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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

Sensor Monitor

dated

20th October 2009

Document History

Issue	Date	Affected page(s)	Description of modifications	Revised by	Approved by
1	20/10/09		Initial release		
2	04/11/09	3,9,10,11	Add periodic transmission results, clarified orientation, add sample calculation	DS	DB

Based on report template:
v090319

Equipment Under Test (EUT):	**Sensor Monitor**
Test Commissioned by:	**Quatro Electronics Ltd Quatro House School Lane Lytham FY8 5NL**
Representative:	**Dave Smith**
Test Started:	**14th October 2009**
Test Completed:	**4th November 2009**
Test Engineer:	**Dave Smith**
Date of Report:	**20th October 2009**

Written by: Dave Smith **Checked by:** Claire Arber

Signature:  **Signature:** 

Date: 20th October 2009 **Date:** 23rd October 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.

CFR 47 : 2008 Class B	***Code of Federal Regulations: Pt 15 Subpart B- Radio Frequency Devices - Unintentional Radiators***

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

CFR 47 : 2008 **PASS**

Test	Port	Method	Limit	PASS/FAIL	*Notes*
Conducted Emissions	ac power	ANSI C63.4:2003	FCC_B	N/A	#1
Radiated Emissions		ANSI C63.4:2003	FCC_B	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 Sensor Monitor with a 434.475MHz intentional transmitter and receiver. The transmitter is intended for periodic operation and was therefore tested to FCC part 15.231 and requires "Certification".

It is understood that the receiver can be authorised under the "Verification" procedure since it forms part of a transceiver for which the transmit portion will be certified (CFR 47 15.101(b)). Results of radiated emissions measurements from the receiver are included in this report.

The device includes a GSM module, but this already has modular FCC "Certification" and so specific testing of the GSM intentional transmitter was not performed.

The device also includes digital electronics that is not associated with the intentional transmitter (e.g. digital voice playback circuitry). Again, it is understood that the "digital device" is subject to "Verification" rather than "Certification". Radiated emissions results from the "digital device" are included in this test report.

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	Sensor Monitor	EUT	7897	

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.

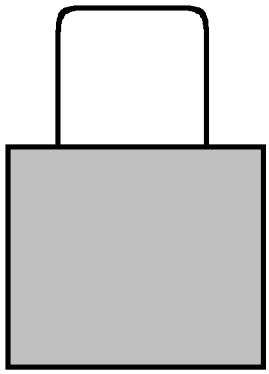
Mod No:	Details	Implemented for
0	Product as of start of testing. This unit had a 1k1 resistor as part of the RF attenuator circuit.	

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	Continually transmitting at 434.475MHz.
2	Pulsed transmission at 434.475MHz.
3	434.475MHz receiver active. Transmitters turned off.
4	Power to GSM control circuitry. Transmitters turned off.
5	Siren active. Transmitters turned off.

Figure 1 General Arrangement of EUT and Peripherals



Eut had an integral antenna and no external cables

Photograph 1 EUT - Front

Photograph 2 EUT - 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 = 58.6 + 20.6 = 79.2dBuV/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)

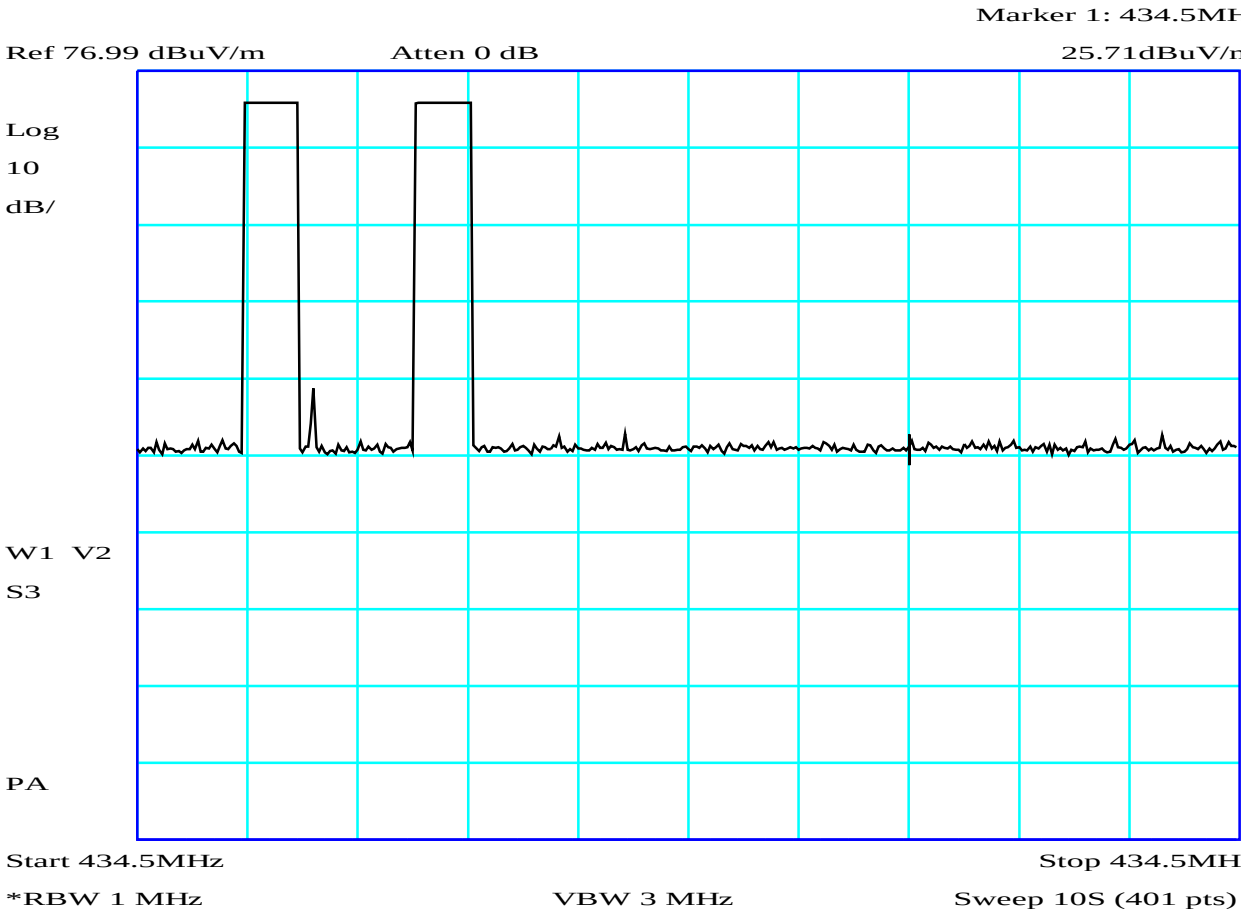
The operation of the transmitter is controlled by a microprocessor. The transmitter is activated when an warning condition is detected and the siren is activated. The warning condition is triggered by a remote sensor (e.g. smoke detector).

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.

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.
- it does not send any transmissions at regular predetermined intervals.



