REPORT ON

FCC CFR 47: Parts 15 B and C Testing in support of a
Class II Permissive Change for a Symbol 802.11a/b/g RLAN Module
(5725-5850MHz)

FCC ID: H9P2121160

Report No OR611511/05 Issue 1 November 2004

TÜV PRODUCT SERVICE

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REPORT ON Limited FCC CFR 47: Parts 15 B and C Testing in support of Class II Permissive Change for a Symbol 802.11a/b/g RLAN Module (5725-5850MHz)

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November 2004

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DATED 09-11-04 | 8th November 2004

DISTRIBUTION

Symbol	Copy 1
BABT	Copy 2
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ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC CFR 47: Parts 15 B & C. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineers;

S Hartley A Guy G Lawler J Holcombe

B Airs

UKAS TESTING 0141 Group

CONTENTS

SECTION 1

REPORT SUMMARY

Limited FCC CFR 47: Parts 15 B and C Testing in support of a
Class II Permissive Change for a Symbol 802.11a/b/g RLAN Module
(5725-5850MHz)

1.1 STATUS

EQUIPMENT UNDER TEST	802.11a/b/g RLAN Module
OBJECTIVE	To undertake measurements to determine the Equipment Under Test's (EUT's) compliance with the specification.
NAME AND ADDRESS OF CLIENT	Symbol Technologies Inc One Symbol Plaza Holtsville 11742-1300, New York United States of America
TYPE NUMBER	21-21160
PART NUMBER	21-21160-01
SERIAL NUMBERS	TH4290335 and TH4290282
HARDWARE VERSION	Rev 3.5
DECLARED VARIANTS	21-1160-02
TEST SPECIFICATION ISSUE/DATE	FCC CFR 47: Part 15, Subparts B and C October 2003
NUMBER OF ITEMS TESTED	Two
SECURITY CLASSIFICATION OF EUT	Commercial In Confidence
INCOMING RELEASE DATE	Declaration of Build Status 24th August 2004
DISPOSAL REFERENCE NUMBER DATE	Held pending disposal Not Applicable Not Applicable
ORDER NUMBER DATE	USI 2000282857 18th March 2004
START OF TEST	25th July 2004
FINISH OF TEST	1st November 2004
RELATED DOCUMENTS	ANSI C63.4 2001. Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. FCC Public Notice document (DA 00-705 released 30 March 2000)

1.2 INTRODUCTION

The information contained within this report is intended to show verification of compliance of the Symbol Technologies Inc 802.11a/b/g RLAN Module to the requirements of FCC Specification Parts 15 B and C for frequency band 5725-5850MHz.

Testing was carried out in support of an application for a Class II Permissive Change in the name of Symbol Technologies Inc.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The device supplied for testing was a 21-21160-01 RF Module, which offers 2.4GHz and 5GHz wireless local area network connectivity employing IEEE 802.11a/b/g technologies.

The 2.4/5GHz wireless local area network connectivity employing IEEE 802.11a, b & g technology was previously tested and the results of this testing can be found in BABT Report Number OR611511/02 Issue 4, dated September 2004.

Variant 21-21160-02
The device is identical to that above, employing the same circuitry and same RF design. The only difference being, the PCB has cutouts and the antenna connection point is on the reverse side of the PCB.

BABT Chief Engineer Mr. Chris Gould examined both the 21-21160-01 and 21-21160-02 Radio Cards. It was determined that both cards are identical in respect of component placement and tracking and that the cards differ only in respect of the physical mounting arrangements.

The 21-21160-01 variant utilises a circuit board, which incorporates retained “snap off” mounting ears. For the 21-21160-02 variant the mounting ears are “snapped off”.

It is considered that the 21-21160-02 variant would not emit any more interference, nor be any more susceptible to interference than the 21-21160-01 variant.

It is therefore concluded that if the EMC/RF performance of the 21-21160-01 variant is satisfactory that the 21-21160-02 can be deemed to be satisfactory on the grounds of similarity.

1.3.2 Modes of Operation

Modes of operation of the EUT during testing were as follows in section 1.3.3.

Applicable testing was carried out with the EUT transmitting at maximum power or receiving as detailed in Section 1.3.3 “Test Configuration”.

1.3 PRODUCT INFORMATION - continued

1.3.3 Test Configuration

1.3.3.3 U-NII Band III & ISM Band Mode

The EUT is capable of using 802.11a modulation (54Mbps); all testing was performed using 802.11a modulation (6Mbps), as this was considered to be the worst case by Symbol Technologies.

802.11a RLAN Transmitting on the following channels and frequencies;
Channel 149 5745MHz
Channel 161: 5805MHz
Channel 166: 5830MHz
The Output Power level (controlled by application software) was set to +16dBm

802.11a RLAN Receiving on the following channels and frequencies;
Channel 149 5745MHz
Channel 161: 5805MHz
Channel 166: 5830MHz

1.3.4 DECLARATION OF BUILD STATUS

EUT	
MANUFACTURERS DESCRIPTION	802.11a/b/g RLAN Module
MANUFACTURER	Symbol Technologies
TYPE NUMBER	21-21160
VARIANT	21-21160-01
SERIAL NUMBER	TH4290335, TH4290281, TH4290339, TH4290073, TH4290282 and TH4290078
HARDWARE VERSION	Rev 3.5
TRANSMITTER OPERATING RANGE	2.4-2.4835 & 5.150-5.350, 5.470-5.725, 5.725-5.875GHz
COUNTRY OF ORIGIN	Taiwan
RECEIVER OPERATING RANGE	2.4-2.4835 & 5.150-5.350, 5.470-5.725, 5.725-5.875GHz
RX INTERMEDIATE FREQUENCIES	Not Applicable (Zero IF)
ITU DESIGNATION OF EMISSION	11M0F1D for DSSS & 20M0D2D for OFDM
MODULATION	DSSS & OFDM
RF POWER	100mW MAX EIRP for 2.4 and 5GHz.
FCC ID	H9P2121160
INDUSTRY CANADA ID	1549D-2121160
TECHNICAL DESCRIPTION	The device supplied for testing was a RF Module, which offers 2.4GHz and 5GHz wireless local area network connectivity employing IEEE 802.11a/b/g technologies.
DECLARED VARIANTS	
MANUFACTURERS DESCRIPTION	802.11a/b/g RLAN Module
MANUFACTURER	Symbol Technologies
TYPE NUMBER	21-21160
VARIANT	21-21160-02
TECHNICAL DESCRIPTION	The device is identical to that above, employing the same circuitry and same RF design. The only difference being, the PCB has cutouts and the antenna connection point is on the reverse side of the PCB.
POWER SUPPLY	
VOLTAGE	RLAN Module Powered by Host. Supply Voltage 3.1-3.6V

Signature 

Date 24th August 2004

D of B S Serial No OS611511_ Issue 1

The unit used for the internal photographs in this report was not the EUT, but was supplied as an identical unit for photographs only. It is declared as being the same build status as the EUT.

BABT formally certifies that the manufacturer's declaration as reproduced in this report, is a true and accurate record of the original received from the applicant.

1.4 BRIEF SUMMARY OF RESULTS

This report relates only to the actual item/items tested.

A brief summary of the tests carried out is shown below.

Test	Spec Clause	Test Description	Result	Levels/ Comments
2.1	15.109	Spurious Radiated Emissions	Pass	
2.2	15.207	Spurious Conducted Emissions on Power Lines	Pass	
2.3	15.247(a)(2)	6dB Bandwidth	Pass	
2.4	15.247(b)(3)	Maximum Peak Output Power	Pass	
2.5	15.247(c)	Spurious Conducted Emissions on Antenna Port	Pass	
2.6	15.247(c)	Spurious Radiated Emissions	Pass	
2.7	15.247(d)	Peak Power Spectral Density	Pass	

1.5 OPINIONS AND INTERPRETATIONS

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

1.6 TEST CONDITIONS

The EUT was set-up simulating a typical user installation on the Alternative Open Field Test Site identified in Appendix A and tested in accordance with the applicable specification.

For all tests, the Symbol 802.11a/b/g RLAN Module was powered by the Host Terminal.

1.7 DEVIATIONS FROM THE STANDARD

Limited tests were applied see Section 1.3.2 Modes of Operation and Section 1.4 Brief Summary of Results.

1.8 MODIFICATION RECORD

Not Applicable.

1.9 ALTERNATIVE TEST SITE

No alternative test site was used.

SECTION 2

TEST DETAILS

Limited FCC CFR 47: Part 15 B Testing in support of an
Application for Grant of Equipment Authorisation
of a Symbol 802.11a/b/g RLAN Module

2.1 SPURIOUS RADIATED EMISSIONS

2.1.1 Specification Reference

FCC CFR 47: Part 15 Subpart B, Section 15.109

2.1.2 Equipment Under Test

802.11 a/b/g RLAN Module

2.1.3 Date of Test

25th July 2004

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified as “Section 2.1” within the Test Equipment Used table shown in Section 3.1.

2.1.5 Test Procedure

Test Performed in accordance with ANSI C63.4.

A preliminary profile of the Spurious Radiated Emissions was obtained by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Using the information from the preliminary profiling of the EUT. The list of emissions was then confirmed or updated under Alternative Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

Emissions identified within the range 30MHz – 1GHz were then formally measured using a CISPR Quasi-Peak detector.

Emissions identified within the range 1GHz – 40GHz were then formally measured using Peak and Average Detectors, as appropriate.

The measurements were performed at a 3m distance unless otherwise stated.

Symbol declared that the highest frequency generated within the EUT was 10GHz and therefore testing to 15.109 was carried out to 40GHz.

2.1 SPURIOUS RADIATED EMISSIONS - continued

2.1.6 Test Results

Equipment Designation: Unintentional Radiator.

The EUT met the requirements of FCC CFR 47: Part 15 Subpart B, Section 15.109 for Spurious Radiated Emissions (30MHz – 1GHz).

Measurements were made with the EUT in 802.11a RLAN Mode (see Section 1.3.3 for details).

EUT Rx on Middle Channel (5805MHz)

The levels of the six highest emissions measured in accordance with the specification are presented below: -

Emission Frequency	Polarisation	Height	Azimuth	Field Strength		Limit	
MHz	Horizontal/ Vertical	cm	degree	dBµV/m	µV/m	dBµV/m	µV/m
99.7	H	176	183	29.5	29.9	43.5	150.0
147.5	H	179	183	27.3	23.2	43.5	150.0
440.0	H	229	168	29.3	29.2	43.5	150.0
480.0	H	174	158	31.1	35.9	46.0	200.0
520.2	V	100	116	27.2	22.9	46.0	200.0
524.7	H	168	205	30.3	32.7	46.0	200.0

The EUT met the requirements of FCC CFR 47: Part 15 Subpart B, Section 15.109 for Spurious Radiated Emissions (1GHz – 40GHz).

Measurements were made with the EUT in 802.11a RLAN Mode (see Section 1.3.3 for details).

EUT Rx on Middle Channel (5805MHz)

Frequency	Antenna		Azm	Peak Field Strength	Peak Limit	Average Field Strength	Average Limit
	Pol	Hgt					
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
1.040	H	152	305	48.7	74.0	41.4	54.0
23.220*	V	100	064	62.9	84.0	55.7	64.0

* Measurement made at 1m, limit increased by 10dB.

SECTION 2

TEST DETAILS

Limited FCC CFR 47: Parts 15 C Testing in support of an
Application for Grant of Equipment Authorisation
of a Symbol 802.11a/b/g RLAN Module

2.2 CONDUCTED EMISSIONS ON POWER LINES

2.2.1 Specification Reference

FCC CFR 47: Part 15 Subpart C, Section 15.207

2.2.2 Equipment Under Test

802.11a/b/g RLAN Module

2.2.3 Date of Test

21st August 2004

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified as “Section 2.2” within the Test Equipment Used table shown in Section 3.1.

2.2.5 Test Procedure

Test performed in accordance with ANSI C63.4.

Conducted Emission Measurements were undertaken within the semi-anechoic chamber. Emissions were measured on the Live and Neutral Lines in turn.

Emissions were formally measured using a Quasi-Peak and Average Detectors, which meet the CISPR requirements. The details of the worst-case emissions for the Live and Neutral Lines are presented in the tables on the following pages.

The Conducted Emissions Measurements were made on the Host Laptop.

The Host Laptop was supplied from a 120V, 60Hz supply.

2.2 CONDUCTED EMISSIONS ON POWER LINES - continued

2.2.6 Test Results

The EUT met the Class B requirements of FCC CFR 47: Part 15 Subpart C, Section 15.207 for Conducted Emissions on the Live and Neutral Lines.

Measurements were made with the EUT in 802.11a RLAN Mode (see Section 1.3.3 for details).

EUT Tx on Bottom Channel (5745MHz) – Live Line

Emission Frequency (MHz)	Quasi-Peak Level (dBµV)	Quasi-Peak Limit (dBµV)	Average Level (dBµV)	Average Limit (dBµV)
0.156	41.6	65.7	23.3	55.7
0.198	43.3	63.7	35.4	53.7
0.262	36.7	61.4	29.4	51.4
0.454	37.0	56.8	33.7	46.8
0.519	34.5	56.0	31.4	46.0
0.584	31.6	56.0	29.2	46.0

The margin between the specification requirements and all other emissions were 19.3dB or more below the specified Quasi-Peak limit and 24.7dB or more below the Average limit.

EUT Tx on Bottom Channel (5745MHz) – Neutral Line

Emission Frequency (MHz)	Quasi-Peak Level (dBµV)	Quasi-Peak Limit (dBµV)	Average Level (dBµV)	Average Limit (dBµV)
0.152	41.5	65.9	22.9	55.9
0.194	44.6	63.9	38.9	53.9
0.261	37.5	61.4	31.5	51.4
0.453	37.1	56.8	33.6	46.8
0.519	34.1	56.0	31.2	46.0
0.584	32.2	56.0	29.7	46.0

The margin between the specification requirements and all other emissions were 21.2dB or more below the specified Quasi-peak limit and 27.4dB or more below the specified Average limit.

