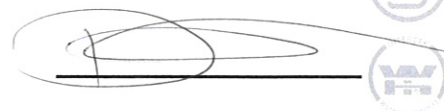


**EMC TEST REPORT****COMPANY: SMITHS DETECTION****PRODUCT : TESTING TO CFR47 Part15:247  
ON A SMITHS DETECTION  
ADRS RADIO MODEM RM013****REPORT : EM09042278a****WRITTEN BY: D Feasey****REVIEWED BY: D Griffin****TEST ENGINEER: D Feasey****ISSUE: 5****DATE: May 13<sup>th</sup> 2010****TOTAL PAGES: 86**

## **JOB DESCRIPTION**

**Equipment:** ADRS Radio Modem transmitterr operating in the frequency band 902 to 928MHz

**Equipment Model No.:** RM013

**Equipment Serial No.:** 900011

**Phase:** Compliance

**Customer:** Smiths Detection (Watford)

**Test Plan Reference:** -

**Test Standards:** CFR47 Part15:247

**FCC Ident** X4M - 16852

**Test Location:** Intertek Semko - Leatherhead

**Test Work Started:** 3<sup>rd</sup> November 2009

**Test Work Completed:** 5<sup>th</sup> May 2010

## 1. TEST SUMMARY

### 1.1. ADRS Radio Modem – RM013

#### 1.1.1. CFR 47 Part 15:247

Test Standards		Test	COMMENT
CFR47 15:247.a(1)	RSS 210 A8.1	channel separation	Pass
CFR47t15:247.a(1)	RSS 210 A8.1	20 dB Bandwidth	Pass
CFR47 15:247.a(1)(1)	RSS 210 A8.1	Dwell Time	Pass
CFR47 15:247.a(1)(111)	RSS 210 A8.1	Number of hopping channels	Pass
CFR47 15:247.b(1)	RSS 210 A8.4	RF Conducted Power	Pass
CFR47 15:247.d	RSS 210 A8.5	Radiated emissions	Pass
CFR47 15:247.e	RSS 210 A8.2	Power Density	Note

Note: Not applicable to frequency hopping systems

#### 1.1.2. CFR 47 Part 15

Product Specific Standard: CFR47 Part 15C

TEST STANDARD		TEST	Comment
CFR47 15: 209	RSS 210. 2.7 Table 1	Radiated Emissions (Note 1)	Pass
CFR47 15: 205	RSS 210: 2.7 Table 2	Restricted Bands of Operation	Pass

Note 1: This test was carried out in a FCC registered chamber, which plies with FCC limits for Radiated Emissions over the frequency range 30MHz to 1000MHz.. There is an emission at 640MHz which has an amplitude within the uncertainty budget.

All the above tests have been carried out to meet the requirements of ANSI C63.4:2003 Test procedures.

## **2. EQUIPMENT UNDER TEST (EUT)**

### **2.1. Description of the EUT**

The Smiths Detection (Watford) Automatic Detection Reporting System (ADRS) Radio Modem enables a collection of Fixed Site Chemical Detectors (FSD) to be combined into a wireless network reporting to a single location to provide centralized recording of FSD data and control and monitoring of the FSDs. Each FSD is connected to a Radio Modem (outstation) which communicates with another Radio Modem (Base Station) connected to a controller Laptop. The Radio Modems also have built in Global Positioning System (GPS) receivers that are activated at startup to obtain position co-ordinates.

The ADRS unit operates in the frequency sub-band of 902MHz to 928MHz and can be powered by internal batteries (6vdc) or powered externally (12vdc – 30vdc). The frequencies tested were 902MHz, 915MHz and 927MHz.

The EUT was as received with no external visible signs of damage and was of production quality.

### **2.2. EUT's Modes of Operation**

All tests are performed with Frequency modulation producing a maximum of 1.6W radiated power unless stated otherwise.

Standard test mode waveform profile is 16KF1D.

### **2.3. EUT Configuration Diagram**

See test set up photographs.

### **2.4. EUT Support Equipment**

Software control computer

### **2.5. Cables Associated With the EUT**

EUT PORT	TYPE	LENGTH (m)	TERMINATION/LOAD
EUT	multicore	1.5m	Laptop controller

## **3. TESTS**

### 3.1. RF Conducted Power

The testing was performed in accordance with FCC CFR47 Part 15:247b (3).

