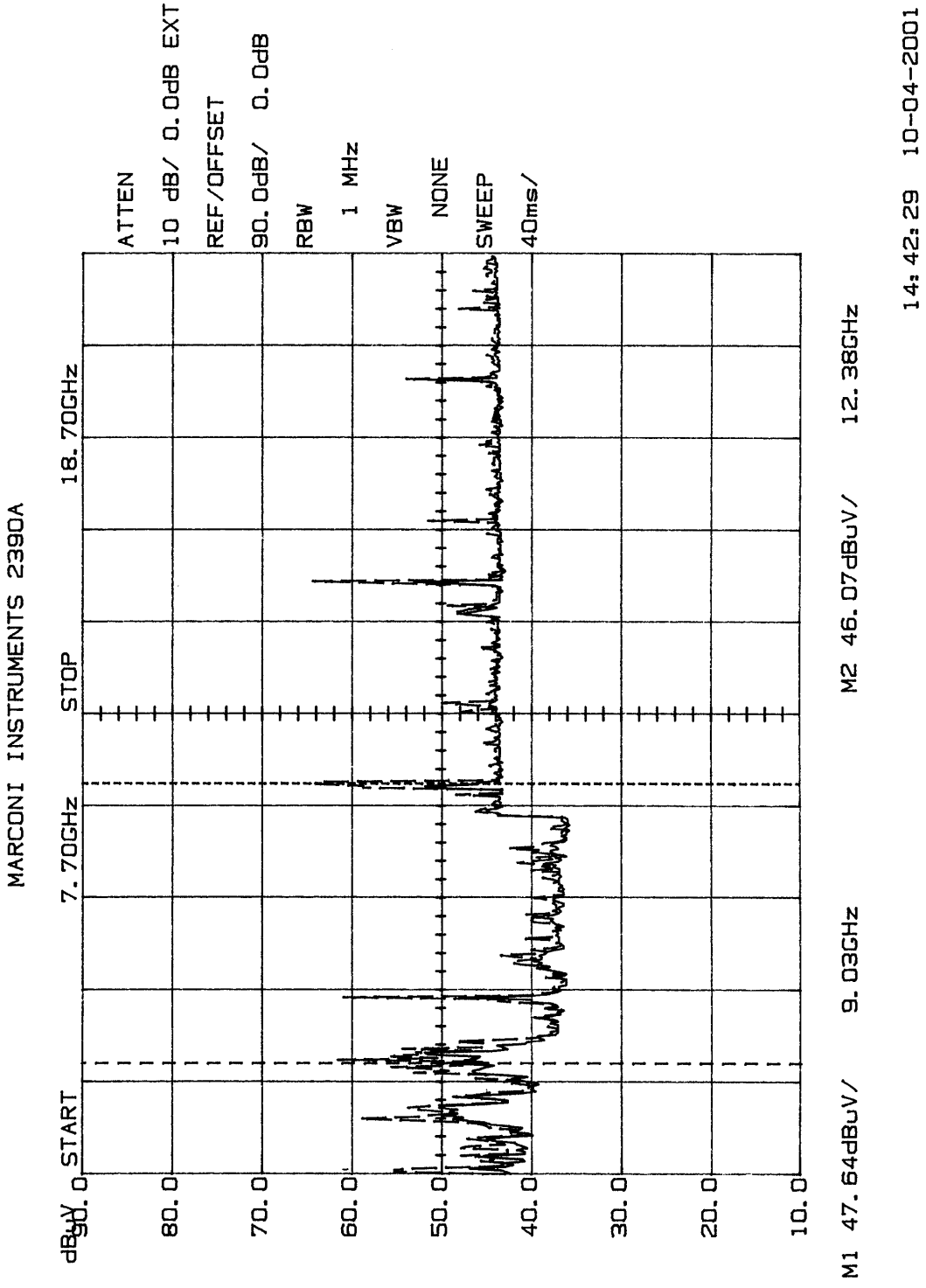
8.3.7.1 Test 3b - Figure 2 – 208V Oven – 1.0 – 2.7GHz Screened Room Emission Uncorrected For Antenna Or Cables Factors