2.2 CONDUCTED EMISSIONS ON POWER LINES - continued

2.2.6 Test Results - continued

EUT Tx on Middle Channel (5805MHz) – Live Line

Emission Frequency (MHz)	Quasi-Peak Level (dBµV)	Quasi-Peak Limit (dBµV)	Average Level (dBµV)	Average Limit (dBµV)
0.165	40.0	65.2	17.2	55.2
0.197	46.2	63.7	40.2	53.7
0.391	33.7	58.0	26.3	48.0
0.456	33.1	56.8	29.0	46.8
0.523	33.0	56.0	27.7	46.0
0.581	33.4	56.0	30.5	46.0

The margin between the specification requirements and all other emissions were 22.6dB or more below the specified Quasi-Peak limit and 24.8dB or more below the Average limit.

EUT Tx on Middle Channel (5805MHz) – Neutral Line

Emission Frequency (MHz)	Quasi-Peak Level (dBµV)	Quasi-Peak Limit (dBµV)	Average Level (dBµV)	Average Limit (dBµV)
0.197	44.0	63.7	37.5	53.7
0.262	35.6	61.4	27.2	51.4
0.390	34.9	58.1	32.6	48.1
0.456	33.3	56.8	33.7	46.8
0.523	33.0	56.0	27.9	46.0
0.584	31.5	56.0	29.5	46.0

The margin between the specification requirements and all other emissions were 33.2dB or more below the specified Quasi-peak limit and 25.2dB or more below the specified Average limit.

2.2 CONDUCTED EMISSIONS ON POWER LINES - continued

2.2.6 Test Results - continued

EUT Tx on Top Channel (5830MHz) – Live Line

Emission Frequency (MHz)	Quasi-Peak Level (dBµV)	Quasi-Peak Limit (dBµV)	Average Level (dBµV)	Average Limit (dBµV)
0.155	41.6	65.7	22.8	55.7
0.198	44.9	63.7	39.3	53.7
0.262	37.2	61.4	31.6	51.4
0.456	33.0	56.8	28.9	46.8
0.519	34.4	56.0	30.9	46.0
0.584	31.6	56.0	29.4	46.0

The margin between the specification requirements and all other emissions were 19.4dB or more below the specified Quasi-Peak limit and 24.6dB or more below the Average limit.

EUT Tx on Top Channel (5830MHz) – Neutral Line

Emission Frequency (MHz)	Quasi-Peak Level (dBµV)	Quasi-Peak Limit (dBµV)	Average Level (dBµV)	Average Limit (dBµV)
0.164	39.8	65.3	16.9	55.3
0.194	44.9	63.9	39.1	53.9
0.259	37.9	61.5	32.3	51.5
0.454	37.1	56.8	33.5	46.8
0.519	34.1	56.0	30.7	46.0
0.584	31.8	56.0	29.2	46.0

The margin between the specification requirements and all other emissions were 32.6dB or more below the specified Quasi-peak limit and 31.1dB or more below the specified Average limit.

2.3 6dB BANDWIDTH

2.3.1 Specification Reference

FCC CFR 47: Part 15 Subpart C, Section 15.247(b)(2)

2.3.2 Equipment Under Test

802.11a/b/g RLAN Module

2.3.3 Date of Test

28th October 2004

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified as Section 2.3 within the Test Equipment Used table shown in Section 3.1.

2.3.5 Test Procedure

Test Performed in accordance with 15.247.

The EUT was transmitted at maximum power at the data rates specified by the manufacturer, via a 20dB Attenuator to the Spectrum Analyser. The Analyser settings were adjusted to display the resultant trace on screen. The peak point of the trace was measured and the markers positioned to give the –6dBc points of the displayed spectrum.

The measurement plots can be seen on the following pages.

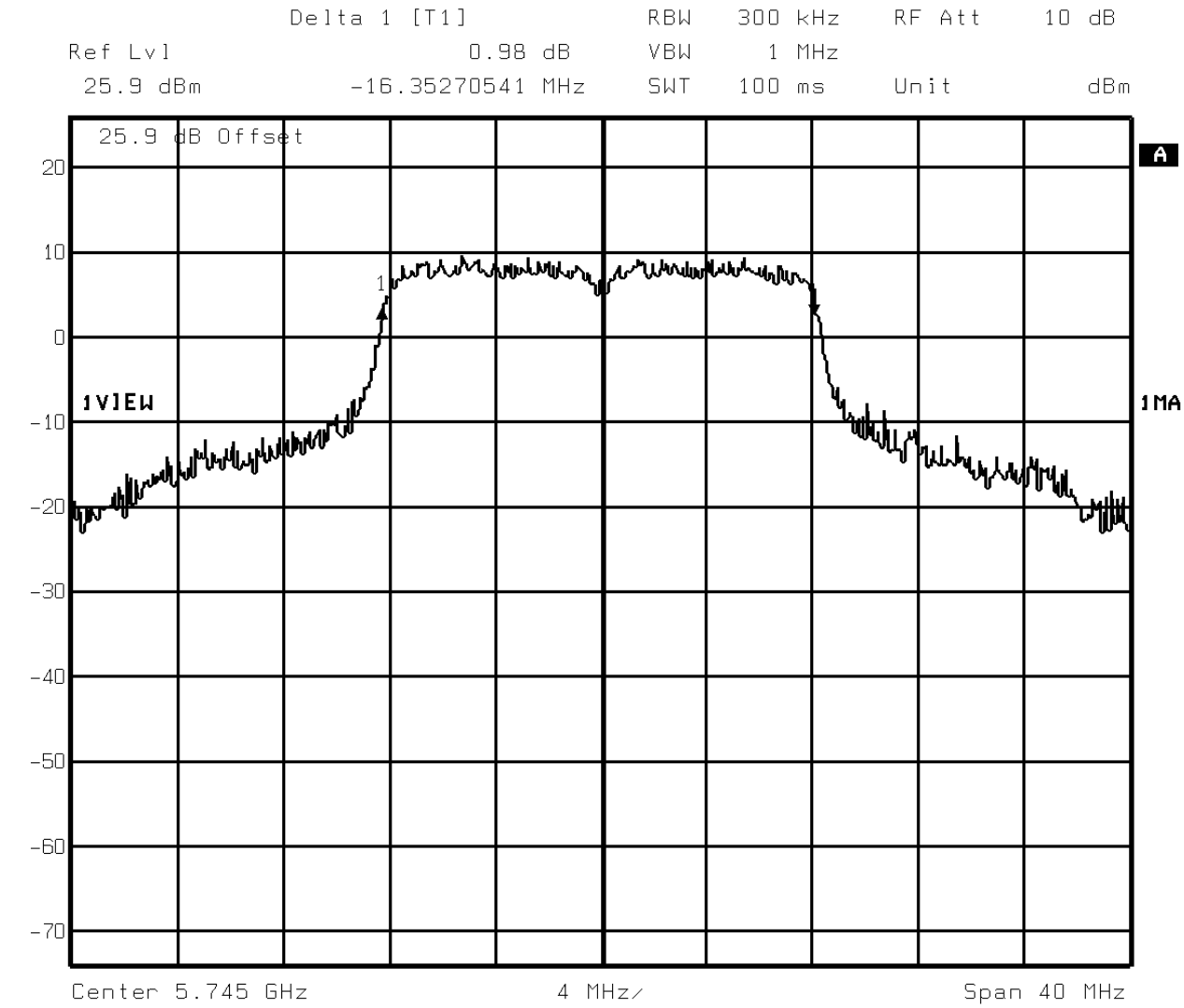
2.3.6 Test Results

Frequency (MHz)	Data Rate (Mbps)	6dB Bandwidth (MHz)
5745	6	16.353
5805	6	16.353
5830	6	16.353

2.3 6dB BANDWIDTH - continued

2.3.6 Test Results - continued

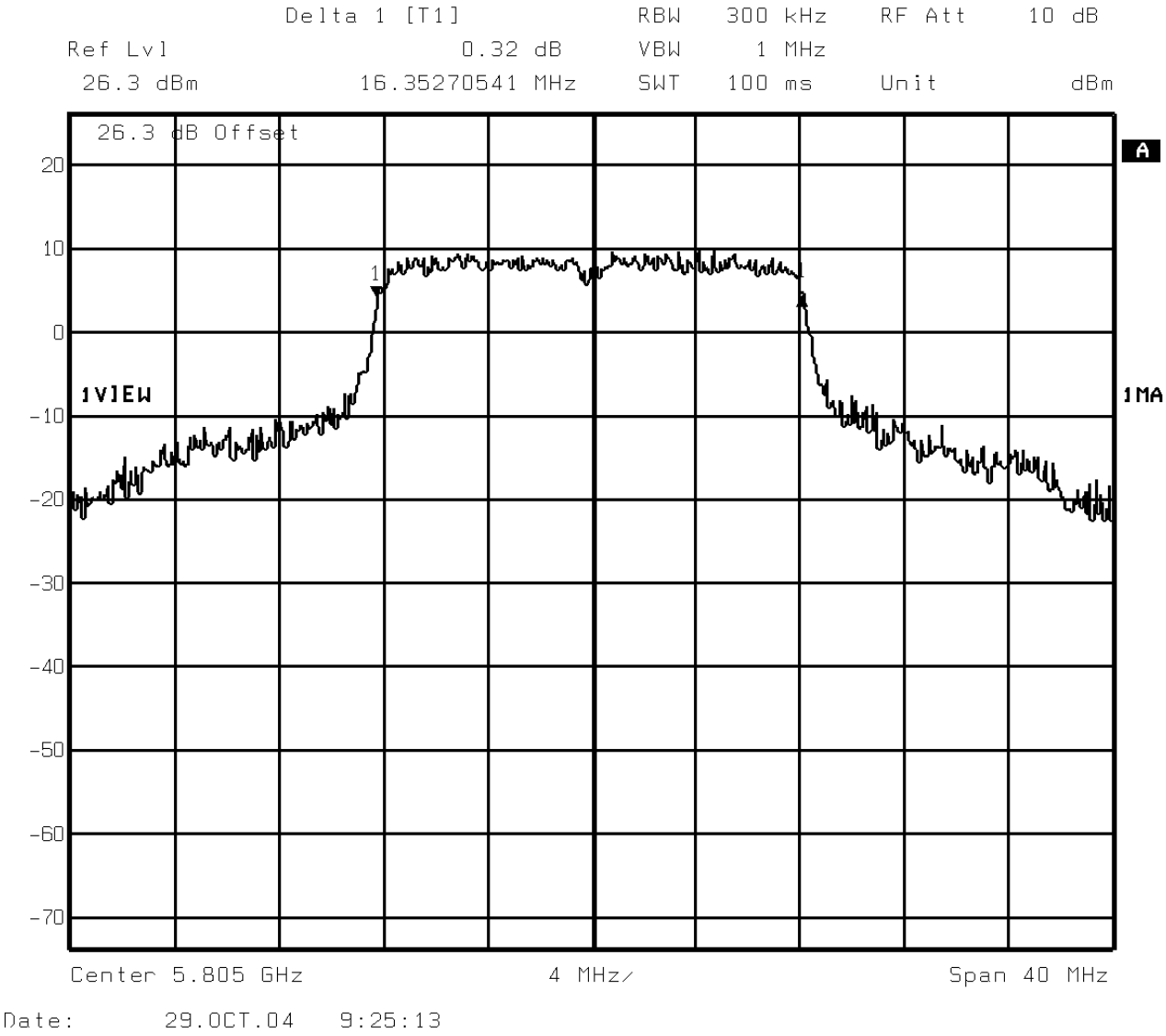
5745MHz – Maximum Power



2.3 6dB BANDWIDTH - continued

2.3.6 Test Results - continued

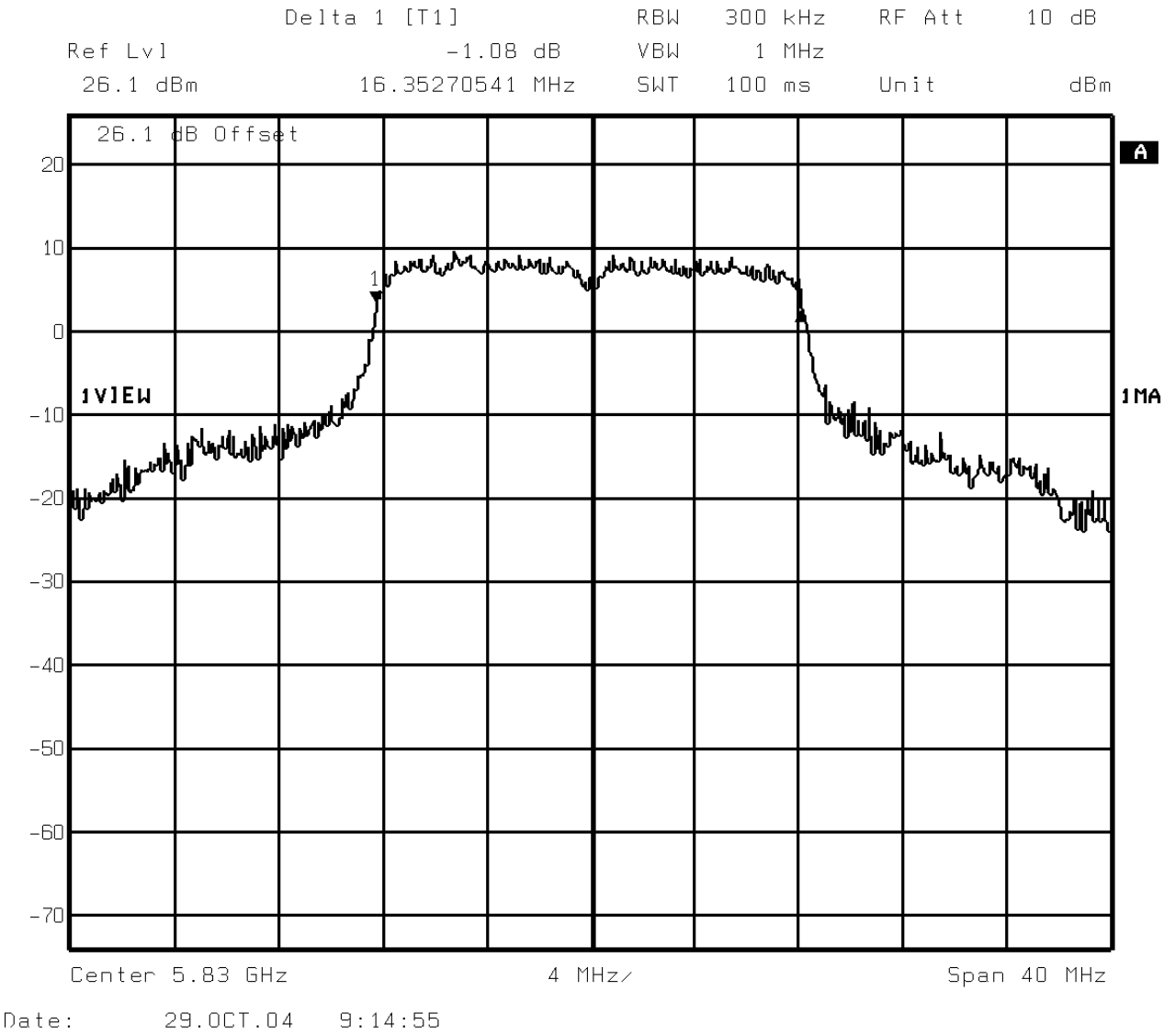
5805MHz – Maximum Power



2.3 6dB BANDWIDTH - continued

2.3.6 Test Results - continued

5830MHz – Maximum Power



2.4 MAXIMUM PEAK OUTPUT POWER

2.4.1 Specification Reference

FCC CFR 47: Part 15 Subpart C, Section 15.247(b)(3)

