
REPORT ON

Limited FCC CFR 47: Part 15 C Testing in support of an
Application for Grant of Equipment Authorisation
of a Symbol LS3478 Laser Scanner

FCC ID: H9P2164381

Report No OR612336/02 Issue 1

September 2004

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PREPARED FOR Symbol Technologies Inc
One Symbol Plaza
Holtsville
NY 11742-1300
New York
United States of America

PREPARED BY



Graeme Lawler
EMC Engineer

APPROVED BY



C Gould
Chief Engineer, EMC Group

DATED

08-10-04

DISTRIBUTION

Symbol

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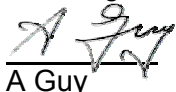
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ENGINEERING STATEMENT

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: Part 15 C. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineers;


A Guy
G Lawler



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SECTION 1

REPORT SUMMARY

Limited FCC CFR 47: Parts 15C Testing in support of an
Application for Grant of Equipment Authorisation
of a Symbol LS3478 Laser Scanner



1.1 STATUS

EQUIPMENT UNDER TEST	LS3478 Laser Scanner
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	LS3478
PART NUMBER	LS3478-ER20005WW
SERIAL NUMBER	ALP80432
HARDWARE VERSION	Rev 9 (To be released as Rev A)
DECLARED VARIANTS	LS3478-FZ
TEST SPECIFICATION ISSUE/DATE	FCC CFR 47: Part 15, Subpart C October 2003
NUMBER OF ITEMS TESTED	One
SECURITY CLASSIFICATION OF EUT	Commercial In Confidence
INCOMING RELEASE DATE	Declaration of Build Status 6 th September 2004
DISPOSAL REFERENCE NUMBER DATE	Held pending disposal Not Applicable Not Applicable
ORDER NUMBER DATE	4500387769 28 th July 2004
START OF TEST	9th September 2004
FINISH OF TEST	16th September 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) FCC Public Notice document FCC 04-165 (ET Docket No 03-201 released 12 July 2004)



1.2 INTRODUCTION

The information contained within this report is intended to show limited verification of compliance of the Symbol Technologies Inc LS3478 Laser Scanner to the requirements of FCC Specification Part 15 C.

Testing was carried out in support of an application for Grant of Equipment Authorisation in the name of Symbol Technologies Inc.



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) LS3478 Laser Scanner is part of the Symbol NGIS series of Laser Scanners supporting Bluetooth Connectivity. The Handheld scanner is used for reading all major bar code Symbologies

The terminal utilizes the approved Symbol 21-64381 Bluetooth Module FCC ID numbers are detailed in Section 1.3.4 "Declaration of Build Status".

1.3.2 Modes of Operation

Modes of operation of the EUT during testing were as follows:

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

1.3.3 Test Configuration

1.3.3.1 Bluetooth Mode

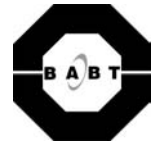
The EUT was configured connecting it to a PC via a serial cable. The required mode was configured using the WDS Commander software. During testing, the PC was removed from the test environment.

Bluetooth Transmitting on the following channels and frequencies;

Channel 2: 2402MHz
Channel 41: 2441MHz
Channel 80: 2480MHz

Bluetooth Receiving on the following channels and frequencies;