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

04/11/09: Plot shows total transmitter activation time as 2.1 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:* Sensor Monitor

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 1/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	58.6	20.6		79.2	80.8	1.6	
2	1	0	3	1	434.478	H	53.8	20.6		74.4	80.8	6.4	
Results						Minimum Margin PASS/FAIL					1.6 dB 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. The unit is a large, relatively heavy object which will ALWAYS be used in the upright position and so testing was restricted to this orientation. It was considered unnecessary to test in three orthoganol planes.

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:* Sensor Monitor

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 1/m	Corr'n Factor dB	Total Level dBuV/m	Limit FCC dBuV/m	Margin FCC dB	Notes
4	1	0	3	1	3476.000	V	51.7	-8.7		43.0	60.8	17.8	
4	1	0	3	1	3476.000	H	47.4	-8.7		38.6	60.8	22.2	
4	1	0	3	1	3910.063	V	55.5	-7.4		48.1	60.8	12.7	
4	1	0	3	1	3910.063	H	49.6	-7.4		42.2	60.8	18.6	

Results	Minimum Margin	12.7	dB
	PASS/FAIL	PASS	

Notes	Comments and Observations
	Results of scans shown in plots 3 and 4. 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:*	Sensor Monitor
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 5 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 = 79.2 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	=	29.3	dBuV/m	=	-49.9 dBc
435.018	MHz	=	30.2	dBuV/m	=	-49 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:*	Sensor Monitor
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 6 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 = 434.4529 MHz
-20dBc point to right of carrier = 434.4904 MHz

Bandwidth = 37.5kHz

This is significantly below the maximum permitted of 1.09MHz.

PASS

4.6 Unintentional Radiator Emissions (15.109)

Factor Set 1:	-	-	-	-	~ m cable
Factor Set 2:	-	-	-	-	
Factor Set 3:	-	-	-	-	
Test Equipment: R8 A24					

Radiated_Emissions

Company:	Quatro Electronics Ltd		*Product:*	Sensor Monitor
Date:	20/10/2009		*Test Eng:*	Dave Smith
Ports:				
Test:	ANSI C63.4:2003	using limits of	FCC_B	
Ports:				
Test:		using limits of		

Notes	Comments and Observations

Radiated emission measurements were performed on the Unintentional Radaitor elements of the EUT.

Scans were performed in the following modes:

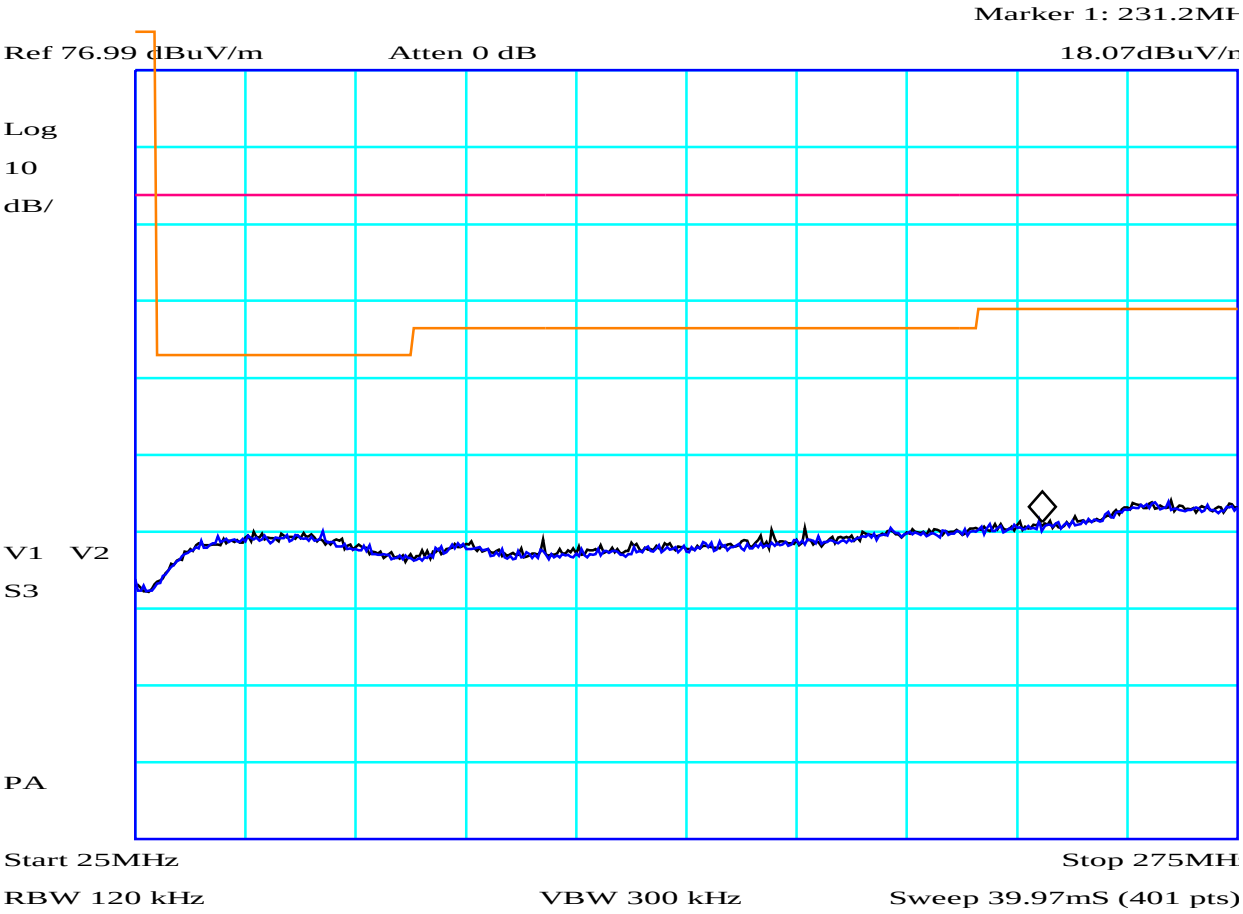
434.475MHz Receiver active
GSM control circuitry active
Siren Active

The results of these scans are shown in plots 7 to 12.

All emissions were sufficiently below the limit line that it was not considered necessary to maximise on the open area test site.

A quick check was also made in digital voice play back. The messages were too short to perform a full sweep but on a live trace there was no evidence of any emissions.

The plots show that the 434.475MHz receiver and the digital electronics meet the requirements for an FCC class B Unintentional Transmitter.



