
TEST REPORT

FCC Part 15C Testing in support of an Application for Grant of Equipment Authorisation of
an Intermec BTM210 Bluetooth Radio
FCC ID: EHA-BTM210

Report Number: OR611453-02 Issue 3

December 2003

REPORT ON

FCC Part 15C Testing in support of an Application for Grant of
Equipment Authorisation of an Intermec BTM210 Bluetooth Radio

FCC ID: EHA-BTM210

Report No OR611453-02 Issue 3

December 2003

EQUIPMENT:

Bluetooth Radio Module

FCC ID:

EHA-BTM210

SPECIFICATION:

47 CFR 15.247

PREPARED FOR:

Intermec Technologies Corporation
550 Second Street S.E
Cedar Rapids
IOWA 52401
USA

**MANUFACTURERS
REPRESENTATIVE:**

Mr Scott Holub

APPROVED BY:



C H GOULD
EMC Signatory



M JENKINS
Radio Signatory

DATED:

10th December 2003

10th December 2003

DISTRIBUTION

Intermec 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;



M Larkin



R Henley



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SECTION 1

REPORT SUMMARY

Document History

This Report replaces Report OR611453-02 Issue 2 and is issued to include omitted test results in the original report and in Issue 2.

FCC Part 15C Testing in support of an Application for Grant of Equipment
Authorisation of an Intermec BTM210 Bluetooth Radio
FCC ID: EHA-BTM210



1.1 STATUS

OBJECTIVE

To undertake measurements to determine the Equipment Under Test's (EUT's) compliance with the specification.

MANUFACTURING DESCRIPTION

Bluetooth Radio Module

APPLICANT

Intermec Technologies
Norand Mobile Systems Division
550 Second Street S.E
Cedar Rapids
IOWA 52401
USA

MANUFACTURERS TYPE NUMBER

BTM210

MANUFACTURERS PART NUMBER

BTM210

SERIAL NUMBER

0020E0935C9D

HARDWARE REVISION

0.6

TEST SPECIFICATION NUMBER

FCC Part 15 Subpart C

REGISTRATION NUMBER

OR611453

QUANTITY OF ITEMS TESTED

One

SECURITY CLASSIFICATION OF EUT

Unclassified

INCOMING RELEASE

Declaration of Build Status

SERIAL NUMBER

OR611453

DATE

DISPOSAL

Held pending disposal

REFERENCE NUMBER

N/A

DATE

N/A

START OF TEST

30th September 2003

FINISH OF TEST

17th October 2003

TEST ENGINEERS

R Henley
M Larkin
J Holcombe

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 Intermec Technologies Inc BTM210 Bluetooth Module to the requirements of FCC Specification Part 15 – Modular Approval.

FCC ID EHA-BTM210

1.3 LOCATION OF TESTING

TUV Product Service Engineers, Jason Holcobe, Ryan Henley, Matthew Larkin, conducted all testing at the premises TUV Product Service, Segensworth Road, Fareham, Hampshire, PO15 5RH. Spurious Radiated Emissions measurements were performed in a 3 metre Anechoic Chamber. A complete site description is on file with the FCC Laboratory Division, Registration Number: 90987. See Annex A.

1.4 BRIEF SUMMARY OF RESULTS

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

Test	Spec Clause	Test Description	Result	Levels/Comments
2.1	FCC: Part 15.247(a)(1)	20dB Bandwidth	PASS	
2.2	FCC: Part 15.247(a)(iii)	Channel Dwell Time (DH1)	PASS	
2.3	FCC: Part 15.247(a)(iii)	Channel Dwell Time (DH3)	PASS	
2.4	FCC: Part 15.247(a)(iii)	Channel Dwell Time (DH5)	PASS	
2.5	FCC: Part 15.247(a)(1)	Channel Separation	PASS	
2.6	FCC: Part 15.247(a)(1)	Number of Hopping Channels	PASS	
2.7	FCC: Part 15.247(b)(1)	Maximum Peak Output Power	PASS	
2.8	FCC: Part 15.247(c)	Spurious Conducted Emissions	PASS	
2.9	FCC: Part 15.247(c)	Spurious Radiated Emissions	PASS	
2.10	FCC: Part 15.247(c)	Band Edge Measurements (Bottom Channel)	PASS	
2.11	FCC: Part 15.247(c)	Band Edge Measurements (Top Channel)	PASS	
2.12	FCC: Part 15.207	Spurious Conducted Emissions – Power Lines	PASS	
2.13	FCC: Part 15.247(b)(3)	Maximum Peak Power Output (EIRP Method)	PASS	

1.5 PRODUCT INFORMATION

1.5.1 Technical Description

The Equipment Under Test (EUT) was a BTM210 Bluetooth Radio, which offers 2.4GHz Wireless connectivity with other Bluetooth devices.

An Intermec Technologies 730 Handheld Computer Terminal was supplied as the host unit, this was used to control the EUT during test. The EUT was outside of the host unit during test.

Manufacturing Description:	Bluetooth Module
Manufacturer:	Intermec Technologies
Model No:	BTM210
Serial No:	0020E0935C9D

1.5.2 Modes of Operation

The test software in the EUT enabled selection of full power and continuous transmit on the following channels;

2.4GHz RLAN functionality

Channel 1: 2402MHz
Channel 6: 2441MHz
Channel 11: 2480MHz

The EUT was set at the Maximum Output Power during testing.



Photograph of EUT



1.6 DEVIATIONS FROM THE STANDARD

No deviations from the standard were made during testing.



1.7 MODIFICATION RECORD

No modifications were made to the test sample.



SECTION 2

TEST DETAILS

FCC Part 15C Testing in support of an Application for Grant of Equipment
Authorisation of an Intermec BTM210 Bluetooth Radio
FCC ID: EHA-BTM210



2.1 20dB BANDWIDTH

2.1.1 Specification Reference

FCC Part 15.247(a)(1)

2.1.2 Equipment Under Test

BTM210 Bluetooth Radio

2.1.3 Date of Test

17th October 2003

2.1.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 1, 4, 6

2.1.5 Test Procedure

Test Performed in accordance with 15.247.

The EUT was transmitted at maximum power at all data rates via a cable 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 –20dBc points of the displayed spectrum.

The measurement plots can be seen on the following pages.

Performed by: S Bennett, Radio Engineer.

2.1.6 Test Results

Frequency (MHz)	Data Rate	20dB Bandwidth (kHz)
2402	DH1	716.432865
2441	DH1	778.306613
2480	DH1	713.176352

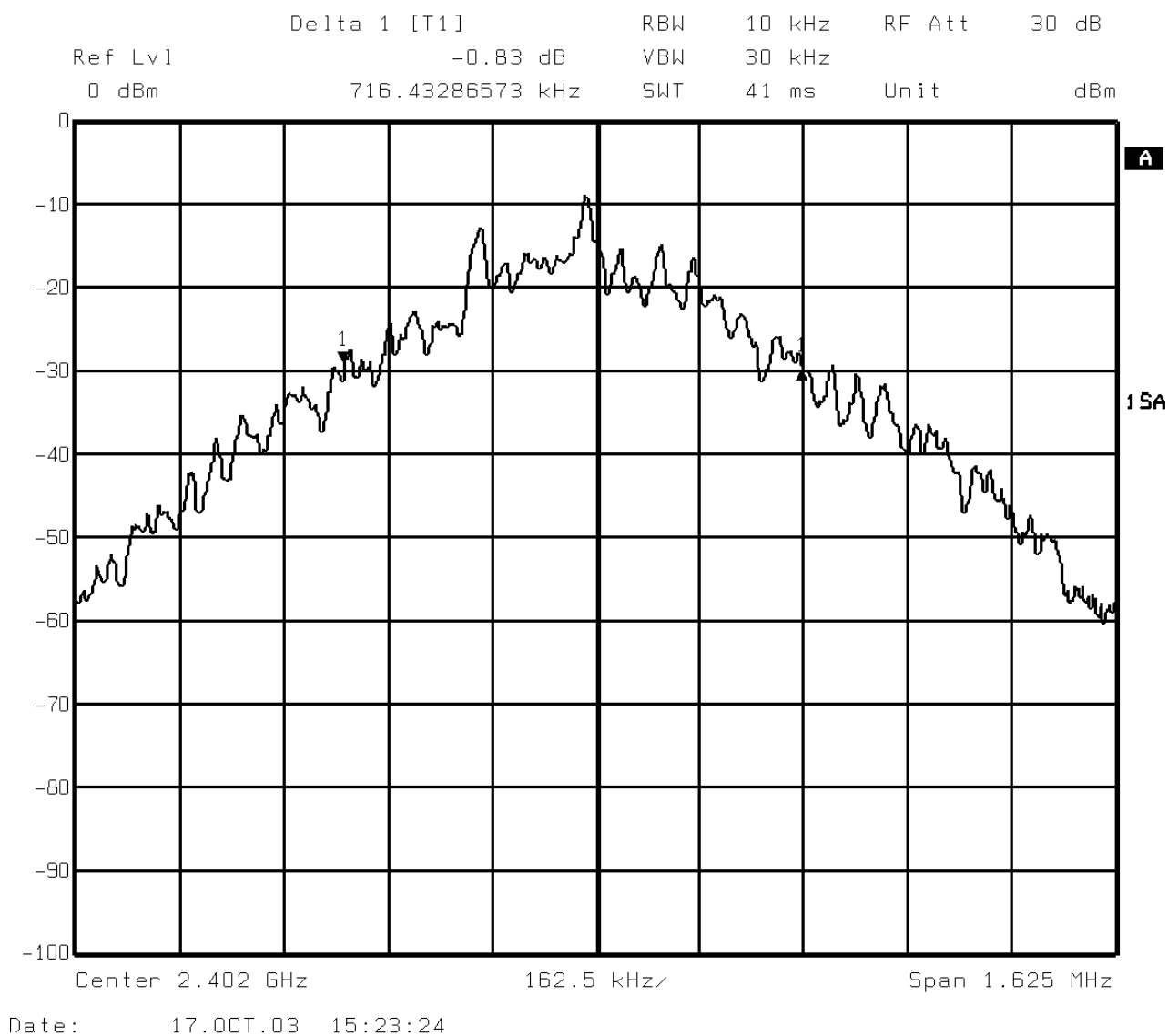
Frequency (MHz)	Data Rate	20dB Bandwidth (kHz)
2402	DH3	787.833667
2441	DH3	787.833667
2480	DH3	791.089178

Frequency (MHz)	Data Rate (Mbps)	20dB Bandwidth (kHz)
2402	DH5	792.006187
2441	DH5	792.006187
2480	DH5	792.006187