Channel 2: 2402MHz
Channel 41: 2441MHz
Channel 80: 2480MHz



1.3.4 DECLARATION OF BUILD STATUS

MAIN EUT	
MANUFACTURING DESCRIPTION	Laser Scanner
MANUFACTURER	Symbol Technologies Inc
TYPE	LS3478
PART NUMBER	LS3478-ER20005WW
SERIAL NUMBER	ALP80420 & ALP80432
HARDWARE VERSION	Rev 9 (To be released as Rev A)
COUNTRY OF ORIGIN	USA
UK AGENT	Symbol Technologies Inc
FCC ID	H9P2164381
INDUSTRY CANADA ID	1549D-2164381
TECHNICAL DESCRIPTION	The LS3478 is part of the Symbol NGIS series of Laser Scanners supporting Bluetooth Connectivity. The Handheld imager used for reading all major bar code Symbologies.
BATTERY/POWER SUPPLY	
MANUFACTURING DESCRIPTION	Battery
MANUFACTURER	Motorola
PART NUMBER	21-62606-01
HARDWARE VERSION	Rev A
VOLTAGE	3.7 V dc
COUNTRY OF ORIGIN	China
MODULE	
MANUFACTURING DESCRIPTION	Symbol Bluetooth Module
MANUFACTURER	Symbol Technologies Inc
TYPE	21-64381
PART NUMBER	21-64381-02
POWER	100mW (+20dBm - Class 1)
TRANSMITTER OPERATING RANGE	2400 – 2483.5MHz
RECEIVER OPERATING RANGE	2400 – 2483.5MHz
INTERMEDIATE FREQUENCIES	Not Applicable (Direct conversion)
ITU DESIGNATION OF EMISSION	1M00F1D
FCC ID	H9P2164381
INDUSTRY CANADA ID	1549D-2164381
DHSS/FHSS/COMBINED OR OTHER	FHSS

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.

Signature

Date
D of B S Serial No

6 September 2004
OR612336-01

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
2.1	15.205	Measurement at Band Edge	Pass
2.2	15.247(b)(2)	Maximum Peak Output Power (Radiated)	Pass
2.3	15.247(c)	Spurious Radiated Emissions	Pass



1.5 TEST CONDITIONS

The EUT was set-up simulating a typical user installation on the Anechoic Chamber (3m) identified in Appendix A, and tested in accordance with the applicable specification.

For all tests, the Symbol LS3478 Laser Scanner was powered by its own internal battery.

1.6 DEVIATIONS FROM THE STANDARD

Limited tests were applied in accordance with Symbol requirements.

1.7 MODIFICATION RECORD

Not Applicable.

1.8 ALTERNATIVE TEST SITE

No alternative test site was used.



SECTION 2

TEST DETAILS

Limited FCC CFR 47: Part 15 C Testing in support of an
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Of a Symbol LS3478 Laser Scanner



2.1 MEASUREMENT AT THE BAND EDGE (MARKER DELTA METHOD)

2.1.1 Specification Reference

FCC CFR 47: Part 15 Subpart C, Section 15.205

2.1.2 Equipment Under Test

LS3478 Laser Scanner

2.1.3 Date of Test

10th September 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.

2.2.5 Test Procedure

Test Performed in accordance with FCC Public Notice document (DA 00-705 released 30 March 2000).

2.1.6 Test Results

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.205 for Band Edge Measurements.

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

Step 1

Bottom Channel Fundamental Field Strength Measurement.

Peak measurements performed utilising a Resolution Bandwidth and Video Bandwidth of 1MHz. Average measurements performed utilising a Resolution Bandwidth of 1MHz and Video Bandwidth of 10Hz.

Frequency	Antenna Polarisation	Height	Azimuth	Peak Field Strength	Average Field Strength
MHz	H/V	cm	deg	dB μ V/m	dB μ V/m
2402	H	104	297	101.4	88.2



2.1 MEASUREMENT AT THE BAND EDGE (MARKER DELTA METHOD)-continued

2.1.6 Test Results - continued

Step 2

Determine Marker delta amplitude between 2402MHz (the fundamental) and 2390MHz (the Band Edge under investigation).

Using a span of 30MHz with Resolution Bandwidth and Video Bandwidth of 300kHz.

