
REPORT ON

Limited FCC CFR 47: Part 15 Testing in support of an Application for Grant of Equipment
Authorisation of a Symbol MC9060 Mobile Computer
FCC ID: H9PMC9060B

Report No OR611533/02 Issue 2

January 2004

REPORT ON

FCC CFR 47: Part 15 Testing in support of an Application for
Grant of Equipment Authorisation of a Symbol MC9060 Mobile
Computer

FCC ID: H9PMC9060B

Report No OR611533/02 Issue 2

January 2004

PREPARED FOR

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APPROVED BY



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DATED

12-02-04

DISTRIBUTION

Symbol Technologies

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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. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineers;



A Guy



M Larkin



G Lawler





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STATUS

OBJECTIVE	To undertake measurements to determine the Equipment Under Test's (EUT's) compliance with the specification.
MANUFACTURING DESCRIPTION	MC9060 Mobile Computer
APPLICANT	Symbol Technologies Inc One Symbol Plaza Holtsville NY 11742-1300 New York United States of America
MANUFACTURERS TYPE NUMBER	MC9060
MANUFACTURERS PART NUMBER	MC9060-KH0JBEEA7WW
SERIAL NUMBER	ALP74995
HARDWARE VERSION	Rev 8 (To be released as Rev A)
DECLARED VARIANTS	None
TEST SPECIFICATION NUMBER	FCC CFR 47: Part 15 Subpart C, August 2002
REGISTRATION NUMBER	OR611533
QUANTITY OF ITEMS TESTED	One
SECURITY CLASSIFICATION OF EUT	Unclassified
INCOMING RELEASE SERIAL NUMBER DATE	Declaration of Build Status OR611533 5 th January 2004
DISPOSAL REFERENCE NUMBER DATE	Held pending disposal N/A N/A
START OF TEST FINISH OF TEST	5 th January 2004 9 th January 2004
TEST ENGINEERS	A Guy M Larkin G Lawler
RELATED DOCUMENTS	ANSI C63.4 2001. Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz. FCC Public Notice DA 00-705, 30 th March 2003



TEST RATIONALE

This report has been re-issued as Issue 2, the original report had several typing errors and the wrong limits were listed under 15.247(c) for Radiated Emissions 30MHz-1GHz. The Part Number of the EUT was also incorrect and the customer has re-issued their Declaration of Build Status to reflect this. This report is intended to replace the original report OR611522/02 Issue 1 issued in January 2004.

The information contained within this report is intended to show verification of compliance of the Symbol Technologies Inc MC9060 Mobile Computer to the requirements of FCC Specification Part 15.

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

FCC ID H9PMC9060B

The unit supplied for testing is a Symbol MC9060 Mobile Computer, which offers 2.4GHz 802.11b Wireless LAN and Bluetooth connectivity with the following options: SE824 Scan Engine; Mono (touch) display; 64/64 memory option; 53 Keyboard; PPC2003; Audio

For results of other tests, refer to the original TÜVPS test report OR611514/01 Issue 2.

The terminal utilizes the approved Symbol Main Terminal Module (MTM) with embedded 802.11b RLAN radio and the Symbol Bluetooth Module. FCC ID numbers are detailed below:

<u>Type:</u>	<u>Description</u>	<u>Approval</u>	<u>FCC ID</u>	<u>Date</u>
21-64436	Main Terminal Module	FCC Part15	H9P2164436	16 th November 2003
21-64381	Symbol Bluetooth Module	FCC Part15	H9P2164381	12 th December 2003

The radios integrated in this terminal are not designed to operate simultaneously and are therefore tested independently.

Sub-equipped version (RLAN only)

A sub-equipped version of the MC9060 is also available; this version will only offer 802.11b RLAN connectivity, as the Bluetooth module is not included.

Section 3 of the report details testing carried out in accordance with:

- FCC: Part 15.205, 15.209, Measurement at Band Edge (Marker Delta Method)
- FCC: Part 15.247(b)(3), Maximum Peak Output Power
- FCC: Part 15.247(c), Spurious Radiated Emissions

Location Of Testing

BABT Engineers Tony Guy, Matthew Larkin and Graeme Lawler, conducted all testing at the premises BABT, Segensworth Road, Fareham, Hampshire, PO15 5RH. A complete site description is on file with the FCC Laboratory Division, Registration Number: 90987. See Annex A.