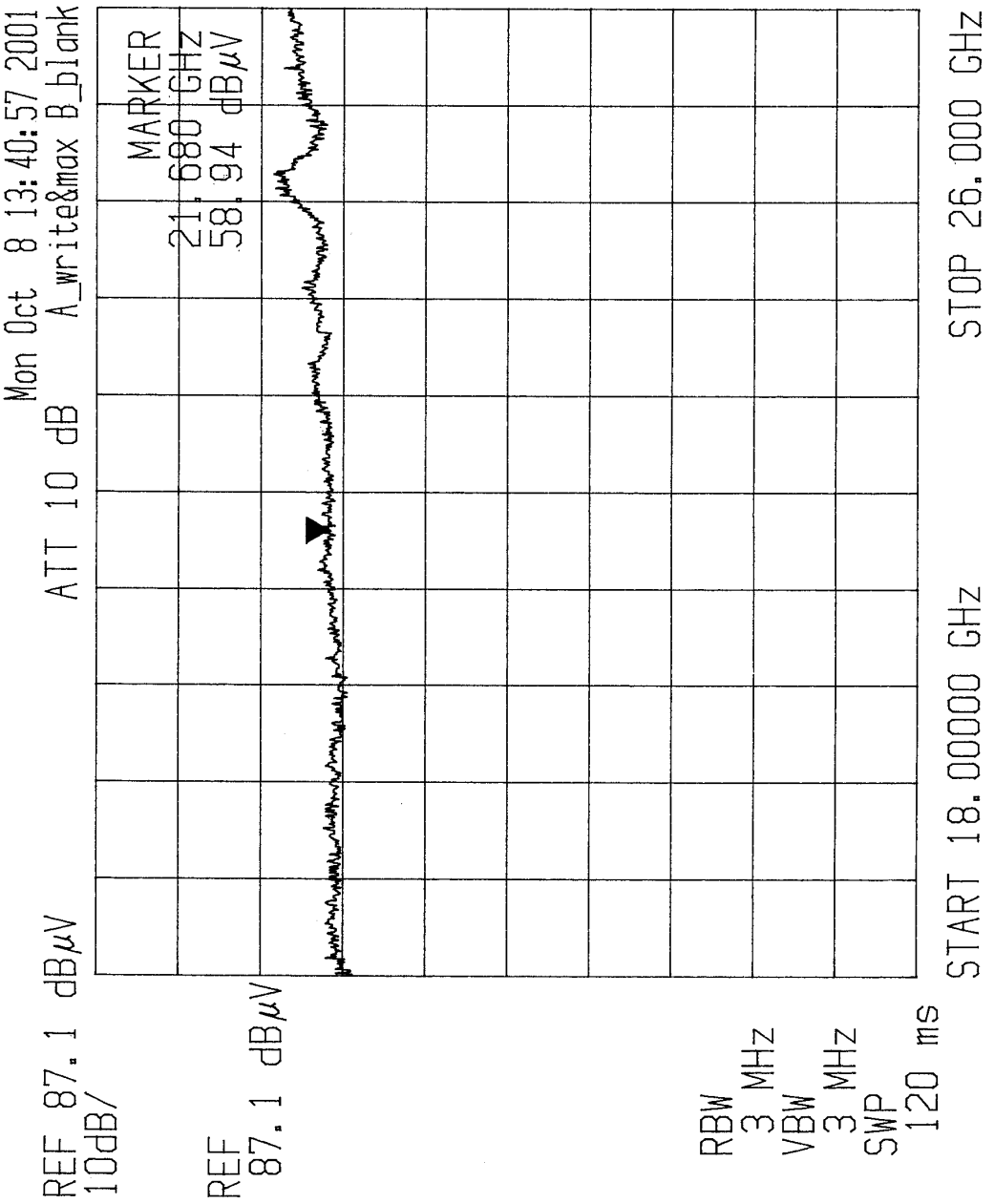
8.3.7.2 Test 3b - Figure 3 – 208V Oven – 2.7 – 7.7GHz Screened Room Emission Uncorrected For Antenna Or Cable Factors