Marker Delta Amplitude = 55.4dB

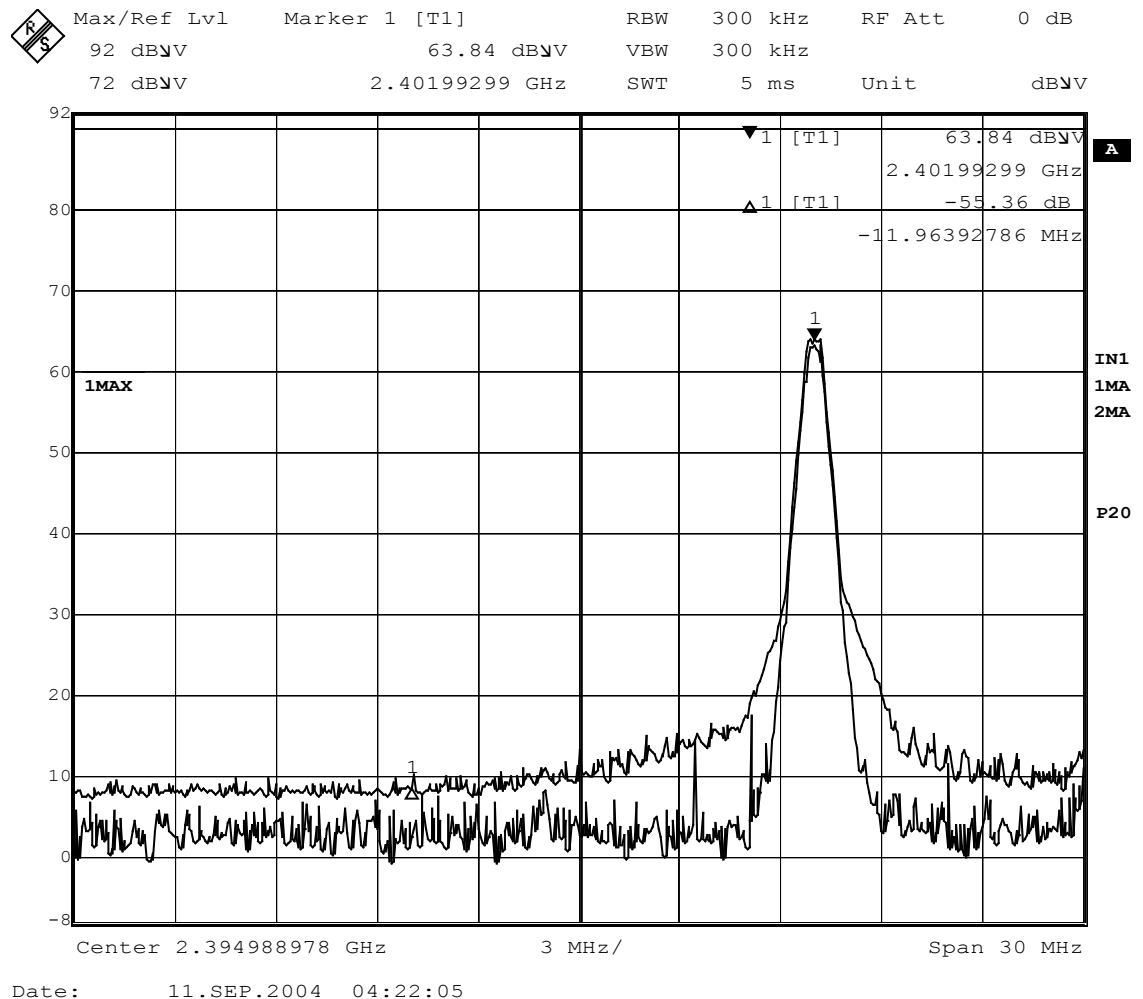
Step 3

Subtracting the Marker Delta obtained from Step 2 from the 2402MHz Field Strength measurement from Step 1, gives following Result:

Peak of 46.0dB μ V/m (Limit is 74.0dB μ V/m)

Average of 32.8dB μ V/m (Limit is 54.0dB μ V/m)

Plot for Bottom Channel 2402MHz





2.1 MEASUREMENT AT THE BAND EDGE (MARKER DELTA METHOD) - continued

2.1.6 Test Results - continued

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.205 for Band Edge Measurements.

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

Step 1

Top Channel Fundamental Field Strength Measurement

Peak measurements performed utilising a Resolution Bandwidth and Video Bandwidth of 1MHz.
Average measurements performed utilising a Resolution Bandwidth of 1MHz and Video Bandwidth of 10Hz.

Frequency	Antenna Polarisation	Height	Azimuth	Peak Field Strength	Average Field Strength
MHz	H/V	cm	deg	dB μ V/m	dB μ V/m
2480	H	127	260	100.5	87.1

Step 2

Determine Marker delta amplitude between 2480MHz (the fundamental) and 2483.5MHz (the Band Edge under investigation).

Using a span of 30MHz with Resolution Bandwidth and Video Bandwidth of 300kHz.