### 3.2. SAR Evaluation

Refer Annex A for Radiated Exposure Levels report.

The RF power output was set to maximum power output (CW) and was measured at the antenna port connected directly to a Spectrum Analyser, at the lower, middle and upper frequencies.

### 3.3. RF Conducted Power Test Results

The RF power output was set to maximum power output (CW) and was measured at the antenna port connected directly to a Spectrum Analyser, at the lower, middle and upper frequencies.

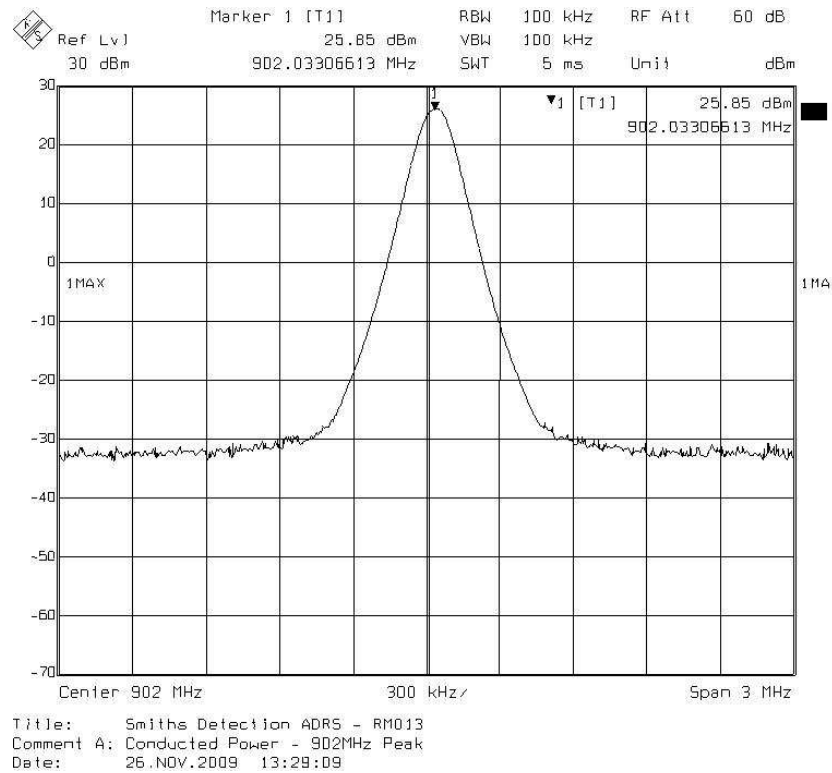
The results are given in Table 1 and pages 8 – 9. These tests were carried out on the 26<sup>th</sup> November 2009.

**Table 1**

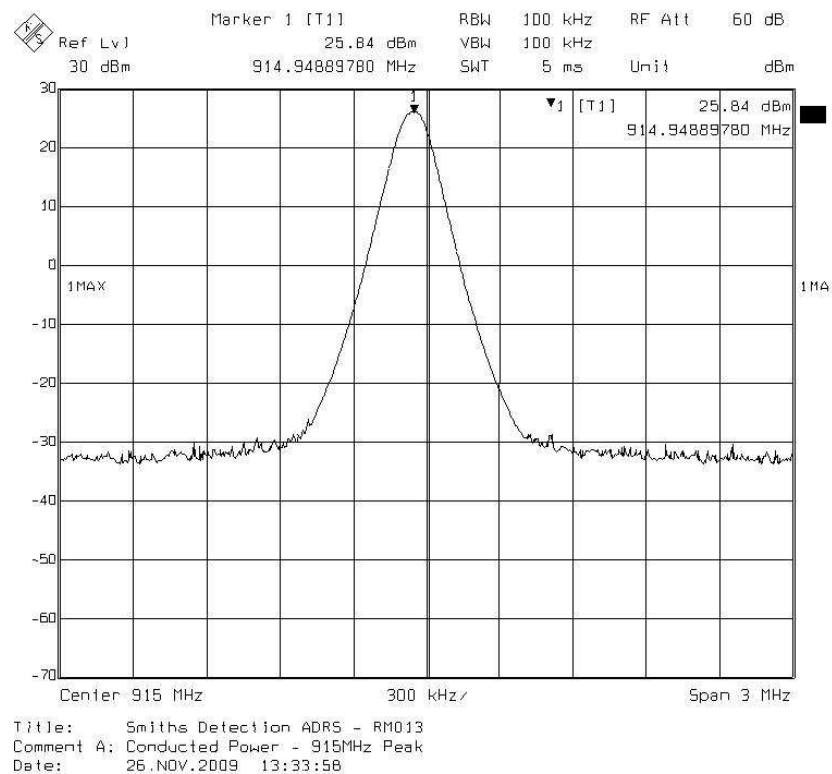
Freq MHz	Peak Power dBm	Peak Power mWatts
902	25.85	384.6
915	25.84	383.7
927	25.24	334.2