2.1.6 Test Results- Continued

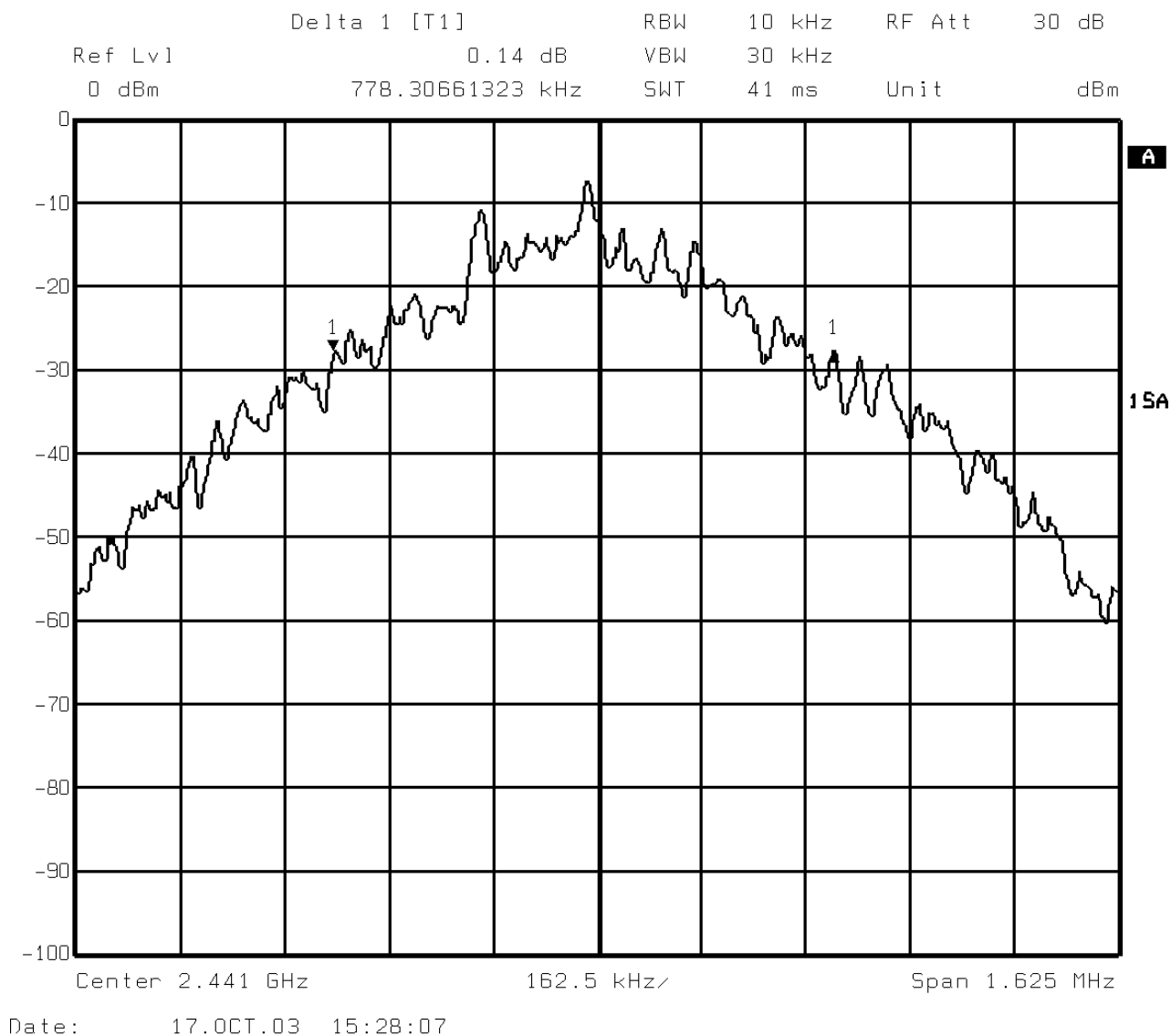
2402.0MHz – Maximum Power DH1





2.1.6 Test Results- Continued

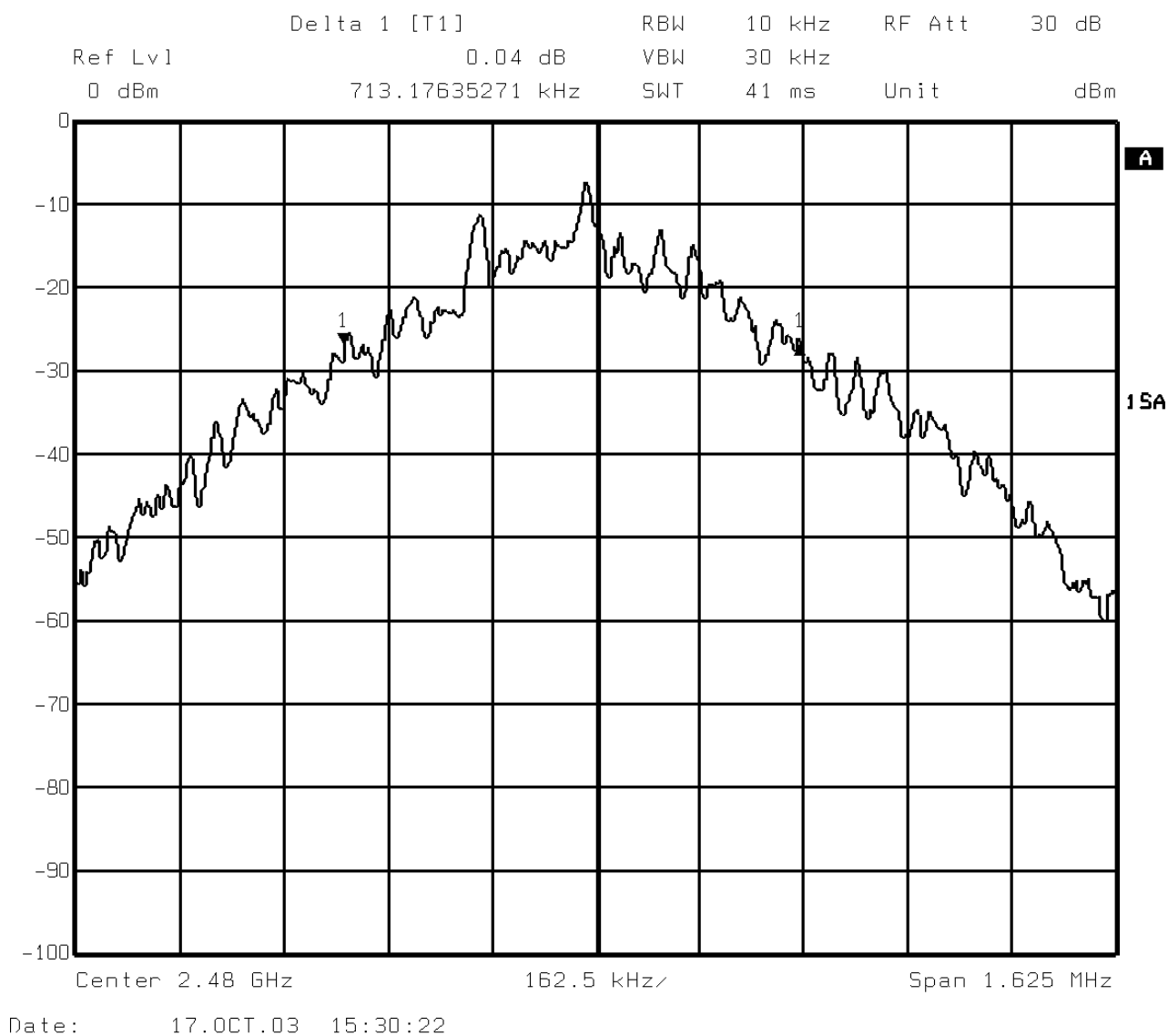
2441.0MHz – Maximum Power DH1





2.1.6 Test Results- Continued

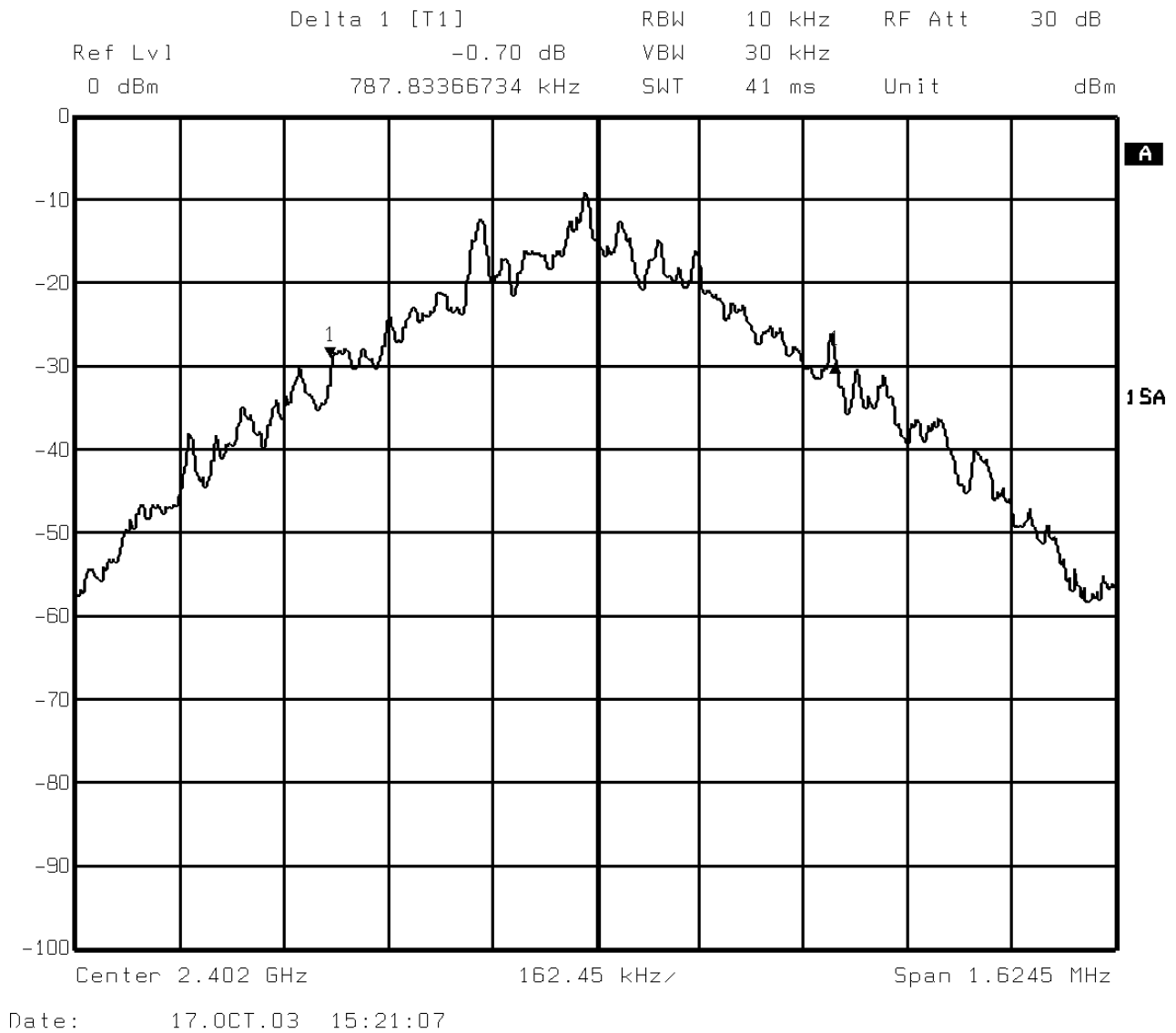
2480.0MHz – Maximum Power DH1





2.1.6 Test Results- Continued

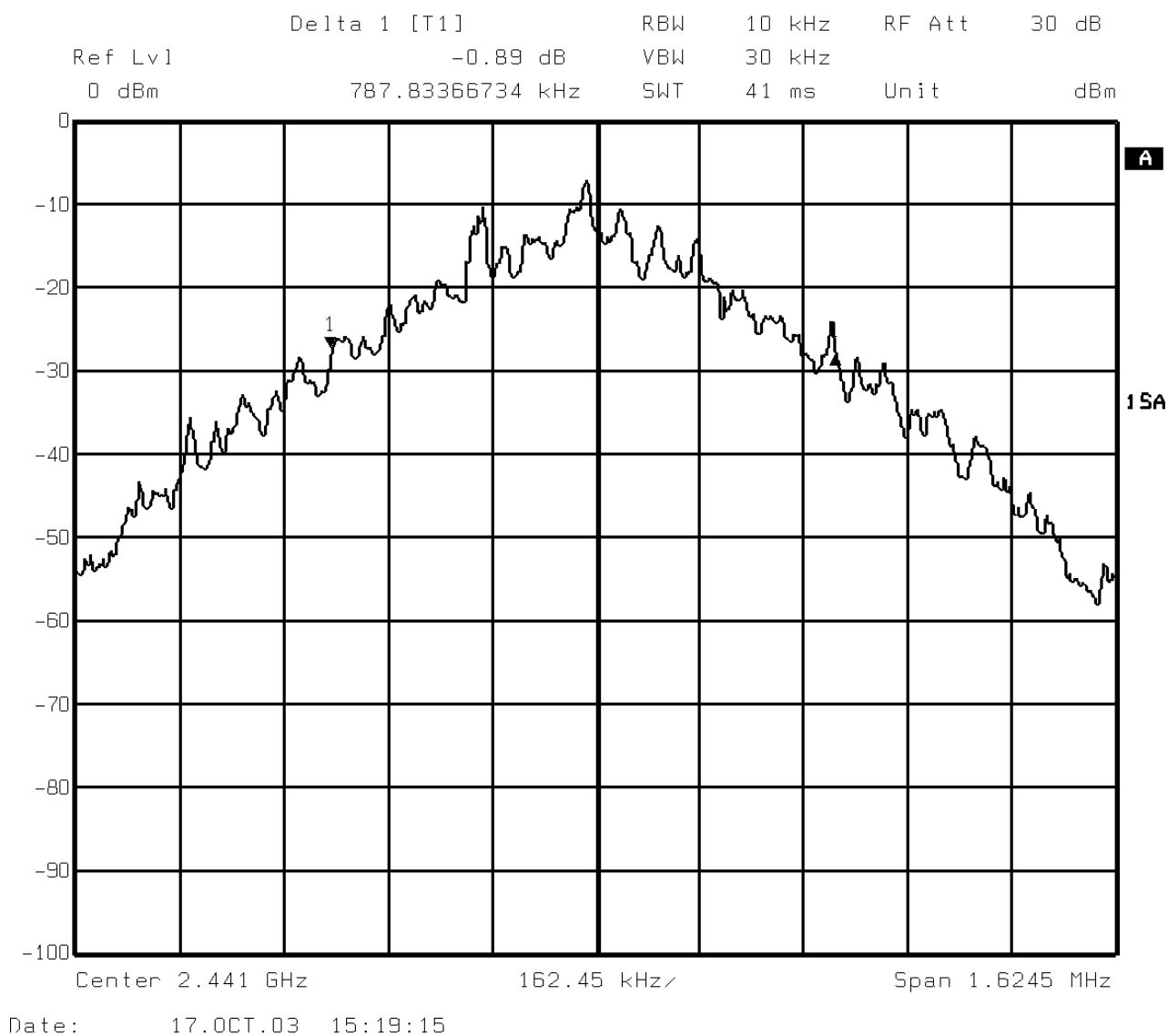
2402.0MHz – Maximum Power DH3





2.1.6 Test Results- Continued

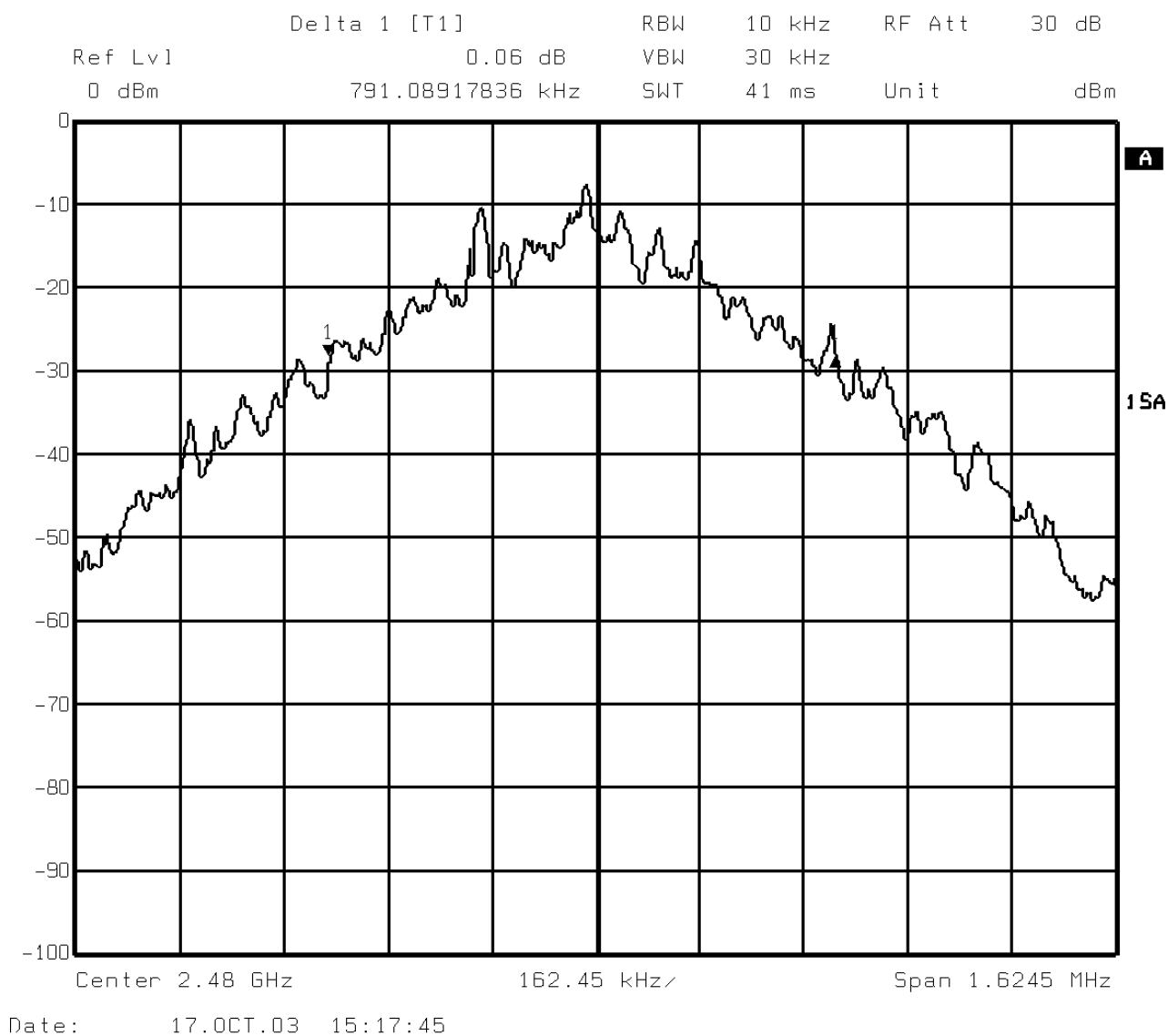
2441.0MHz – Maximum Power DH3





2.1.6 Test Results- Continued

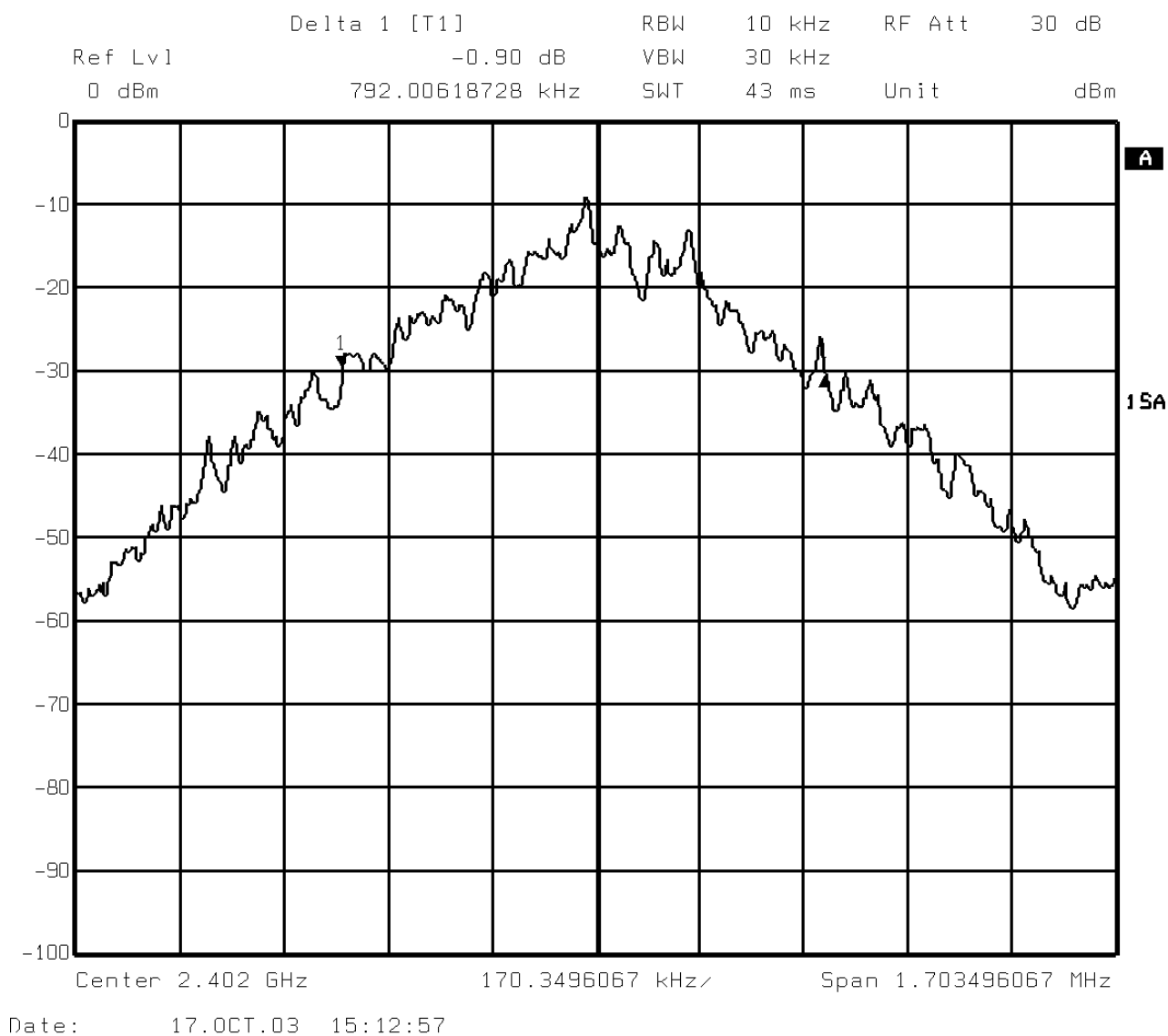
2480.0MHz – Maximum Power DH3





2.1.6 Test Results- Continued

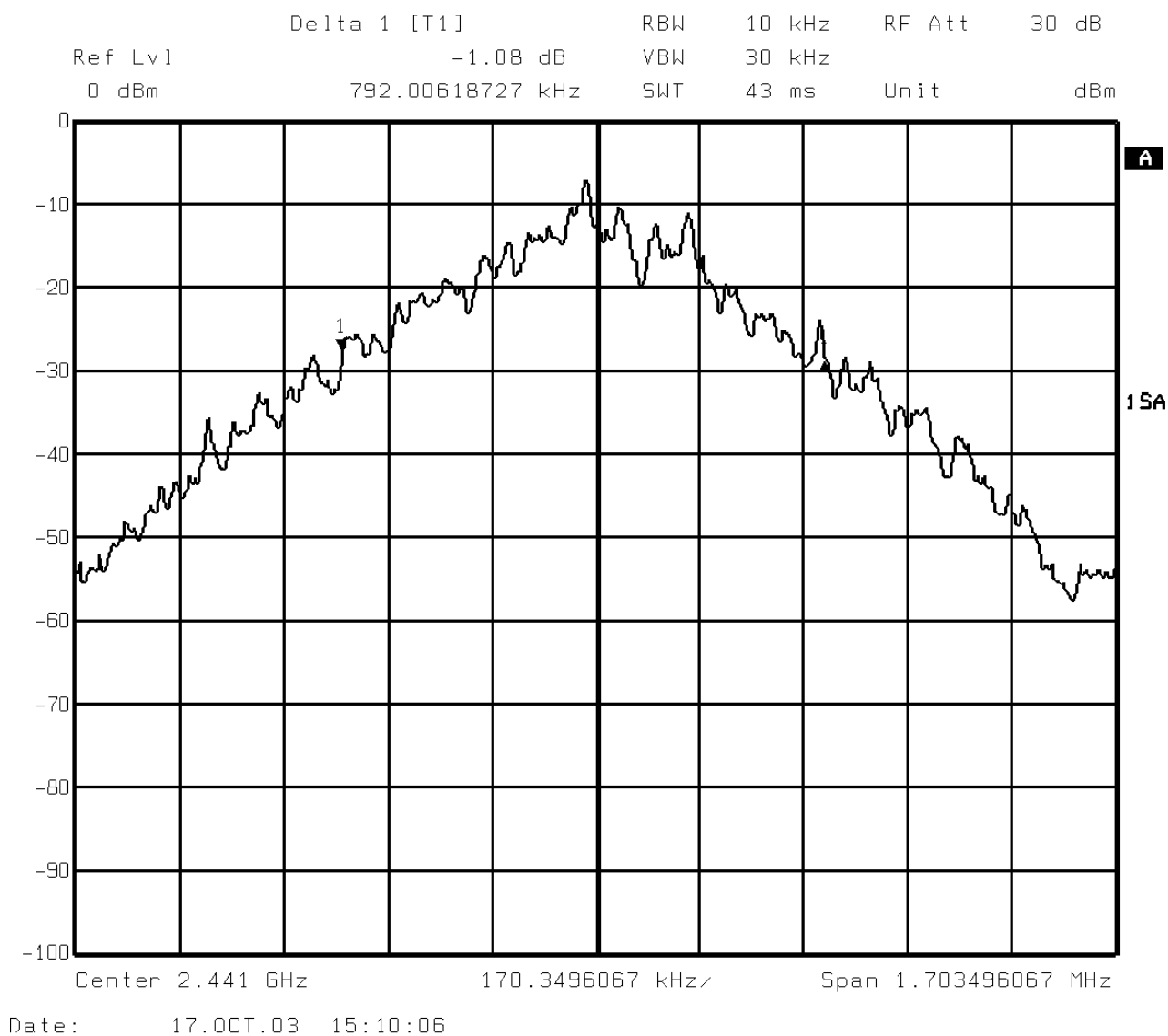
2402.0MHz – Maximum Power DH5





2.1.6 Test Results- Continued

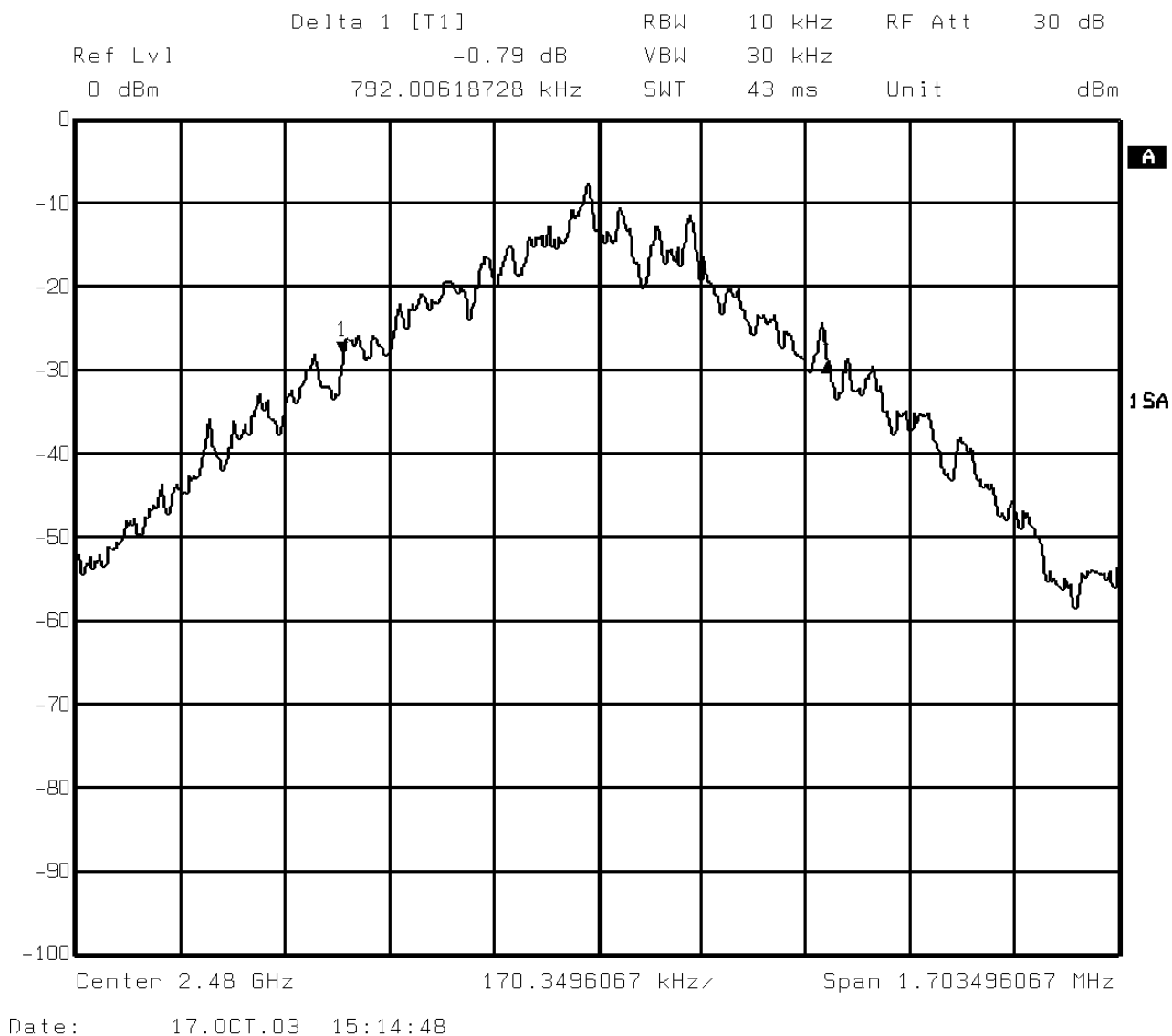
2441.0MHz – Maximum Power DH5





2.1.6 Test Results- Continued

2480.0MHz – Maximum Power DH5





2.2 CHANNEL DWELL TIME (DH1)

2.2.1 Specification Reference

FCC Part 15.247(a)(iii)

2.2.2 Equipment Under Test

BTM210 Bluetooth Radio

2.2.3 Date of Test

16th October 2003

2.2.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 1, 4, 6

2.2.5 Test Procedure

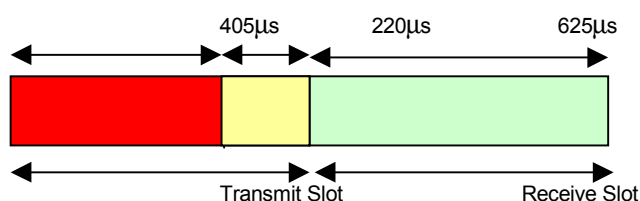
Procedure: Test Performed in accordance with 15.247.

The Bluetooth system hops at a rate of 1600 times per second. Thus, this equates to 1600 timeslots in 1 second. The DH1 data rate operates on a Transmit on 1 timeslot and Receive on 1 timeslot basis. Thus, in 1 second, there are 800 Transmit timeslots and 800 Receive Timeslots.

Thus:

$$1 \text{ Timeslot} = \frac{1}{1600} = 625\mu\text{s}$$

In 1 transmit timeslot, the transmit on time is only 405 μ s. 220 μ s is reserved as off time for the synthesizer to re-tune ready for the next transmit frequency. The following timeslot is a receive slot. This process continues assuming the data rate remains the same.



DH1 Timeslot Arrangement Showing One Complete Transmit and Receive Cycle

So, with 800 Tx and 800 Rx timeslots, the transmitter is on for $800 \times 405\mu\text{s} = 0.324$ seconds.