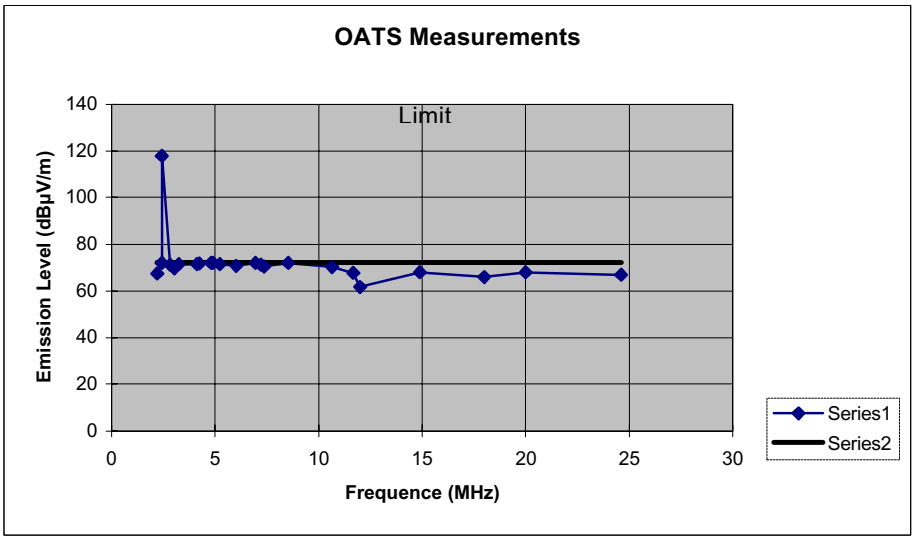
8.3.7.3 Test 3b - Figure 4 – 208V Oven – 7.7 – 18.7GHz Screened Room Emission Uncorrected For Antenna, Cable Or Amplifier



8.3.7.4 Test 3b - Figure 5 – 208V Oven – 18 – 26GHz OATS Emission Measurements Uncorrected For Antenna, Cable Or Amplifier.



8.3.7.5 Test 3b - Figure 6 - Radiated Emissions 3m OATS



8.3.7.6 Test 3b - Table 1- Radiated Emissions, Data

Freq GHz	Total dBµV/m	Limit dBµV/m @ 3m	Reading dBµV/m	Antenna & Cable Correction	Antenna
2.2	67.5	72.2	38.5	29	DRG2
2.42	71.9	72.2	42	29.9	DRG2
2.44	117.9		88.2	29.7	DRG2
2.82	71.17	72.2	38.87	32.3	DRG2
3.01	69.87	72.2	36.87	33	DRG2
3.26	71.6	72.2	37.8	33.8	DRG2
4.13	71.56	72.2	37.56	34	DRG2
4.23	71.7	72.2	37.1	34.6	DRG2
4.81	72	72.2	37.2	34.8	DRG2
4.9	72	72.2	36.2	35.8	DRG2
5.23	71.4	72.2	34.8	36.6	DRG2
6.02	70.7	72.2	32.2	38.5	DRG2
6.94	71.9	72.2	33	38.9	DRG2
7.21	71.2	72.2	32.2	39	DRG2
7.38	70.5	72.2	31.1	39.4	DRG2
8.53	72	72.2	31.7	40.3	DRG2
10.64	70.2	72.2	29	41.2	DRG2
11.67	67.8	72.2	26.3	41.5	DRG2
12	61.8	72.2	19.9	41.9	DRG2
14.88	67.96	72.2	24.2	43.76	DRG2
18	65.9	72.2	20	45.9	3116
20	67.95	72.2	22	45.95	3116
24.6	66.92	72.2	20	46.92	3116