The duty cycle is defined in Operational Description in Annex 2.

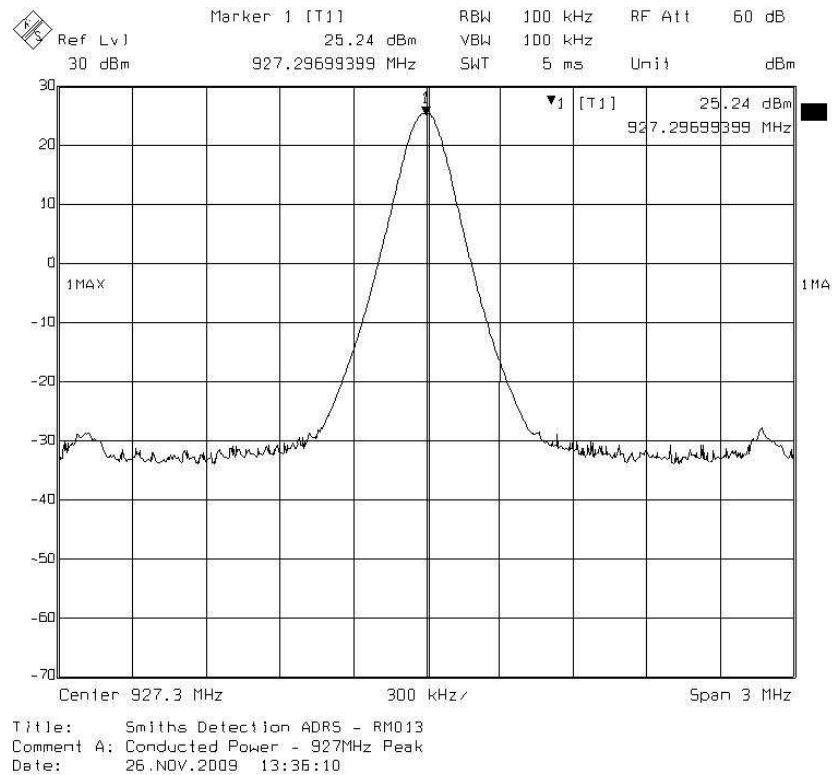
### 3.4. Test Plots – Conducted Power



902MHz Peak Power (367.28mW)



915MHz(366mW)



Peak Power 927.3MHz (334.2mW)