$$\therefore \frac{\text{Total Tx Time On}}{\text{No Of Channels}} = \frac{0.324}{79} = 4.10\text{ms}$$

So, in 32 seconds, the transmitter dwell time per channel is:

$$32 \times 4.10\text{ms} = 0.1312 \text{ seconds}$$



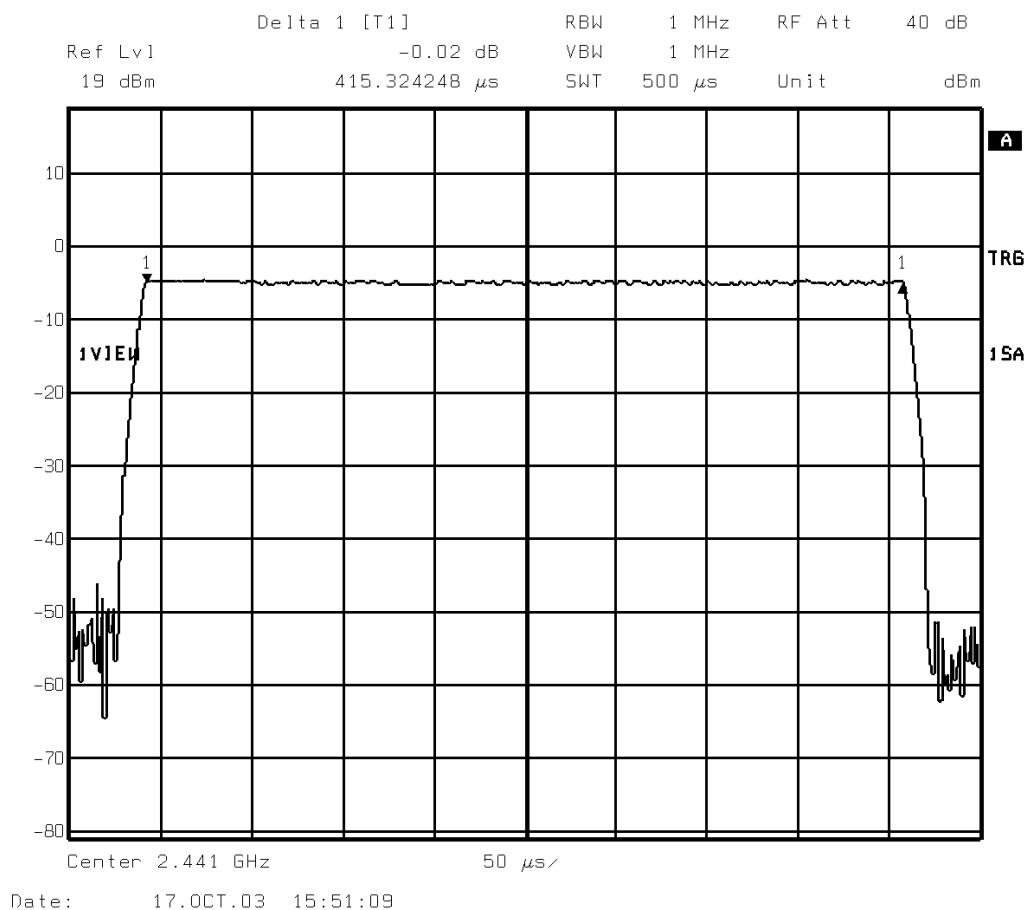
2.2.5 Test Procedure_ - Continued

Remarks

Thus, the transmitter dwell time for data rate DH1 is meets the requirements specified in 15.247(a)(iii)

Performed by: S Bennett, Radio Engineer.

2.2.6 Test Results



Plot Showing DH1 Timeslot



2.3 CHANNEL DWELL TIME (DH3)

2.3.1 Specification Reference

FCC Part 15.247(a)(iii)

2.3.2 Equipment Under Test

BTM210 Bluetooth Radio

2.3.3 Date of Test

16th October 2003

2.3.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 1, 4, 6

2.3.5 Test Procedure

Test Performed in accordance with 15.247.

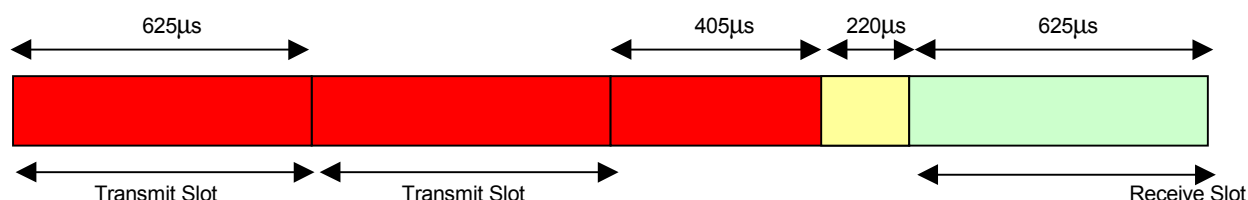
The Bluetooth system hops at a rate of 1600 times per second. Thus, this equates to 1600 timeslots in 1 second. With data rate DH3, the data payload is higher and can use up to 3 timeslots. When more than one timeslot is used, the frequency does not hop and transmission is continuous on all 3 slots, (ie. no receive slot in-between the 3 transmit slots). The 220 μ s off time for synthesizer re-tuning at the end of a slot is only used on the final slot. Thus, for one cycle, there are 3 transmit timeslots. 2 are 625 μ s long and the final slot is transmitting for 405 μ s.

The DH3 data rate operates on a Transmit on 3 timeslots and Receives on 1 timeslot basis, (assuming maximum data payload). The frequency-hopping rate is the same. Thus, in 1 second, there are 1200 Transmit timeslots and 400 Receive Timeslots.

Thus:

$$1 \text{ Timeslot} = \frac{1}{1600} = 625\mu\text{s}$$

The first 2 Transmit timeslots are transmitting for the complete 625 μ s. In the third transmit slot, the transmit on time is only 405 μ s. 220 μ s is reserved as off time for the synthesizer to re-tune ready for the next transmit frequency. The following timeslot is a receive slot. This process continues assuming the data rate remains the same.



