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REPORT ON ELECTROMAGNETIC COMPATIBILITY TESTS

Performed at:
TWENTY PENCE TEST SITE

Twenty Pence Road,
Cottenham,
Cambridge
U.K.
CB24 8PS

on

Quatro Electronics Ltd

Smoke Detector

dated

6th November 2009

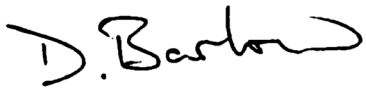
Document History

Issue	Date	Affected page(s)	Description of modifications	Revised by	Approved by
1	13/11/09		Initial release		
2	16/11/09	10	Clarify operation description.	DS	DB

Based on report template:
v090319

Equipment Under Test (EUT):	**Smoke Detector**
Test Commissioned by:	**Quatro Electronics Ltd** **Quatro House** **School Lane** **Lytham** **FY8 5NL**
Representative:	**Dave Smith**
Test Started:	**14th October 2009**
Test Completed:	**6th November 2009**
Test Engineer:	**Dave Smith**
Date of Report:	**6th November 2009**

Written by: Dave Smith **Checked by:** Derek Barlow

Signature:  **Signature:** 

Date: 6th November 2009 **Date:** 13th November 2009

dB Technology can only report on the specific unit(s) tested at its site. The responsibility for extrapolating this data to a product line lies solely with the manufacturer.

Test Standards Applied

CFR 47 : 2008	***Code of Federal Regulations: Pt 15 Subpart C - Radio Frequency Devices - Intentional Radiators***

In particular, the rules of CFR 47 part 15.231 were applied.

Emissions Test Results Summary

CFR 47 : 2008 **PASS**

Test	Port	Method	Limit	PASS/FAIL	*Notes*
Conducted Emissions	ac power	ANSI C63.4:2003	15.207	N/A	#1
Periodic Operation			15.231(a)	PASS	
Radiated Emissions		ANSI C63.4:2003	15.231(b)	PASS	
Bandwidth		ANSI C63.4:2003	15.231(c)	PASS	

specs_fccv090511

#1 Test not required because EUT is battery operated and does not have any connection to the mains.

Contents

1 EUT Details

1.1 General

The EUT was a Smoke Detector with a 434.475MHz intentional transmitter. The transmitter is intended for periodic operation and was therefore tested to FCC part 15.

Details of the EUT and associated peripherals used during the tests are listed below. Figure 1 shows the interconnections between the EUT and peripherals.

Item	Manufacturer	Model	Description	Serial No:	Notes
1	Quatro	Smoke Detector	EUT	10000	

1.2 Modifications to EUT and Peripherals

Details of any modifications that were required to achieve compliance are listed below. The modification numbers are referred to in the results sections as appropriate.

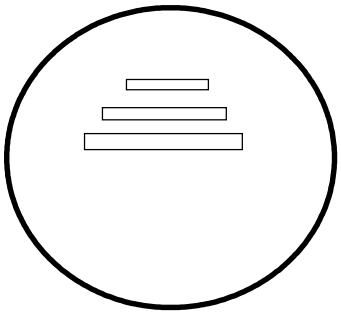
Mod No:	Details	Implemented for
0	Product as of start of testing. This unit had a 270R resistor as part of the RF attenuator circuit.	

1.3 EUT Operating Modes

The EUT was tested in the following operating mode or modes. Generally, operating modes are chosen that will exercise the functions of the EUT as fully as possible and in a manner likely to produce maximum emission levels or susceptibility. Individual test result sheets reference the operating mode of the EUT.

Operating Mode	Details
1	Pulsed transmission at 434.475MHz. The duty cycle was much higher than in normal use in order to aid testing. In normal operation the transmitter is continuously on for a duration of more than 100msec and so no additional reduction in levels could be made by calculating an average based on duty cycle.

Figure 1 General Arrangement of EUT and Peripherals



Eut had an integral antenna and no external cables

Photograph 1 EUT - Flat

Photograph 2 EUT - Upright - Front

Photograph 3 EUT - Upright - Back

2 Test Equipment

The test equipment used during the tests was one or more of the items listed below. Individual test result sheets indicate which items were used.

Ref No:	Details	Serial Number
A24	Chase X-wing Bilog CBL6144 26MHz-3GHz	27590
A4	Chase HFBilog CBL6112	2027
A8	EMCO 3115 DR Guide	6070
PRE7	LUCIX 0.1GHz to 20GHz	24485
R7	R&S ESVD	841729/003
R8	Agilent E7405A Spectrum Analyser	MY44212494

3 Test Methods

3.1 Radiated Emissions

This section describes the general method of performing this test. The specific method used and any deviations from this general method are listed in the appropriate results section.

Initial scans are performed in a semi-anechoic screened room at a distance of 3m. Scans are performed over the frequency range specified in the test standard with the antenna both horizontally and vertically polarised. During these scans the EUT and peripherals are rotated through 360°. Bench top EUTs are placed on a non-conducting bench at a height of 0.8m above the ground plane. Floor standing EUTs are placed 0.1m above the ground plane. The results of the scans are shown in the plots included at the end of the report.

Significant emissions identified by the scans are measured on an open area test site at the appropriate test distance using a CISPR16 quasi-peak receiver. Maximised readings are obtained by rotating the EUT through 360° and adjusting the height of the antenna from 1m to 4m. Measurements are made with the antenna both horizontally and vertically polarised and the results tabulated.

Tabulated results show levels based on the following calculation:

Field Strength (dBuV) = receiver reading (dBuV) + CF (1/m)

CF is the correction factor for the antenna and cable.

For example:

at 434.478MHz receiver reading was 58.6dBuV, combined correction factor = 20.6 (1/m).

Total field strength = 57.2 + 20.6 = 77.8dBuV/m.

4 Test Results

The following sections contain tabulated test results. Plots of various scans are included at the back of this section.