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

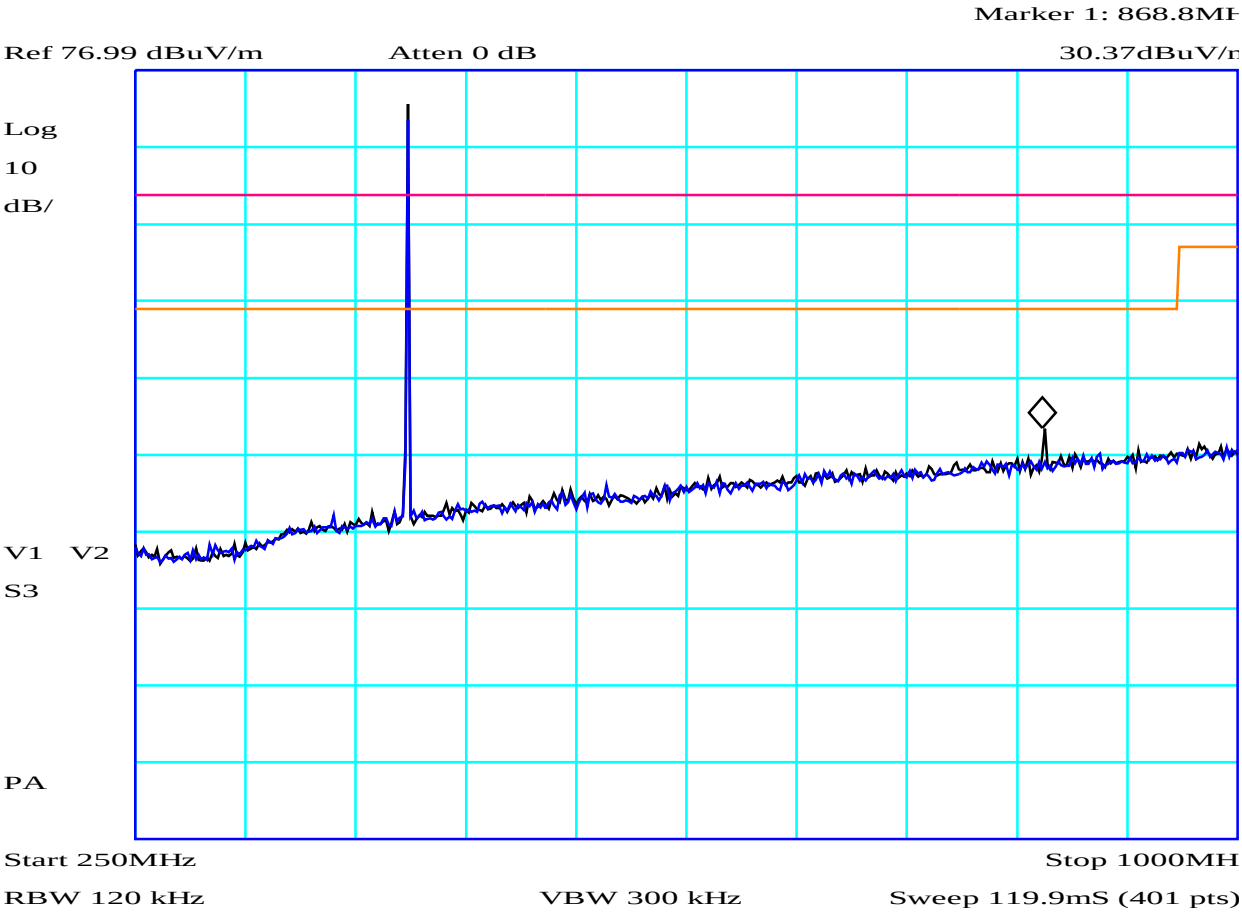
PLOT 1 Radiated Emissions - 25MHz to 275MHz - Transmitting

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:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Transmitting

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H991971A		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

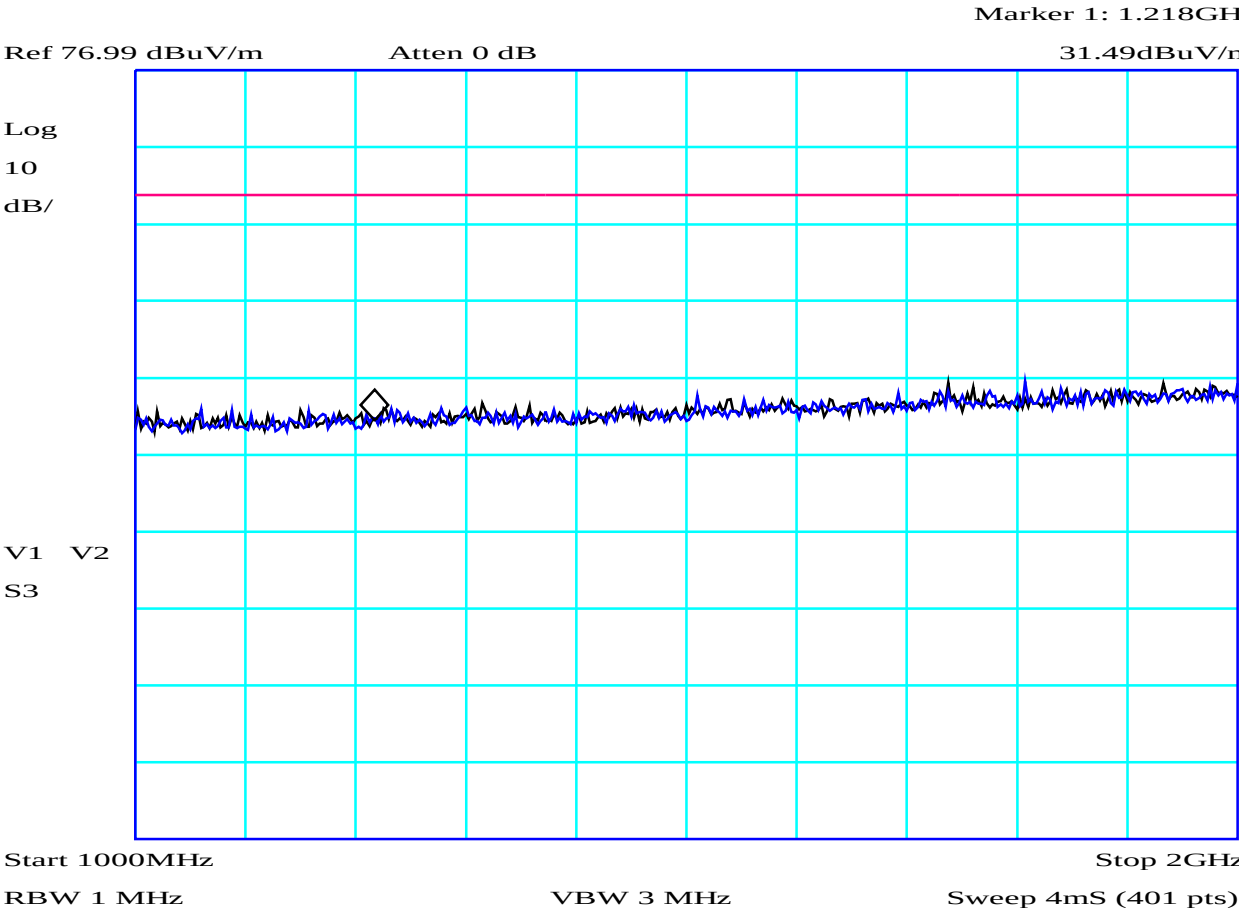
PLOT 2 Radiated Emissions - 250MHz to 1GHz - Transmitting

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:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Transmitting