DH3 Timeslot Arrangement Showing One Complete Transmit and Receive Cycle.
(Maximum Payload)



2.3.5 Test Procedure – Continued

Thus, the transmitter for one complete transmit and receive cycle would be on for:

$$\text{Tx} \quad (2 \times 625\mu\text{s}) + (1 \times 405\mu\text{s}) = 1.655\text{ms}$$

So:

$$\begin{aligned} 800 \times 625\mu\text{s} &= 0.5 \text{ seconds} \\ 400 \times 405\mu\text{s} &= 0.162 \text{ seconds} \end{aligned}$$

Thus: $0.5 + 0.162 = 0.662 \text{ seconds}$

$$\therefore \frac{\text{Total Tx Time On}}{\text{No Of Channels}} = \frac{0.662}{79} = 8.380\text{ms}$$

So, in 32 seconds, the transmitter dwell time per channel is:

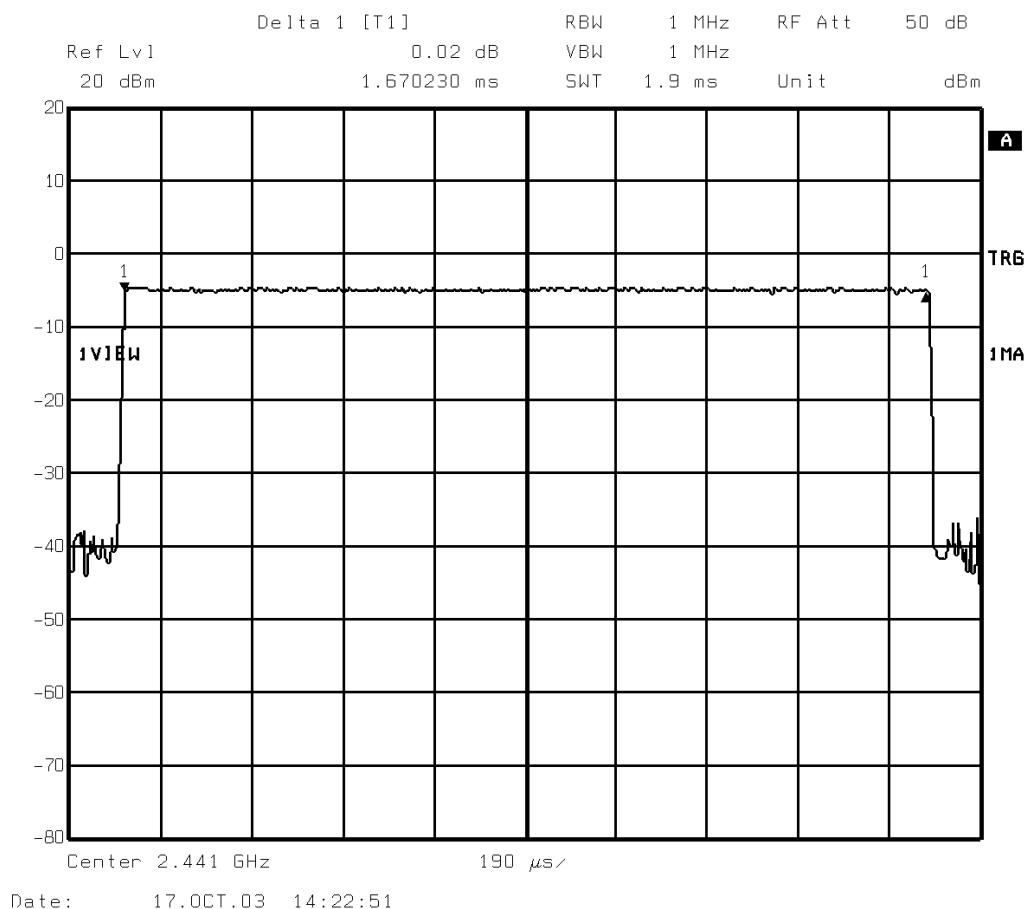
$$32 \times 8.380\text{ms} = 0.2682 \text{ seconds}$$

Remarks

Thus, the transmitter dwell time for data rate DH3 meets the requirements specified in 15.247(a)(iii)

Performed by: S Bennett, Radio Engineer.

2.3.6 Test Results



Plot Showing DH3 Timeslot



2.4 CHANNEL DWELL TIME (DH5)

2.4.1 Specification Reference

FCC Part 15.247(a)(iii)

2.4.2 Equipment Under Test

BTM210 Bluetooth Radio

2.4.3 Date of Test

16th October 2003

2.4.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 1, 4, 6

2.4.5 Test Procedure

Test Performed in accordance with 15.247.

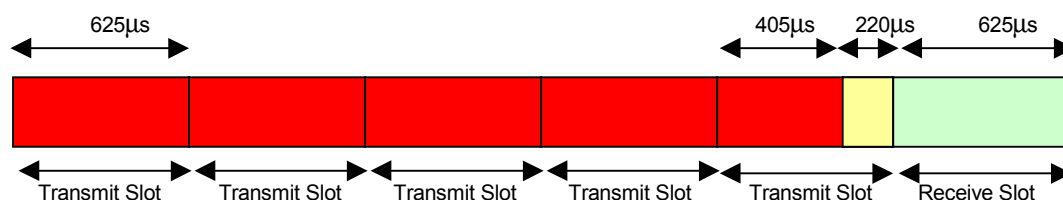
The Bluetooth system hops at a rate of 1600 times per second. Thus, this equates to 1600 timeslots in 1 second. With data rate DH5, the data payload is higher and can use up to 5 timeslots. When more than one timeslot is used, the frequency does not hop and transmission is continuous on all 5 slots, (ie. no receive slot in-between the 5 transmit slots). The 220µs off time for synthesizer re-tuning at the end of a slot is only used on the final slot. Thus, for one cycle, there are 5 transmit timeslots. 4 are 625µs long and the final slot is transmitting for 405µs.

The DH5 data rate operates on a Transmit on 5 timeslots and Receives on 1 timeslot basis, (assuming maximum data payload). The frequency-hopping rate is the same. Thus, in 1 second, there are 1333.3 Transmit timeslots and 266.7 Receive Timeslots.

Thus:

$$1 \text{ Timeslot} = \frac{1}{1600} = 625\mu\text{s}$$

The first 4 Transmit timeslots are transmitting for the complete 625µs. In the fifth transmit slot, the transmit on time is only 405µs. 220µs is reserved as off time for the synthesizer to re-tune ready for the next transmit frequency. The following timeslot is a receive slot. This process continues assuming the data rate remains the same.



DH5 Timeslot Arrangement Showing One Complete Transmit and Receive Cycle.
(Maximum Payload)



2.4.5 Test Procedure - Continued

Thus, the transmitter for one complete transmit and receive cycle would be on for:

$$\text{Tx} \quad (2 \times 625\mu\text{s}) + (1 \times 405\mu\text{s}) = 2.905\text{ms}$$

So:

$$1066.7 \times 625\mu\text{s} = 0.666 \text{ seconds}$$

$$266.7 \times 405\mu\text{s} = 0.108 \text{ seconds}$$

$$\text{Thus:} \quad 0.666 + 0.108 = 0.774 \text{ seconds}$$

$$\therefore \frac{\text{Total Tx Time On}}{\text{No Of Channels}} = \frac{0.774}{79} = 9.797\text{ms}$$

So, in 32 seconds, the transmitter dwell time per channel is:

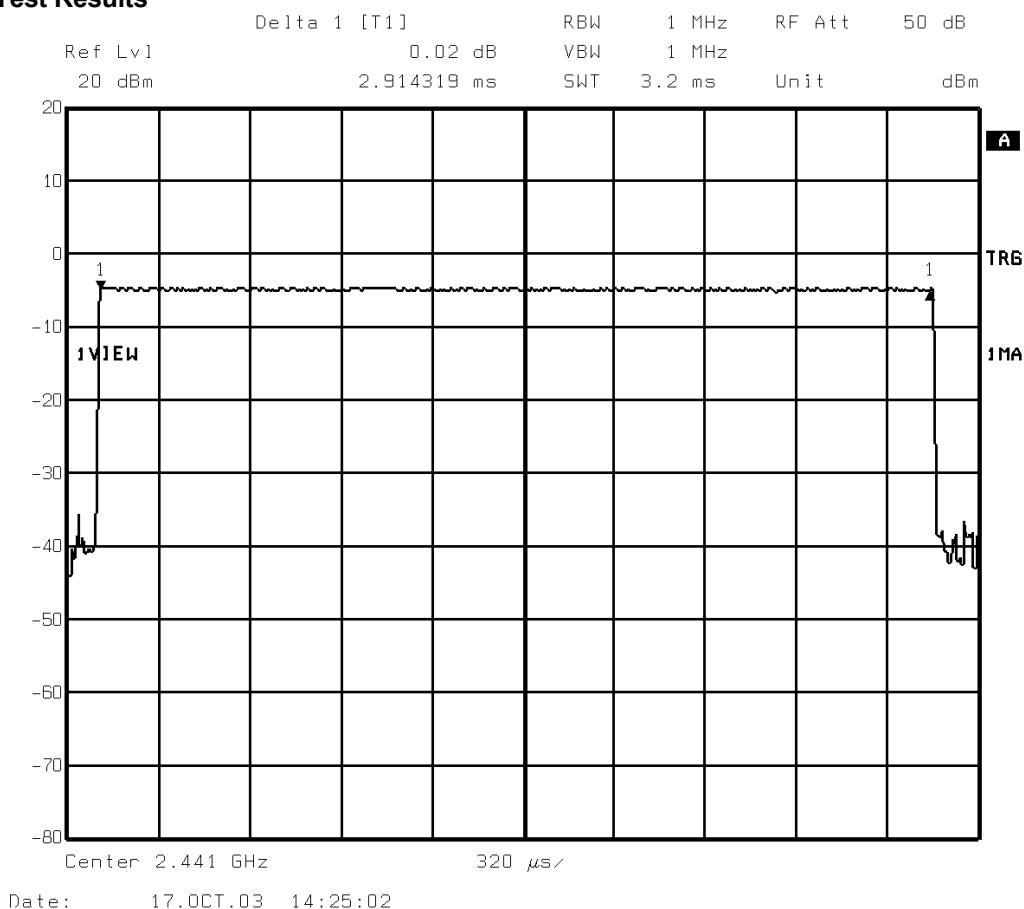
$$32 \times 9.797\text{ms} = 0.31 \text{ seconds}$$

Remarks

Thus, the transmitter dwell time for data rate DH5 meets the requirements specified in 15.247(a)(iii)

Performed by: S Bennett, Radio Engineer.

2.4.6 Test Results



Plot Showing DH5 Timeslot



2.5 CHANNEL SEPARATION

2.5.1 Specification Reference

FCC Part 15.247(a)(1)

2.5.2 Equipment Under Test

BTM210 Bluetooth Radio

2.5.3 Date of Test

9th October 2003

2.5.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

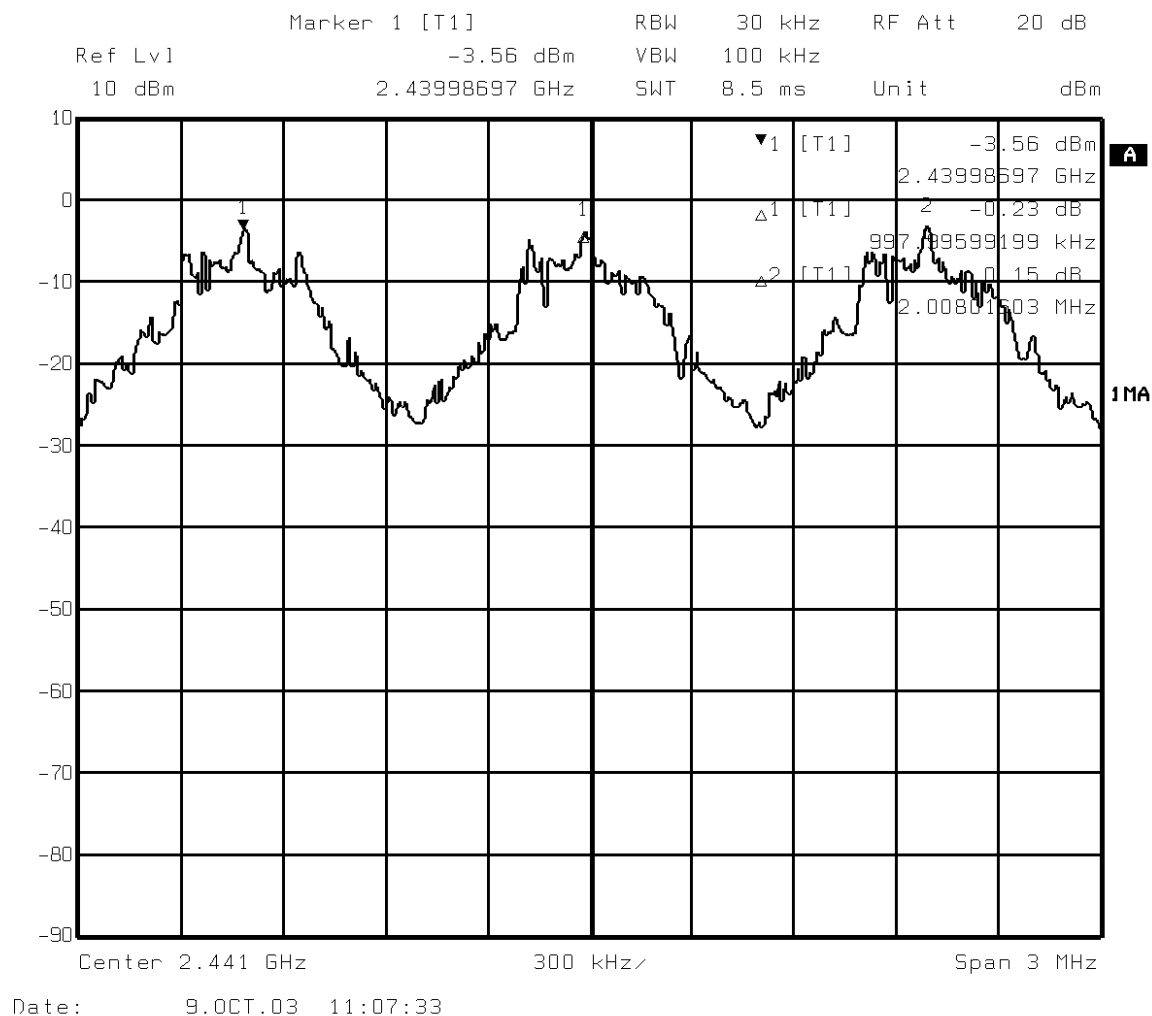
Items: 1, 5, 6

2.5.5 Test Procedure

The EUT was transmitted at maximum power into a Spectrum Analyser. The trace was set to Max Hold to store several adjacent channels on screen. Using the marker delta function, the markers were positioned to show the separation between adjacent channels.



2.5.6 Test Result



The system channel separation is specified as being 1MHz. The measured channel separation from the plot above is: 997.995991kHz.

Limit	>25kHz or 20dB Bandwidth (whichever is Greater)
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Remarks

The equipment met the requirements outlined in 15.247(a)(1).



2.6 NUMBER OF HOPPING CHANNELS

2.6.1 Specification Reference

FCC Part 15.247(a)(1)

2.6.2 Equipment Under Test

BTM210 Bluetooth Radio

2.6.3 Date of Test

9th October 2003

2.6.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 1, 4, 6

2.6.5 Test Procedure

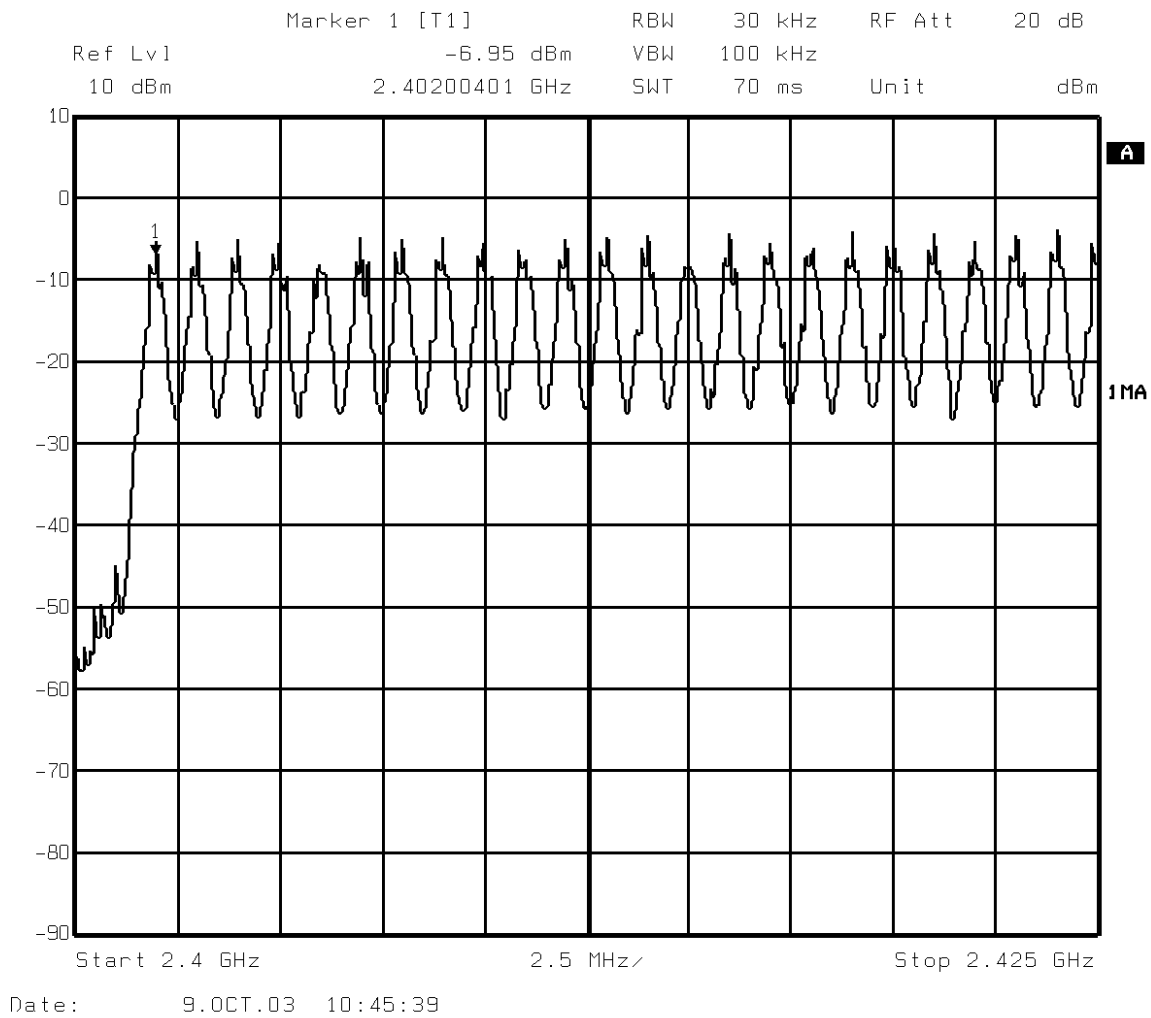
Test Performed in accordance with 15.247.