4.1 Intermittent Operation Information - 15.231(a)

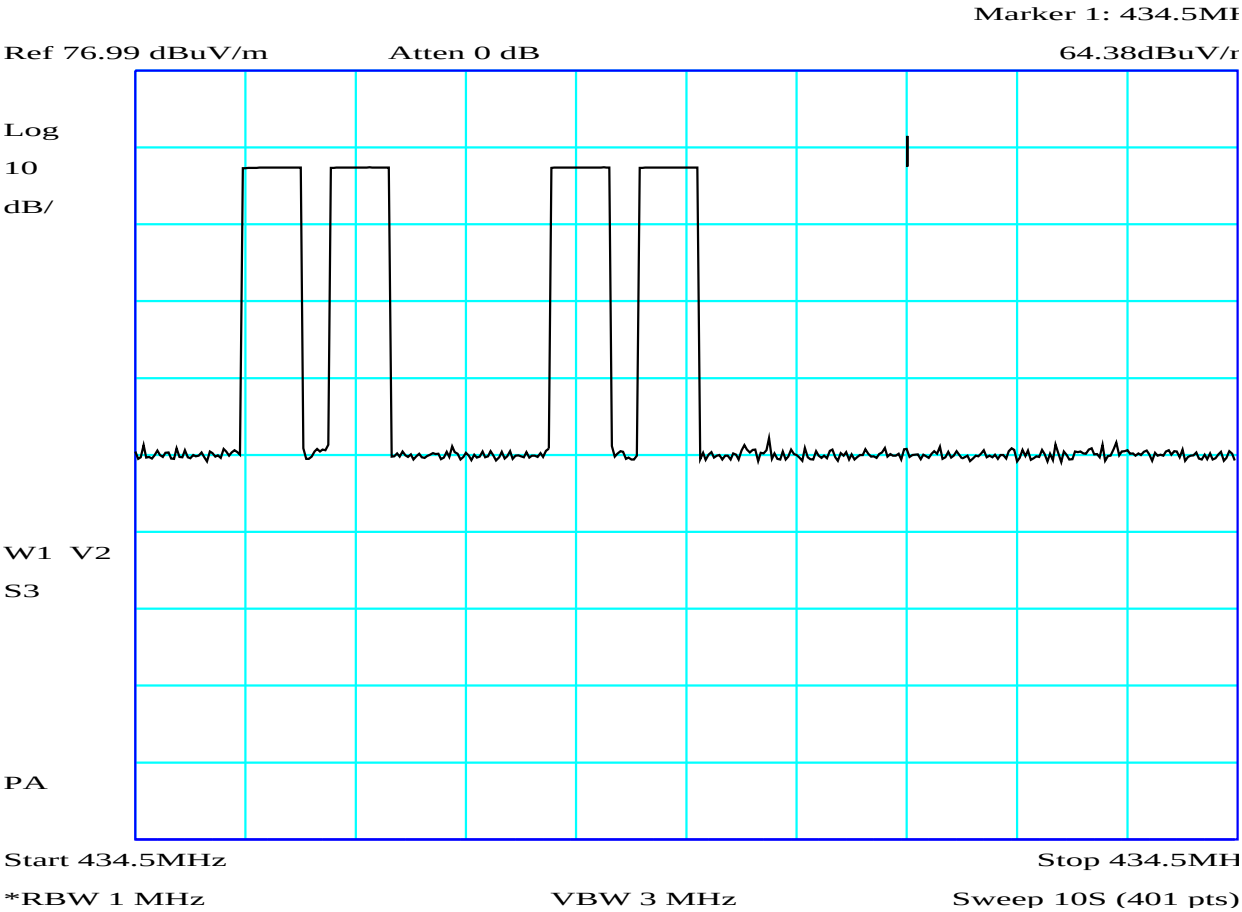
The operation of the transmitter is controlled by a microprocessor. The transmitter is activated when a warning condition is detected (i.e. Smoke).

When activated the transmitter sends a single sequence of pulses which lasts for less than 5 seconds - see plot below. No other sequence of pulses is transmitted until the warning condition has been cleared and a new warning condition detected.

In addition, this same sequence of pulses is sent out once every 18 hours for supervisory purposes.

This is considered to meet the rules of 15.231 as:

- it is an automatically operated device which transmits for a period of less than 5 seconds.
- transmissions at regular predetermined intervals are limited to supervision transmissions to determine system integrity in a security or safety application and does not exceed a rate of 2 seconds per hour.



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

06/11/09: Plot shows total transmitter activation time as 4.175 seconds.

4.2 Radiated Emissions Results - Below 1GHz - 15.231(b)

Factor Set 1:	A4_10m_09B	-	-	CSET005_07A	25 m cable
Factor Set 2:	-	-	-	-	
Factor Set 3:	-	-	-	-	
Test Equipment:	R7 A4 CSET005				

Radiated_Emissions

Company:	Quatro Electronics Ltd	*Product:*	Smoke Detector
Date:	14/10/2009	*Test Eng:*	Dave Smith
Ports:			
Test:	ANSI C63.4:2003 using limits of	15.231(b)	
Ports:			
Test:	using limits of		

Plot	Op Mode	Mod State	Dist m	Fact Set	Freq. MHz	Ant Pol	Rec. Level dBuV	Corr'n Factor dB/m	Corr'n Factor dB	Total Level dBuV/m	Limit FCC dBuV/m	Margin FCC dB	Notes
2	1	0	3	1	434.478	V	55.3	20.6		75.9	80.8	4.9	#a
2	1	0	3	1	434.478	H	58.3	20.6		78.9	80.8	1.9	#a
2	1	0	3	1	434.478	V	50.4	20.6		71.0	80.8	9.8	#b
2	1	0	3	1	434.478	H	57.2	20.6		77.8	80.8	3.0	#b

Results	Minimum Margin	1.9 dB	
	PASS/FAIL	PASS	

Notes	Comments and Observations
	Results of scans shown in plots 1 and 2. All measurements are peak measurements with 120kHz detector. Limit shown is average limit. Since all peak measurements are below the average limit there is no requirement to perform average measurements. As the unit could be fitted vertically or horizontally both orientations were tested. With the rotation of the EUT on the turntable this effectively tests three orthogonal planes. a: upright, b: flat

4.3 Radiated Emissions Results - Above 1GHz - 15.231(b)

Factor Set 1:	A8_3m_09D	PRE7_C51_C53_09A	RFF11_09B	-
Factor Set 2:	-	-	-	-
Factor Set 3:	-	-	-	-
Test Equipment:	R8 A8 PRE7			

Radiated_Emissions

Company: Quatro Electronics Ltd *Product:* Smoke Detector

Date: 19/10/09 *Test Eng:* Dave Smith

Ports:

Test: ANSI C63.4:2003 using limits of 15.231(b)