Marker Delta Amplitude = 51.5dB

Step 3

Subtracting the Marker Delta obtained from Step 2 from the 2483.5MHz Field Strength measurement from Step 1, gives following Result

Peak of 49.0dB μ V/m (Limit is 74.0dB μ V/m)

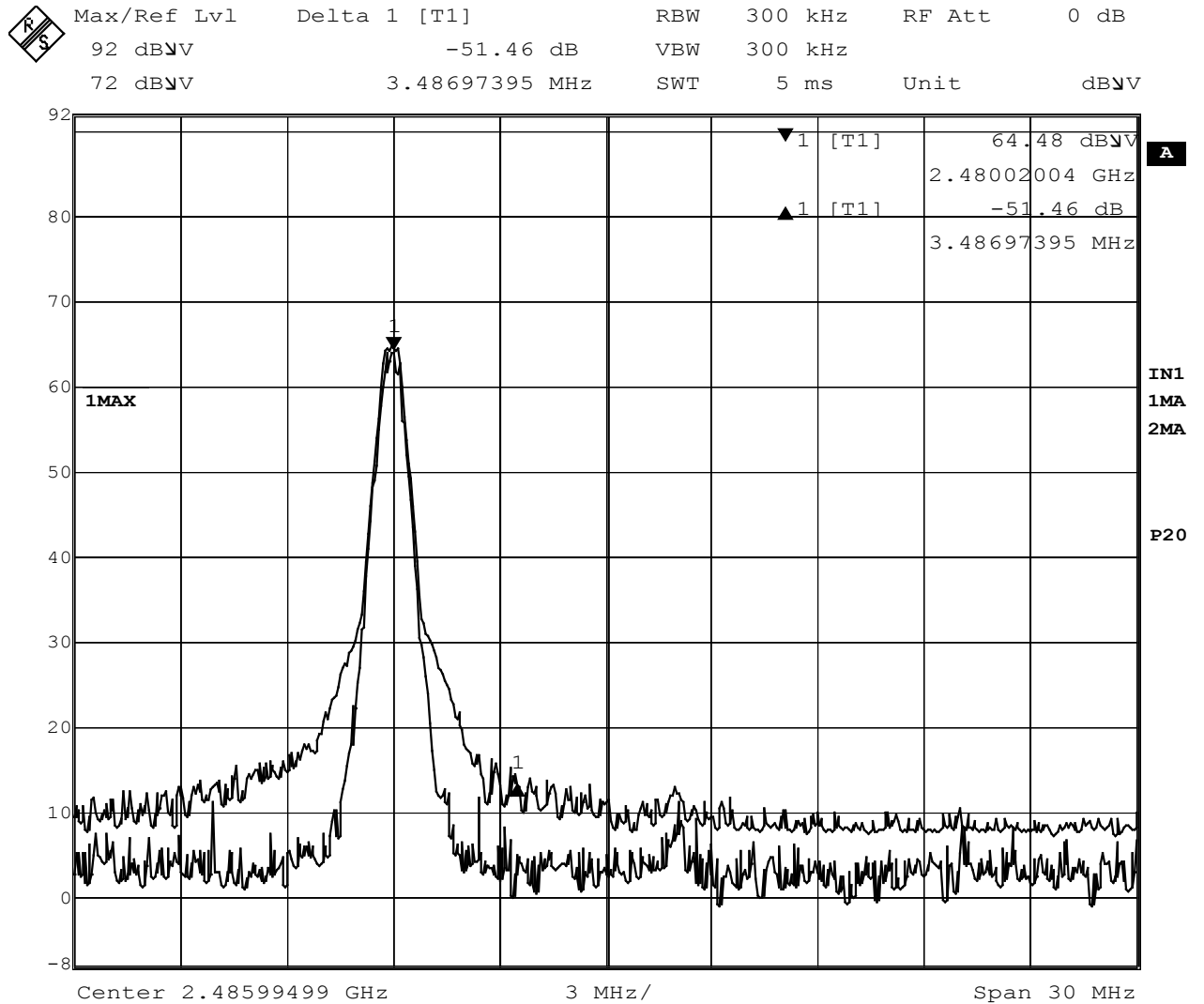
Average of 35.6dB μ V/m (Limit is 54.0dB μ V/m)



2.1 MEASUREMENT AT THE BAND EDGE (MARKER DELTA METHOD) - continued

2.1.6 Test Results - continued

Plot for Top Channel 2480MHz



Date: 11.SEP.2004 04:46:16



2.2 MAXIMUM PEAK OUTPUT POWER (Radiated Method)

2.2.1 Specification Reference

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

2.2.2 Equipment Under Test

LS3478 Laser Scanner

2.2.3 Date of Test

9th September 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.