These tests carried out on the 26<sup>th</sup> November 2009

### 3.5. Modifications Performed During Testing

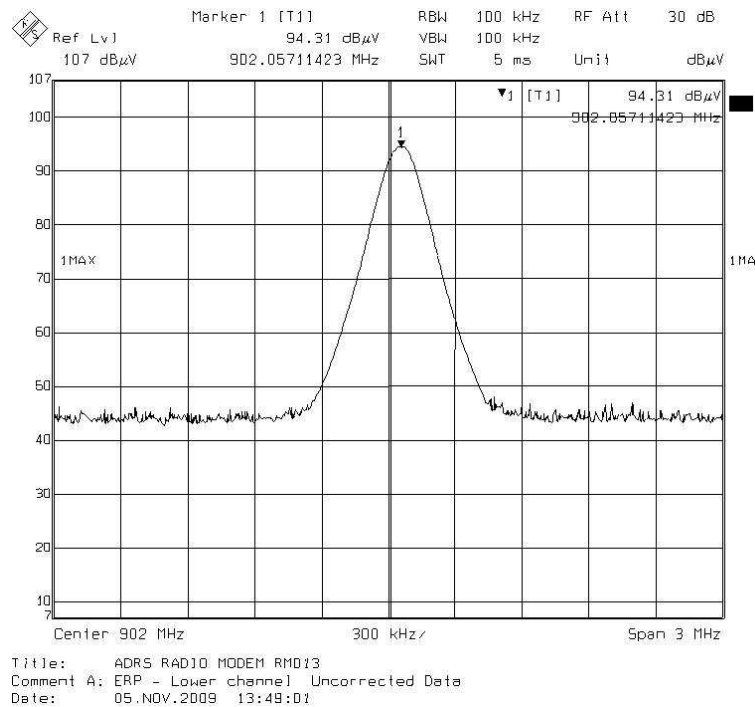
None.

### 3.6. RF Conducted Power Tests

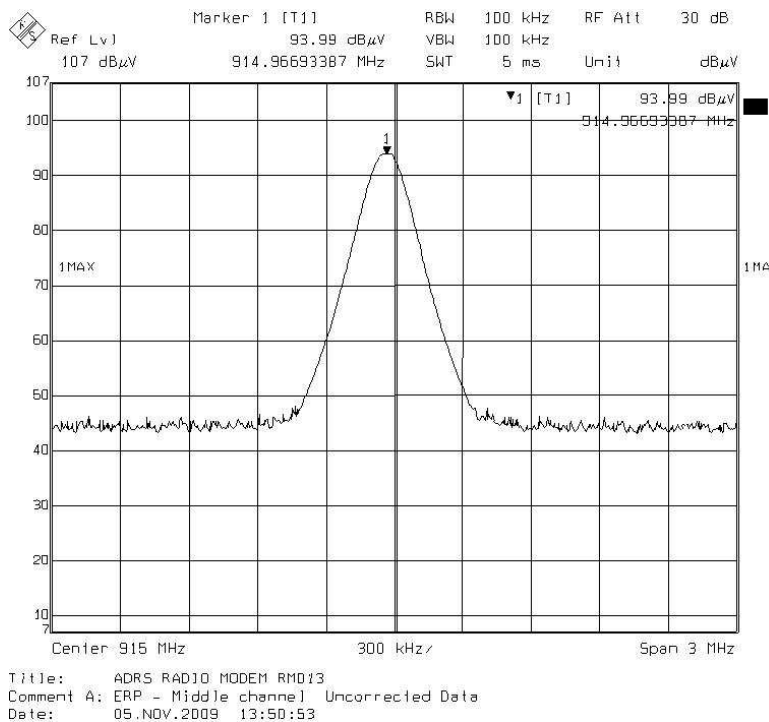
The EUT complied with CFR47:Part 15:247b(3)

### 3.7. Radiated Peak Powers

$$\begin{aligned} \text{EIRP} &= \text{Analyser dB}\mu\text{V(dBm)} + \text{AFdB} + \text{cab1} + \text{cab2} + \text{cab3} + \text{cab4} = \text{dBm} \\ \text{Field Strength(dB}\mu\text{V/m)} &= \text{Analyser(dB}\mu\text{V} + \text{AF(dBm)} + \text{cabs(dB)} \\ \text{EIRP} &= \text{Field Strength(dB}\mu\text{V/m)} - 95.2(\text{conversion from dB}\mu\text{V/m to dBm}) \end{aligned}$$