Ports:

Test: using limits of

Plot	Op Mode	Mod State	Dist m	Fact Set	Freq. MHz	Ant Pol	Rec. Level dBuV	Corr'n Factor dB/m	Corr'n Factor dB	Total Level dBuV/m	Limit FCC dBuV/m	Margin FCC dB	Notes
4	1	0	3	1	2606.900	V	53.0	-10.7		42.3	60.8	18.5	
4	1	0	3	1	2606.900	H	55.0	-10.7		44.2	60.8	16.6	
4	1	0	3	1	3041.406	V	55.2	-9.5		45.7	60.8	15.1	
4	1	0	3	1	3041.406	H	59.3	-9.5		49.8	60.8	11.0	
4	1	0	3	1	3476.000	V	59.1	-8.7		50.4	60.8	10.4	
4	1	0	3	1	3476.000	H	57.8	-8.7		49.1	60.8	11.7	
4	1	0	3	1	3910.325	V	61.6	-7.4		54.2	60.8	6.6	
4	1	0	3	1	3910.325	H	64.3	-7.4		56.9	60.8	3.9	

Results	Minimum Margin	3.9	dB
	PASS/FAIL	PASS	

Notes	Comments and Observations
	Results of scans shown in plots 3 to 7. Tabulated results are the highest of the upright/flat readings. All measurements are peak measurements with 1MHz RBW and 1MHz VBW. Limit shown is average limit. Since all peak measurements are below the average limit there is no requirement to perform average measurements.

4.4 Radiated Emissions Results - At Band Edges - 15.231(b)

Factor Set 1:	-	-	-	-
Factor Set 2:	-	-	-	-
Factor Set 3:	-	-	-	-
Test Equipment:	R7 A4 CSET005			

Radiated_Emissions

Company:	Quatro Electronics Ltd	*Product:*	Smoke Detector
Date:	20/10/2009	*Test Eng:*	Dave Smith
Ports:			
Test:	ANSI C63.4:2003 using limits of	15.231(b)	=FCC_B
Ports:			
Test:	using limits of		

Notes	Comments and Observations

The band edges were assumed to be at the maximum permitted occupied band limits i.e. +/- 0.125% above and below the operating frequency.

Plot 7 shows emissions measurements over this band. This plot shows transient emissions produced when the transmitter turns on. These emissions were captured because a peak detector was employed along with a "maximum hold" on the spectrum analyser. The plot is a maximum hold of a large number of sweeps.

To establish that these transients were not an issue, quasi peak measurements were made at the nominal band edge points.

The results are as follows:

Carrier level at 434.475MHz = 78.9 dBuV/m

Bandwidth may be up to 0.0025 * carrier frequency: = 1.09 MHz

At the band edges calculated on that basis:

433.932	MHz	=	24.2	dBuV/m	=	-54.7 dBc
435.018	MHz	=	26.4	dBuV/m	=	-52.5 dBc

The emissions levels at the nominal band edge are more than 20dB below the carrier when using a quasi peak detector and are therefore compliant.

PASS

4.5 Bandwidth - 15.231(c)

Factor Set 1:	-	-	-	-
Factor Set 2:	-	-	-	-
Factor Set 3:	-	-	-	-

Test Equipment: R8 A24

Radiated_Emissions

Company:	Quatro Electronics Ltd	*Product:*	Smoke Detector
Date:	20/10/2009	*Test Eng:*	Dave Smith
Ports:			
Test:	ANSI C63.4:2003 using limits of	15.231(c)	
Ports:			
Test:	using limits of		

Notes	Comments and Observations

The bandwidth must not exceed 0.25% of operating frequency.

In this case, as the operating frequency is 434.475MHz, the maximum allowable bandwidth is 1.09MHz
Plot 8 shows emissions measurements over this band.

The bandwidth is defined at points 20dB down from the carrier.