SYSTEM CONFIGURATION DURING EMC TESTING

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

For all tests, the Symbol MC9060 Mobile Computer was powered by its own internal battery and fitted with a Symbol Headset.

The test software in the EUT enabled the Test Engineer to select full power and continuous transmit on the following channels;

2.4GHz RLAN functionality

Channel 1: 2412MHz
Channel 6: 2437MHz
Channel 11: 2462MHz

2.4GHz Bluetooth functionality

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

TEST SET UP PHOTOGRAPH

The photograph below shows the EUT configuration during Radiated Emission testing.



Photograph 1



EQUIPMENT INFORMATION

Equipment under Test (EUT):

MAIN EUT		
MANUFACTURING DESCRIPTION	Mobile Computer	
MANUFACTURER	Symbol Technologies Inc.	
COUNTRY OF ORIGIN	USA	
TYPE	MC9060	
PART NUMBER	MC9060-KH0JBEEA7WW	
SERIAL NUMBER	(FCC1) ALP74995; (EMI1) ALP74994	
HARDWARE VERSION	Rev 8 (Manufactured as Rev A)	
FCC ID	H9PMC9060B	
INDUSTRY CANADA ID	1549D-MC9060B	
RADIO MODULES INTEGRATED	RLAN, (21-64436) and Bluetooth, (21-64381)	
TECHNICAL DESCRIPTION	The unit supplied for testing is a Symbol MC9060 Mobile Computer, which offers 2.4GHz 802.11b Wireless LAN and Bluetooth connectivity with the following options: SE824 Scan Engine; Mono (touch) display; 64/64 memory option; 53 Keyboard; PPC2003; Audio	
BATTERY/POWER SUPPLY		
MANUFACTURING DESCRIPTION	Lithium Battery	
MANUFACTURER	Symbol Technologies Inc.	
COUNTRY OF ORIGIN	USA	
TYPE	N/A	
PART NUMBER	21-65587-01	
VOLTAGE	7.2V	
UK AGENT	SYMBOL TECHNOLOGIES LTD	
RADIO MODULES		
MANUFACTURING DESCRIPTION	Main Terminal Module with Embedded RLAN Radio	Bluetooth Module
MANUFACTURER	Symbol Technologies Inc	Symbol Technologies Inc
COUNTRY OF ORIGIN	USA	USA
TYPE	21-64436	21-64381
POWER	7 - 16V	3.3V
TRANSMITTER OPERATING RANGE	2400 – 2483.5MHz	2400 – 2483.5MHz
TRANSMITTER POWER	100mW (20dBm)	100mW (20dBm)
RECEIVER OPERATING RANGE	2400 – 2483.5MHz	2400 – 2483.5MHz
INTERMEDIATE FREQUENCIES	374MHz	N/A Direct conversion
EMISSION DESIGNATOR	11M0F1D	1M00F1D
DHSS/FHSS/COMBINED OR OTHER	DSSS	FHSS
FCC ID & DATE	H9P2164436 (26-Nov-03)	H9P2164381 (12-Dec-03)
INDUSTRY CANADA ID & DATE	1549D-2164436 (Dec 03)	1549D-2164381 (Dec 03)
ANCILLARIES		
MANUFACTURING DESCRIPTION	Headset	
MANUFACTURER	VXI Corporation	
TYPE	VXI 61-SYB	
PART NUMBER	50-11300-050	
SERIAL NUMBER	Not Serialised	
HARDWARE VERSION	Rev A	
COUNTRY OF ORIGIN	USA	
UK AGENT	SYMBOL TECHNOLOGIES INC	

Marco Belli = **BUILD STATUS**
Signature

Date 5 January 2004
D of B S Serial No OR611533

BABT Product Service Limited 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



EQUIPMENT INFORMATION - continued

Equipment under Test (EUT):

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.