9. CONCLUSIONS

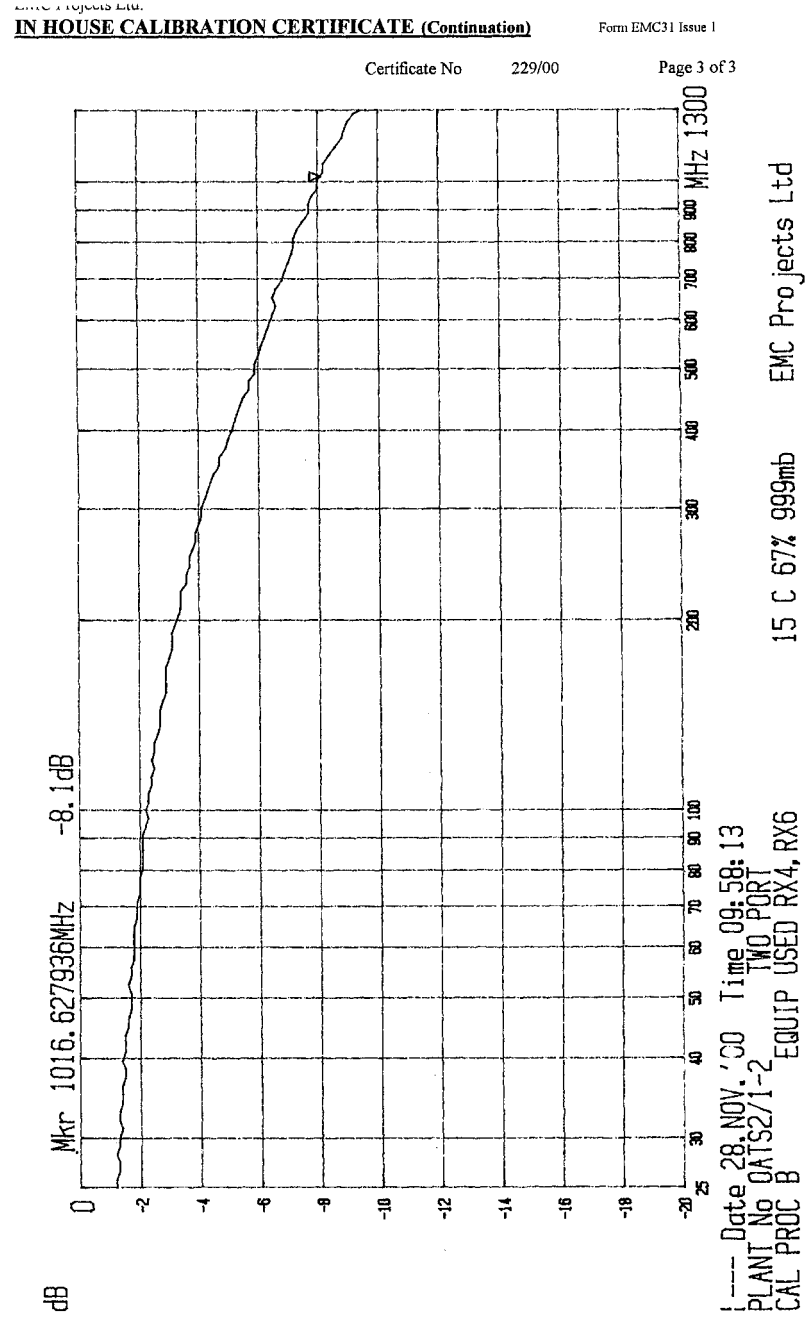
The EUT was found to meet the specification requirements detailed when modified as recorded in para 8.3 and tested to the customers requirements.