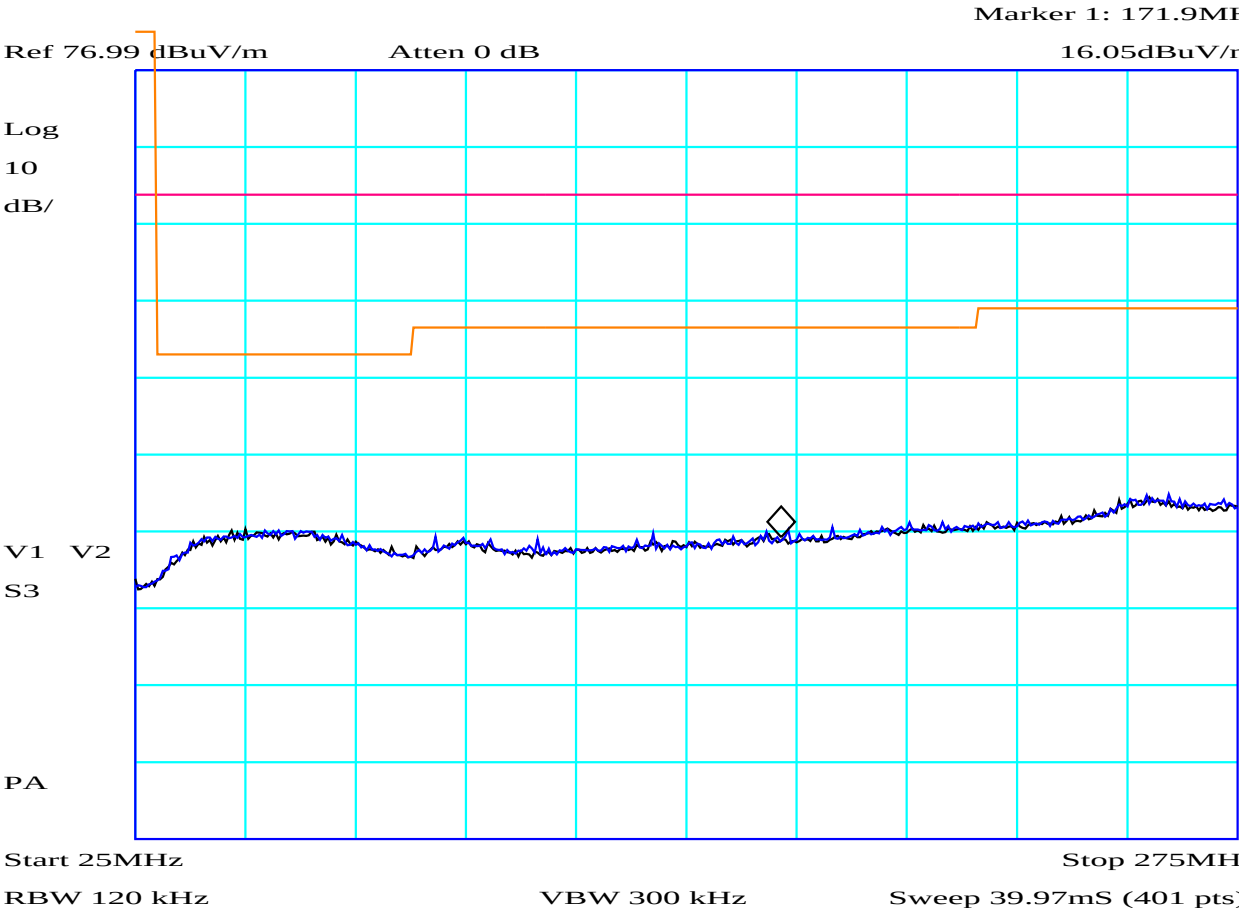
From plot 6 it can be determined that

-20dBc point to left of carrier = 434.4534 MHz
-20dBc point to right of carrier = 434.4954 MHz

Bandwidth = 42kHz

This is significantly below the maximum permitted of 1.09MHz.

PASS



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

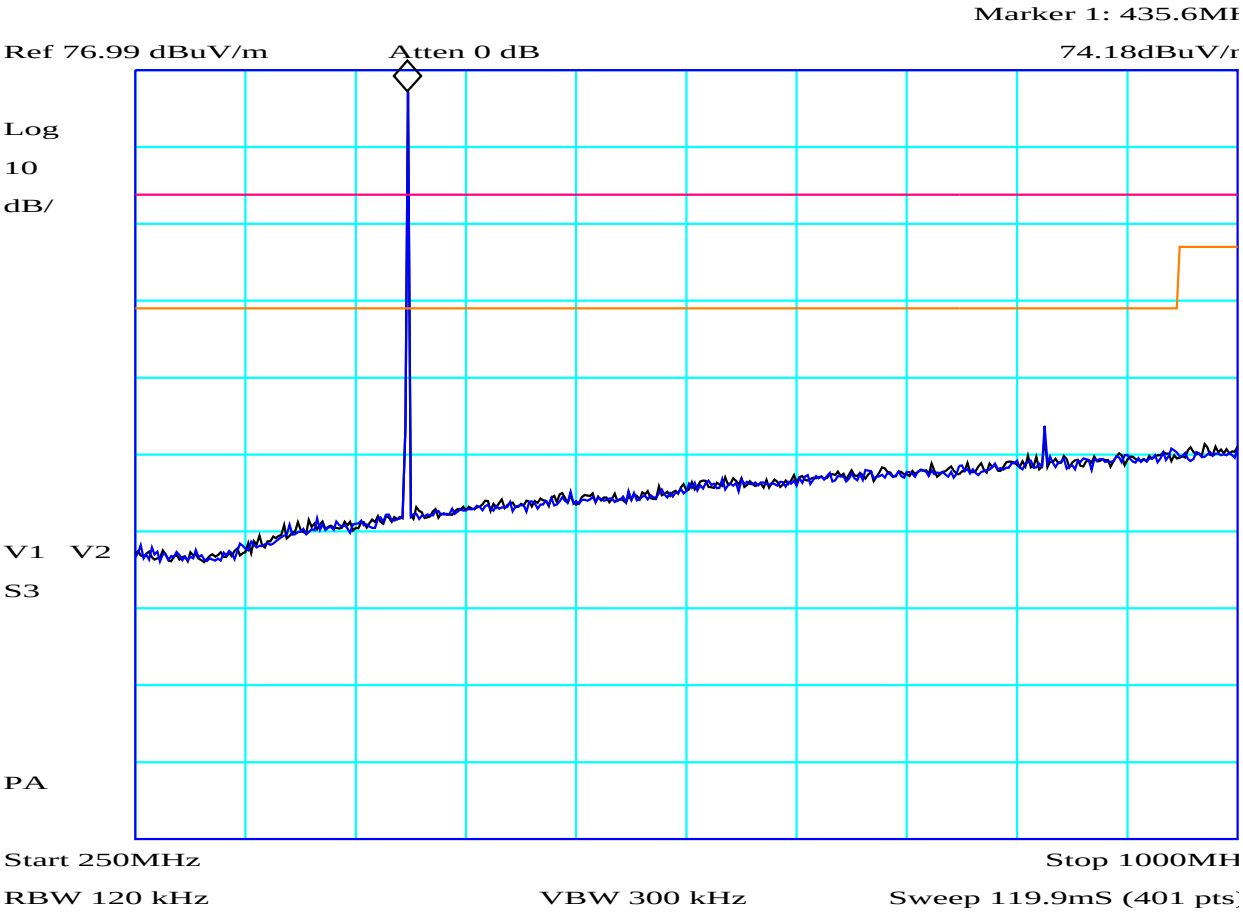
PLOT 1 Radiated Emissions - 25MHz to 275MHz (upright + flat)

Company:	Quatro	Product:	Smoke Detector
Date:	19/10/09	Test Eng:	Dave Smith
Method:	ANSI C63.4	Method:	
Limit1:(VIO)	Harmonics - 15.231(b)	Limit2:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Transmitting
Maximum of upright and flat scans.