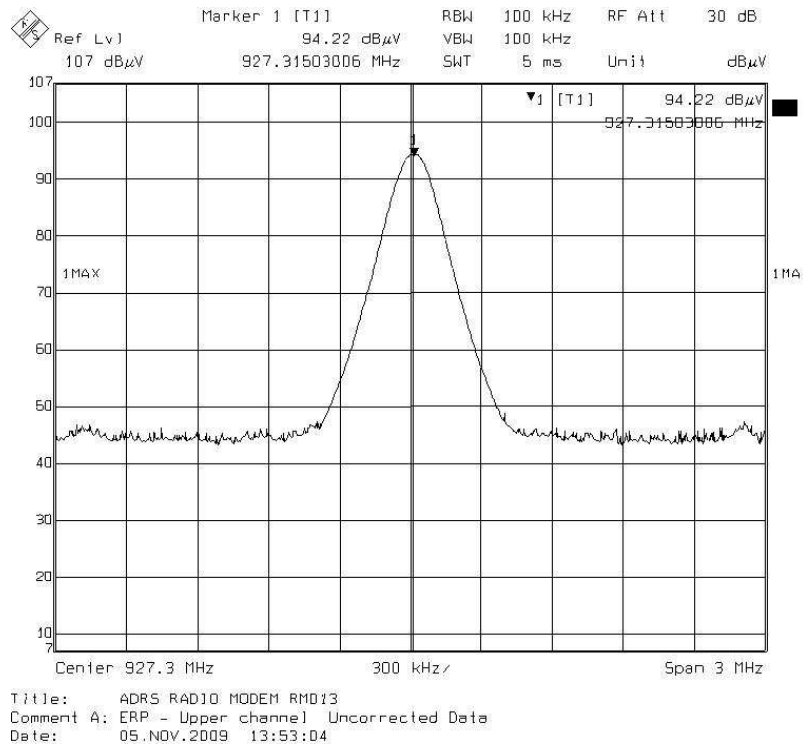


$$\begin{aligned} \text{EIRP} &= 94.31 + 21.2 + 7.7 - 95.2 = 28.01\text{dBm} \\ \text{EIRP} &= 632\text{mW} \end{aligned}$$