2.4.2 Equipment Under Test

802.11a/b/g RLAN Module

2.4.3 Date of Test

29th July 2004

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified as “Section 2.4” within the Test Equipment Used table shown in Section 3.1.

2.4.5 Test Procedure

Test Performed in accordance with FCC CFR 47: Part 15.247(b)(3).

The EUT was connected to a Peak Power Analyser via a 10dB Attenuator. The path loss previously measured was used as an offset in the Peak Power Analyser and the Peak Power was measured.

2.4.6 Test Results

Measurements were made with the EUT in 802.11a RLAN Mode (see Section 1.3.3 for details).

Frequency (MHz)	Data Rate (Mbps)	Output Power (dBm)	Result (mW)
5745	6	18.60	72.44
5805	6	18.39	69.02
5830	6	18.76	75.16

Limits

Frequency (MHz)	Limit (W)
5745	1.0
5805	1.0
5830	1.0

2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT

2.5.1 Specification Reference

FCC CFR 47: Part 15 Subpart C, Section 15.247(c)

2.5.2 Equipment Under Test

802.11a/b/g RLAN Module

2.5.3 Date of Test

29th October 2004

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified as “Section 2.5” within the Test Equipment Used table shown in Section 3.1.

2.5.5 Test Procedure

Test Performed in accordance with FCC CFR 47: Part 15 Subpart C, Section 15.247(c).

In accordance with Part 15.247(c), Spurious Conducted Emissions from the antenna terminal were measured. The transmitter output power was attenuated using a combination of filters and attenuators and the frequency spectrum investigated from 9kHz to 40GHz. The EUT was set to transmit on full power, at the data rates specified by the manufacturer. The resolution and video bandwidths were set to 100kHz in accordance with Part 15.247(c). The spectrum analyser detector was set to Max Hold.

For measuring the range 9kHz to 7GHz, a 20dB attenuator was used. From 7GHz to 18GHz, a high pass filter was used. From 18GHz to 26GHz and from 26GHz to 40GHz, pieces of waveguide were used as a high pass filter.

The Maximum “fundamental peak” level measured was used to determine the limit line as displayed on the following plots.

The maximum path loss across each measurement band was used as the reference level offset to ensure worst case

2.5.6 Test Results

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(c) for Spurious Conducted Emissions on the Antenna Port.

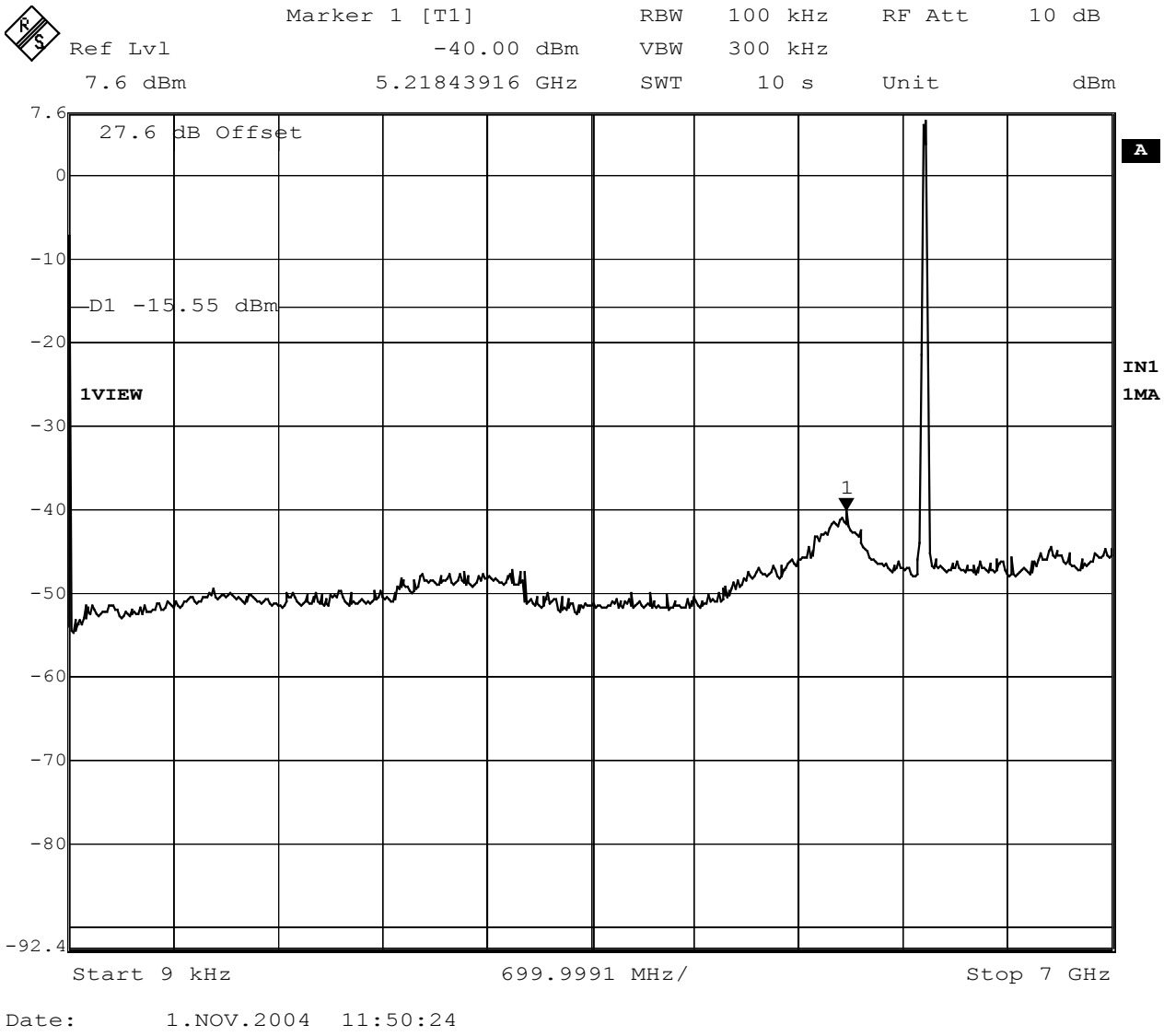
The plots on the following pages show the EUT’s Antenna Ports Spurious Conducted Emissions over the frequency range 9kHz to 40GHz.

2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (9kHz – 7GHz)

EUT Tx on 5745MHz – Maximum Power 6Mbps

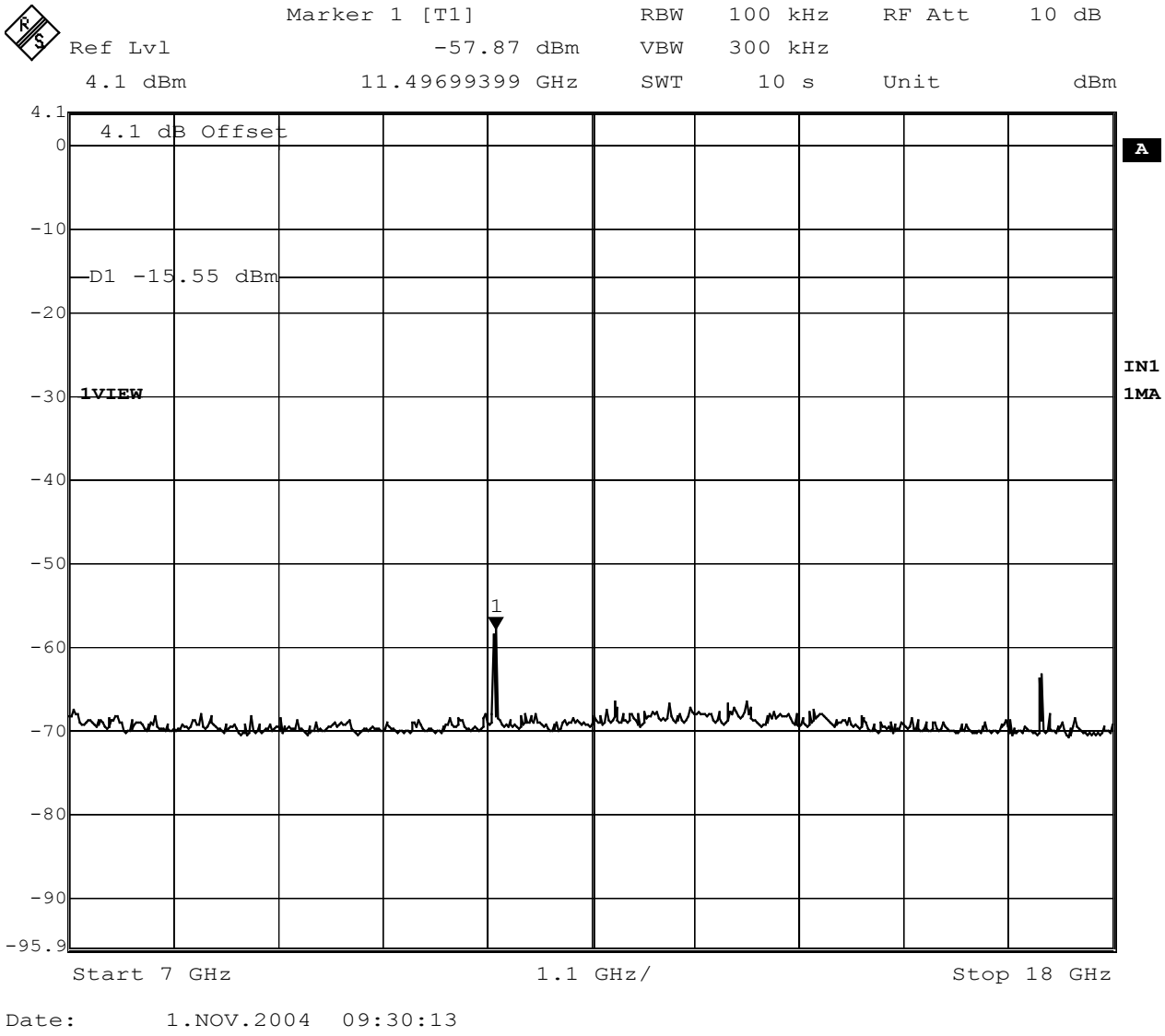


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (7GHz – 18GHz)