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H9919717		



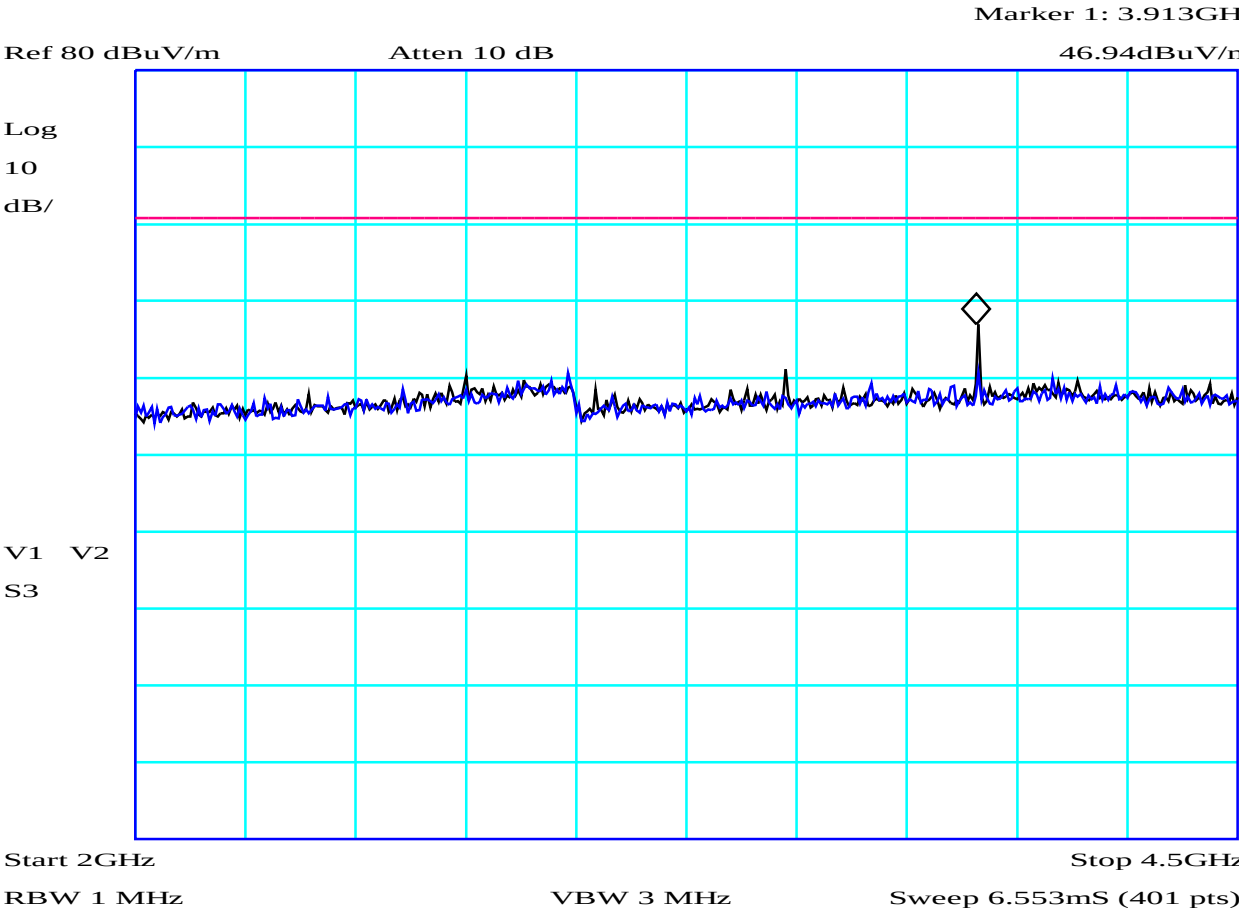
CF1:A8_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306 CF3:PRE7_090306

PLOT 3 Radiated Emissions - 1GHz to 2GHz - Transmitting

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:	

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H9919706		



CF1:A8_3m_090306 CF2:PRE7_C51_C53_090215 CF3:RFF11_090306

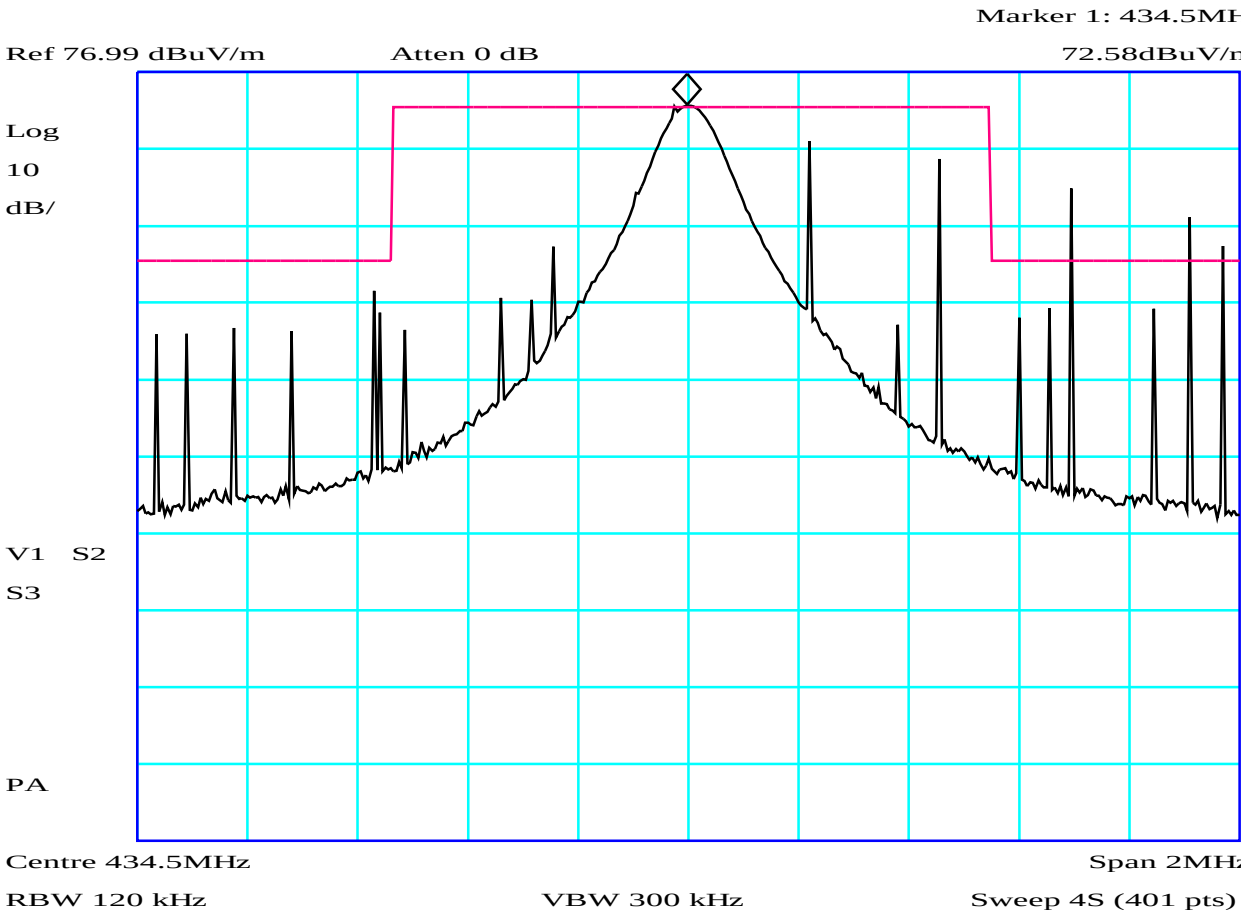
PLOT 4 Radiated Emissions - 2GHz to 4.5GHz - Transmitting