$$\text{EIRP} = 93.99 + 21.2 + 7.7 - 95.2 = 27.69\text{dBm} = 587\text{mW}$$



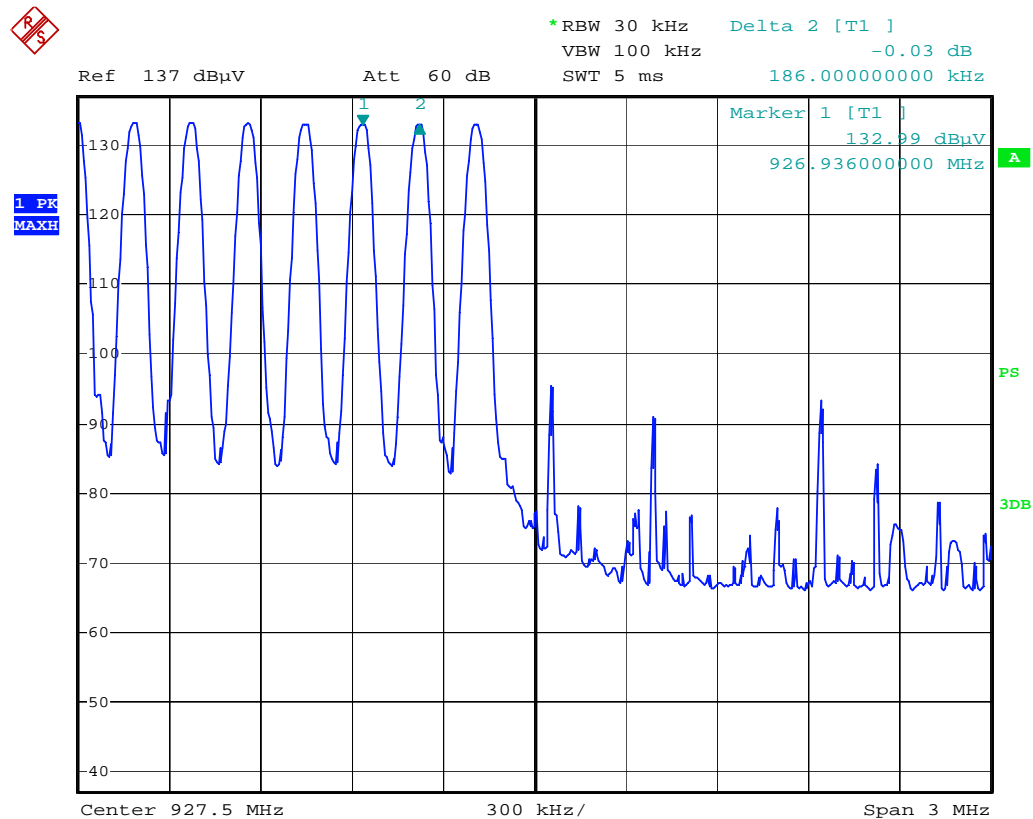


$$\text{EIRP} = 94.22 + 21.2 + 7.7 - 95.2 = 27.92 \text{ dBm} = 619 \text{ mW}$$

These tests carried out on the 5<sup>th</sup> November 2009

#### 4. HOPPING CHANNEL SEPARATION

Channel Separation (186.00kHz)



100 kHz RBW

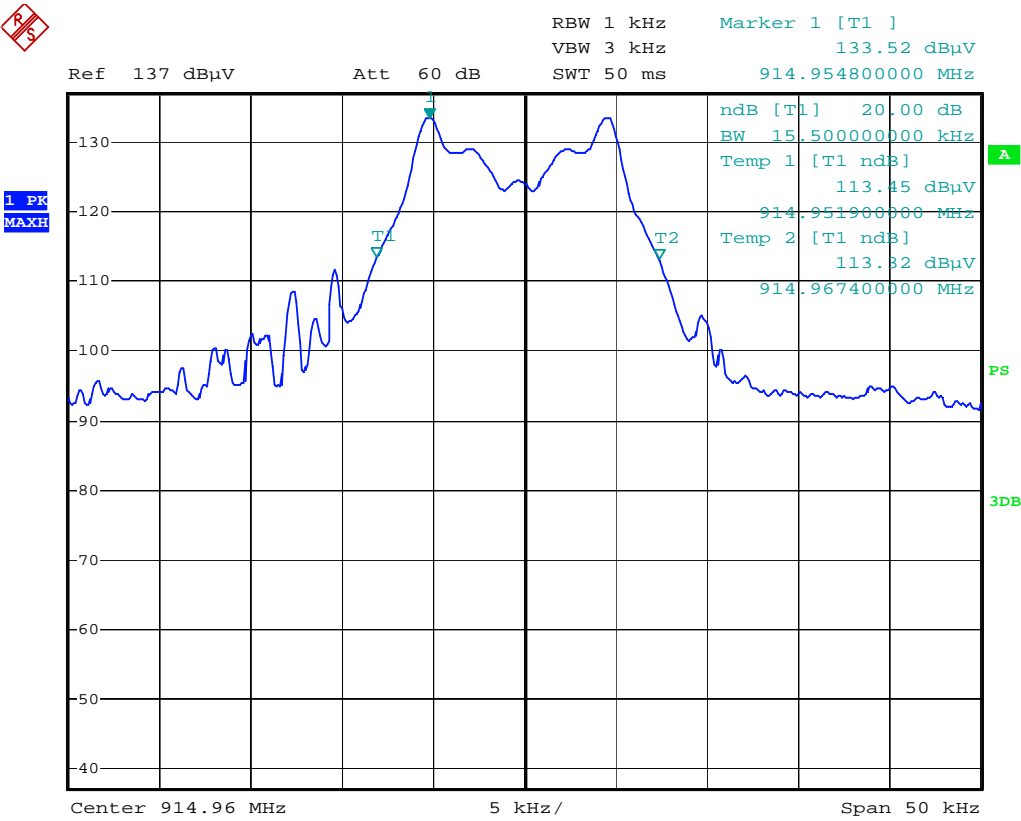
Date: 5.MAY.2010 13:53:37

#### 4.1. Pseudorandom Hopping and Receiver Hopping

The client attests that the receiver bandwidth hops in synchrony with the transmit bandwidth. This is necessary for the correct operation of the equipment.