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99197B5		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

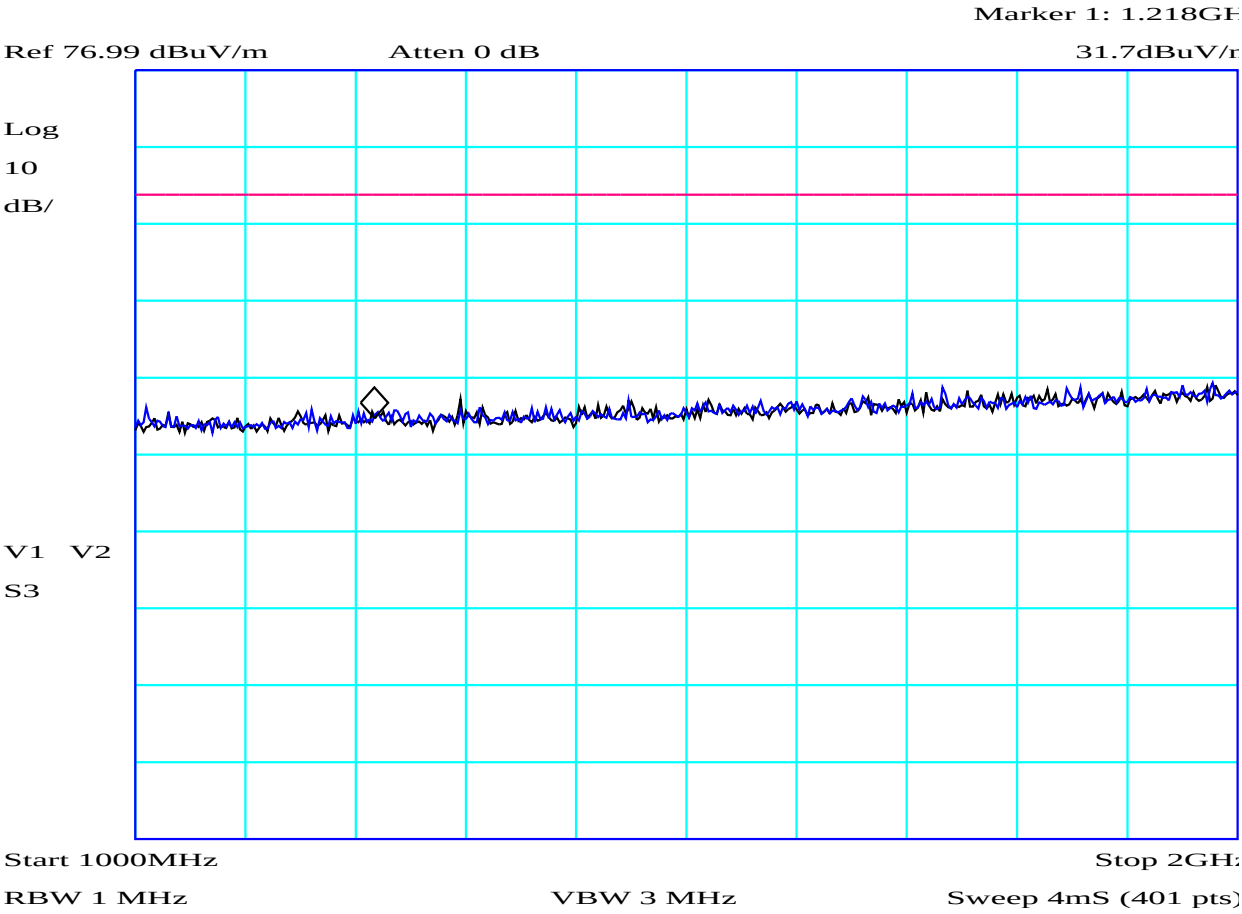
PLOT 2 Radiated Emissions - 250MHz to 1GHz (upright + flat)

Company:	Quatro	Product:	Smoke Detector
Date:	19/10/09	Test Eng:	Dave Smith
Method:	ANSI C63.4	Method:	
Limit1:(VIO)	Harmonics - 15.231(b)	Limit2:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Transmitting
Maximum of upright and flat scans.

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99197BC		



CF1:A8_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306 CF3:PRE7_090306

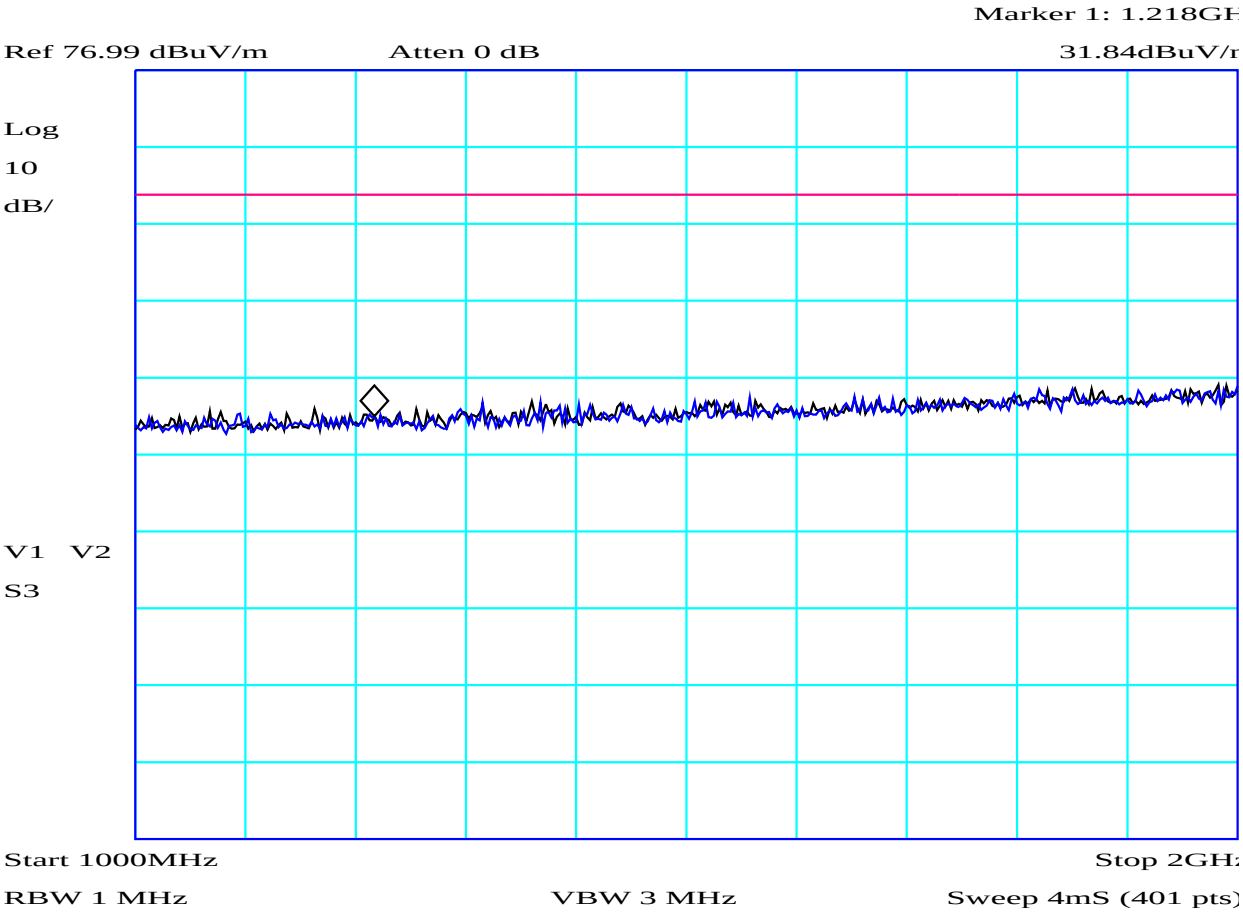
PLOT 3 Radiated Emissions - 1GHz to 2GHz (upright)