The EUT contains an integral antenna and therefore the Maximum Peak Output Power was made using the EIRP method.

The Spectrum Analyser was tuned to the test frequency. The device Output Power setting was controlled as specified in the Product Information, Section 1.5 of this document. The device was then rotated through 360 degrees until the highest power level was observed in both horizontal and vertical polarisation. The device was then replaced with a substitution antenna, whose input signal level into the antenna was adjusted until the received level matched that of the previously detected emission.



2.2 MAXIMUM PEAK OUTPUT POWER (Radiated Method) - continued

2.2.6 Test Results - continued

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(b)(2) for Maximum Peak Output Power.

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

Frequency (MHz)	Result EIRP (dBm)	Result EIRP (mW)
2402	14.6	28.4
2441	11.9	15.4
2480	10.2	10.4
Limit	<+36dBm or <4W	



2.3 SPURIOUS RADIATED EMISSIONS

2.3.1 Specification Reference

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

2.3.2 Equipment Under Test

LS3478 Laser Scanner

2.12.3 Date of Test

10th September 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 ANSI C63.4.

FCC CFR 47: Part 15 Subpart C, Section 15.247(c), for Radiated Emissions also requires Sections 15.205 and 15.209 to be applied.

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 Anechoic Chamber (3 metres) 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 – 26GHz were then formally measured using Peak and Average Detectors, as appropriate.

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



2.3 SPURIOUS RADIATED EMISSIONS - continued

2.3.5 Test Procedure - continued

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 dB μ V/m	Limit for Spurious Outside Restricted Band (Carrier F S -20dB) dB μ V/m
Bluetooth	2402	100.5	80.5
Bluetooth	2441	100.9	80.9
Bluetooth	2480	99.9	79.9

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 μ V/m	Quasi Peak Field Strength dB μ V/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 dB μ V/m	Peak Field Strength dB μ V/m
		54.0	74.0

2.3.6 Test Results

30MHz - 1GHz Frequency Range

Equipment Designation: Intentional Radiator.

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(c), 15.205 and 15.209 for Radiated Emissions (30MHz – 1GHz).

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

EUT Tx on Bottom Channel (2402MHz)

Emission Frequency MHz	Pol H/V	Hgt cm	Azm deg	Field Strength at 3m		Specification Limit	
				dB μ V/m	μ V/m	dB μ V/m	μ V/m
183.2	V	100	20	19.6	9.5	43.5	150
370.9	V	160	0	27.7	24.3	46.0	200
387.0	V	131	0	30.9	35.1	46.0	200
419.3	V	123	325	31.0	35.5	46.0	200



2.3 SPURIOUS RADIATED EMISSIONS – continued

EUT Tx on Middle Channel (2441MHz)

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
				dB μ V/m	μ V/m	dB μ V/m	μ V/m
183.9	V	100	157	22.1	12.7	43.5	150
370.5	V	155	0	27.5	23.7	46.0	200
380.1	V	139	0	26.4	20.9	46.0	200
387.0	V	136	0	31.2	36.3	46.0	200
419.2	V	130	329	31.5	37.6	46.0	200

EUT Tx on Top Channel (2480MHz)

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
				dB μ V/m	μ V/m	dB μ V/m	μ V/m
183.5	V	100	160	20.8	11.0	43.5	150
370.6	V	154	0	26.4	20.9	46.0	200
387.0	V	129	0	29.9	31.3	46.0	200
403.0	V	154	0	27.8	24.5	46.0	200
419.5	V	127	341	32.1	40.3	46.0	200

ABBREVIATIONS FOR ABOVE TABLES

H Horizontal Polarisation
 Pol Polarisation
 deg degree

V Vertical Polarisation
 Hgt Height
 Azm Azimuth



2.3 SPURIOUS RADIATED EMISSIONS - continued

2.3.6 Test Results - continued

1GHz - 26GHz Frequency Range

Equipment Designation: Intentional Radiator.