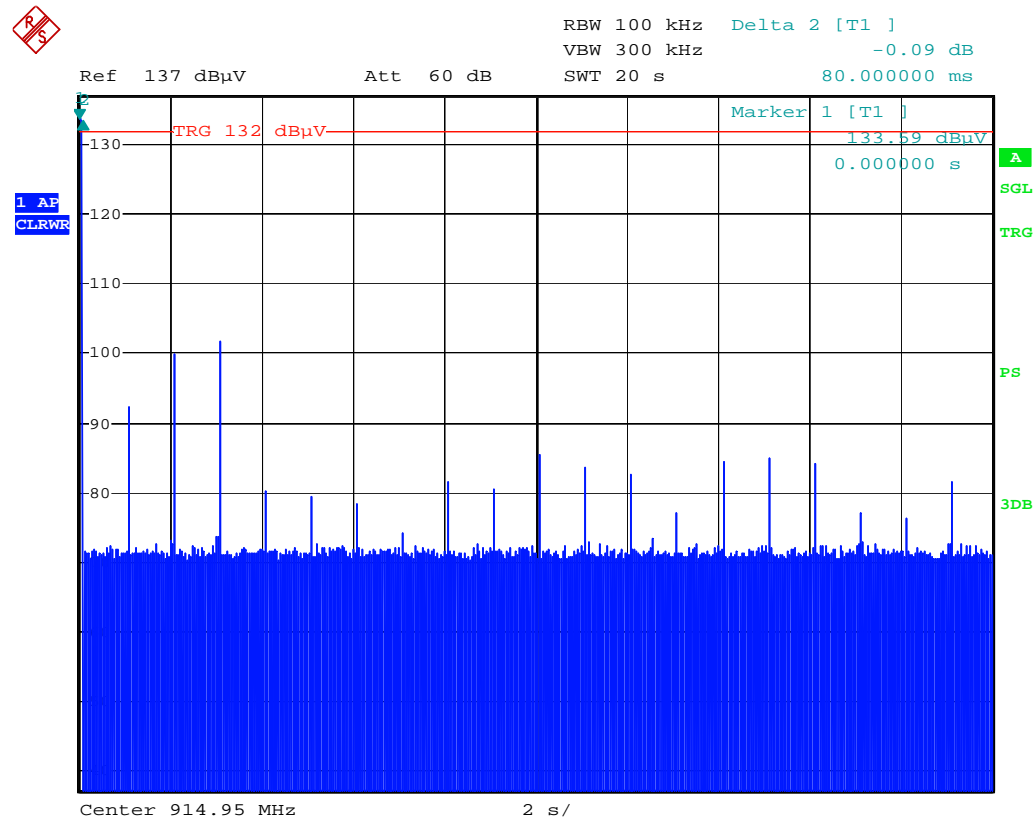
4.2. Hopping Channel Bandwidth

20dB Bandwidth(15.5 kHz)