EUT Tx on 5745MHz – Maximum Power 6Mbps

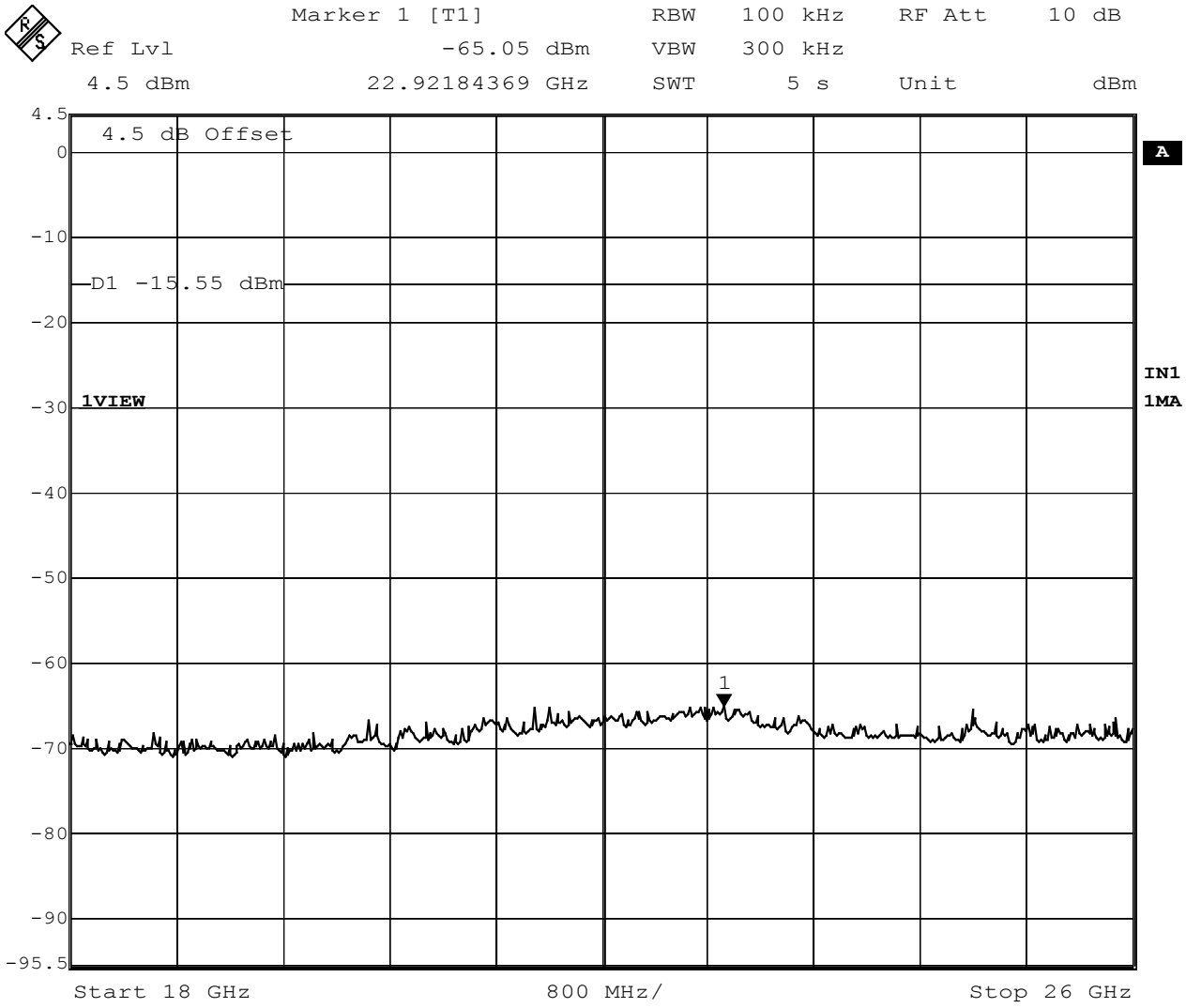


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (18GHz – 26GHz)

EUT Tx on 5745MHz – Maximum Power 6Mbps



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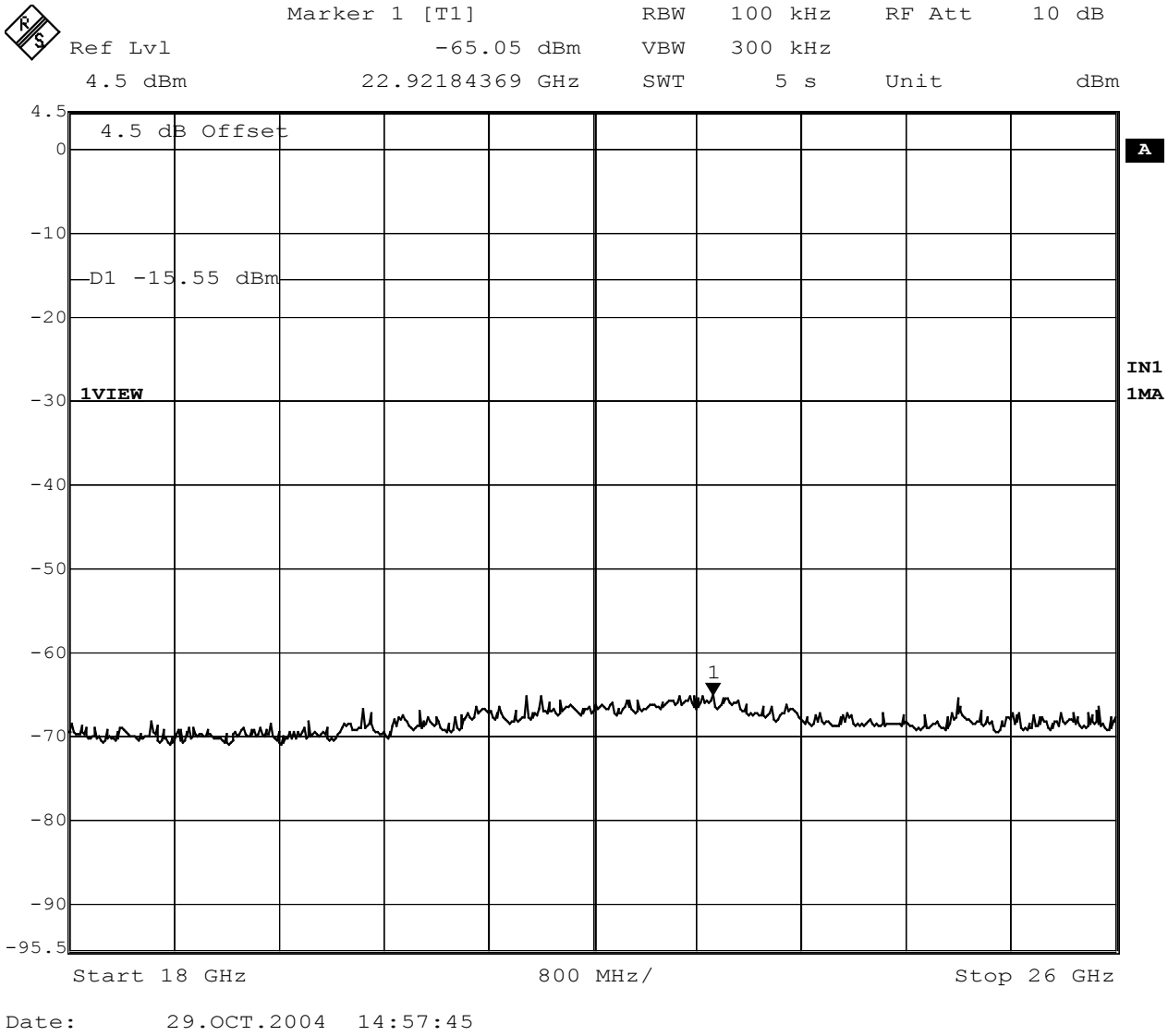
2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (26GHz – 40GHz)

EUT Tx on 5745MHz – Maximum Power 6Mbps

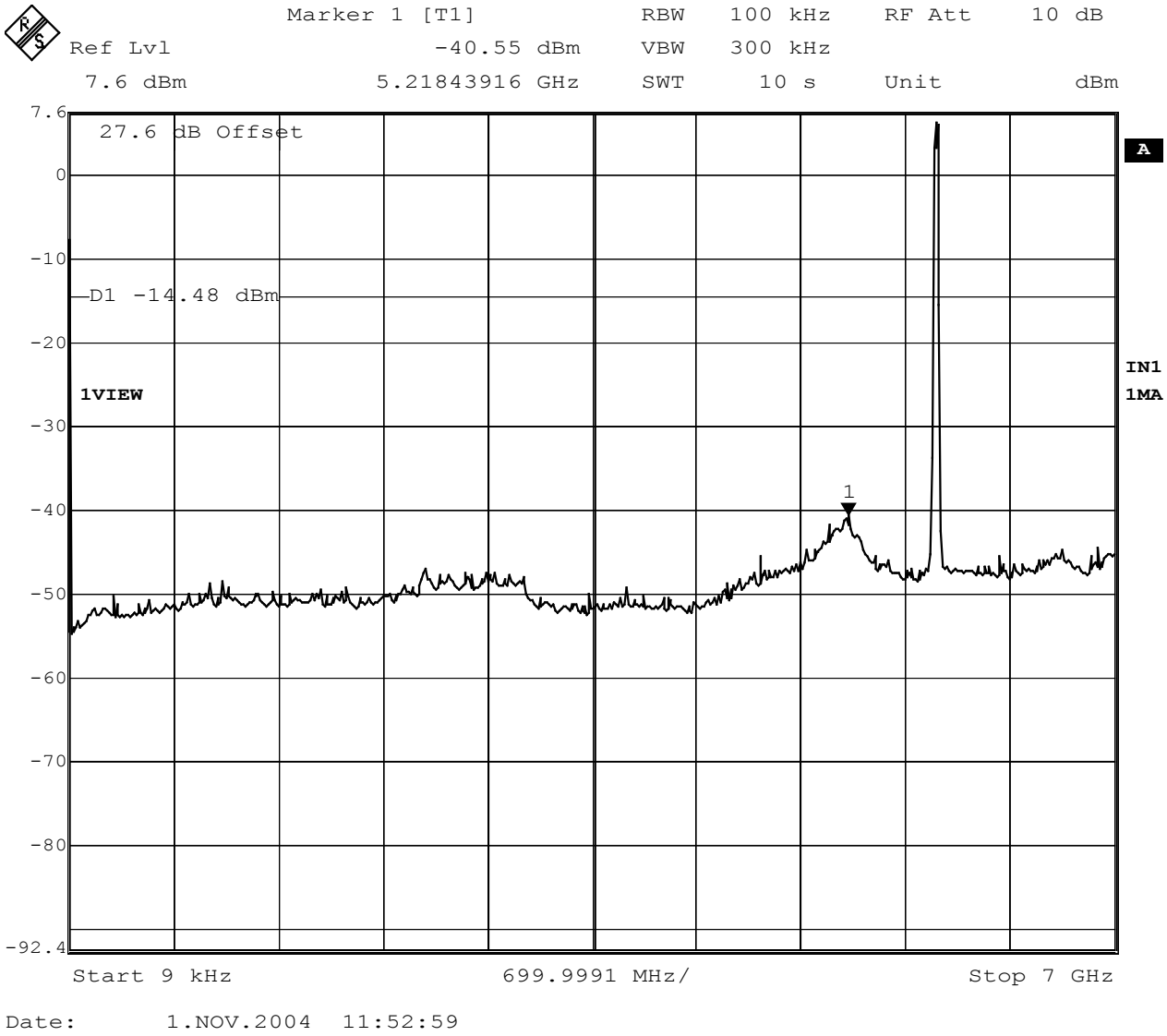


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (9kHz – 7GHz)

EUT Tx on 5805MHz – Maximum Power 6Mbps

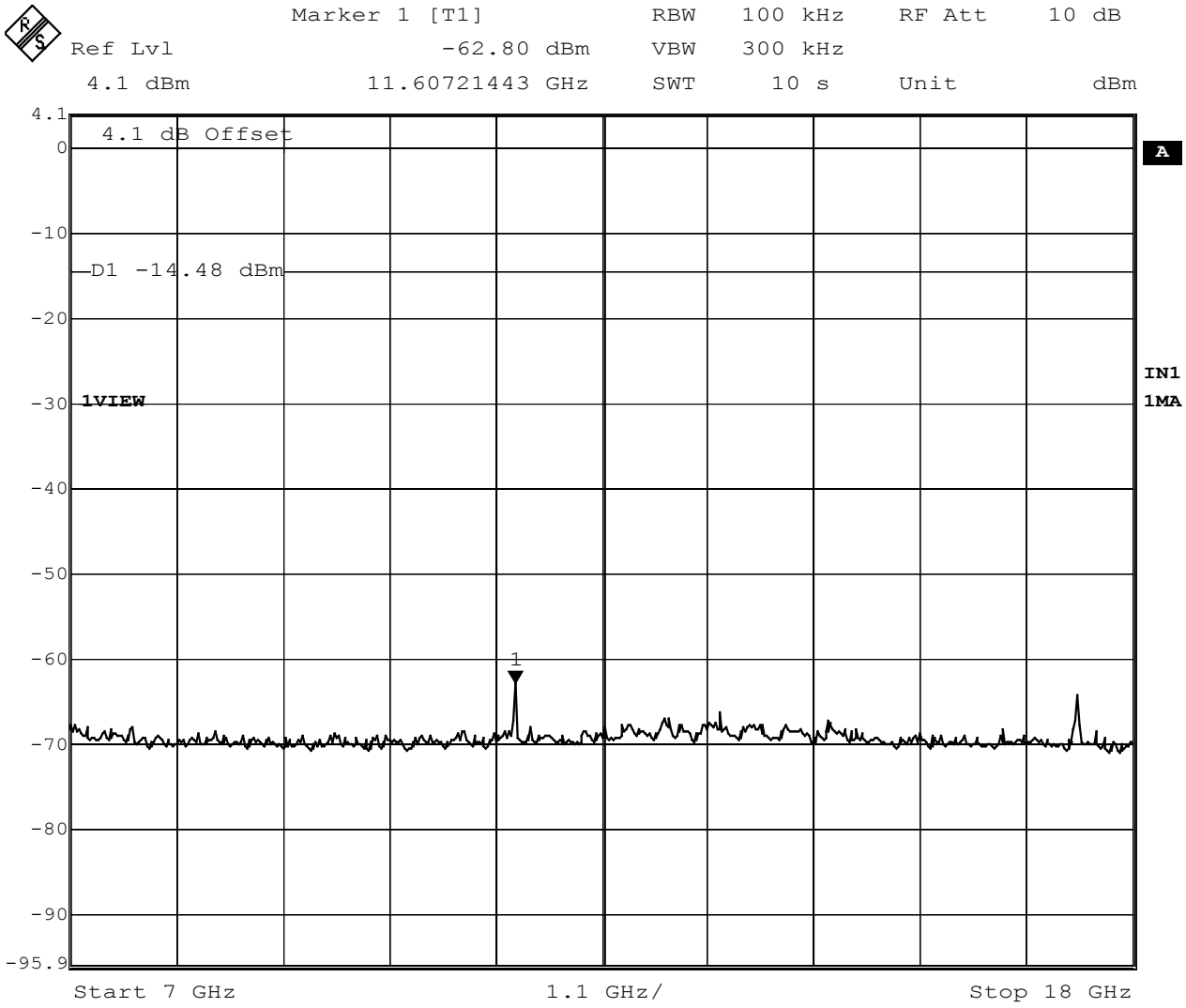


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (7GHz – 18GHz)