The EUT was connected to a Spectrum Analyser via a cable. The EUT was set to transmit on maximum power and hopping on all channels. The span was adjusted to show the individual channels. To reasonably display the number of channels, the occupied band was split into four traces. The display trace was set to Max Hold and the plots recorded.

Performed by: R Henley, Radio Engineer.



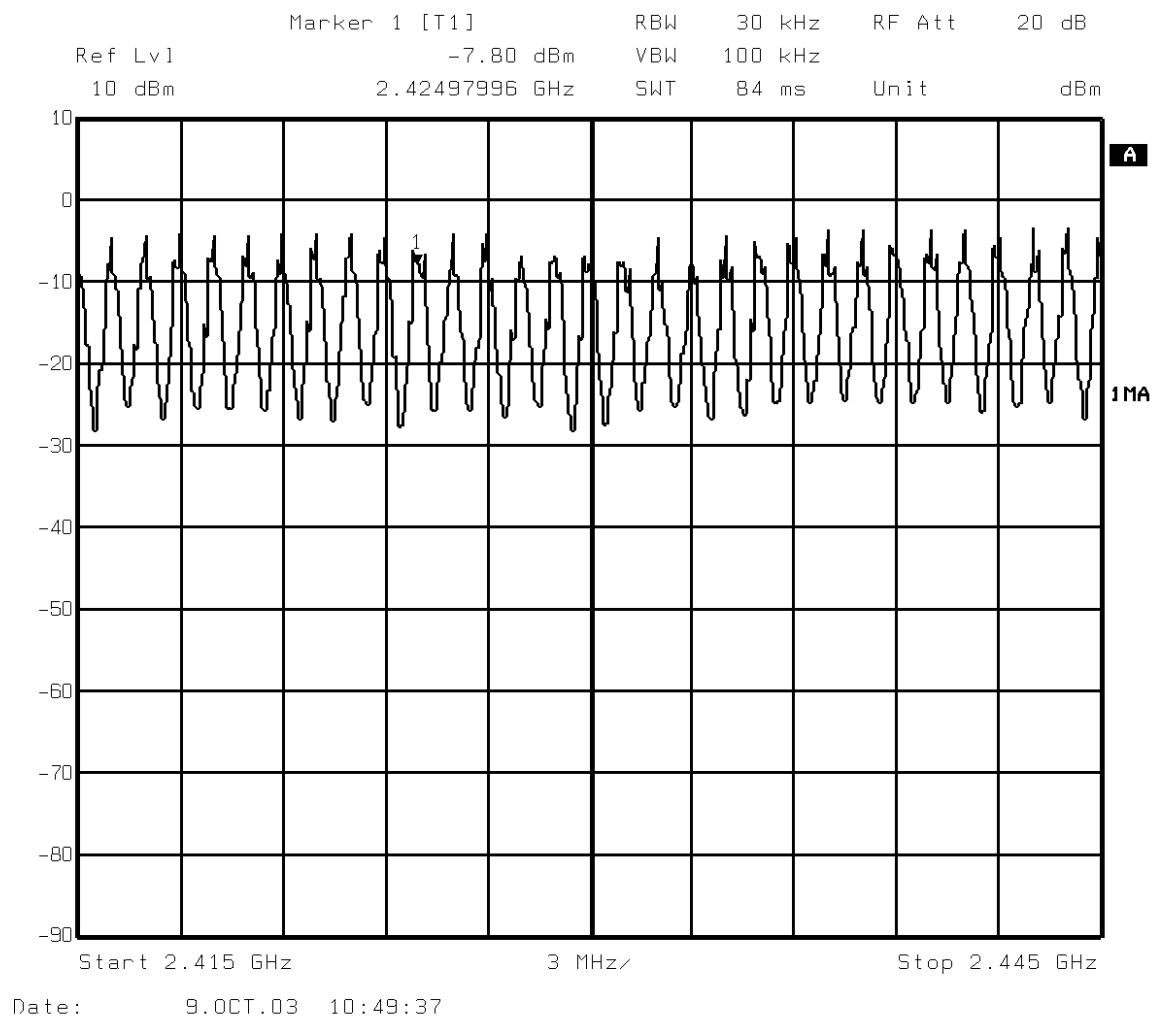
2.6.6 Test Results



Trace Showing Channels 1 - 23



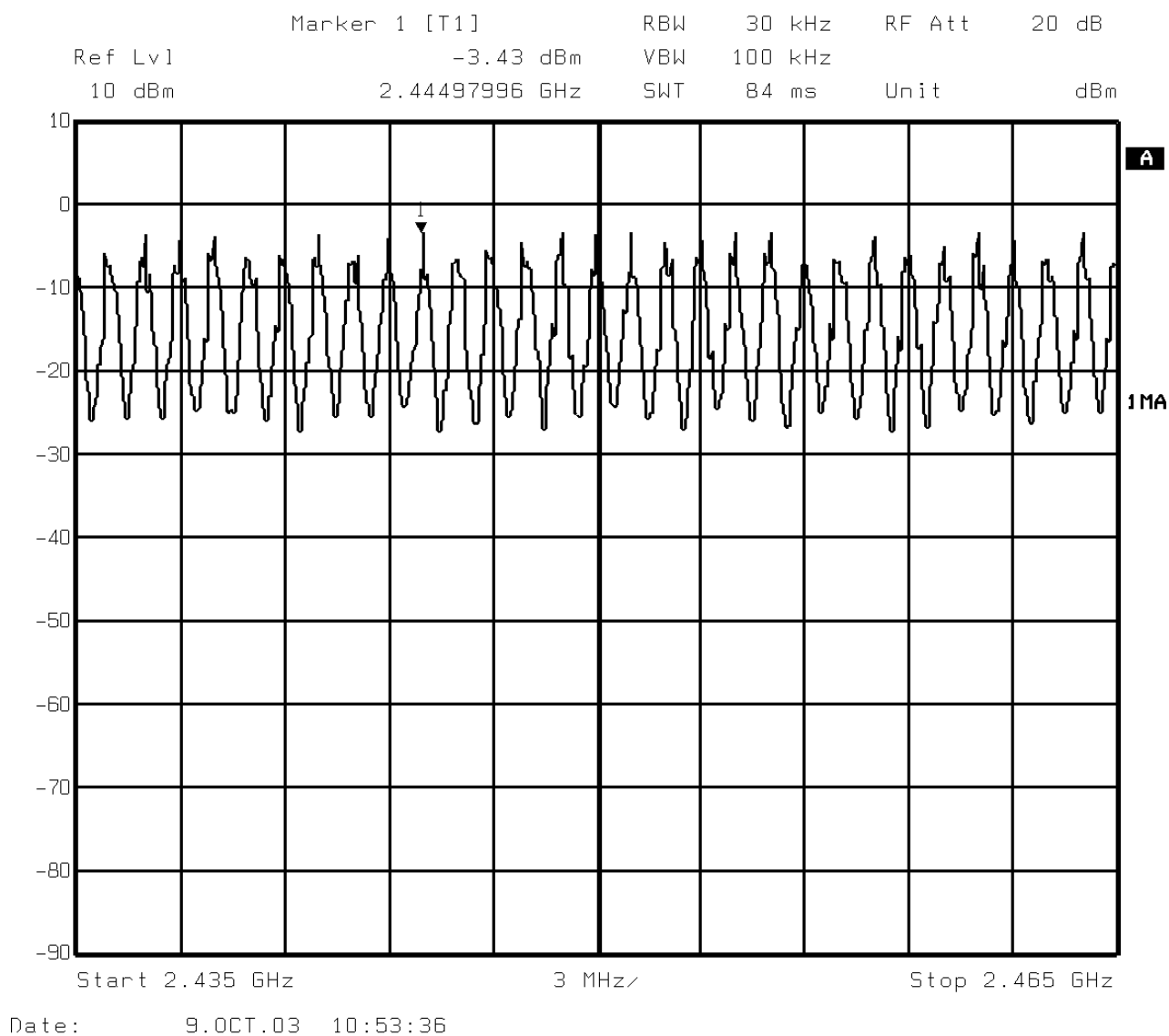
2.6.6 Test Results - Continued



Trace Showing Channels 24 - 43



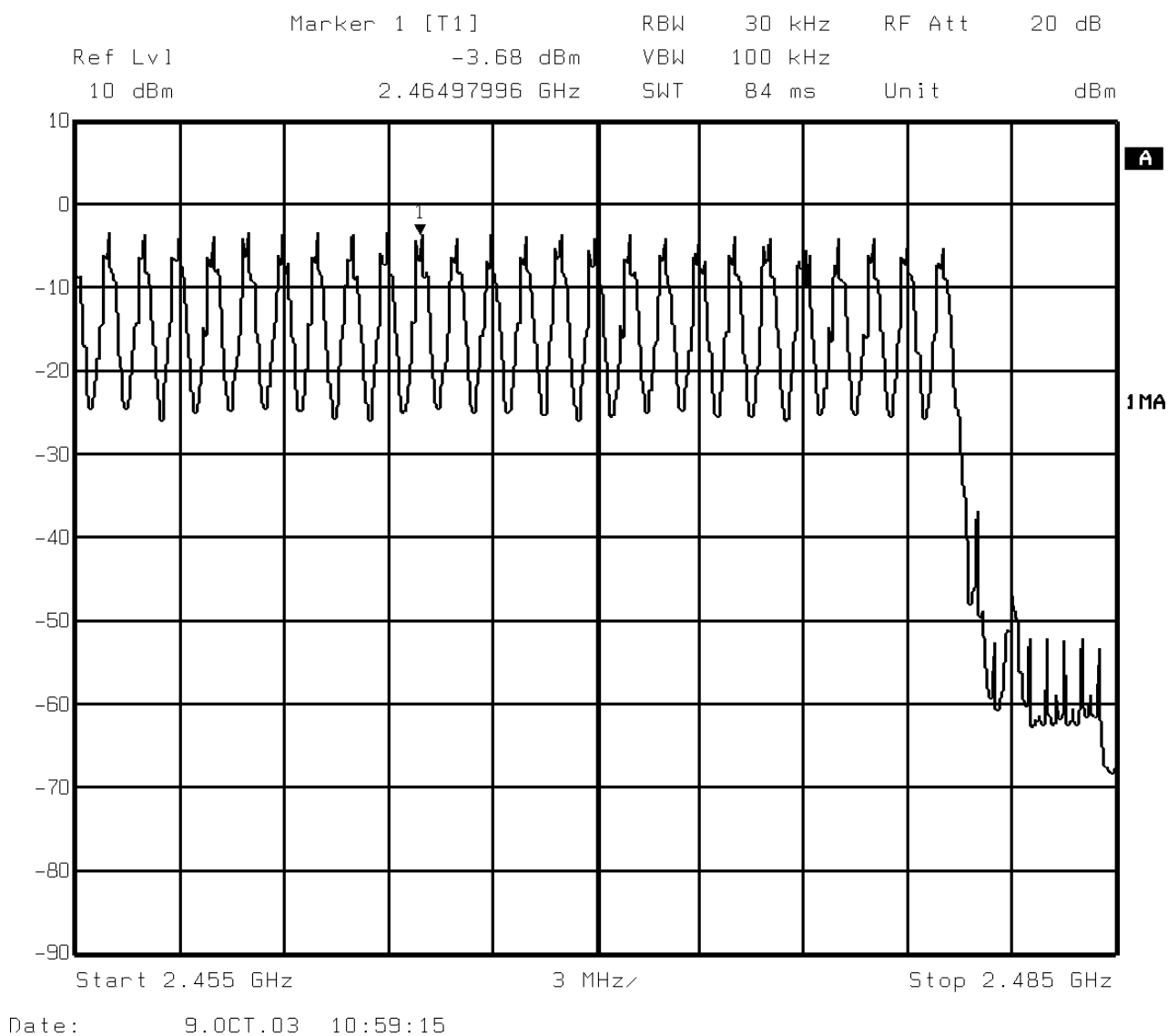
2.6.6 Test Results - Continued



Trace Showing Channels 44 - 63



2.6.6 Test Results - Continued



Trace Showing Channels 64 – 79

Limit	≥75 channels
-------	--------------

Remarks

EUT complies with CFR 47 15.247(a)(1)(iii). The EUT utilises more than 75 channels.



2.7 MAXIMUM PEAK OUTPUT POWER

2.7.1 Specification Reference

FCC Part 15.247(b)(1)

2.7.2 Equipment Under Test

BTM210 Bluetooth Radio

2.7.3 Date of Test

9th October 2003

2.7.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 2, 3, 5, 6

2.7.5 Test Procedure

Test Performed in accordance with 15.247.

The EUT was connected to a Peak Power Analyser, (8990A), via an RF cable. Using a Signal Generator and the 8990A, the path loss of the cable was measured and entered as an offset adjustment into the 8990A. The peak level was recorded and compared with the test limits.

Performed by: R Henley, Radio Engineer.

2.7.6 Test Results

DH1

Frequency (MHz)	Path Loss (dB)	Output Power (dBm)	Result (mW)
2402.0	0.47	-4.57	0.349
2441.0	0.61	-2.53	0.558
2480.0	0.51	-3.15	0.484

DH3

Frequency (MHz)	Path Loss (dB)	Output Power (dBm)	Result (mW)
2402.0	1.3	-5.20	0.302
2441.0	1.2	-3.63	0.434
2480.0	1.2	-3.80	0.417



2.7.6 Test Results - Continued

DH5

Frequency (MHz)	Path Loss (dB)	Output Power (dBm)	Result (mW)
2402.0	1.3	-5.03	0.314
2441.0	1.2	-3.47	0.450
2480.0	1.2	-3.63	0.434

Limit	<1W or <+30dBm
-------	----------------

Remarks

EUT complies with CFR 47 15.247(b)(1). The EUT does not exceed 1W or +30dBm at the measured frequencies.



2.8 SPURIOUS CONDUCTED EMISSIONS

2.8.1 Specification Reference

FCC Part 15.247(c)

2.8.2 Equipment Under Test

BTM210 Bluetooth Radio

2.8.3 Date of Test

15th October 2003

2.8.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 1, 4, 6

2.8.5 Test Procedure

In accordance with Part 15.247(c), the 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 25 GHz. The EUT was set to transmit on full power and frequency hopping on all channels. The resolution and video bandwidths were set to 100kHz in accordance with Part 15.247. The spectrum analyser detector was set to Max Hold.

With the EUT transmitting at maximum power, the Spectrum Analyser was set to Max Hold and the fundamental peak measured in a RBW and VBW of 100kHz. This level was used to determine the limit line as displayed on the plots of -20dBc.

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

Remarks

The EUT passed the requirements laid out in 15.247(c).

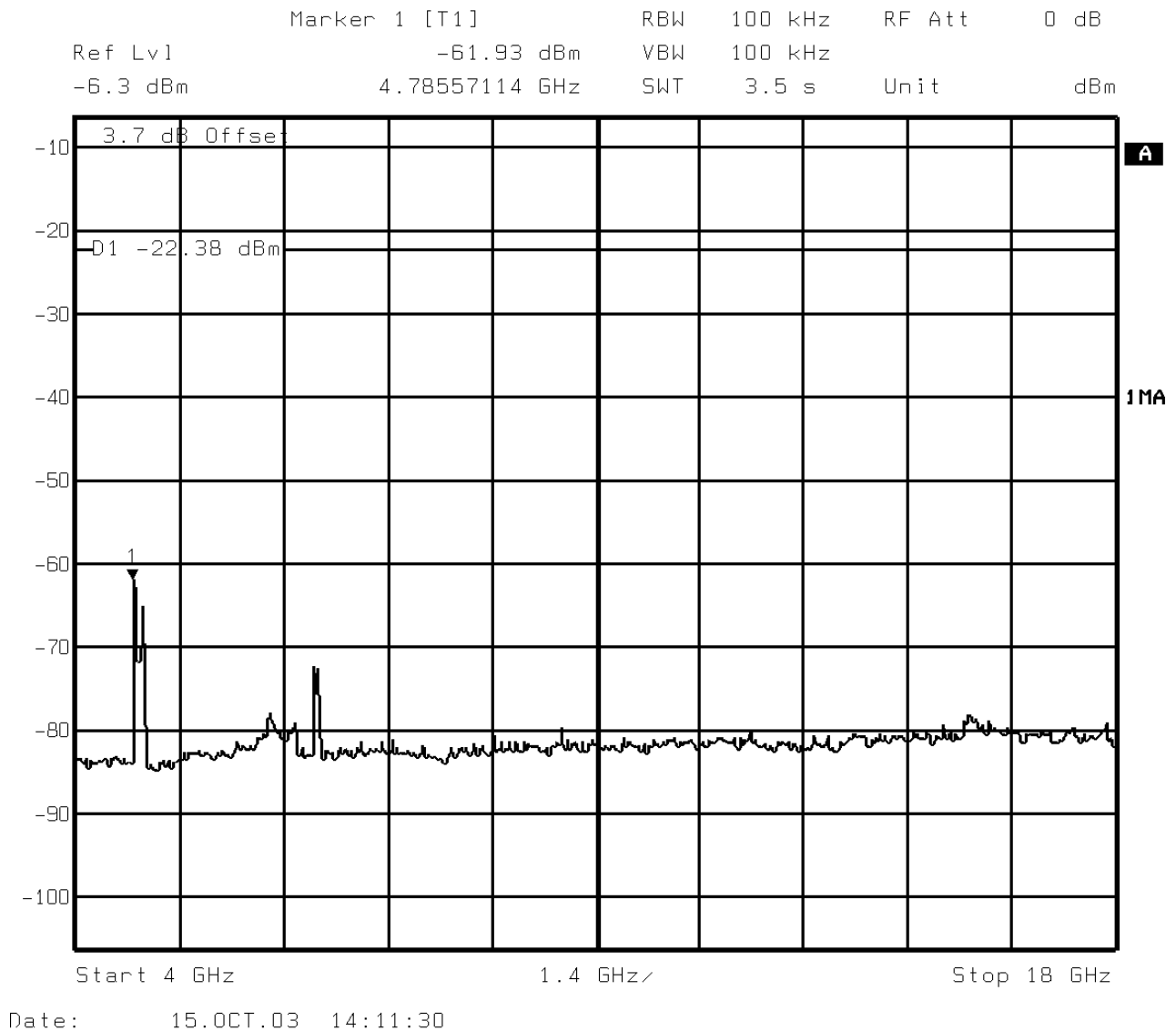
The plots on the following pages show the frequency spectrum from 9kHz to 25GHz of the EUT.