Test Equipment and Ancillaries Used For Test

Instrument	Manufacturer	Type No.	EMC No.
Room 5	Siemens and Matsushita	----	2533
EMI Receiver	Hewlett Packard	8542E	2286
Bilog Antenna	Chase	CBL 6143	2860
Turntable & Controller	HD	HD 050	2528
Antenna Mast	EMCO	2070	----
Antenna Mast Controller	EMCO	2090	----
Test Receiver	Rohde & Schwarz	ESIB 26.5	2958
Signal Generator	Hewlett Packard	8672A	411
High Pass Filter	RLC Electronics	F-100-3000-5-R	4467
Low Noise Amplifier (1GHz-8GHz)	Miteq	AMF-3D-001080-18-13P	2457
Horn	EMCO	3115	2297
Horn	EMCO	3155	2397
Horn	Advanced Microtek	AM180 HA-K-TU2	2945
Horn	Flann	2024-20	1396
Low Noise Amplifier (8GHz-18GHz)	Avantek	AWT-18036	1081
Low Noise Amplifier (18GHz-26GHz)	Avantek	AMT-26177-33	2072
Barometer	Dimplex	----	1938
Hygrometer	Rotronic	A1	3156

Table of Instrumentation Used for Testing

Note(s)

- 1) All items are calibrated annually, except where labelled TU (Traceability Unscheduled). These items are calibrated within the test configurations using calibrated equipment from the tables above.



**TEST RESULTS
RLAN MODE**



MEASUREMENT AT THE BAND EDGE

TEST PROCEDURE

Testing to the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.205, for Restricted Bands of Operation was carried out on the Measurement Test Facility detailed in Annex A.

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 at the Band Edges with the following results;

Channel Frequency	Band Edge Frequency	Antenna Polarisation	Height	Azimuth	Peak Field Strength	Limit Peak Field Strength	Average Field Strength	Limit Average Field Strength
MHz	MHz	H/V	cm	deg	dB μ V/m	dB μ V/m	dB μ V/m	dB μ V/m
2412	2390.0	V	111	216	60.6	74.0	47.9	54.0
2462	2483.5	V	106	177	60.0	74.0	39.2	54.0

Table of Results for Measurement at the Band Edge

Procedure: Test Performed in accordance with ANSI C63.4.

Performed by: M Larkin, EMC Engineer.



MAXIMUM PEAK OUTPUT POWER (EIRP Method)

TEST PROCEDURE

Testing to the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(b)(1), for Maximum Peak Output Power was carried out.

The EUT contains an integral antenna and therefore the Maximum Peak Output Power measurement 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 System Configuration Section 1 of this document. The device was then rotated through 360 degrees until the highest power level was observed in both planes of polarisation. The device was then replaced with a substitution antenna, the signal to the antenna was adjusted to equal the related level detected from the device.

Maximum Peak Output Power measurements were made with the EUT set to continuous transmit at maximum power on the following channels:

2412MHz
2437MHz
2462MHz

TEST RESULTS

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(b)(1) for Maximum Peak Output Power.

Frequency (MHz)	Result EIRP (dBm)	Result EIRP (mW)
2412	20.4	109.6
2437	20.8	120.2
2462	20.0	100.0
Limit	<+36dBm or <4W	

Table of Results for Maximum Peak Output Power

Procedure: Test Performed in accordance with FCC CFR 47: Part 15.247(b)(1) for Maximum Peak Output Power.

Performed by: A Guy, EMC Engineer.



SPURIOUS RADIATED EMISSIONS

TEST PROCEDURE

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

A preliminary profile of the 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 25GHz. 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 a CISPR Quasi-Peak detector.
1GHz - 25GHz emissions levels were then formally measured a 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 EUT was operating off its internal battery, the battery was replaced at regular intervals to ensure optimum performance of the EUT.

Measurements were made with the EUT transmitting on the following channels.

2412MHz
2437MHz
2462MHz

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

Radiated Emissions from 1GHz to 25GHz were made using a Rhode and Schwarz ESIB 40 Test Receiver.

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



SPURIOUS RADIATED EMISSIONS - continued

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).