EUT Tx on 5805MHz – Maximum Power 6Mbps

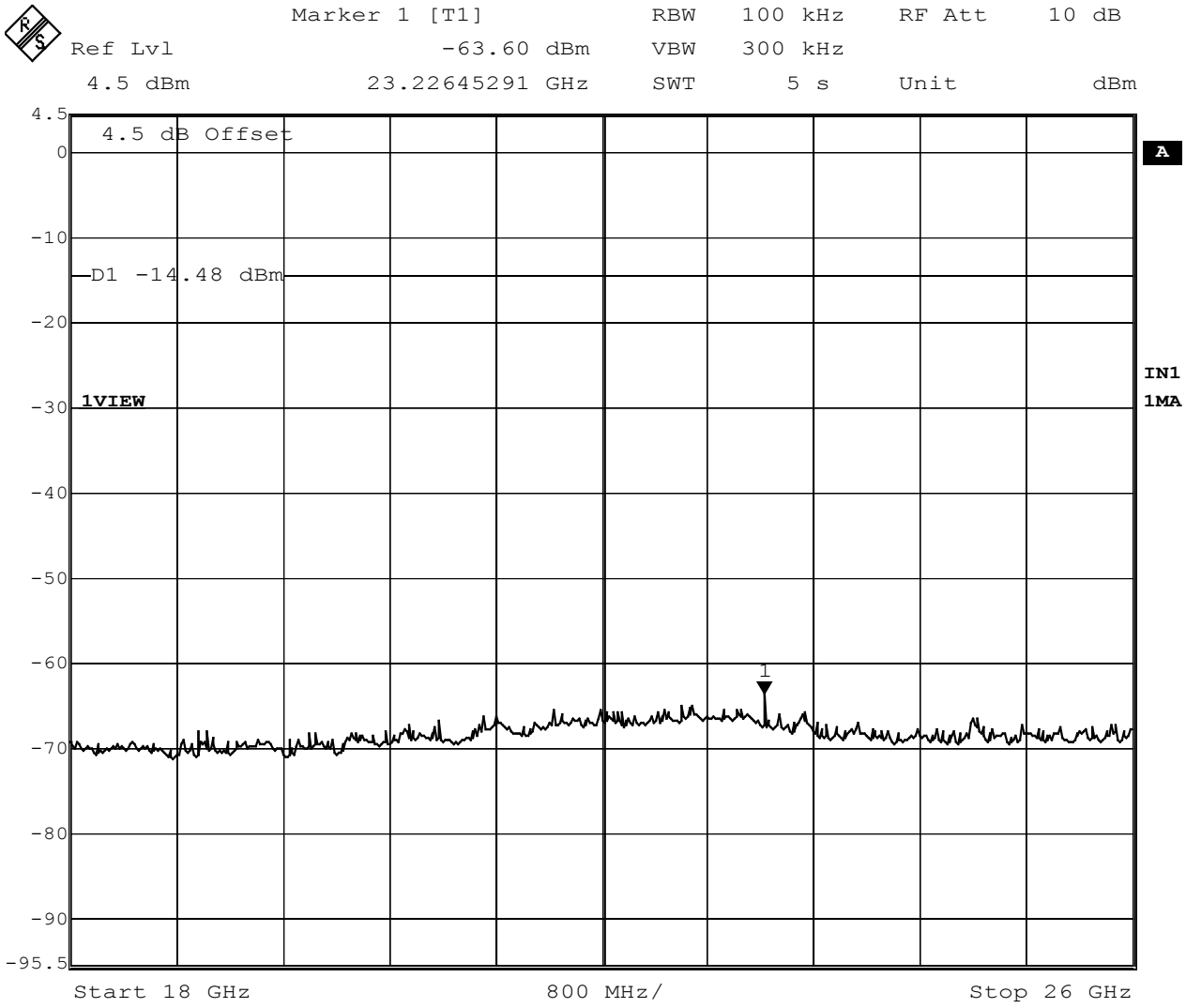


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (18GHz – 26GHz)

EUT Tx on 5805MHz – Maximum Power 6Mbps

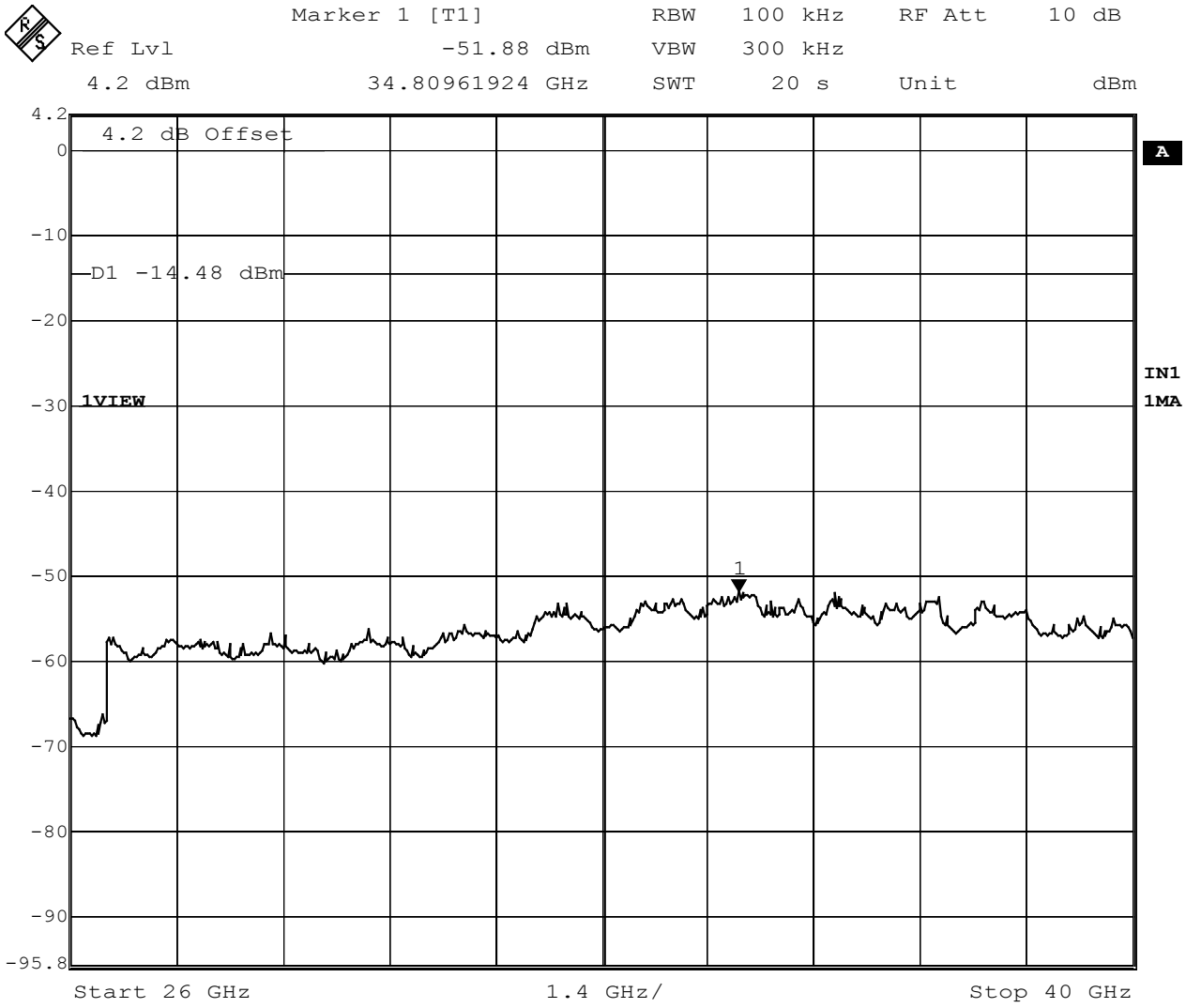


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (26GHz – 40GHz)

EUT Tx on 5805MHz – Maximum Power 6Mbps

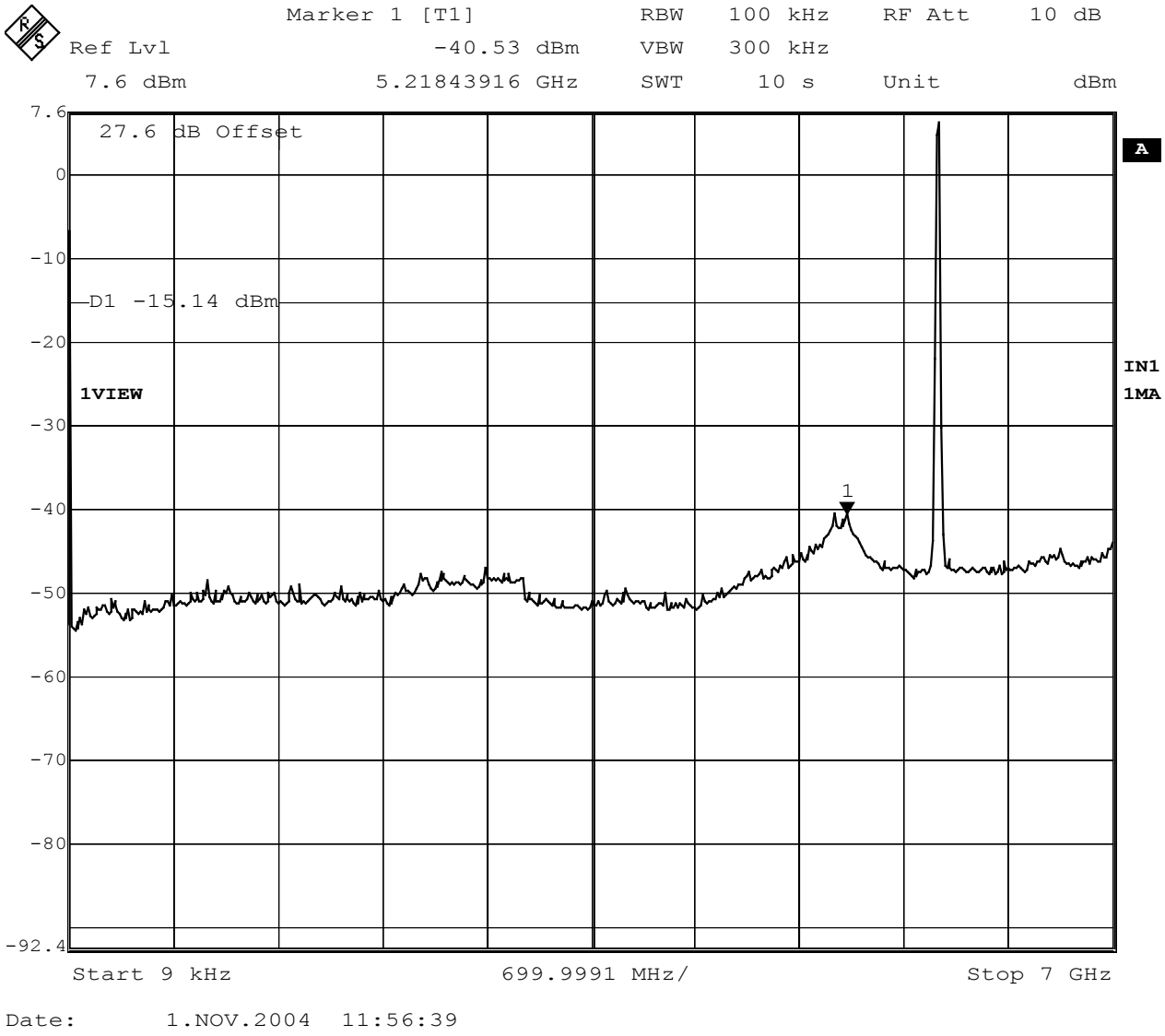


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (9kHz – 7GHz)

EUT Tx on 5830MHz – Maximum Power 6Mbps

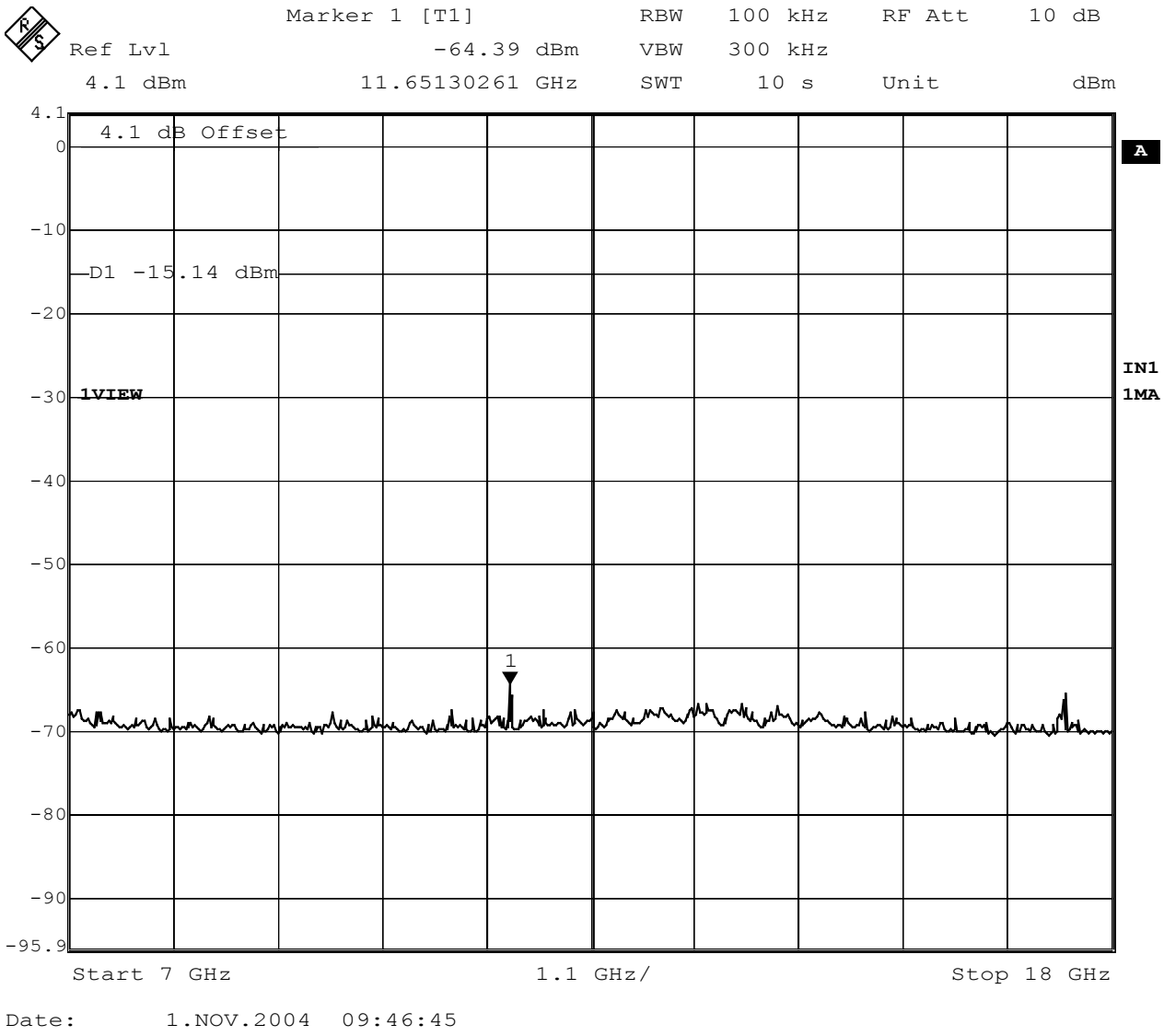


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (7GHz – 18GHz)