10. ANNEX A - TEST EQUIPMENT LIST

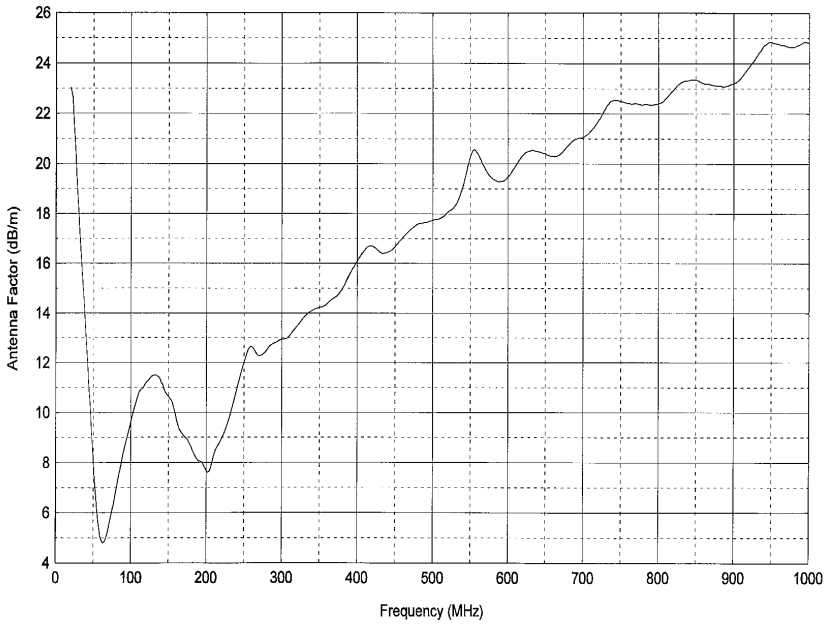
Plant No	Manufacturer	Description	Serial No	Cal Period	Cal Due
BA1	A H System	Bilog Antenna SAS 200/521	134	24 Months	10 Oct 02
BA3	Chase	Bilog Antenna,CBL6111A	1733	24 Months	14-Mar-03
BA4	Chase	Bilog Antenna,CBL6111A	1667	24 Months	17-Mar-01
DB20	Rhode & Schwarz	30dB Attenuator 33664/50	1601/2	12 Months	10-Mar-01
DB76	Nitsuki	9305A Step Attenuator	54D653	12 Months	19 Dec 01
DERA	Hewlett Packard	HP8563E	3623A05267	12 Months	02–April-01
DL50/3	RS components	50W Load	613-690	12 Months	15-Nov -01
DRG2	EMCO	3115	9704-5167	24 Months	08-Mar -01
L6/2	EMC Projects Ltd.	CISPR16 9kHz-30MHz (30A,50 /50µH), MIL STD 461D		12 Months	10-Feb-02
L6/3	EMC Projects Ltd.	CISPR16 9kHz-30MHz (30A,50 /50µH), MIL STD 461D		12 Months	10-Feb-02
Loan	Advantest	Spectrum Analyser R3271A	45050075	12 Months	25 June 02
Loan	EMCO	3116	2011	12 Months	12 –Jan- 01
OTS2	EMC Projects Ltd.	Open test site 2		12 Months	24-Nov-01
OTS2/1	EMC Projects Ltd.	Installed Receive Coax Cable on OTS2		12 Months	24-Nov-01
OTS2/2	EMC Projects Ltd.	Installed Receive Coax Cable on OTS2		12 Months	24-Nov-01
PA2	EMC Projects Ltd.	HF Pre Amplifier	001	12 Months	20 Feb 02
PA5	Hewlett Packard.	8449B Pre Amplifier	3008A00176	12 Months	26 July 02
Room1	Ray Proof	Screen room 3.7m x 5m x3m	1662	12 Months	29-Nov-01
RX1	Rhode & Schwarz	Receiver ESH3	860318/008	12 Months	05-Sept-01
RX2	Rhode & Schwarz	Receiver ESVP	894790/005	12 Months	11-Sept-01
RX3	Rhode & Schwarz	Spectrum Monitor EZM	861 192/009	12 Months	06-Sept-01
RX9	Eaton	Eaton Field Intensity Meter NM67	0208 82054	12 Months	24 May 02
RX10	Chase	Receiver LHR7000	1077	12 Months	4-Sept-02
RX11	Chase	Receiver UHR7000	6114	12 Months	3-Sept-02
SA9	Anritsu	Spectrum Analyser MS2601B	MT54360	12 Months	10-Oct-01
SA10	Marconi	Spectrum Analyser 2390A	1601	12 Months	4 Mar 02
TC1		Sealectro cable 065-9AA-2000-00	63703	12 Months	27 Mar 02
TC2		Sealectro cable 065-9AA-2000-00	59528	12 Months	2 Oct 02
UHR1	Chase	Receiver UHR4000	6000	12 Months	04-Dec-01
YI5	Yokogawa	Digital Temperature Indicator	2455	12 Months	07 June 01

11. ANNEX B - CORRECTION FACTORS

11.1 Cable Attenuation OATS cable 30-1000MHz



11.2 Antenna Correction Factors BA4 30-1000MHz



Antenna factor: Antenna model CBL6111A, s/n 1733.

11.3 Antenna Correction Factors DRG2 1-18GHz