Company:	Quatro	Product:	Smoke Detector
Date:	19/10/09	Test Eng:	Dave Smith
Method:	Harmonics - 15.231(b)	Limit2:(ORG)	FCC(B)@3m
Limit1:(VIO)	EN55022(B)@3m	Limit2:	
Limit3:		Limit4:	

Upright.

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99196FC		



CF1:A8_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306 CF3:PRE7_090306

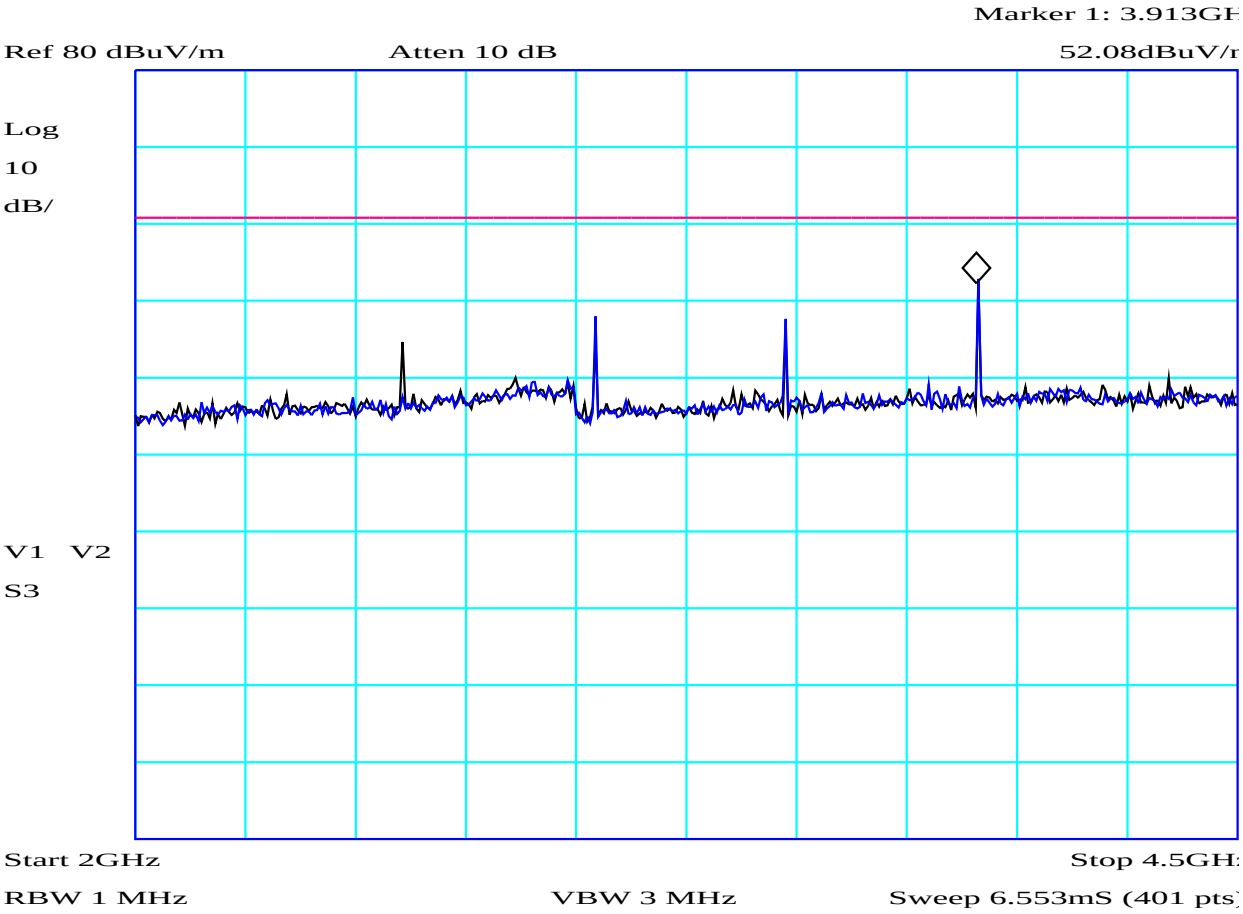
PLOT 4 Radiated Emissions - 1GHz to 2GHz (flat)

Company:	Quatro	Product:	Smoke Detector
Date:	19/10/09	Test Eng:	Dave Smith
Method:	Harmonics - 15.231(b)	Limit2:(ORG)	FCC(B)@3m
Limit1:(VIO)	EN55022(B)@3m	Limit2:	
Limit3:		Limit4:	

Flat.