EUT Tx on Bottom Channel (2412MHz)

30MHz – 1GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
				MHz	H/V	cm	deg
527.100*	V	100	324	27.9	24.8	92.1	40271.0
597.200*	V	100	350	30.5	33.5	92.1	40271.0
611.900	V	100	355	28.2	25.7	46.0	200.0
623.000*	H	115	151	27.9	24.8	92.1	40271.0
626.700*	V	100	0	27.8	24.5	92.1	40271.0
748.000*	H	100	167	30.0	31.6	92.1	40271.0

Table of Results for Spurious Radiated Emissions

EUT Tx on Middle Channel (2437MHz)

30MHz – 1GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
				MHz	H/V	cm	deg
527.100*	V	100	326	29.1	28.5	91.7	38459.0
597.200*	V	100	355	30.9	35.1	91.7	38459.0
611.900	V	100	347	27.8	24.5	46.0	200.0
622.900*	H	119	150	27.6	24.0	91.7	38459.0
626.700*	V	100	0	27.7	24.3	91.7	38459.0
748.000*	H	100	161	29.9	31.3	91.7	38459.0

Table of Results for Spurious Radiated Emissions

* Note: The measurements in the above tables marked * do not fall within the Restricted Band (15.205) and hence a limit of 20dB below the highest desired power level for the Carrier Frequency.



SPURIOUS RADIATED EMISSIONS - continued

TEST RESULTS - continued

30MHz - 1GHz Frequency Range

EUT Tx on Top Channel (2462MHz)

30MHz – 1GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
				MHz	H/V	cm	deg
527.000*	V	100	338	28.5	26.6	91.9	39355.0
597.200*	V	100	352	30.8	34.7	91.9	39355.0
611.900	V	100	335	28.4	26.3	46.0	200.0
622.700*	H	115	149	28.4	26.3	91.9	39355.0
626.700*	V	100	0	27.4	23.4	91.9	39355.0
748.000*	H	100	134	28.8	27.5	91.9	39355.0

Table of Results for Spurious Radiated Emissions

* Note: The measurements in the above tables marked * do not fall within the Restricted Band (15.205) and hence a limit of 20dB below the highest desired power level for the Carrier Frequency.

ABBREVIATIONS FOR ABOVE TABLES

H Horizontal Polarisation
Pol Polarisation
deg degree

V Vertical Polarisation
Hgt Height
Azm Azimuth

Procedure: Test Performed in accordance with ANSI C63.4.

Performed by: G Lawler, EMC Engineers.



SPURIOUS RADIATED EMISSIONS - continued

TEST RESULTS - continued

1GHz - 25GHz Range

Equipment Designation: Intentional Radiator.

The EUT met the requirements of FCC CFR 47: Part 15.247(c), 15.205 and 15.209 for Spurious Radiated Emissions (1GHz – 25GHz).

EUT Tx on Bottom Channel (2412MHz)

Note: measurement of the carrier frequency (2412MHz) produced a Field Strength of 112.1dB μ V/m. Therefore the specification limit for any spurious emissions found outside of the Restricted Band table (Section 15.205) is 92.1dB μ V/m (carrier level minus 20dB)

1GHz – 26GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average* Field Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	cm	deg	dB μ V/m	dB μ V/m	dB μ V/m	dB μ V/m
4.076	V	121	332	54.6	74.0	49.6	54.0
4.824	V	100	272	57.7	74.0	45.6	54.0
8.152	V	100	138	55.0	74.0	44.2	54.0
9.648	V	100	0	32.7	92.1	N/A	N/A
10.190	V	100	0	33.5	92.1	N/A	N/A
12.060	V	100	0	33.1	74.0	33.1	54.0

Table of Results for Spurious Radiated Emissions

* 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.



SPURIOUS RADIATED EMISSIONS - continued

TEST RESULTS - continued

1GHz - 25GHz Range

Equipment Designation: Intentional Radiator.

The EUT met the requirements of FCC CFR 47: Part 15.247(c), 15.205 and 15.209 for Spurious Radiated Emissions (1GHz – 25GHz).