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:	

Upright

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H9919524		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

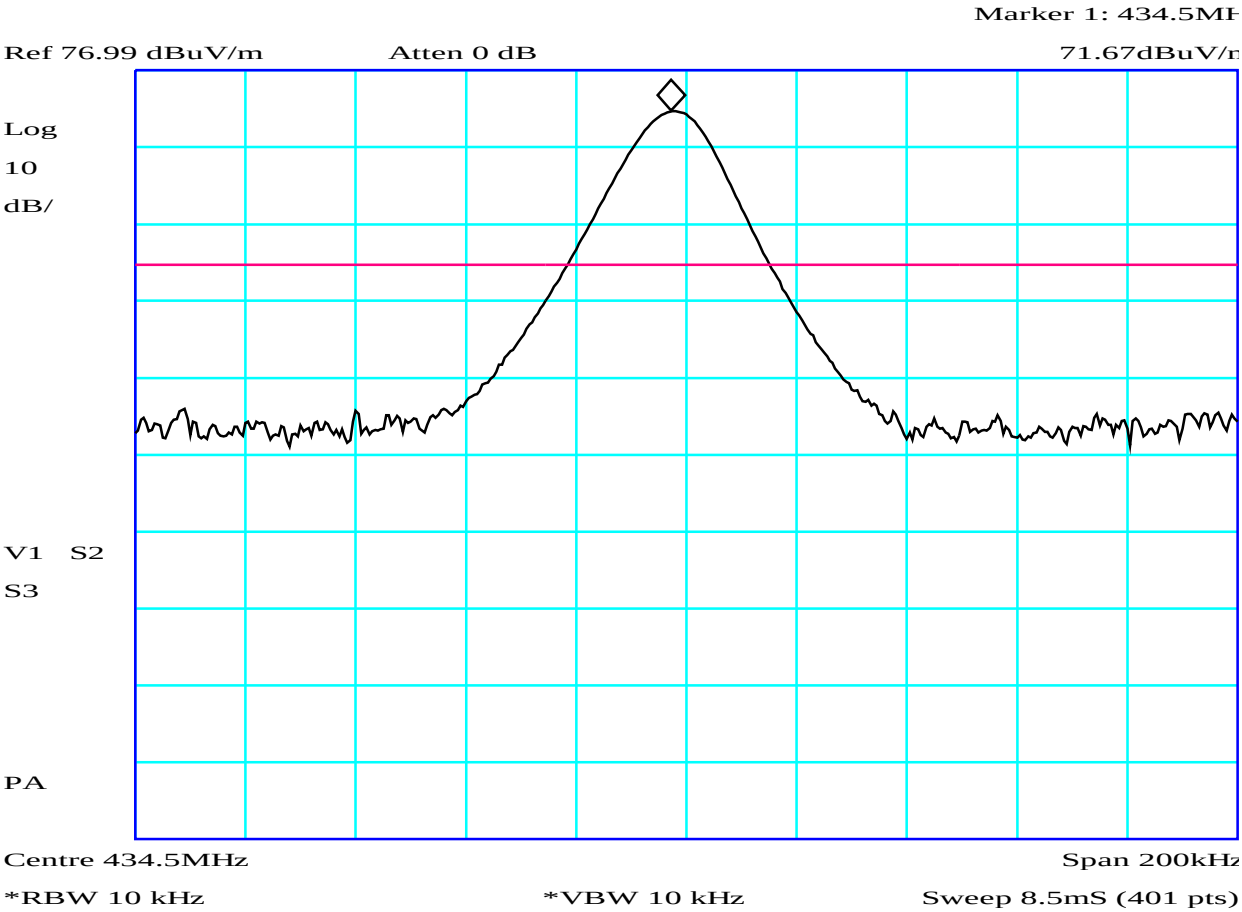
PLOT 5 Radiated Emissions at Band Edges

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 peaks levels of these transients were very low - see tabulated results for "Radiated Emissions at Band Edges".

Facility:	Anech_2	Height	1m	Mode:	2
Distance	3m	Polarisation	V	Modification State:	0
Angle	0-360	File:	H9919739		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