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H9919700		



CF1:A8_3m_090306 CF2:PRE7_C51_C53_090215 CF3:RFF11_090306

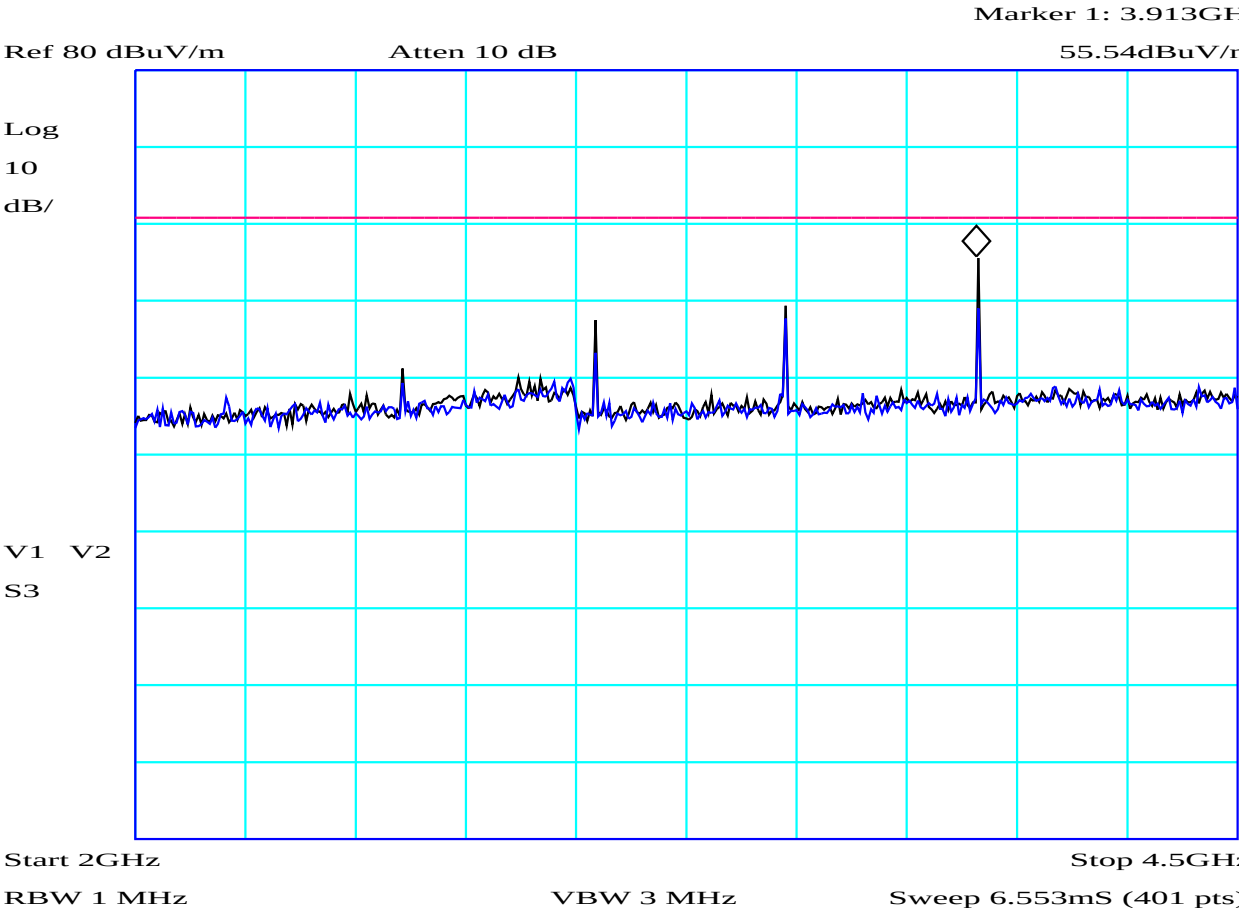
PLOT 5 Radiated Emissions - 2GHz to 4.5GHz (upright)

Company:	Quatro	Product:	Smoke Detector
Date:	19/10/09	Test Eng:	Dave Smith
Method:	Harmonics - 15.231(b)	Limit2:(ORG)	FCC(B)@3m
Limit1:(VIO)	EN55022(B)@3m	Limit2:	
Limit3:		Limit4:	

Upright

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H9919500		



CF1:A8_3m_090306 CF2:PRE7_C51_C53_090215 CF3:RFF11_090306

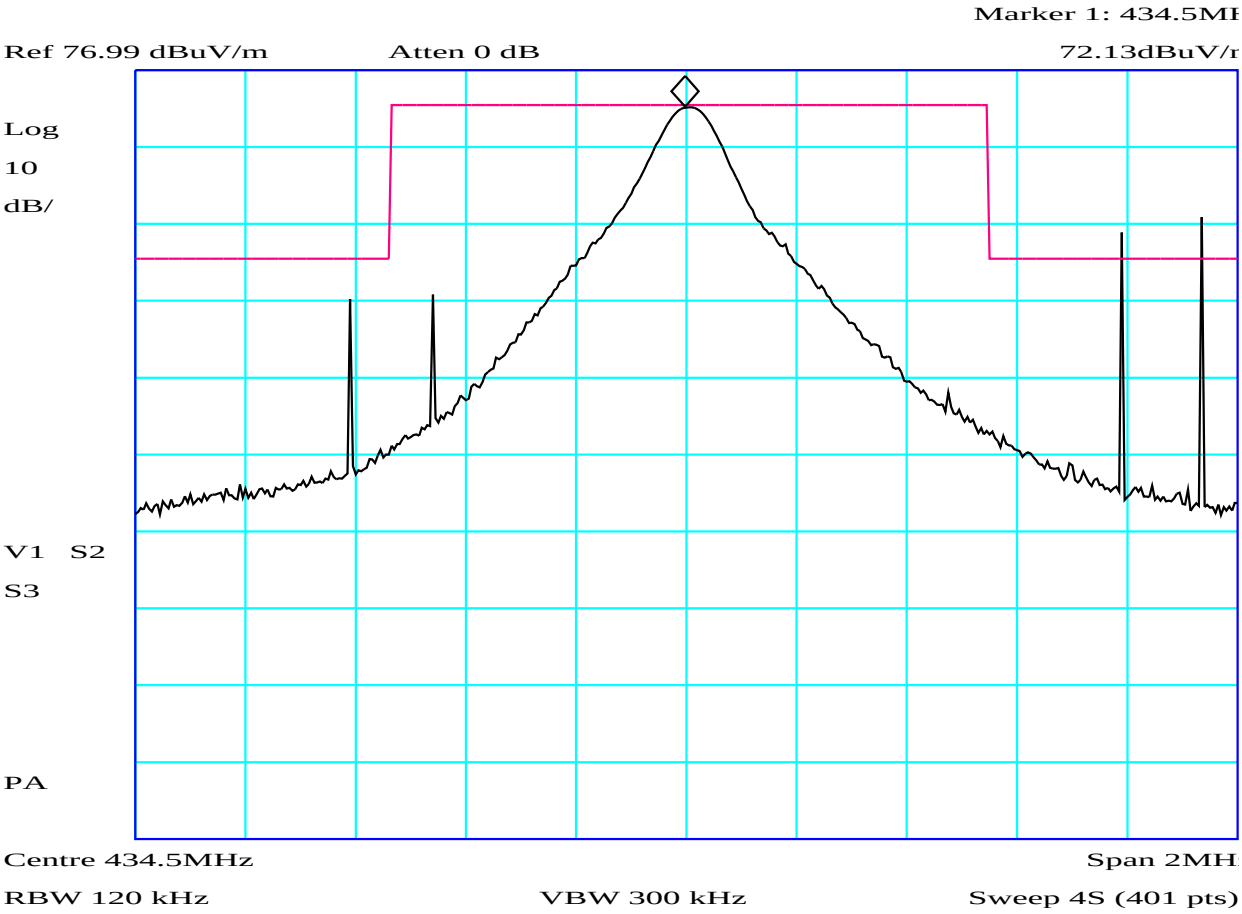
PLOT 6 Radiated Emissions - 2GHz to 4.5GHz (flat)