EUT Tx on Middle Channel (2437MHz)

Note: measurement of the carrier frequency (2437MHz) produced a Field Strength of 111.7dBµV/m. Therefore the specification limit for any spurious emissions found outside of the Restricted Band table (Section 15.205) is 91.7dBµV/m (carrier level minus 20dB)

1GHz – 26GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average* Field Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
4.126	V	100	327	51.2	74.0	44.7	54.0
4.874	V	100	294	60.8	74.0	47.7	54.0
8.252	V	100	85	54.1	74.0	43.8	54.0
9.748	V	100	0	32.2	91.7	N/A	N/A
10.315	V	100	0	33.4	91.7	N/A	N/A
12.185	V	100	0	32.8	74.0	32.8	54.0

Table of Results for Radiated Emissions

* 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.



SPURIOUS RADIATED EMISSIONS - continued

TEST RESULTS

1GHz - 25GHz Range

Equipment Designation: Intentional Radiator.

The EUT met the requirements of FCC CFR 47: Part 15.247(c), 15.205 and 15.209 for Spurious Radiated Emissions (1GHz – 25GHz).

EUT Tx on Top Channel (2462MHz)

Note: measurement of the carrier frequency (2462MHz) produced a Field Strength of 111.9dBµV/m. Therefore the specification limit for any spurious emissions found outside of the Restricted Band table (Section 15.205) is 91.9dBµV/m (carrier level minus 20dB)

1GHz – 26GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average* Field Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
4.176	V	128	188	49.8	74.0	41.5	54.0
4.924	V	100	299	58.6	74.0	45.6	54.0
6.264	V	142	126	50.8	74.0	42.7	54.0
8.352	H	138	218	53.1	74.0	42.9	54.0
9.848	V	100	0	33.0	91.9	N/A	N/A
10.440	V	100	0	32.8	91.9	N/A	N/A
12.310	V	100	0	33.7	74.0	33.7	54.0

Table of Results for Spurious Radiated Emissions

* 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.

Procedure: Test Performed in accordance with ANSI C63.4.

Performed by: A Guy and M Larkin, EMC Engineers.



**TEST RESULTS
BLUETOOTH MODE**



MEASUREMENT AT THE BAND EDGE

TEST PROCEDURE

Testing to the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.205, for Restricted Bands of Operation was carried out on the Measurement Test Facility detailed in Annex A.

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 at the Band Edges with the following results;

Channel Frequency	Band Edge Frequency	Antenna Polarisation	Height	Azimuth	Peak Field Strength	Limit Peak Field Strength	Average Field Strength	Limit Average Field Strength
MHz	MHz	H/V	cm	deg	dB μ V/m	dB μ V/m	dB μ V/m	dB μ V/m
2402	2390.0	V	109	65	60.8	74.0	23.0*	54.0
2480	2483.5	V	108	68	59.8	74.0	31.8*	54.0

Table of Results for Measurement at the Band Edge

* Note these results have been corrected using the Bluetooth Duty Cycle Correction Factor for the EUT, as calculated on page 21 of this report.

Procedure: Test Performed in accordance with ANSI C63.4.

Performed by: M Larkin, EMC Engineer.



MAXIMUM PEAK OUTPUT POWER (EIRP Method)

TEST PROCEDURE

Testing to the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(b)(1), for Maximum Peak Output Power was carried out.

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 System Configuration Section 1 of this document. The device was then rotated through 360 degrees until the highest power level was observed in both planes of polarisation. The device was then replaced with a substitution antenna, the signal to the antenna was adjusted to equal the related level detected from the device.

Maximum Peak Output Power measurements were made with the EUT set to continuous transmit at maximum power on the following channels:

2402MHz
2441MHz
2480MHz

TEST RESULTS

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(b)(1) for Maximum Peak Output Power.

Frequency (MHz)	Result EIRP (dBm)	Result EIRP (mW)
2402	15.7	37.1
2441	18.3	67.6
2480	18.3	67.6
Limit	<+36dBm or <4W	

Table of Results for Maximum Peak Output Power

Procedure: Test Performed in accordance with FCC CFR 47: Part 15.247(b)(1) for Maximum Peak Output Power.

Performed by: A Guy, EMC Engineer.



SPURIOUS RADIATED EMISSIONS

TEST PROCEDURE

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

A preliminary profile of the 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 25GHz. 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 a CISPR Quasi-Peak detector.
1GHz - 25GHz emissions levels were then formally measured a 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 EUT was operating off its internal battery; the battery was replaced at regular intervals to ensure optimum performance of the EUT.