2.8.6 Test Results - Continued

Spurious Conducted Emissions (4GHz – 18GHz)

Frequency Hopping On All Channels – Maximum Power DH1

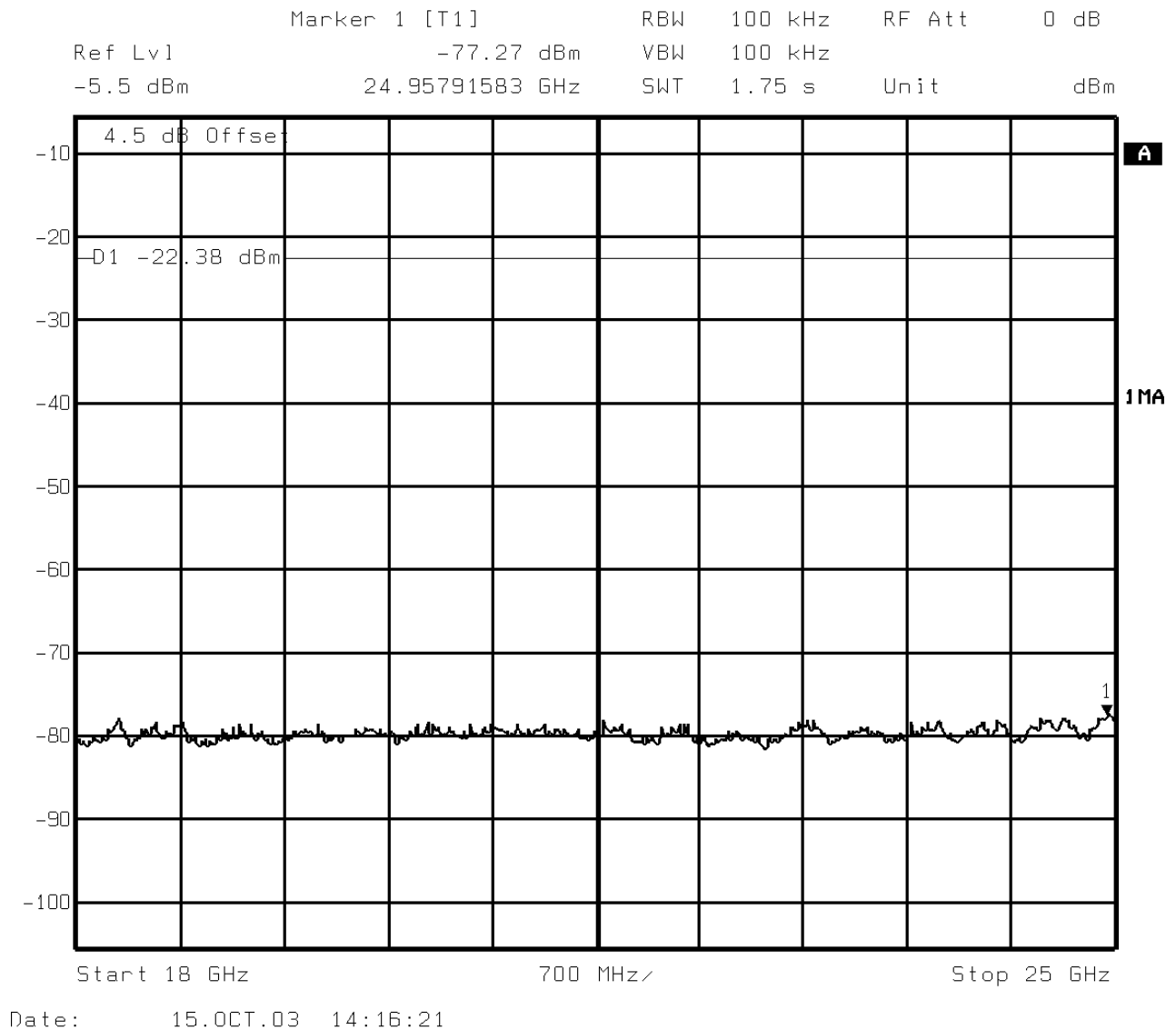




2.8.6 Test Results - Continued

Spurious Conducted Emissions (18GHz – 25GHz)

Frequency Hopping On All Channels – Maximum Power DH1

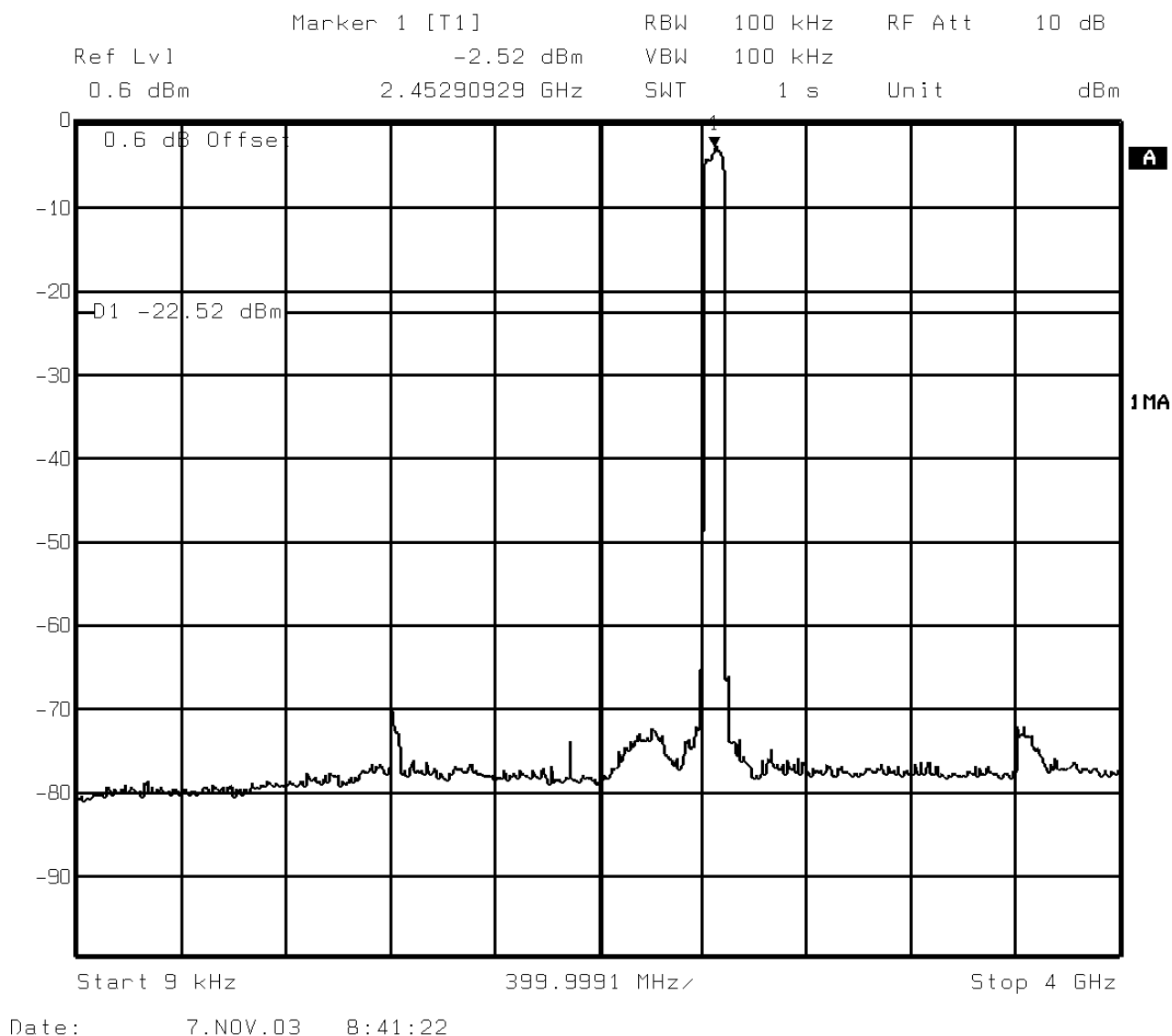




2.8.6 Test Results - Continued

Spurious Conducted Emissions (9kHz – 4GHz)

Frequency Hopping On All Channels – Maximum Power DH3

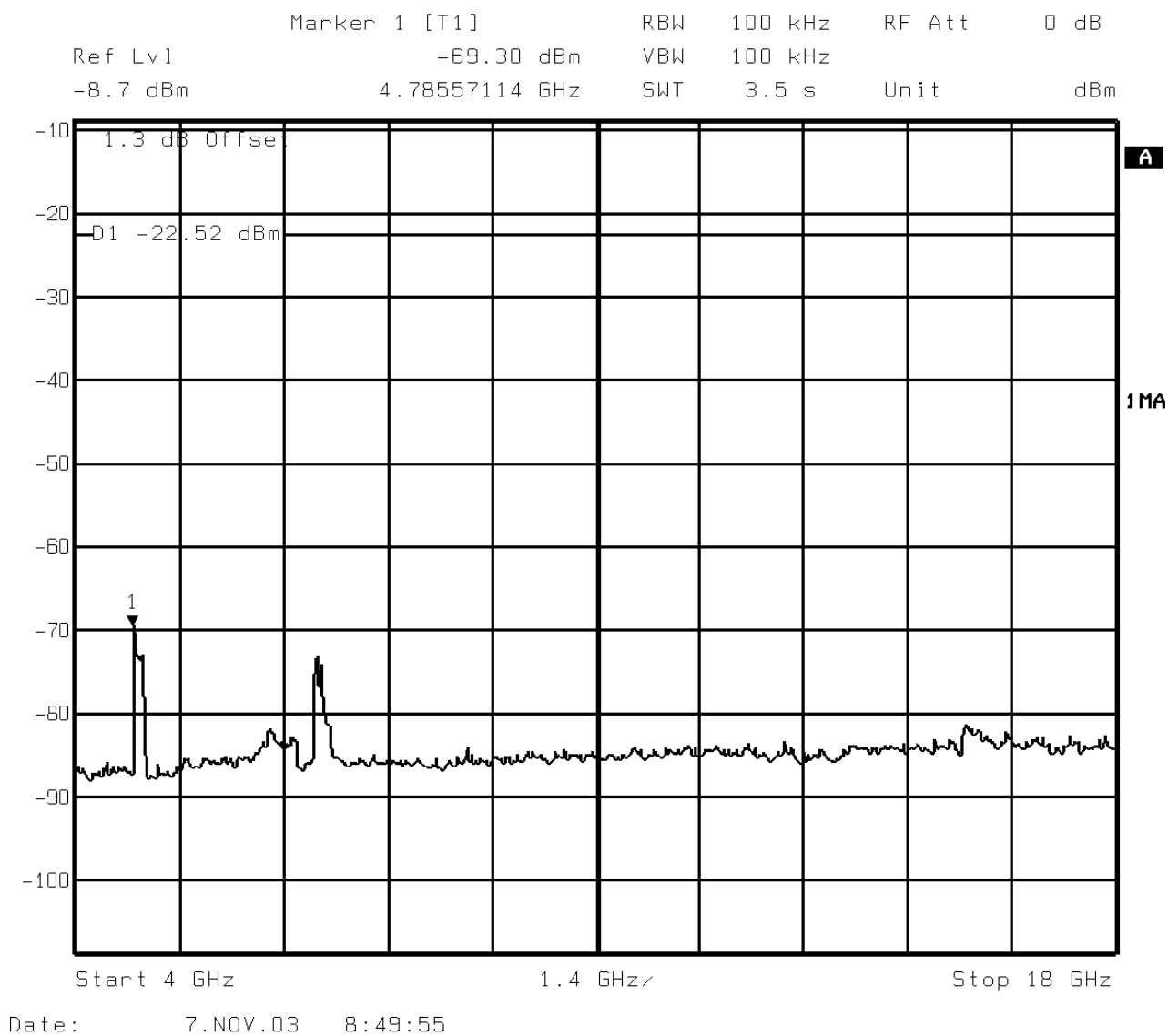




2.8.6 Test Results - Continued

Spurious Conducted Emissions (4GHz – 18GHz)

Frequency Hopping On All Channels – Maximum Power DH3

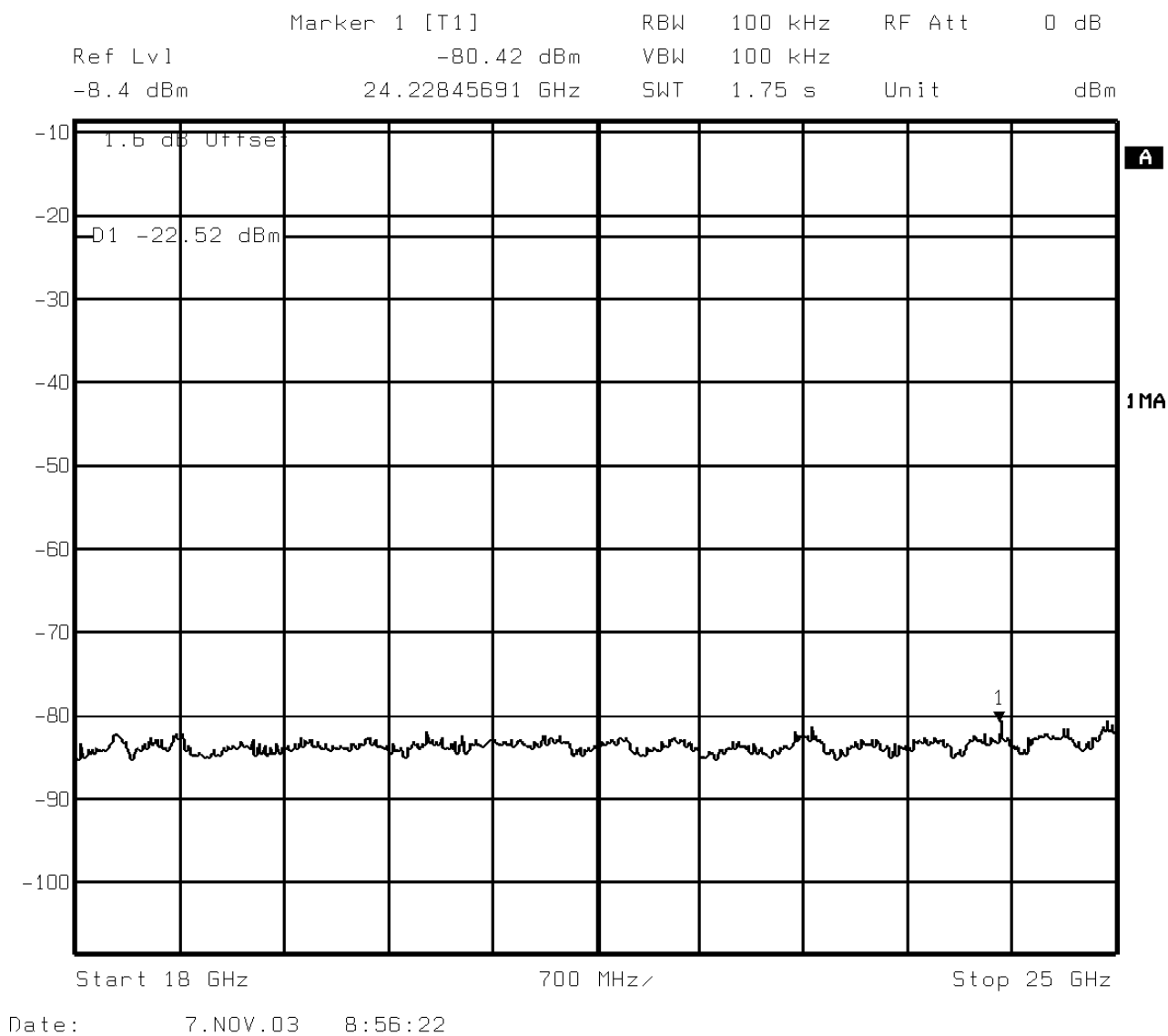




2.8.6 Test Results - Continued

Spurious Conducted Emissions (18GHz – 25GHz)