Company:	Quatro	Product:	Smoke Detector
Date:	19/10/09	Test Eng:	Dave Smith
Method:	ANSI C63.4	Method:	
Limit1:(VIO)	Harmonics - 15.231(b)	Limit2:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Flat

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99194FA		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

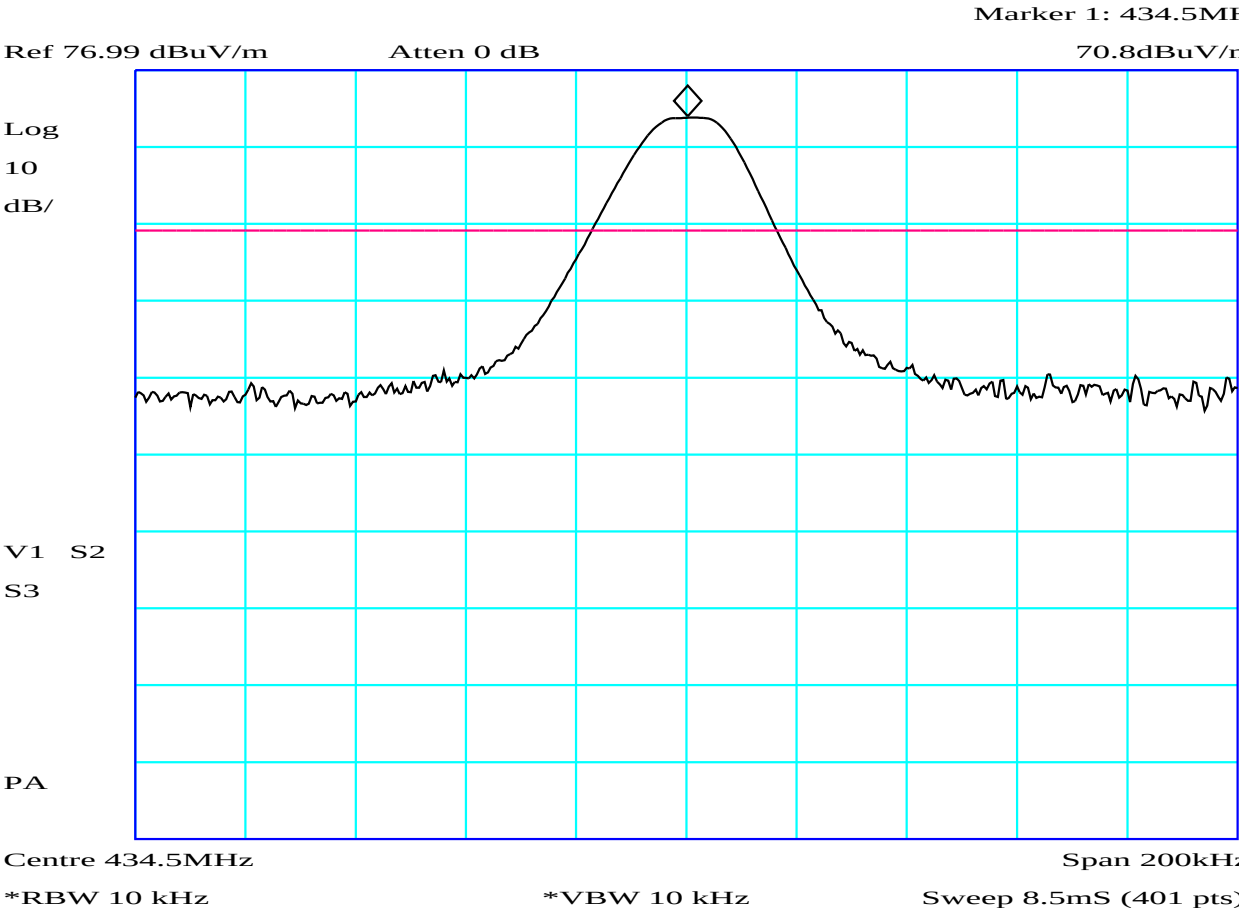
PLOT 7 Radiated Emissions at Band Edges

Company:	Quatro	Product:	Sensor Monitor
Date:	19/10/09	Test Eng:	Dave Smith
Method:	ANSI C63.4	Method:	
Limit1:(VIO)	Harmonics - 15.231(b)	Limit2:	
Limit3:		Limit4:	

The band edges were assumed to be the maximum occupied band limits i.e. width = 0.25% of operating frequency. The limit shown is the carrier limit within the allowed occupied band (carrier +/- 0.125%) and the spurious limit outside of this band.

"Spikes" were transients when transmitter turns on. The quasi-peak levels of these transients were very much lower - see tabulated results for "Radiated Emissions at Band Edges".

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V	Modification State:	0
Angle	0-360	File:	H9919763		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

PLOT 8 Bandwidth Plot

Company:	Quatro	Product:	Sensor Monitor
Date:	19/10/09	Test Eng:	Dave Smith
Method:	ANSI C63.4	Method:	
Limit1:(VIO)	-20dBc	Limit2:	
Limit3:		Limit4:	

peak = 70.8 dBuV/m
50.8dBuV/m to left of peak = 434.4534MHz
50.8dBuV/m to right of peak = 434.4954MHz

Occupied bandwidth = 42kHz
Limit = 1.086MHz

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V	Modification State:	0
Angle	0-360	File:	H9919781		