Measurements were made with the EUT transmitting on the following channels.

2402MHz
2441MHz
2480MHz

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

Radiated Emissions from 1GHz to 25GHz were made using a Rhode and Schwarz ESIB 40 Test Receiver.

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

In accordance with FCC Public Notice DA 00-705, Released 30th March 2003, Section 15.247(c) Spurious Radiated Emissions "If the dwell time per channel of the hopping signal is less than 100ms, then the reading obtained with the 10Hz VBW may be further adjusted by a "duty cycle correction factor", derived from $20\log(\text{dwell time}/100\text{ms})$, in an effort to demonstrate compliance with the 15.209 limit the following adjustment has been calculated for use with Average Measurements only;

Dwell Time = 5.81ms this is derived from;

Total slot time per time slot for DH5 packet $625\mu\text{s} \times 5 = 3.125\text{ms}$

Actual transmit time during this time slot is 2.905ms and the reply time slot after each DH5 packet is 625 μs .

Total time slot length per channel $3.125 + 0.625 = 3.75\text{ms}$.

Multiply Total time slot length per channel by 32 channels per hop sequence $32 \times 3.75 = 120\text{ms}$

It is therefore possible to have a maximum of two hop sequences in any given 100ms period, a single channel could occur twice within any 100ms time window. $2 \times 2.905 = 5.81\text{ms}$

Therefore; the Bluetooth Duty Cycle Correction Factor for the EUT is $20 \log (5.81/100) = -24.7\text{dB}$



SPURIOUS RADIATED EMISSIONS - continued

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).

EUT Tx on Bottom Channel (2402MHz)

30MHz – 1GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
				MHz	H/V	cm	deg
527.100*	V	100	318	30.6	33.9	91.4	37155.0
582.500*	V	100	32	27.7	24.3	91.4	37155.0
589.900*	V	100	0	26.4	20.9	91.4	37155.0
597.200*	V	100	355	28.8	27.5	91.4	37155.0
611.900	V	100	20	28.0	25.1	46.0	200.0
623.000*	H	127	333	35.9	62.4	91.4	37155.0

Table of Results for Spurious Radiated Emissions

EUT Tx on Middle Channel (2441MHz)

30MHz – 1GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Emission Frequency	Pol	Hgt	Azm	Field Strength at 3m		Specification Limit	
				MHz	H/V	cm	deg
527.200*	V	100	315	30.4	33.1	88.5	26607.0
582.400*	V	100	21	27.6	24.0	88.5	26607.0
589.700*	V	100	0	26.5	21.1	88.5	26607.0
597.200*	V	100	335	29.3	29.2	88.5	26607.0
612.000	V	100	19	27.8	24.5	46.0	200.0
623.000*	H	116	330	36.4	66.1	88.5	26607.0

Table of Results for Spurious Radiated Emissions

* Note: The measurements in the above tables marked * do not fall within the Restricted Band (15.205) and hence a limit of 20dB below the highest desired power level for the Carrier Frequency.



SPURIOUS RADIATED EMISSIONS - continued

TEST RESULTS - continued

30MHz - 1GHz Frequency Range

EUT Tx on Top Channel (2480MHz)

30MHz – 1GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

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
527.200*	V	100	322	30.7	34.3	88.5	26607.0
582.300*	V	100	30	27.6	24.0	88.5	26607.0
589.700*	V	100	0	26.5	21.1	88.5	26607.0
597.200*	V	100	347	29.5	29.9	88.5	26607.0
612.000	V	100	17	27.9	24.8	46.0	200.0
622.900*	H	115	328	36.8	69.2	88.5	26607.0

Table of Results for Spurious Radiated Emissions

* Note: The measurements in the above tables marked * do not fall within the Restricted Band (15.205) and hence a limit of 20dB below the highest desired power level for the Carrier Frequency.

ABBREVIATIONS FOR ABOVE TABLES

H Horizontal Polarisation
Pol Polarisation
deg degree

V Vertical Polarisation
Hgt Height
Azm Azimuth

Procedure: Test Performed in accordance with ANSI C63.4.