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(c), 15.205 and 15.209 for Radiated Emissions (1GHz – 26GHz).

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

EUT Tx on Bottom Channel (2402MHz)

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average Field Strength	Average Limit
	Pol	Height	Azimuth				
GHz	H/V	cm	deg	dB μ V/m	dB μ V/m	dB μ V/m	dB μ V/m
4.804	H	100	320	48.2	74.0	39.0	54.0
7.206	V	100	156	48.1	80.5	N/A	N/A

EUT Tx on Middle Channel (2441MHz)

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average Field Strength	Average Limit
	Pol	Height	Azimuth				
GHz	H/V	cm	deg	dB μ V/m	dB μ V/m	dB μ V/m	dB μ V/m
4.882	V	100	270	46.2	74.0	34.6	54.0



2.3 SPURIOUS RADIATED EMISSIONS - continued

2.3.6 Test Results - continued

1GHz - 26GHz Frequency Range - continued

EUT Tx on Top Channel (2480MHz)

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average Field Strength	Average Limit
	Pol	Height	Azimuth				
GHz	H/V	cm	deg	dB μ V/m	dB μ V/m	dB μ V/m	dB μ V/m
4.960	H	100	290	45.3	74.0	43.1	54.0

Note: The 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
 Pol Polarisation
 deg degree

V Vertical Polarisation
 Hgt Height
 Azm Azimuth



2.3 SPURIOUS RADIATED EMISSIONS - continued

2.3.7 Set Up Photograph



Spurious Radiated Emissions Set Up Photograph



SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

Instrument	Manufacturer	Type No	EMC / INV No	Cal. Due
Section 2.1				
Turntable & Controller	HD Gmbh	HD050	2528	TU
Antenna Mast	EMCO	1051	2182	TU
Screened Room 5	Siemens	EAC54300	2533	TU
10dB Attenuator	Marconi	6534/3	1494	TU
Signal Generator	Hewlett Packard	8673B	953	10/06/2005
Test Receiver	Rohde & Schwarz	ESIB	2989	08/04/2005
Hygrometer / Barometer	Oregon Scientific	BAA913HG	Room5	TU
Section 2.2				
Turntable & Controller	HD Gmbh	HD050	2528	TU
Antenna Mast	EMCO	1051	2182	TU
Screened Room 5	Siemens	EAC54300	2533	TU
Test Receiver	Rohde & Schwarz	ESIB	2989	08/04/2005
Horn	EMCO	3115	2297	07/07/2005
Horn	EMCO	3115	2397	07/07/2005
10dB Attenuator	Marconi	6534/3	1494	TU
Signal Generator	Hewlett Packard	8673B	953	10/06/2005
Hygrometer / Barometer	Oregon Scientific	BAA913HG	Room5	TU
Section 2.3				
Turntable & Controller	HD Gmbh	HD050	2528	TU
Antenna Mast	EMCO	1051	2182	TU
Screened Room 5	Siemens	EAC54300	2533	TU
Test Receiver	Rohde & Schwarz	ESIB	2989	08/04/2005
Low Noise Amplifier (1-8GHz)	Miteq	AMF-3D-001080-18-13P	2457	TU
Low Noise Amplifier (8-18GHz)	Avantek	AWT-18036	1081	26/06/2005
Low Noise Amplifier (18-26GHz)	Avantek	AMT-26177-33	2072	23/06/2005
Horn	EMCO	3115	2297	07/07/2005
Signal Generator	Hewlett Packard	8673B	953	10/06/2005
Horn	Advanced Microtek	AM180HA KTU2	2945	24/06/2006
Hygrometer / Barometer	Oregon Scientific	BAA913HG	Room5	TU



3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	Frequency / Parameter	MU
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

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

* In accordance with CISPR 16-4



SECTION 4

EUT PHOTOGRAPH



EUT PHOTOGRAPH



Front View



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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).

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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