Frequency Hopping On All Channels – Maximum Power DH3

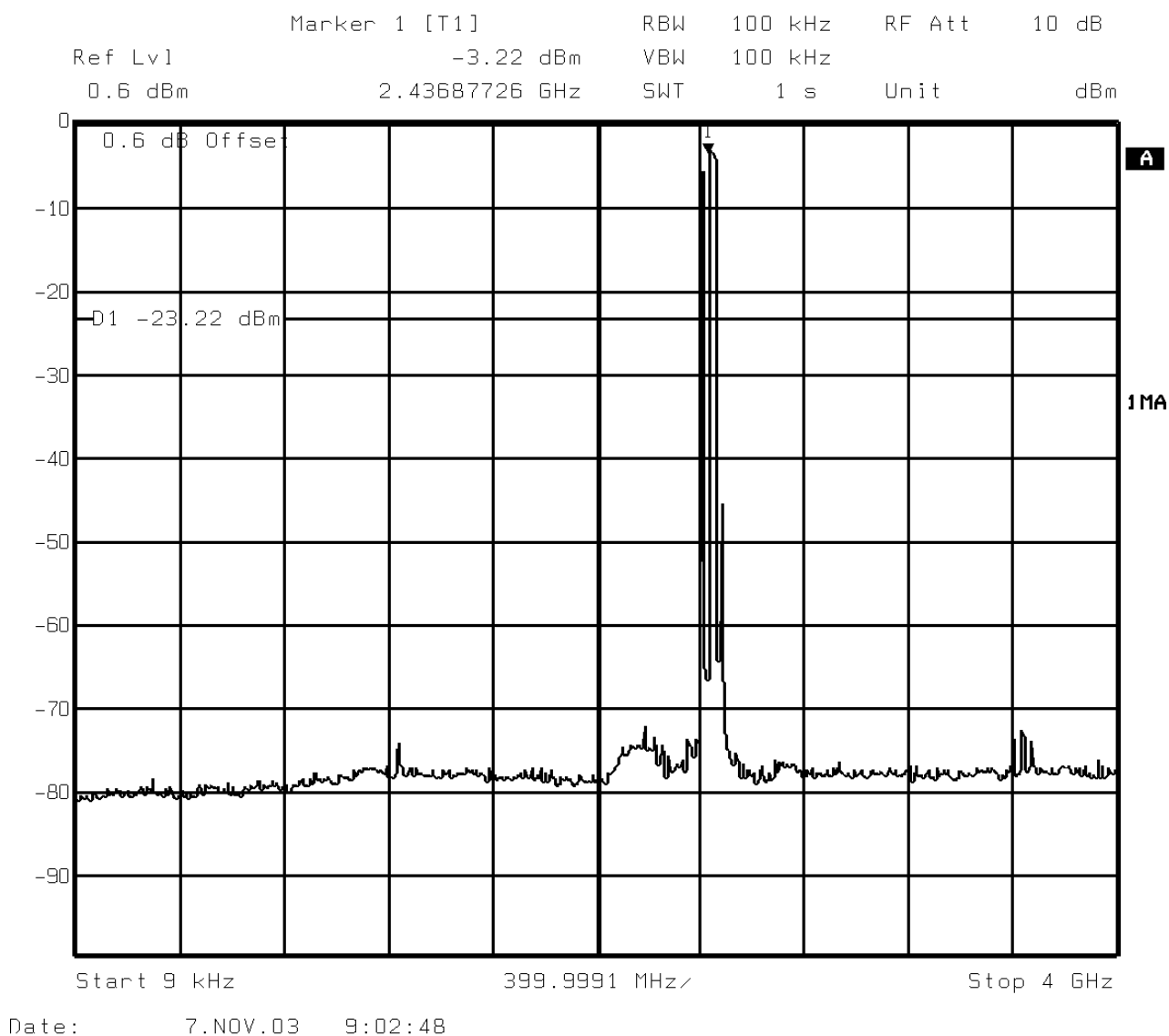




2.8.6 Test Results - Continued

Spurious Conducted Emissions (9kHz – 4GHz)

Frequency Hopping On All Channels – Maximum Power DH5

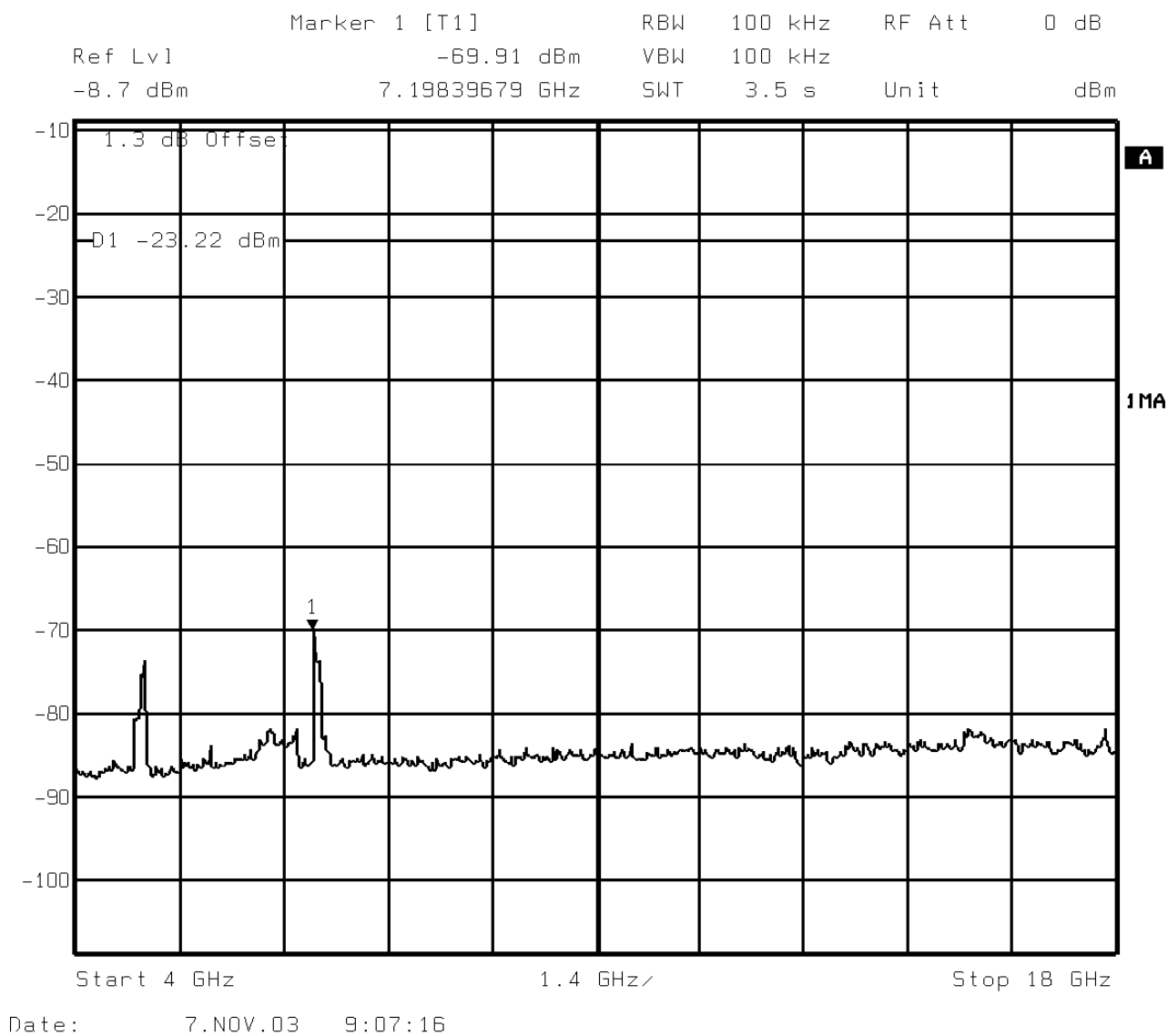




2.8.6 Test Results - Continued

Spurious Conducted Emissions (4GHz – 18GHz)

Frequency Hopping On All Channels – Maximum Power DH5

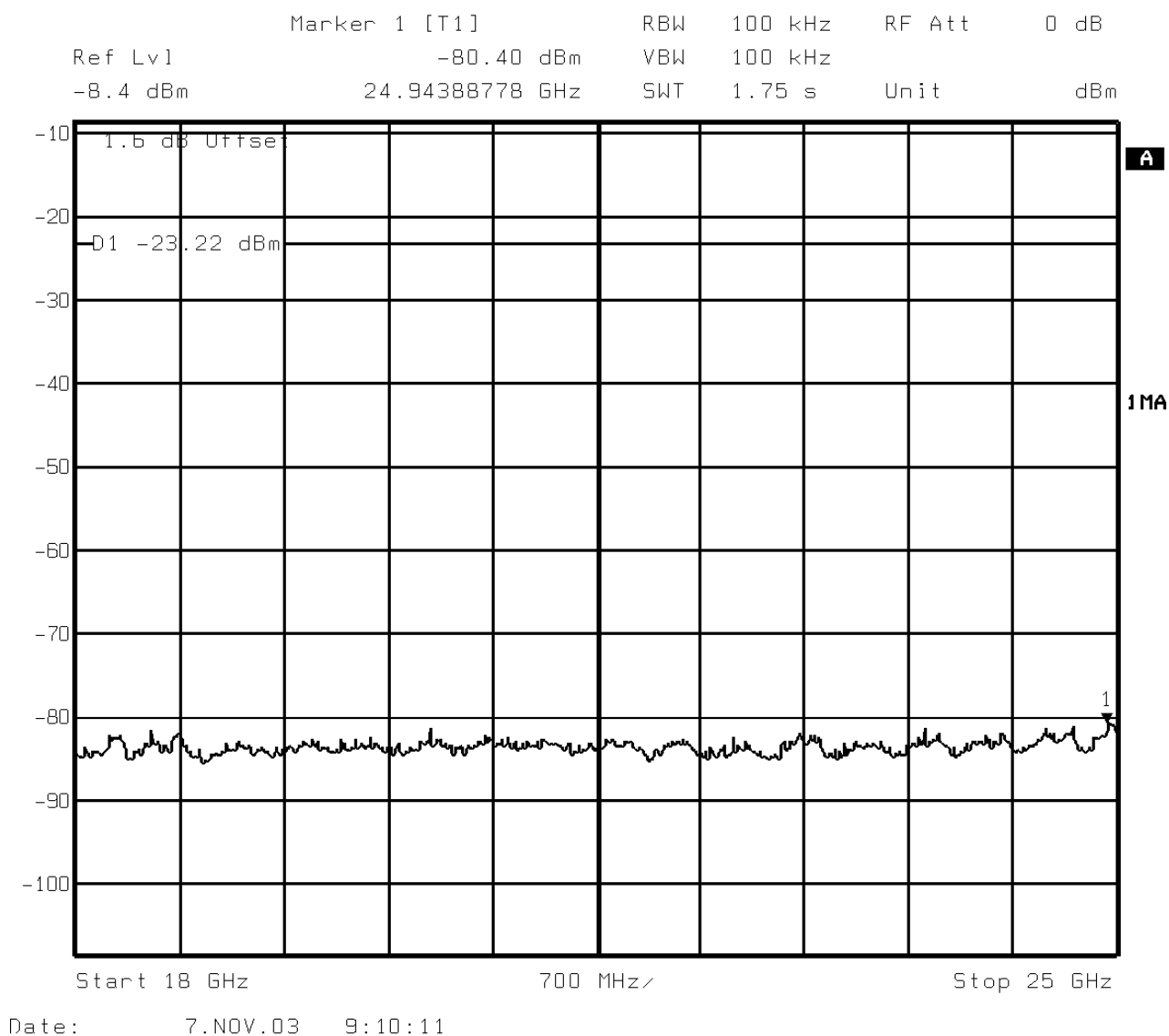




2.8.6 Test Results - Continued

Spurious Conducted Emissions (18GHz – 25GHz)

Frequency Hopping On All Channels – Maximum Power DH5



2.9 SPURIOUS RADIATED EMISSIONS

2.9.1 Specification Reference

FCC Part 15.247(c)

2.9.2 Equipment Under Test

BTM210 Bluetooth Radio



Photograph of EUT during Radiated Emissions Test



2.9.3 Date of Test

30th September to 1st October 2003

2.9.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22
--

2.9.5 Test Procedure

Testing to the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(c), for Radiated Electric Field 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 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 using a CISPR Quasi-Peak detector.
1GHz – 25GHz 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 EUT was operating via the internal power supply of the Host.

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

Channel 1: 2402 MHz
Channel 6: 2441 MHz
Channel 11: 2480 MHz

Spurious Radiated Emissions from 30MHz to 1GHz were made using a Rhode & Schwarz ESVP Receiver and performed on an Open Area Test Site.

Spurious Radiated Emissions from 1GHz to 25GHz were made using a Rhode and Schwarz ESIB 40 Test Receiver and performed on an Alternative Open Area Test Site.

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

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

Equipment Designation: Intentional Radiator.

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

Performed by M Larkin, EMC Engineer.



2.9.6 Test Results

Measurement of radiated carrier field strength on top, middle and bottom channels are detailed in the table below.

Freq MHz	Res BW kHz	Vid BW kHz	Ant Pol V/H	Ant Hgt cm	EUT Arc Deg	Raw PEAK dBμV	Cable loss dB	Antenna Factor dB	Result Peak dBμV/m
2402	200	200	V	119	176	55.7	28.8	4.2	88.70
2441	200	200	V	119	220	59.37	28.8	4.2	92.37
2480	200	200	V	142	212	60.5	28.8	4.2	85.10

EUT Tx on Bottom Channel (2402MHz)

30MHz – 1GHz Test Site Results: The levels of the six 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	dBμV/m	μV/m	dBμV/m	μV/m
280.6	V	100	170	41.4	117.5	46.0	199.5
334.1	V	100	085	43.1	142.9	46.0	199.5
497.7	V	100	260	40.0	100.0	46.0	199.5
668.2	H	100	189	42.5	133.4	46.0	199.5
735.0	V	100	150	40.5	105.9	46.0	199.5
801.8	V	100	180	39.9	98.9	46.0	199.5

EUT Tx on Middle Channel (2441MHz)

30MHz – 1GHz Test Site Results: The levels of the six 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	dBμV/m	μV/m	dBμV/m	μV/m
280.6	V	100	000	34.4	52.9	46.0	199.5
334.1	H	123	116	43.5	149.6	46.0	199.5
497.7	V	100	279	40.1	101.2	46.0	199.5
534.6	V	100	105	39.4	93.3	46.0	199.5
601.4	V	100	065	36.9	70.0	46.0	199.5
668.2	H	100	200	41.7	121.6	46.0	199.5



2.9.6 Test Results - Continued

EUT Tx on Top Channel (2480MHz)

30MHz – 1GHz Test Site Results: The levels of the six 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	dBµV/m	µV/m	dBµV/m	µV/m
267.3	V	100	054	43.3	146.2	46.0	199.5
280.6	V	100	284	42.9	139.6	46.0	199.5
334.1	H	100	100	41.1	113.5	46.0	199.5
497.7	V	100	031	41.7	121.6	46.0	199.5
668.2	H	100	130	41.5	118.9	46.0	199.5
735.0	V	100	138	42.8	138.0	46.0	199.5

ABBREVIATIONS FOR ABOVE TABLES

H Horizontal Polarisation
Pol Polarisation
deg degree

V Vertical Polarisation
Hgt Height
Azm Azimuth



2.9.6 Test Results - Continued

EUT Tx on Bottom Channel (2402MHz)

1GHz – 25GHz Test Site Results: The levels of the highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average Filed Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	Cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
1.002	V	100	146	46.7	74.0	38.1	54.0
1.336	V	100	176	48.6	74.0	38.9	54.0
1.403	V	100	168	46.4	74.0	37.1	54.0
4.803	H	131	156	52.5	74.0	48.1	54.0

EUT Tx on Middle Channel (2441MHz)

1GHz – 25GHz Test Site Results: The levels of the highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average Filed Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	cm	deg	dBµV/m	dBµV/m	dBµV/m	dBµV/m
1.002	V	112	144	43.9	74.0	36.2	54.0
1.336	V	100	168	47.4	74.0	37.0	54.0
1.403	V	112	167	45.0	74.0	36.8	54.0
4.881	H	119	131	55.0	74.0	50.3	54.0



2.9.6 Test Results - Continued

EUT Tx on Top Channel (2480MHz)

1GHz – 25GHz Test Site Results: The levels of the highest emissions measured in accordance with the specification are presented below: -

Frequency	Antenna		Turntable	Peak Field Strength	Peak Limit	Average Filed Strength	Average Limit
	Polarisation	Height	Azimuth				
GHz	H/V	cm	deg	dBμV/m	dBμV/m	dBμV/m	dBμV/m
1.002	V	107	160	46.5	74.0	37.9	54.0
1.336	V	100	180	46.8	74.0	36.9	54.0
1.403	V	100	160	44.6	74.0	36.4	54.0
4.881	H	185	328	52.2	74.0	46.5	54.0



2.10 BAND EDGE MEASUREMENTS – Bottom Channel

2.10.1 Specification Reference

FCC Part 15.247(c)

2.10.2 Equipment Under Test

BTM210 Bluetooth Radio

2.10.3 Date of Test

01/10/2003

2.10.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22
--

2.10.5 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.