Performed by: G Lawler, EMC Engineer.



SPURIOUS RADIATED EMISSIONS - continued

TEST RESULTS - continued

1GHz - 25GHz Range

Equipment Designation: Intentional Radiator.

The EUT met the requirements of FCC CFR 47: Part 15.247(c), 15.205 and 15.209 for Spurious Radiated Emissions (1GHz – 25GHz).

EUT Tx on Bottom Channel (2402MHz)

Note: measurement of the carrier frequency (2402MHz) produced a Field Strength of 111.4dBµV/m. Therefore the specification limit for any spurious emissions found outside of the Restricted Band table (Section 15.205) is 91.4dBµV/m (carrier level minus 20dB).

1GHz – 26GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average* Field Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
4.804	V	102	167	73.3	74.0	38.9* ¹	54.0
7.206	V	112	233	67.1	91.4	N/A	N/A
9.921	H	100	122	49.2	91.4	N/A	N/A
12.400	H	100	123	64.8	74.0	28.5* ¹	54.0

Table of Results for Spurious Radiated Emissions

EUT Tx on Middle Channel (2441MHz)

Note: measurement of the carrier frequency (2441MHz) produced a Field Strength of 108.5dBµV/m. Therefore the specification limit for any spurious emissions found outside of the Restricted Band table (Section 15.205) is 88.5dBµV/m (carrier level minus 20dB).

1GHz – 26GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average* Field Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
4.882	V	102	171	65.7	74.0	33.2* ¹	54.0
7.323	V	100	28	71.6	74.0	36.8*	54.0
9.763	H	100	238	54.4	88.5	N/A	N/A
12.205	V	100	113	66.3	74.0	30.7* ¹	54.0

Table of Results for Radiated Emissions

* 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.

*¹ Note these results have been corrected using the Bluetooth Duty Cycle Correction Factor for the EUT, as calculated on page 21 of this report.



SPURIOUS RADIATED EMISSIONS - continued

TEST RESULTS

1GHz - 25GHz Range

EUT Tx on Top Channel (2480MHz)

Note: measurement of the carrier frequency (2480MHz) produced a Field Strength of 108.5dBµV/m. Therefore the specification limit for any spurious emissions found outside of the Restricted Band table (Section 15.205) is 88.5dBµV/m (carrier level minus 20dB)

1GHz – 26GHz Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average* Field Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
4.960	V	101	185	59.5	74.0	18.2 * ¹	54.0
7.439	V	159	207	65.0	74.0	31.6* ¹	54.0
9.919	H	100	235	49.5	88.5	N/A	N/A
12.400	H	100	125	64.7	74.0	28.2* ¹	54.0

Table of Results for Spurious Radiated Emissions

The Average Field Strengths shown in the Table above have been normalised by subtracting 24.7dB (Duty Cycle Correction Factor) from the measured Field Strength.

* 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.

*¹ Note these results have been corrected using the Bluetooth Duty Cycle Correction Factor for the EUT, as calculated on page 21 of this report.

Procedure: Test Performed in accordance with ANSI C63.4.

Performed by: M Larkin & G Lawler, EMC Engineers.

PHOTOGRAPH OF EQUIPMENT



Photograph 2
Front view



MEASUREMENT UNCERTAINTY

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

In the frequency range 30MHz to 1000MHz

For 6dB Bandwidth

Frequency $\pm 210.894\text{kHz}$

Amplitude $\pm 0.5\text{dB}$

For Maximum Output Power

Amplitude $\pm 0.5\text{dB}$

For Spurious Conducted Emissions

Amplitude $\pm 3.0\text{dB}$

For Radiated Emissions, Quasi-Peak Measurements using the ESVP Test Receiver and Bilog Antenna: -

Frequency $\pm 5\text{ppm} + 500\text{Hz}$

Amplitude $\pm 4.1\text{dB}$

In the frequency range 1GHz to 25GHz

For Spurious Radiated Emissions measurements: -

Frequency $\pm 2 \times 10^{-7} \times \text{Centre Frequency}$

Amplitude $\pm 3.4\text{dB}$

For Peak Power Spectral Density

Amplitude $\pm 1.8\text{dB}$



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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ANNEX A
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