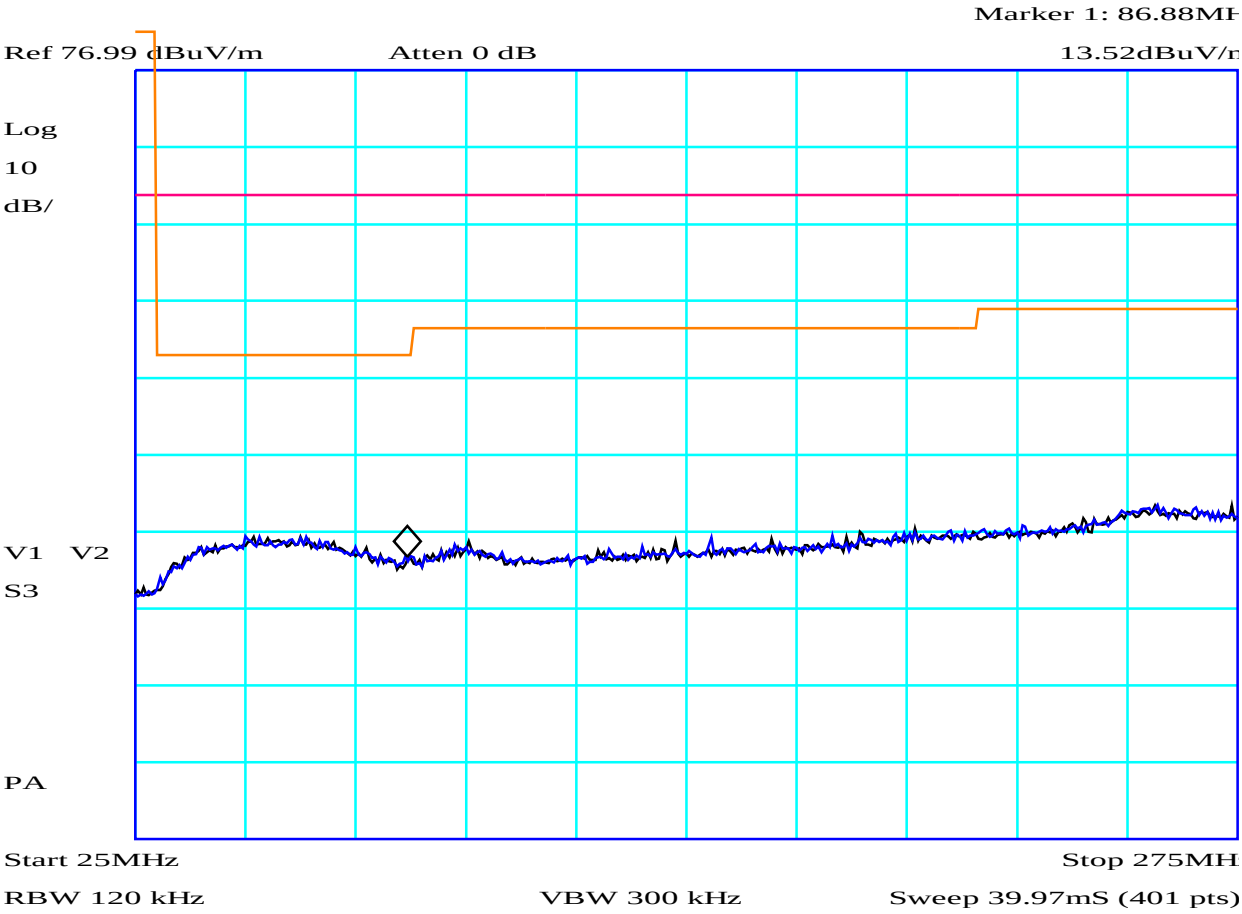
PLOT 6 Bandwidth Plot

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 = 71.67 dBuV/m
51.67dBuV/m to left of peak = 434.4529MHz
51.67dBuV/m to right of peak = 434.4904MHz

Occupied bandwidth = 37.5kHz
Limit = 1.086MHz

Facility:	Anech_2	Height	1m	Mode:	1
Distance	3m	Polarisation	V	Modification State:	0
Angle	0-360	File:	H9919792		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

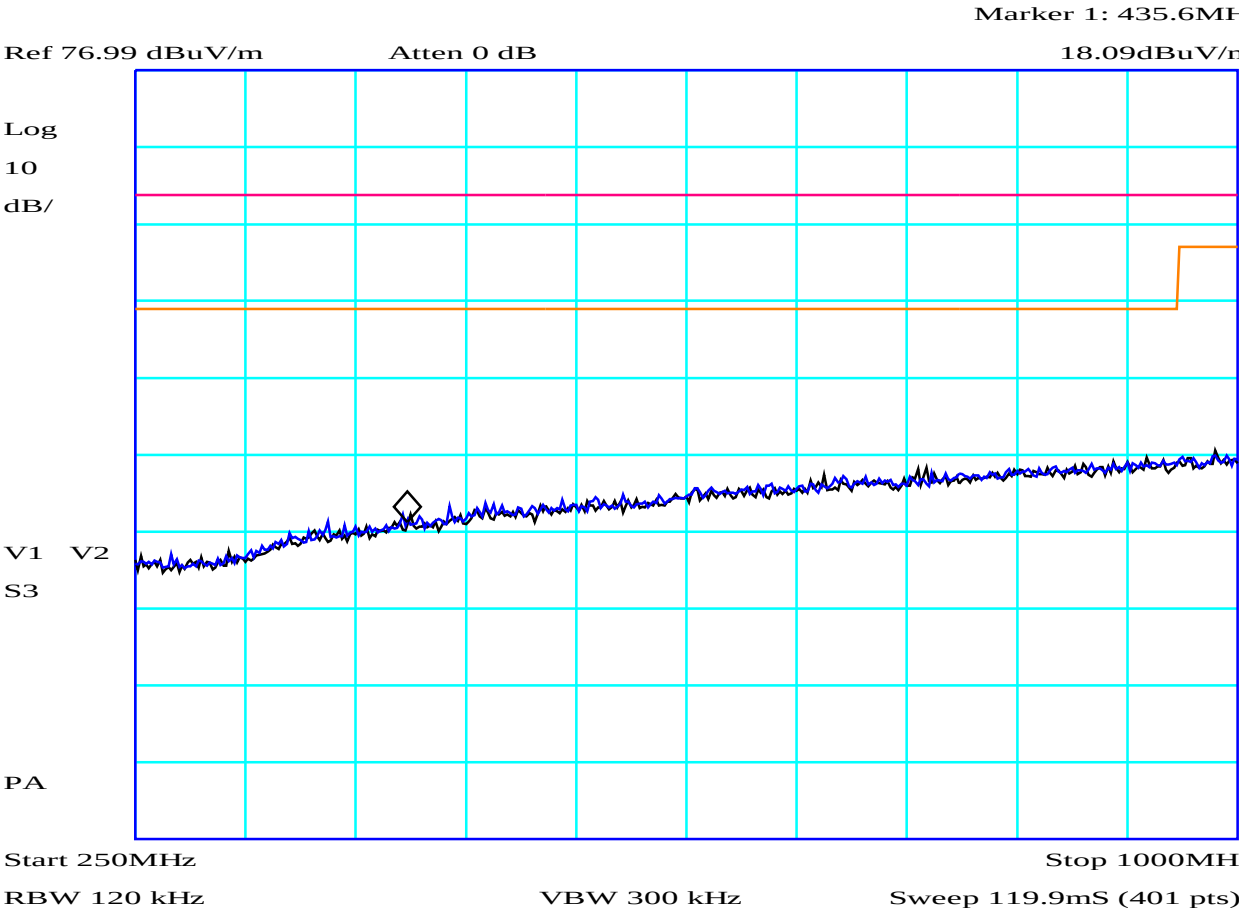
PLOT 7 Radiated Emissions - 25MHz to 275MHz - 434.475MHz Receiver Active

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:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Receive Mode

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	3
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99197DA		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