EUT Tx on 5830MHz – Maximum Power 6Mbps



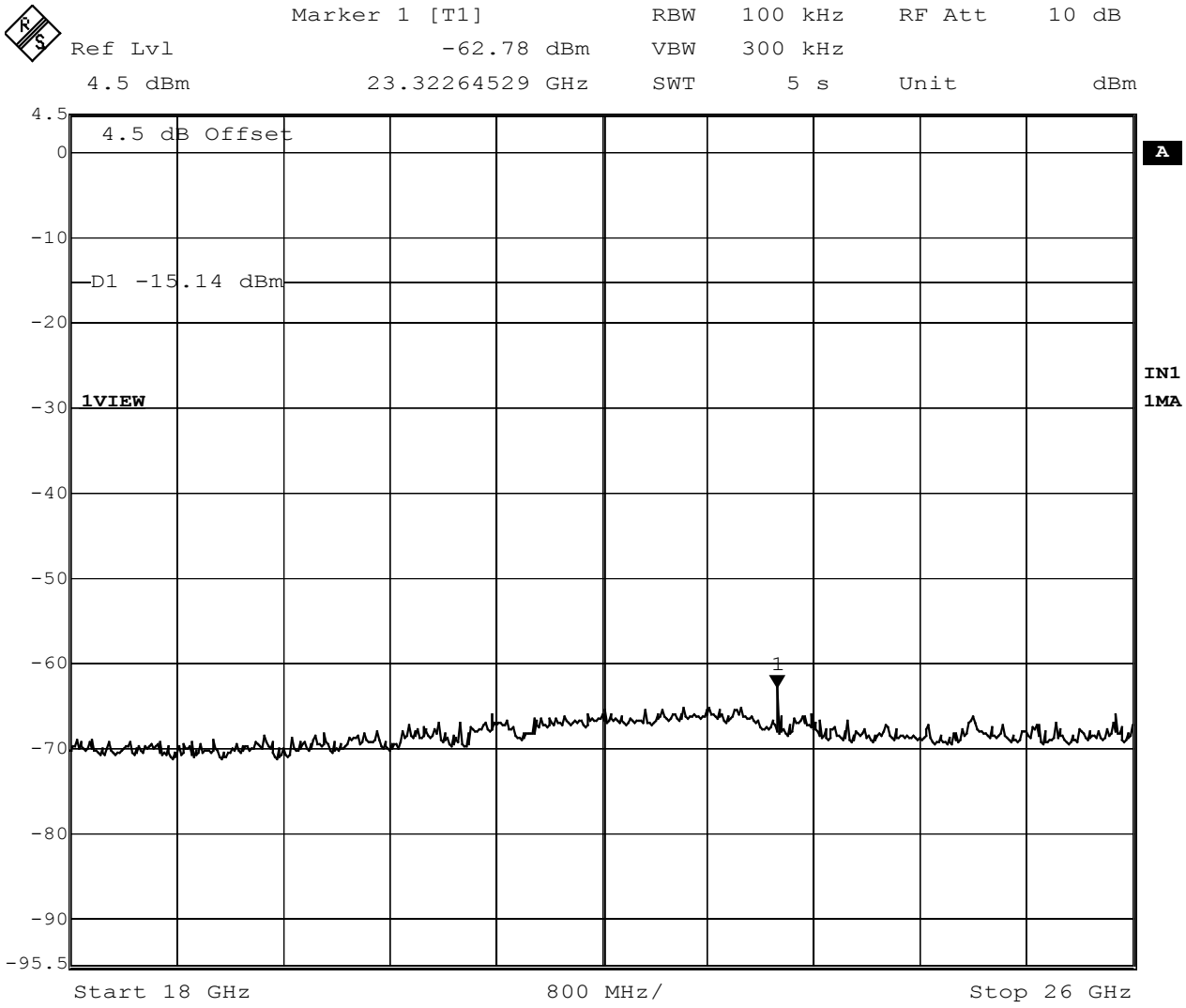
Date: 1.NOV.2004 09:46:45

2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (18GHz – 26GHz)

EUT Tx on 5830MHz – Maximum Power 6Mbps

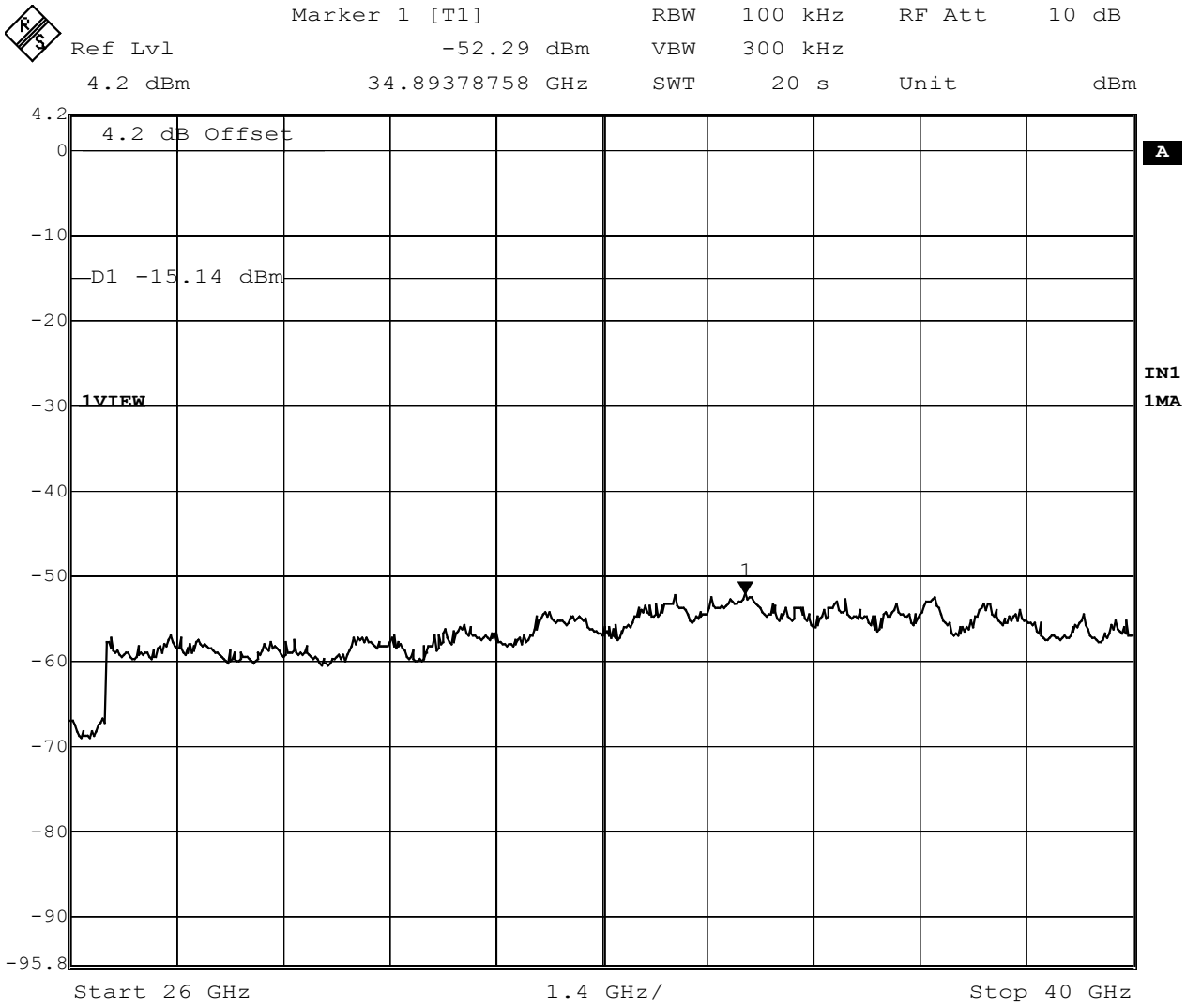


2.5 SPURIOUS CONDUCTED EMISSIONS ON ANTENNA PORT - continued

2.5.6 Test Results – continued

Spurious Conducted Emissions (26GHz – 40GHz)

EUT Tx on 5830MHz – Maximum Power 6Mbps



2.6 SPURIOUS RADIATED EMISSIONS

2.6.1 Specification Reference

FCC CFR 47: Part 15 Subpart C, Section 15.247(c)

2.6.2 Equipment Under Test

802.11a/b/g RLAN Module

2.6.3 Date of Test

25th July 2004

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified as Section 2.6 within the Test Equipment Used table shown in Section 3.1.

2.6.5 Test Procedure

Testing to the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(c), for Spurious Radiated Emissions was carried out on the Measurement Test Facility detailed in Annex A. Section 15.247(c) also requires Rule parts 15.205 and 15.209 to be applied.

A preliminary profile of the Spurious Radiated Emissions was obtained by operating the Equipment Under Test (EUT) on a remotely controlled turntable within a semi-anechoic chamber; measurements were taken at a 3m distance unless otherwise stated. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Using the information from the preliminary profiling of the EUT, a search was made in the frequency range 30MHz to 40GHz. The list of worst-case emissions was then confirmed or updated under Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

30MHz – 1GHz emissions levels were then formally measured using a CISPR Quasi-Peak detector. 1GHz – 40GHz emissions levels were then formally measured using Peak and Average detectors.

(Note: Peak measurements performed using a Resolution and Video Bandwidth of 1MHz, Average measurements performed using a Resolution Bandwidth of 1MHz and a Video Bandwidth of 10Hz)

The Host Laptop was connected to a 120V 60Hz supply.

2.6 SPURIOUS RADIATED EMISSIONS - continued

2.6.5 Test Procedure - continued

Spurious Radiated Emissions from 30MHz to 1GHz were made using a HP 8542E Test Receiver.

Spurious Radiated Emissions from 1GHz to 40GHz were made using a Rhode and Schwarz ESIB 40 Test Receiver.

The test was performed in accordance with ANSI C63.4.

The measurements were performed at a 3m distance unless otherwise stated.

The limits for Spurious Emissions Outside the Restricted Bands have been measured and calculated as shown in the table below:

Test Mode	Carrier Frequency GHz	Carrier Field Strength dBµV/m	Limit for Spurious Outside Restricted Band (Carrier F S –20dB) dBµV/m
802.11a RLAN	5.745	104.4	84.4
802.11a RLAN	5.805	104.6	84.6
802.11a RLAN	5.830	105.1	85.1

The limits for Spurious Emissions Inside the Restricted Bands are in accordance with 15.205(a) & (b), which call up the limits in 15.209 (a)

Frequency Range MHz	Field Strength µV/m	Quasi Peak Field Strength dBµV/m	
30-88	100	40.0	
88-216	150	43.5	
216-960	200	46.0	
960-1000	500	54.0	
Above 1000	500	Average Field Strength dBµV/m	Peak Field Strength dBµV/m
		54.0	74.0

2.6 SPURIOUS RADIATED EMISSIONS - continued

2.6.6 Test Results

30MHz - 1GHz Frequency Range

Equipment Designation: Intentional Radiator.

The EUT met the requirements of FCC Part 15.247(c), 15.205 and 15.209 for Spurious Radiated Emissions (30MHz – 1GHz).

Measurements were made with the EUT in 802.11a RLAN Mode (see Section 1.3.3 for details).