The following Test Results were obtained using the FCC Public Notice document (DA00-705 released 30 March2000) for making measurements at the Band Edge, incorporating the 'Marker Delta Method'.

EUT was operating at maximum power.

BOTTOM CHANNEL

Step 1

Bottom Channel Fundamental Field Strength Measurement.

Performed in accordance with ANSI C63.4

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.

Freq	Ant Pol	Hgt	Azi	Peak FS	Average FS
GHz	H/V	cm	deg	dBµV/m	dBµV/m
2.402	V	119	176	89.5	88.6



2.10.5 Test Procedure - continued

Step 2

Determine Marker delta amplitude between 2.390GHz fundamental and 2.402GHz the Band Edge under investigation.

Using a span of 20MHz with Resolution Bandwidth and Video Bandwidth of 200kHz.

The Marker Delta = 46.5dB

Step 3

By subtracting the Marker Delta obtained from Step 2 from the 2.412GHz Field Strength measurement from Step 1, gives following Result

Performed by: M Larkin, EMC Engineer

2.10.6 Test Results

Peak of 89.5dB μ V/m – 46.5dB (Delta) = 43.0dB μ V/m (Limit is 74.0dB μ V/m = Pass)

Ave. of 88.6dB μ V/m – 46.5dB (Delta) = 42.1dB μ V/m (Limit is 54.0dB μ V/m = Pass)



2.11 BAND EDGE MEASUREMENTS – Top Channel

2.11.1 Specification Reference

FCC Part 15.247(c)

2.11.2 Equipment Under Test

BTM210 Bluetooth Radio

2.11.3 Date of Test

01/10/2003

2.11.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22
--

2.11.5 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.

The following Test Results were obtained using the FCC Public Notice document (DA00-705 released 30 March2000) for making measurements at the Band Edge, incorporating the 'Marker Delta Method'.

EUT was operating at maximum power.

TOP CHANNEL

Step 1

Bottom Channel Fundamental Field Strength Measurement.

Performed in accordance with ANSI C63.4

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.

Freq	Ant Pol	Hgt	Azi	Peak FS	Average FS
GHz	H/V	cm	deg	dBµV/m	dBµV/m
2.480	V	142	212	93.8	93.5



2.11.5 Test Procedure - continued

Step 2

Determine Marker delta amplitude between 2.480GHz fundamental and 2.4835GHz the Band Edge under investigation.

Using a span of 20MHz with Resolution Bandwidth and Video Bandwidth of 200kHz.

The Marker Delta = 51.8dB

Step 3

By subtracting the Marker Delta obtained from Step 2 from the 2.412GHz Field Strength measurement from Step 1, gives following Result

Performed by: M Larkin, EMC Engineer

2.11.6 Test Results

Peak of 93.8dB μ V/m – 51.8dB (Delta) = 42.0dB μ V/m (Limit is 74.0dB μ V/m = Pass)

Ave. of 93.5dB μ V/m – 51.8dB (Delta) = 41.7dB μ V/m (Limit is 54.0dB μ V/m = Pass)



2.12 SPURIOUS CONDUCTED EMISSIONS ON POWER LINES

2.12.1 Specification Reference

FCC Part 15.207

2.12.2 Equipment Under Test

BTM210 Bluetooth Radio

2.12.3 Date of Test

20th October 2003 – Middle Channel: 10th December 2003 – Top and Bottom Channels

2.12.4 Test Equipment Used

The following major items of test equipment identified in Section 3.1 were used for the above tests.

Items: 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22
--

2.12.5 Test Procedure

Testing to the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.207, for Conducted Emissions was carried out on the Measurement Test Facility detailed in Annex A.

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

Emissions were formally measured using 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 Tables below respectively.

The EUT was connected to a 120V 60Hz supply.

The Conducted Emission measurements were made using a Hewlett Packard 8542E EMI Receiver.

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

Performed by: J Holcombe EMC Engineer



2.12 SPURIOUS CONDUCTED EMISSIONS ON POWER LINES - Continued

2.12.6 Test Results

The EUT met the Class B requirements of 47 CFR 15.207 for Conducted Emissions on the Live and Neutral Lines.

EUT Tx on Top Channel (2480MHz)

Conducted Emissions - Live Line

Emission Frequency (MHz)	Quasi-Peak Level (dBμV)	Quasi-Peak Limit (dBμV)	Average Level (dBμV)	Average Limit (dBμV)
0.1500	46.2	65.9	24.9	55.9
0.1711	42.5	65.0	22.5	55.0
0.2109	48.1	63.2	40.3	53.2
0.3513	41.8	58.9	38.9	48.9
2.8099	33.6	56.0	30.4	46.0
3.2314	23.9	56.0	30.0	46.0

The margin between the specification requirements and all other emissions were 23.8dB or more below the specified Quasi-Peak limit and 32.0dB or more below the Average limit.

Conducted Emissions Neutral Line :

Emission Frequency (MHz)	Quasi-Peak Level (dBμV)	Quasi-Peak Limit (dBμV)	Average Level (dBμV)	Average Limit (dBμV)
0.1500	47.2	66.0	25.3	56.0
0.2108	48.3	63.2	40.0	53.2
0.2811	43.4	60.7	37.7	50.7
0.3513	41.8	58.9	39.6	48.9
0.4227	37.5	57.3	35.1	47.3
2.7390	36.3	56.0	33.9	46.0

The margin between the specification requirements and all other emissions were 36.0dB or more below the specified Quasi-peak limit and 12.6dB or more below the specified Average limit.



2.12 SPURIOUS CONDUCTED EMISSIONS ON POWER LINES - Continued

2.12.6 Test Results

The EUT met the Class B requirements of 47 CFR 15.207 for Conducted Emissions on the Live and Neutral Lines.

EUT Tx on Middle Channel (2441MHz)

Conducted Emissions - Live Line

Emission Frequency (MHz)	Quasi-Peak Level (dBμV)	Quasi-Peak Limit (dBμV)	Average Level (dBμV)	Average Limit (dBμV)
0.2108	46.6	63.2	40.4	53.2
0.3515	41.3	58.9	38.8	48.9
0.4920	30.1	56.0	28.8	46.0
2.4600	26.5	60.0	22.1	50.0
2.8144	31.0	60.0	28.1	50.0
2.2339	30.6	60.0	28.1	50.0

The margin between the specification requirements and all other emissions were 31.8dB or more below the specified Quasi-Peak limit and 27.2dB or more below the Average limit.

Conducted Emissions Neutral Line :

Emission Frequency (MHz)	Quasi-Peak Level (dBμV)	Quasi-Peak Limit (dBμV)	Average Level (dBμV)	Average Limit (dBμV)
0.2109	48.2	63.2	40.3	53.2
0.2812	43.6	60.7	38.5	50.7
0.4218	38.2	57.3	37.1	47.3
2.6710	36.2	56.0	34.0	46.0
3.1630	36.6	56.0	35.1	46.0
3.2330	36.9	56.0	35.7	46.0

The margin between the specification requirements and all other emissions were 20.6dB or more below the specified Quasi-peak limit and 14.0dB or more below the specified Average limit.



2.12 SPURIOUS CONDUCTED EMISSIONS ON POWER LINES - Continued

2.12.6 Test Results

The EUT met the Class B requirements of 47 CFR 15.207 for Conducted Emissions on the Live and Neutral Lines.

EUT Tx on Bottom Channel (2402MHz)

Conducted Emissions - Live Line

Emission Frequency (MHz)	Quasi-Peak Level (dB μ V)	Quasi-Peak Limit (dB μ V)	Average Level (dB μ V)	Average Limit (dB μ V)
0.1505	49.1	65.9	26.8	55.9
0.1800	44.1	64.5	23.6	54.5
0.2108	52.2	63.2	42.4	53.2
0.2811	45.1	60.7	38.5	50.7
0.3514	37.5	58.9	28.6	48.9
3.0912	37.4	56.0	34.5	46.0

The margin between the specification requirements and all other emissions were 25.9dB or more below the specified Quasi-Peak limit and 30.8dB or more below the Average limit.

Conducted Emissions Neutral Line :

Emission Frequency (MHz)	Quasi-Peak Level (dB μ V)	Quasi-Peak Limit (dB μ V)	Average Level (dB μ V)	Average Limit (dB μ V)
0.1500	48.0	66.0	26.1	56.0
0.1686	44.8	65.0	23.6	55.0
0.2108	50.0	63.2	40.9	53.2
0.2811	45.1	60.7	39.6	50.7
0.4215	38.9	57.3	37.1	47.3
6.1612	37.7	56.0	36.6	46.0

The margin between the specification requirements and all other emissions were 21.3dB or more below the specified Quasi-peak limit and 31.2dB or more below the specified Average limit.



2.13 MAXIMUM PEAK OUTPUT POWER (EIRP Method)

2.13.1 Specification Reference

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

2.13.2 Equipment Under Test

BTM210 Bluetooth Radio

2.13.3 Date of Test

21 October 2003

2.13.4 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 5.1.

2.13.5 Test Procedure

Test Performed in accordance with FCC CFR 47: Part 15.247(b)(1).

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, who's input signal level into the antenna was adjusted until the received level matched that of the previously detected emission.



2.13 MAXIMUM PEAK OUTPUT POWER (EIRP Method) - continued

2.13.6 Test Results - continued

The EUT met the requirements of FCC CFR 47: Part 15 Subpart C, Section 15.247(b)(3) for Maximum Peak Output Power.

Measurements were made with the EUT in Bluetooth Mode.

Frequency (MHz)	Result EIRP (dBm)	Result EIRP (mW)
2412	-9.1	0.123
2437	-5.2	0.302
2462	-2.6	0.549
Limit	<4W or <+36dBm	



SECTION 3

TEST EQUIPMENT USED & MEASUREMENT UNCERTAINTIES



3.1 TEST EQUIPMENT USED

Item	Instrument	Manufacturer	Type No	Serial No	EMC / INV No	Cal. Due
1	Spectrum Analyser	Rohde & Schwarz	FSEM	827156/006	INV 4034	16/12/03
2	Peak Power Analyser	Hewlett Packard	8990A	3107A00124	1660	14/08/04
3	Peak Power Sensor	Hewlett Packard	84812A	3107A00126	1662	14/08/04
4	Cable	TUV	N Type	CS0578	CS0578	-
5	Hygromer	Rotronic	1-1000	826-15	INV 3227	04/10/04
6	Cable	Sucoflex	-	-	-	-
7	EMI Receiver	Hewlett Packard	8542E	3617A00165_00 154	2286	13/12/03
8	Bilog Antenna	Schaffner	CBL 6143	-	2860	11/04/04
9	Turntable & Controller	HD Gmbh	HD 050	050-396	2528	TU
10	Antenna Mast	EMCO	2070	-	-	TU
11	Antenna Mast Controller	EMCO	2090	-	-	TU
12	Screened Room 5	Siemens	EAC54300	-	2533	TU
13	Low Noise Amplifier (1-8GHz)	Miteq	AMF-3D-001080-18-13P	UNK	2457	TU
14	Low Noise Amplifier (8-18GHz)	Miteq	AMF-4E-080180-15-10P	492562	2430	TU
15	Antenna	EMCO	3115	96964848	2297	04/07/04
16	Antenna	EMCO	3115	97015079	2397	04/07/04
17	Signal Generator	Hewlett Packard	8673B	2147A00421	953	TU
18	Hygromer	Rotronic	Hygromer	-	4066	28/11/03
19	3dB Pad	Hewlett Packard	8419B	15108	-	TU
20	Antenna	Link Microtek Ltd	AM180HA-K-TU2	2007	2945	15/08/04
21	Amplifier	Avantek	AMT-26177-33	6669	2072	26/06/04
22	Amplifier	Avantek	AWT-18036	F13365 8452	1081	26/06/04



3.2 MEASUREMENT UNCERTAINTY

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

In the frequency range 30MHz to 1000MHz

For 20dB Bandwidth

Frequency	$\pm 210.894\text{kHz}$
Amplitude	$\pm 0.5\text{dB}$

For Maximum Output Power

Amplitude	$\pm 0.5\text{dB}$
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For Spurious 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	$\pm 2 \times 10^{-7} \times \text{Centre Frequency}$
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Amplitude	$\pm 3.4\text{dB}$
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For Peak Power Spectral Density

Amplitude	$\pm 1.8\text{dB}$
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For Spurious Conducted Emissions

Amplitude	$\pm 3.0\text{dB}$
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SECTION 4

PHOTOGRAPHS OF TEST SAMPLE

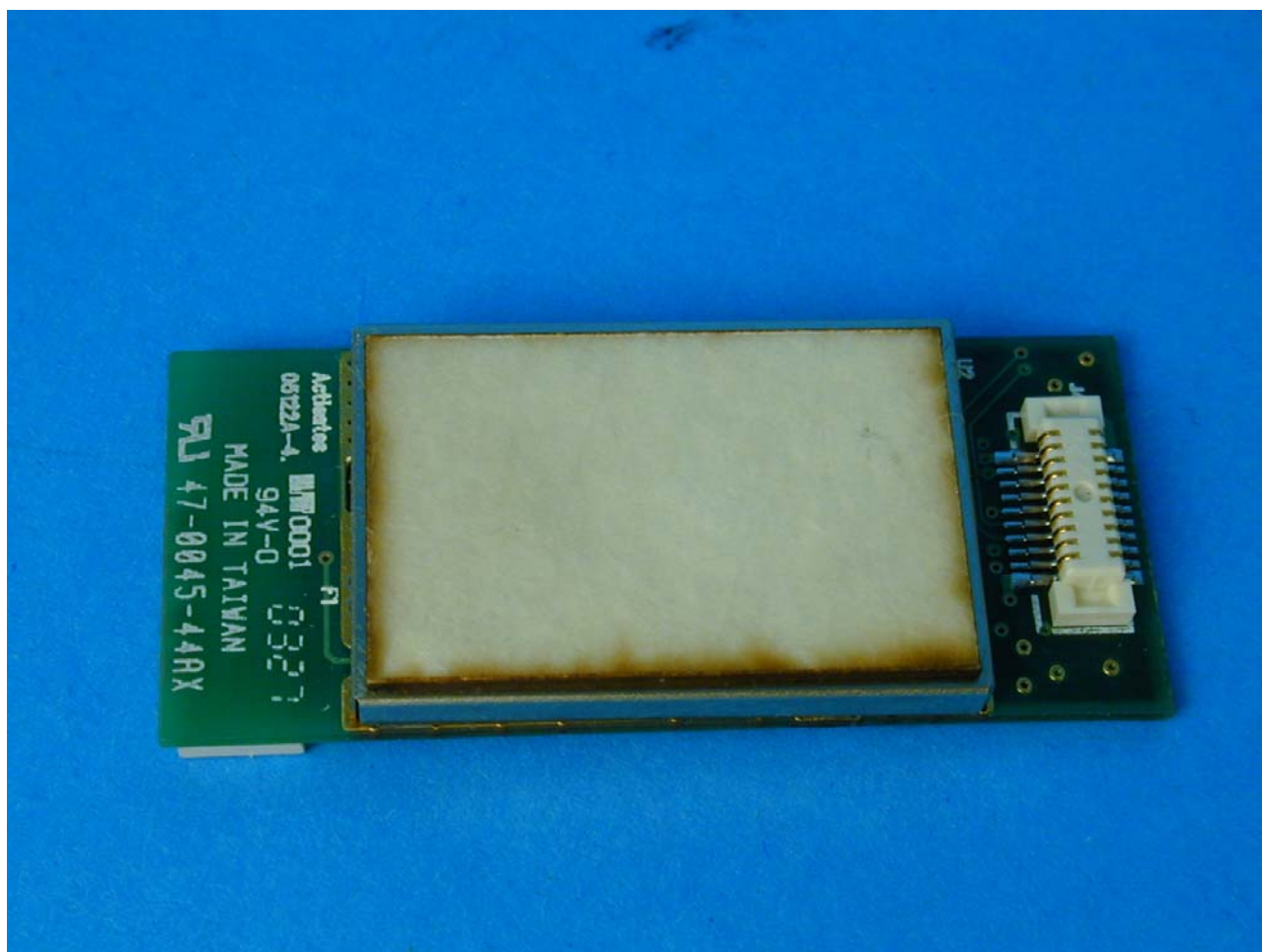
3.1 PHOTOGRAPHS OF EQUIPMENT



Front View of Bluetooth Module

Integral Antenna

3.1 PHOTOGRAPHS OF EQUIPMENT - Continued



Rear View of Bluetooth Module



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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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