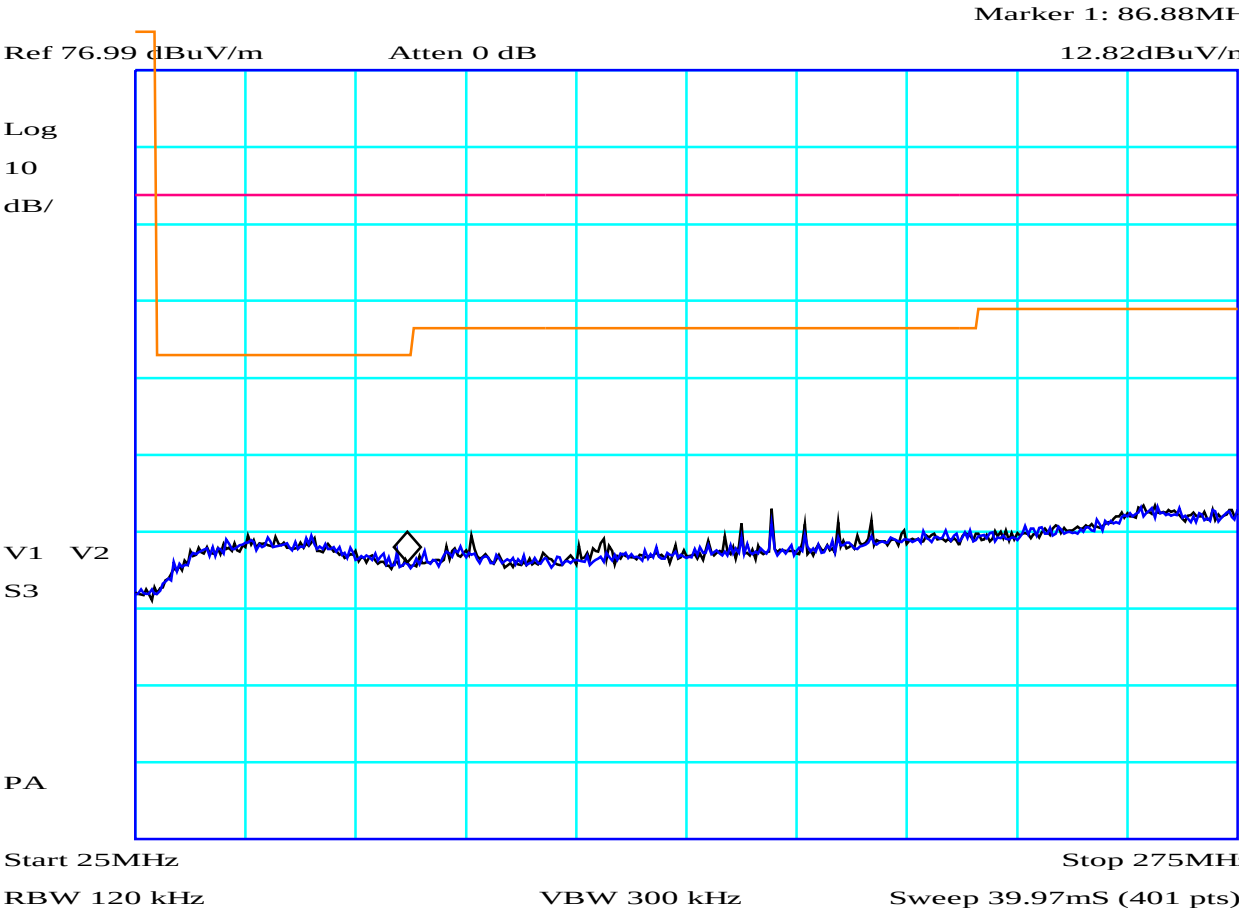
PLOT 8 Radiated Emissions - 250MHz to 1GHz - 434.475MHz Receiver Active

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:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Receive Mode

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	3
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99197DD		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

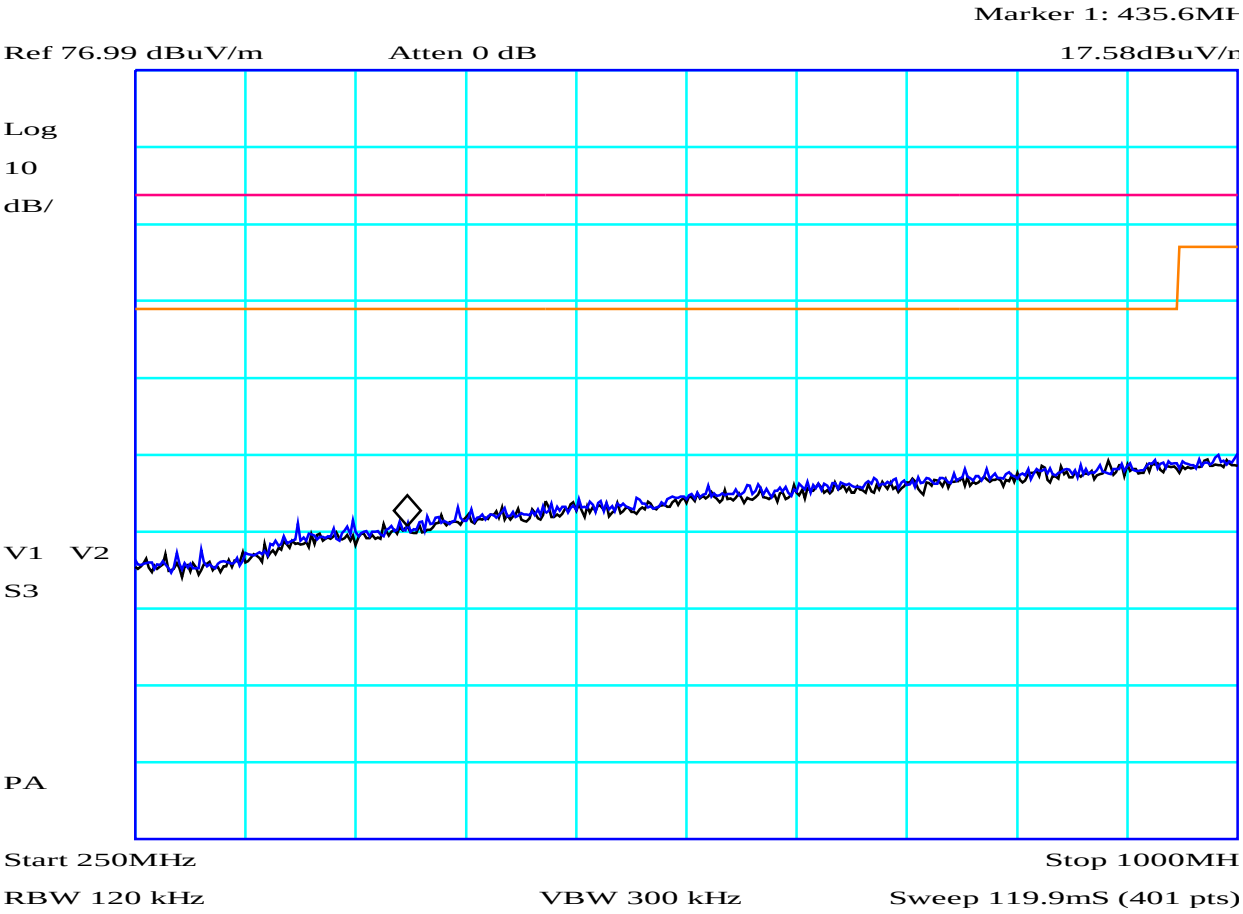
PLOT 9 Radiated Emissions - 25MHz to 275MHz - GSM Control Circuit Active

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:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

GSM control circuit active.

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	4
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99197E2		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