EUT Tx on Bottom Channel (5745MHz)

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
MHz	H/V	cm	deg	dBµV/m	µV/m	dBµV/m	µV/m
99.43	V	100	087	24.0	15.8	43.5	150.0
99.43	H	260	195	29.3	29.2	43.5	150.0
147.00	H	178	173	26.4	20.9	46.0	200.0
440.00	H	204	185	29.6	30.2	46.0	200.0
480.00	H	210	170	32.2	40.7	46.0	200.0
524.00	H	199	211	31.5	37.6	46.0	200.0

EUT Tx on Middle Lower Channel (5805MHz)

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
MHz	H/V	cm	deg	dBµV/m	µV/m	dBµV/m	µV/m
99.70	H	179	200	28.7	27.2	43.5	150.0
147.50	H	179	191	26.3	20.7	43.5	150.0
440.00	H	225	174	29.1	28.5	46.0	200.0
480.00	H	176	162	31.7	28.5	46.0	200.0
520.20	V	100	127	28.4	26.3	46.0	200.0
524.90	H	170	199	30.8	34.7	46.0	200.0

2.6 SPURIOUS RADIATED EMISSIONS - continued

2.6.6 Test Results – continued

30MHz - 1GHz Frequency Range

EUT Tx on Top Channel (5830MHz)

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
MHz	H/V	cm	deg	dBµV/m	µV/m	dBµV/m	µV/m
99.70	H	169	195	28.3	26.0	43.5	150.0
147.40	H	172	198	25.8	19.5	43.5	150.0
440.00	H	221	176	29.0	28.2	46.0	200.0
480.00	H	184	170	32.0	39.8	46.0	200.0
520.20	V	100	134	29.0	28.2	46.0	200.0
524.70	H	179	197	31.1	35.9	46.0	200.0

ABBREVIATIONS FOR ABOVE TABLES

H	Horizontal Polarisation	V	Vertical Polarisation
Pol	Polarisation	Hgt	Height
deg	degree	Azm	Azimuth

2.6 SPURIOUS RADIATED EMISSIONS - continued

2.6.6 Test Results - continued

1GHz - 40GHz Frequency Range

Equipment Designation: Intentional Radiator.

The EUT met the requirements of FCC Part 15.247(c)), 15.205 and 15.209 for SPURIOUS RADIATED Emissions (30MHz – 25GHz).

Measurements were made with the EUT in 802.11a RLAN Mode (see Section 1.3.3 for details).

EUT Tx on Bottom Channel (5745MHz)

Frequency	Antenna		Azm	Peak Field Strength	Peak Limit	Average Field Strength	Average Limit
	Pol	Hgt					
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
1.040	V	100	062	48.5	74.0	41.3	54.0
5.147	V	100	229	63.6	74.0	49.7	54.0
11.491	V	100	000	56.4	74.0	42.3	54.0
22.680*	V	100	181	61.4	94.4	N/A	N/A

EUT Tx on Middle Channel (5805MHz)

Frequency	Antenna		Azm	Peak Field Strength	Peak Limit	Average Field Strength	Average Limit
	Pol	Hgt					
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
1.040	V	100	062	48.7	74.0	41.4	54.0
5.147	V	100	225	63.0	74.0	49.5	54.0
23.220*	V	100	317	62.6	94.6	N/A	N/A

* Measurement made at 1m, limit increased by 10dB.

EIRP Results are only taken for frequencies that fall Outside the Restricted Band in accordance 15.247(c.)

Note: The Average Measurements in the above tables marked N/A are Not Applicable because the frequency does not fall within the Restricted Band (15.205) and hence Average Measurements are not required.

2.6 SPURIOUS RADIATED EMISSIONS - continued

2.6.6 Test Results – continued

1GHz - 40GHz Frequency Range

The EUT met the requirements of FCC Part 15.247(c), 15.205 and 15.209 for Spurious Radiated Emissions (30MHz – 40GHz).

EUT Tx on Top Channel (5830MHz)

Frequency	Antenna		Azm	Peak Field Strength	Peak Limit	Average Field Strength	Average Limit
	Pol	Hgt					
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
1.040	V	100	065	48.4	74.0	41.1	54.0
5.098	V	100	229	64.0	74.0	49.8	54.0
23.320*	V	115	168	60.0	95.1	N/A	N/A

* Measurement made at 1m, limit increased by 10dB.

Note: The Average Measurements in the above tables marked N/A are Not Applicable because the frequency does not fall within the Restricted Band (15.205) and hence Average Measurements are not required.

ABBREVIATIONS FOR ABOVE TABLES

H	Horizontal Polarisation	V	Vertical Polarisation
Pol	Polarisation	Hgt	Height
deg	degree	Azm	Azimuth

2.7 PEAK POWER SPECTRAL DENSITY

2.7.1 Specification Reference

FCC CFR 47: Part 15 Subpart C, Section 15.247(d)

2.7.2 Equipment Under Test

802.11a/b/g RLAN Module

2.7.3 Date of Test

1st November 2004

2.7.4 Test Equipment Used

The major items of test equipment used for the above tests are identified as “Section 2.7” within the Test Equipment Used table shown in Section 3.1.

2.7.5 Test Procedure

The EUT was connected to the Spectrum Analyser via a 20dB Attenuator. The EUT was set to transmit at maximum output power on all three channels and at a 6Mbps data rate.

With the EUT transmitting, the trace was adjusted to display the 6dB bandwidth of the fundamental. The RBW was adjusted to 3kHz and VBW to 10kHz. The spectrum analyser detector was set to Max Peak. The trace was then set to Max Hold where the peak response was identified and centered on the trace. With the peak centered the span was adjusted to 1.5MHz, and the sweep time adjusted to 500s.

Two sweeps with the trace set to Max Hold were taken, and then view marker peak was used to find the peak power density result. One plot of each channel was taken, and the results are given in the table below.

Test Performed In Accordance With 15.247(d).

2.7 PEAK POWER SPECTRAL DENSITY– continued

2.7.6 Test Results

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, 15.247(d) for Peak Power Spectral Density).

Measurements were made with the EUT in 802.11a RLAN Mode (see Section 1.3.3 for details).

The results are recorded in the table below.

Frequency (MHz)	Data Rate (Mbps)	Measurement Bandwidth (kHz)	Result (dBm)
5745	6	3	-9.75
5805	6	3	-9.80
5830	6	3	-9.66

Limit	≤ +8dBm/3kHz

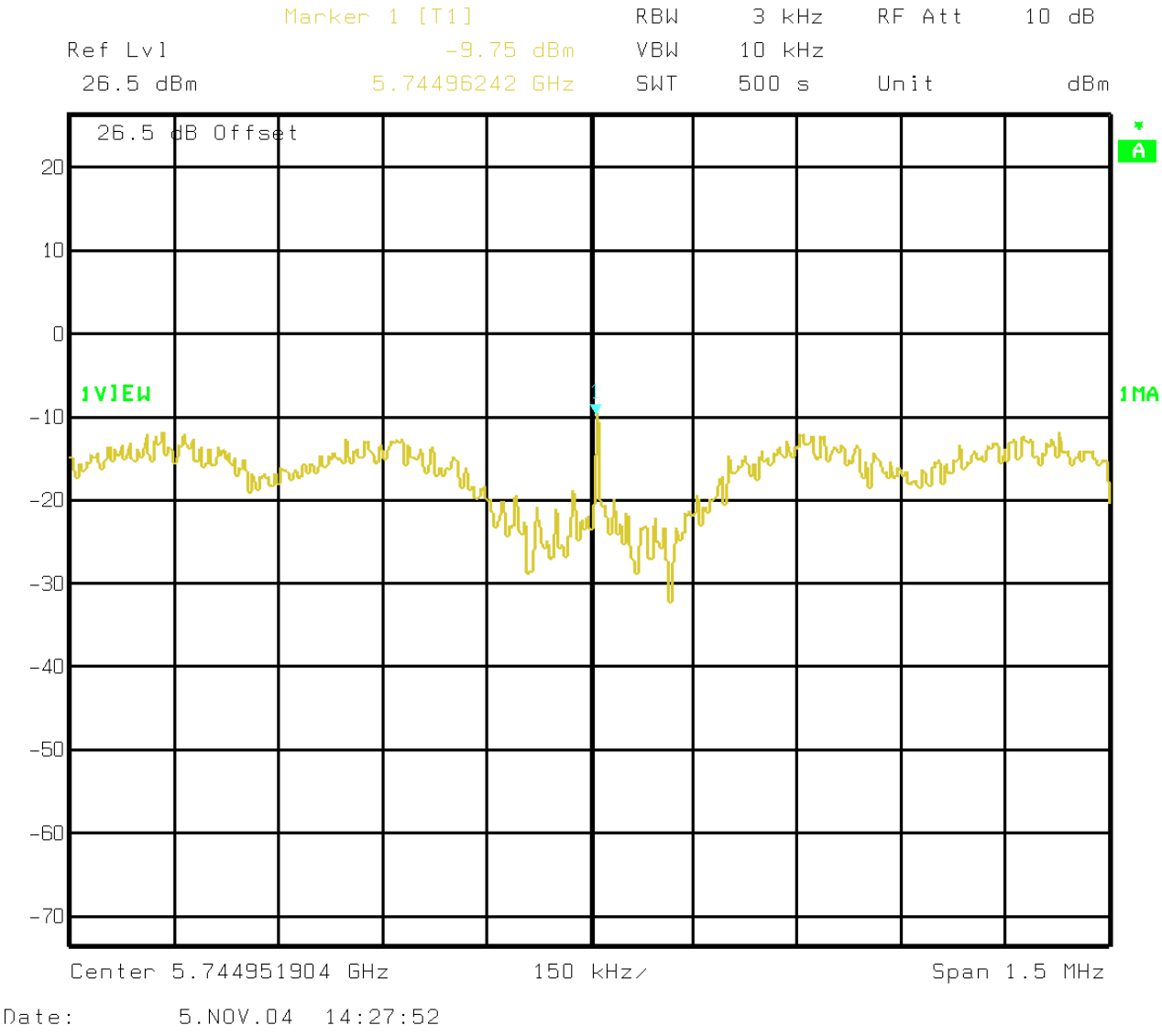
Remarks

The EUT met the requirements specified in Clause 15.247(d). The Peak Power Spectral Density was below the +8dBm/3kHz limit.