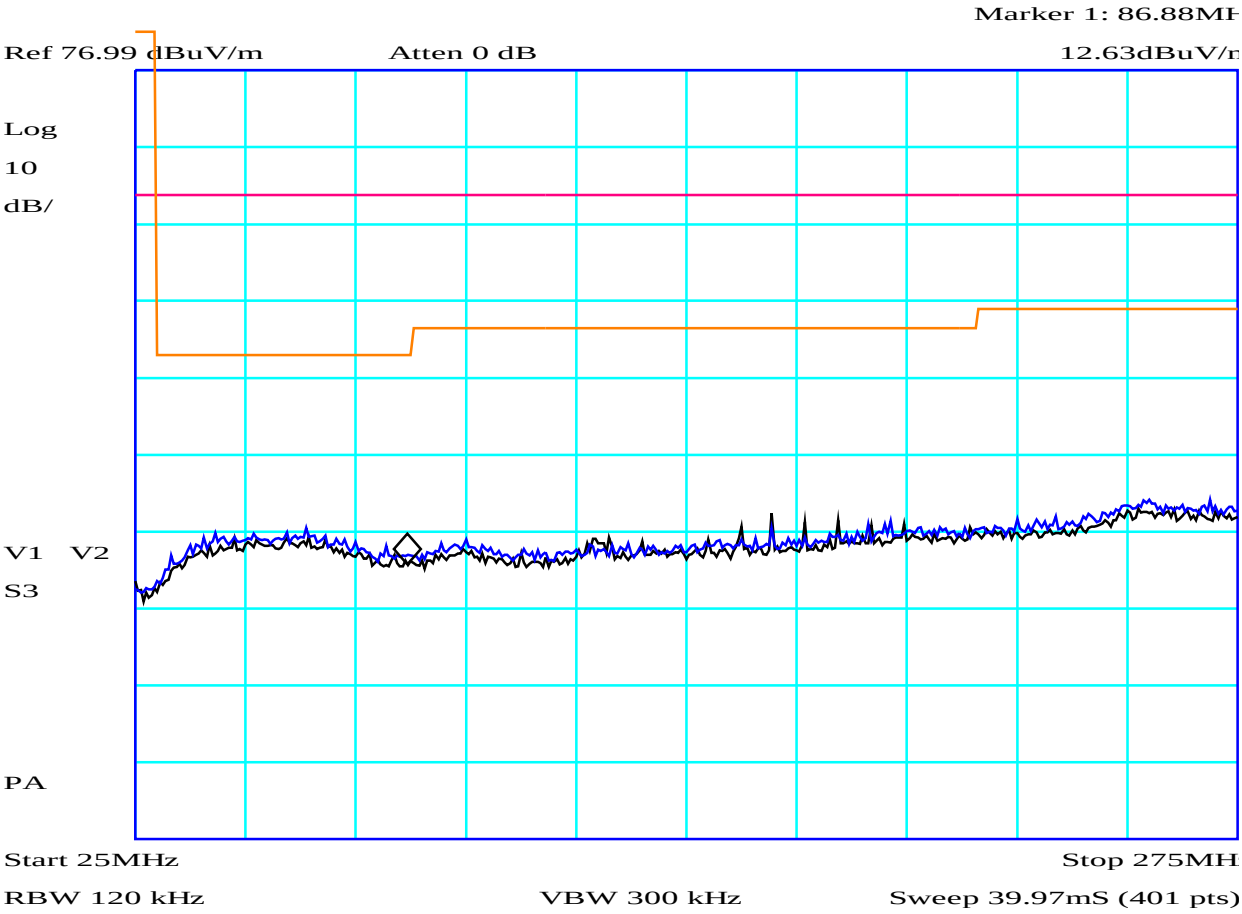
PLOT 10 Radiated Emissions - 250MHz to 1GHz - GSM Control Circuit Active

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:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

GSM control circuit active.

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	4
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99197E5		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

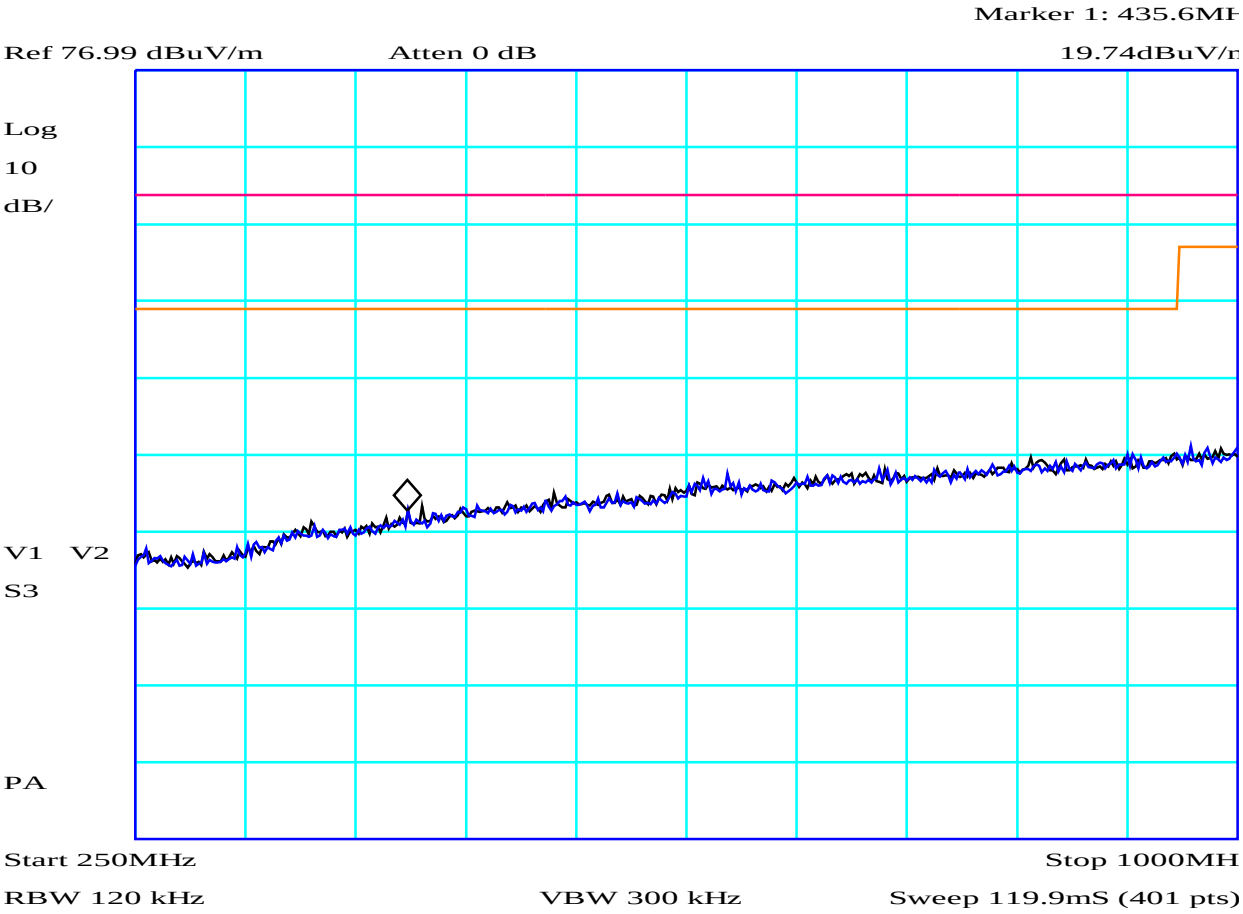
PLOT 11 Radiated Emissions - 25MHz to 275MHz - Siren On

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:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Siren on.

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	5
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99197E8		



CF1:A24_3m_090306 CF2:CBL059_CBL062_CBL065_CBL060_090306

PLOT 12 Radiated Emissions - 250MHz to 1GHz - Siren On

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:(ORG)	FCC(B)@3m
Limit3:		Limit4:	

Siren on.

Black - Vertical
Blue - Horizontal

Facility:	Anech_2	Height	1m	Mode:	5
Distance	3m	Polarisation	V+H	Modification State:	0
Angle	0-360	File:	H99197EB		