2.7 PEAK POWER SPECTRAL DENSITY– continued

2.7.6 Test Results - continued

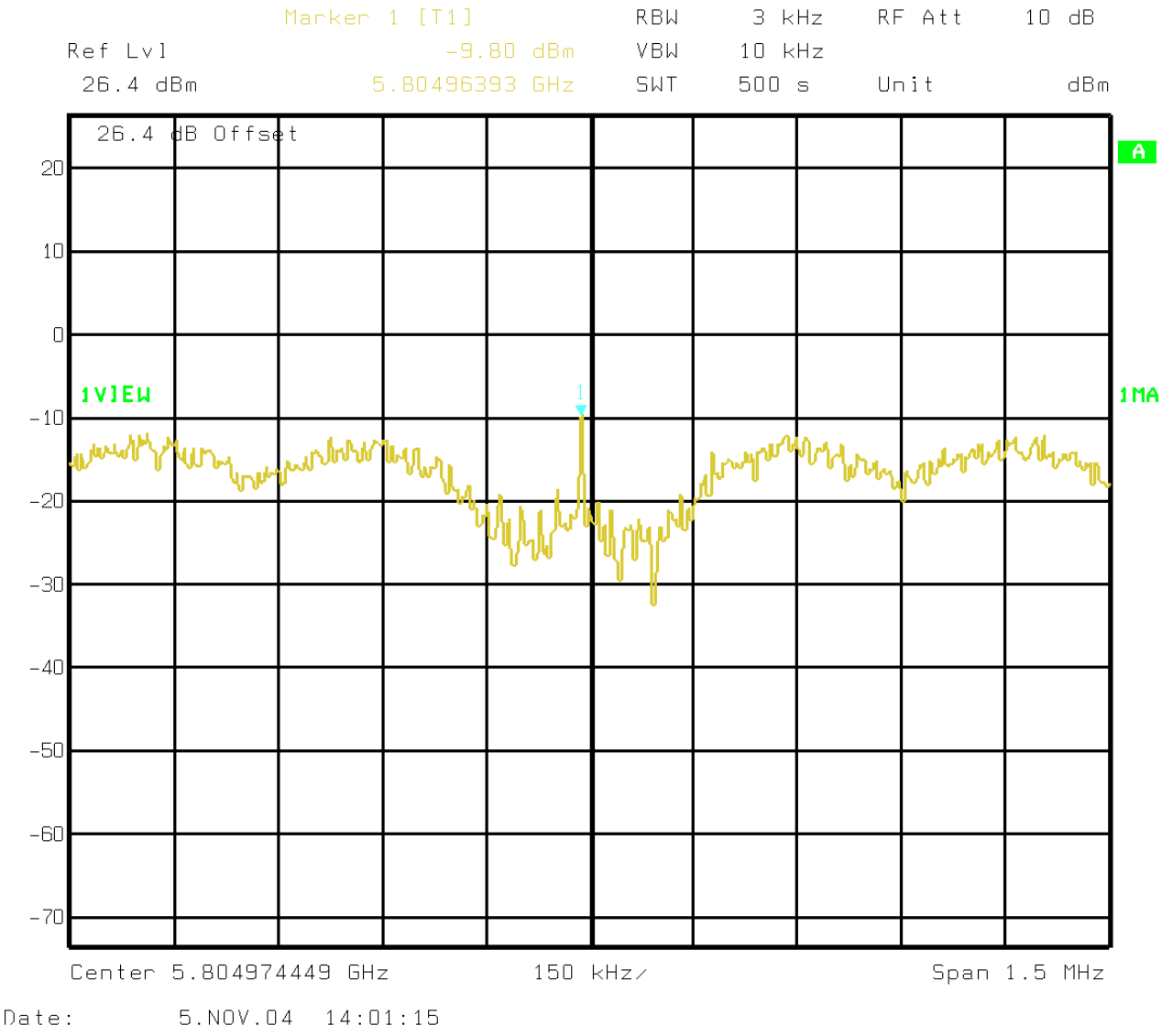
5745MHz – Maximum Power 6Mbps



2.7 PEAK POWER SPECTRAL DENSITY– continued

2.7.6 Test Results - continued

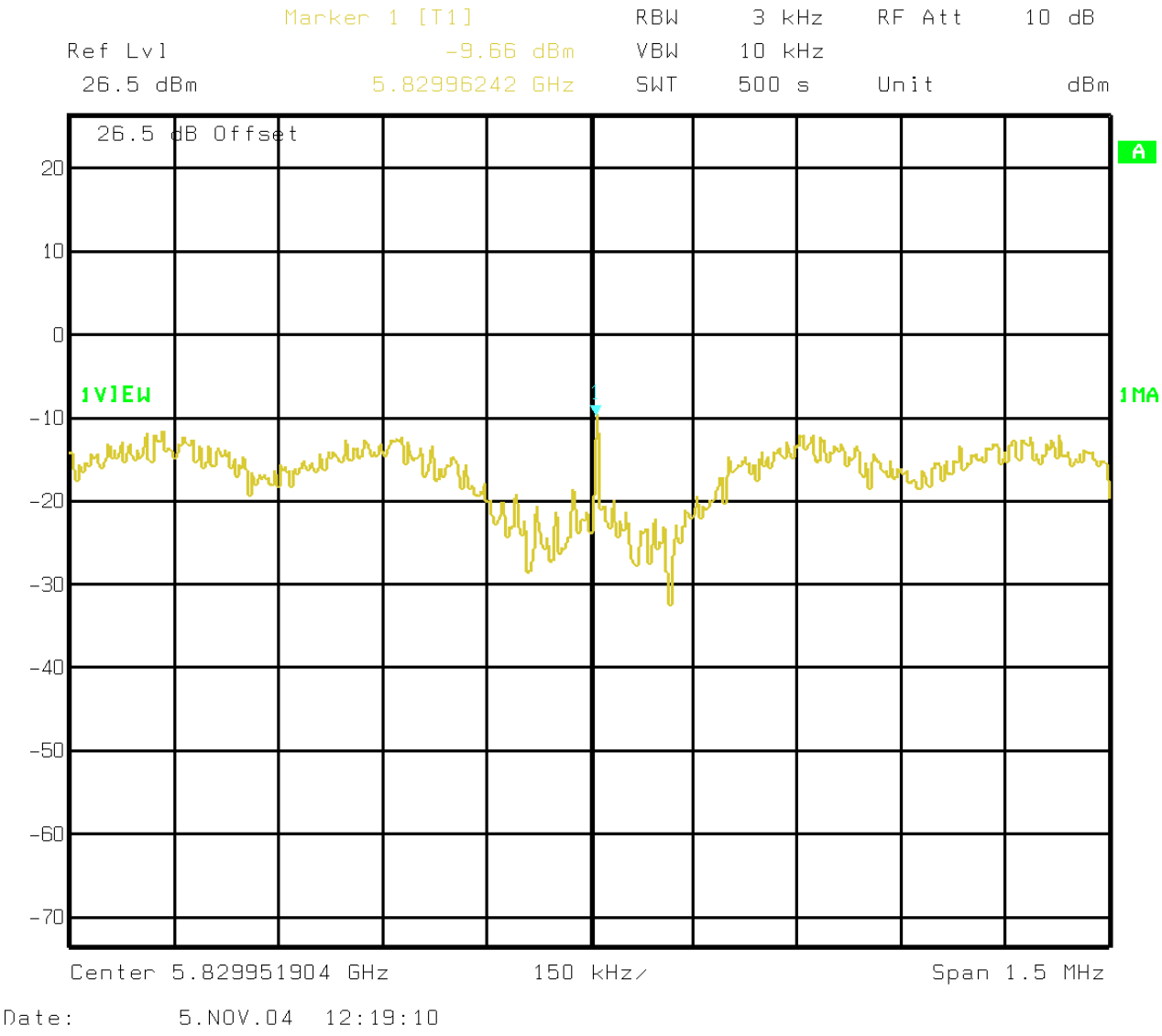
5805MHz – Maximum Power 6Mbps



2.7 PEAK POWER SPECTRAL DENSITY– continued

2.7.6 Test Results - continued

5830MHz – Maximum Power 6Mbps



SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

Instrument	Manufacturer	Type No	EMC / INV No	Cal. Due
Section 2.1				
Turntable Controller	H-D	HD 050	2528	TU
Antenna Mast 6m	EMC	1051-2	2182	TU
Screened Room 5	SIE	EAC54300	2533	TU
EMI Receiver	HEW	8542E	2286	09/12/2004
Bilog Antenna	SCH	CBL6143	2965	19/09/2005
EMI Test Receiver	ROH	ESIB40	2917	11/02/2005
EMI Test Receiver	ROH	ESIB40	2989	08/04/2005
Low Noise Amplifier	MIQ	AMF-3d-001080-18-13P	2457	TU
Solid State Amplifier	AVA	AWT-18036	1081	26/06/2005
LNA 18-40GHz	NAR	NARDA DB02-0447	2936	28/04/2005
1-18GHz DRG Horn Ant	EMC	3115	2297	07/07/2005
1-18GHz DRG Horn Ant	EMC	3115	2397	07/07/2005
Signal Generator	ROH	SWM02	2477	10/11/2005
Signal Generator	MAR	2031	2199	29/09/2004
Signal Generator	HEW	8673B	2551	19/06/2005
Attenuator Fixed	NAR	4768-3	2961	TU
Digital Barometer	ORE	BAA913HG	Room 5	TU
Drg Horn Antenna	LML	AM180-HA-K-TU2	2945	24/06/2005
Section 2.2				
Screened Room 5	SIE	EAC54300	2533	TU
Test Receiver	ROH	ESH3	1020	16/09/2004
Spectrum Analyser	ROH	EZM	1416	TU
LISN	ROH	ESH2-Z5	1584	02/10/2004
Transient Limiter	HEW	11947A	2243	24/01/2005
Digital Barometer	ORE	BAA913HG	Room 5	TU
Section 2.3 & 2.7				
Signal Generator	ROH	SWM02	INV2477	10/01/2005
Power Meter Sensor	HEW	8481A	295	25/08/2005
Power Meter	HEW	8495H	755	10/06/2005
20dB Attenuator	WEI	45-20-43	2843	TU
Hygrometer	ROT	I-1000	INV 3232	07/04/2005
Spectrum Analyser	ROH	ESIB40	2972	08/11/2004
Section 2.4				
Power Supply	HEW	6253A	992	-
Meter	FLU	70	INV 3550	18/02/2005
Hygrometer	ROT	I-1000	INV 3232	07/04/2005
Attenuator	WEI	1	INV 2651	08/10/2004
Analyser	HEW	8990A	1670	14/08/2004
Signal Generator	HEW	8673B	953	10/06/2005

3.1 TEST EQUIPMENT USED – continued

Instrument	Manufacturer	Type No	EMC / INV No	Cal. Due
Section 2.5				
Hygrometer	ROT	I-1000	INV 3232	07/04/2005
20dB Attenuator	WEI	45-20-43	2843	TU
Test Equipment	ROH	ESIB40	2972	08/11/2004
HP Filter	LOR	5HP7-2500-5R	INV3998	15/10/2005
26-40GHZ Cable	UTI	FB142A0010M2020	-	TU
HPF Waveguide	FMI	206935	-	TU
HPF Waveguide	FMI	22093KF	-	TU
Section 2.6				
Turntable Controller	H-D	HD 050	2528	TU
Antenna Mast 6m	EMC	1051-2	2182	TU
Screened Room 5	SIE	EAC54300	2533	TU
EMI Test Receiver	ROH	ESIB40	2917	11/02/2005
EMI Receiver	HEW	8542E	2286	09/12/2004
Bilog Antenna	SCH	CBL6143	2965	19/09/2005
Low Noise Amplifier	MIQ	AMF-3d-001080-18-13P	2457	TU
Solid State Amplifier	AVA	AWT-18036	1081	26/06/2005
LNA 18-40GHz	NAR	NARDA DB02-0447	2936	28/04/2005
Drg Horn Ant	EMC	3115	2297	07/07/2005
Signal Generator	HEW	8672A	411	02/03/2005
Thermo Stirrer	GAL	WATER 85	1494	TU
Digital Barometer	ORE	BAA913HG	Room 5	TU
Dual PSU	THU	PL320	1582	TU
Attenuator Fixed	NAR	4768-3	2961	TU
Signal Generator	MAR	2031	2199	29/09/2004
Section 2.7				
Power Supply	HEW	6253A	992	-
Meter	FLU	70	INV 3550	18/02/2005
Hygrometer	ROT	I-1000	INV 3232	07/04/2005
Attenuator	WEI	1	INV 2651	08/10/2004
Sensor	HEW	8482A	777	21/06/2005
Analyser	HEW	8990A	1670	14/08/2004
Meter	HEW	436A	757	10/06/2005
Signal Generator	ROH	SWM02	2477	10/01/2005
Spectrum Analyser	ROH	FSEM	4034	05/01/2005

Key To Manufacturers

AVA	Avantek	EMC	Emco
FMI	FMI UK	GAL	Gallenkamp
H-D	No Data	HEW	Hewlett Packard
LML	Link Microtek Ltd	LOR	Lortech
MAR	Marconi	MIQ	Miteq Corp
NAR	Narda	ORE	Oregan Scientific
ROH	Rohde & Schwarz	SIE	Siemens
THU	Thurlby	UTI	Utiflex

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are: -

Test Discipline	Frequency / Parameter	MU
For 6dB Bandwidth	±210.894kHz	±0.5dB
For Maximum Output Power	Not Applicable	±0.5dB
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Conducted Emissions, LISN	150kHz to 30MHz Amplitude	3.2dB*
Substitution Antenna, Radiated Field	30MHz to 18GHz Amplitude	2.6dB
For Peak Power Spectral Density	Not Applicable	±1.8dB
For Effective Radiated Power (ERP) measurements	Not Applicable	±1.45dBm

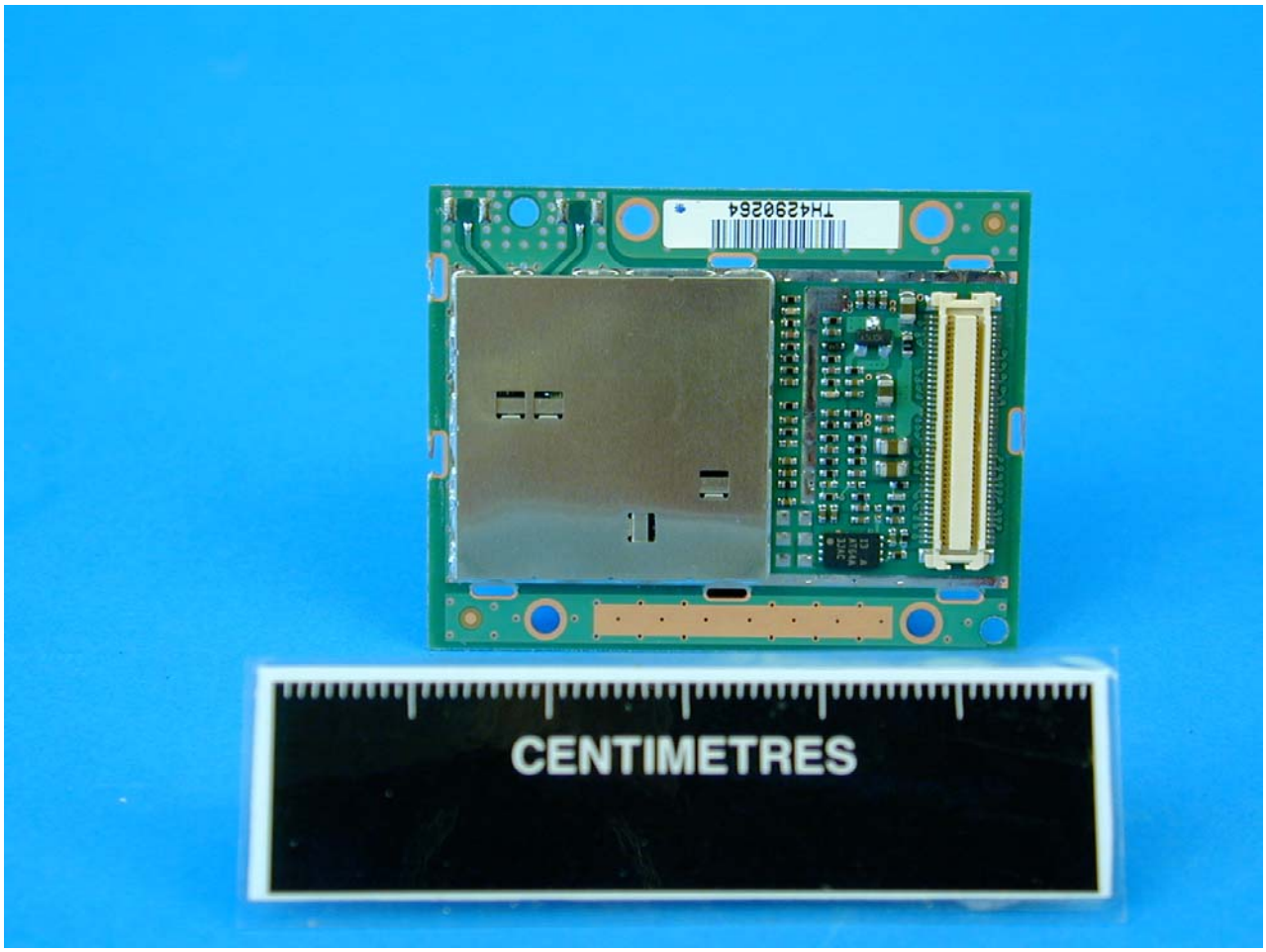
Worst case error for both Time and Frequency measurement 12 parts in 10^6.

* In accordance with CISPR 16-4

SECTION 4

EUT PHOTOGRAPH

4.1 EUT PHOTOGRAPH



Front View

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

Group

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

APPENDIX A

TITCHFIELD FCC SITE COMPLIANCE LETTER

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

October 18, 2002

Registration Number: 90987

TUV Product Service Ltd
Segensworth Road
Titchfield
Fareham, Hampshire, PO15 5RH
United Kingdom
Attention: Kevan Adsetts

Re: Measurement facility located at Titchfield
Anechoic chamber (3 meters) and 3 & 10 meter OATS
Date of Listing: October 18, 2002

Gentlemen:

Your request for registration of the subject measurement facility has been reviewed and found to be in compliance with the requirements of Section 2.948 of the FCC rules. The information has, therefore, been placed on file and the name of your organization added to the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Thomas W Phillips
Electronics Engineer