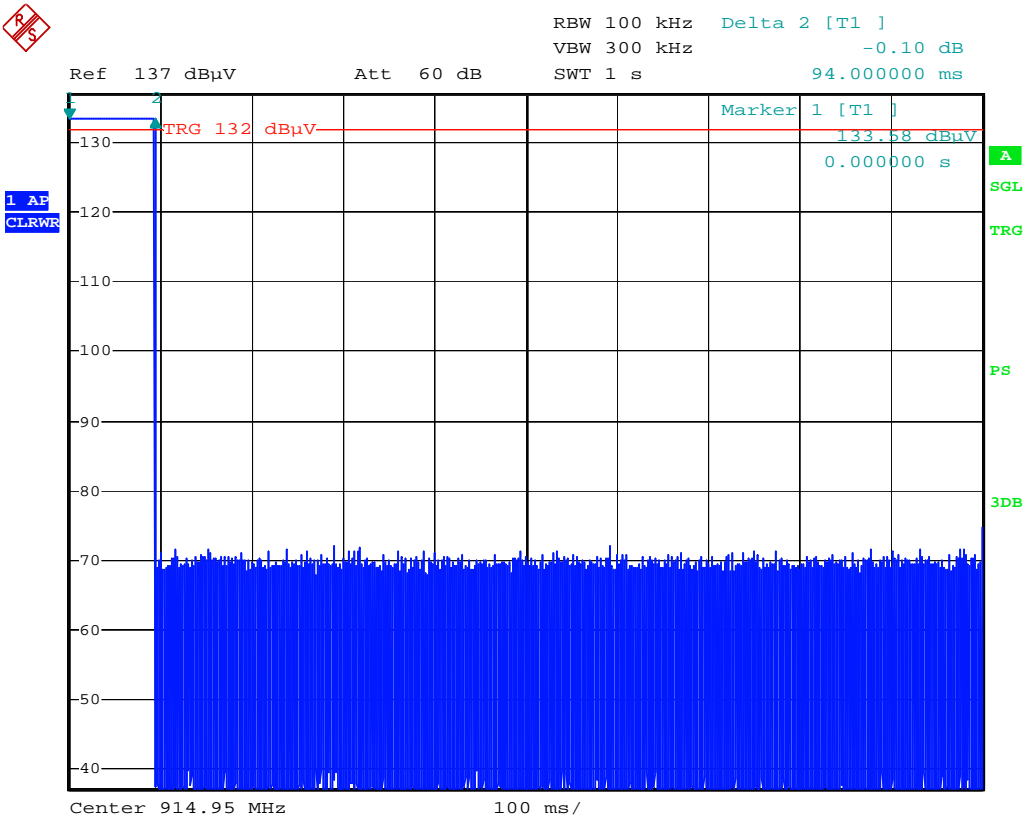
100 kHz RBW  
Date: 5.MAY.2010 10:46:45

4.3. Dwell Time

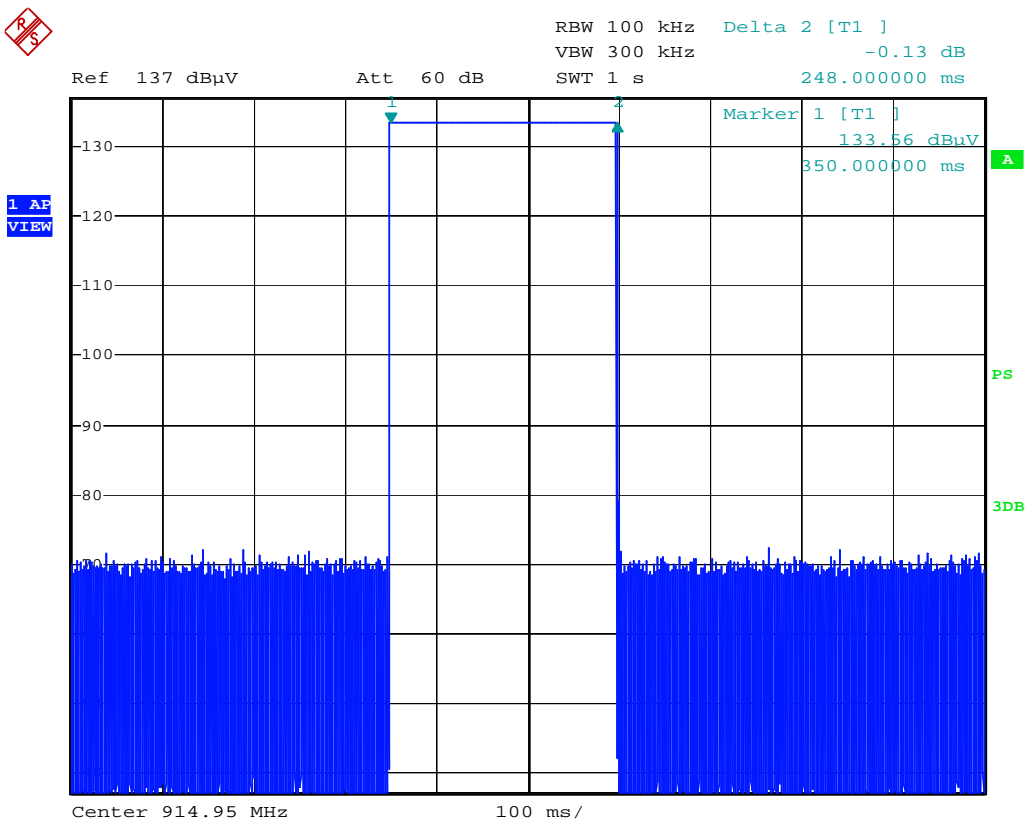


100 kHz RBW

Date: 5.MAY.2010 11:45:08

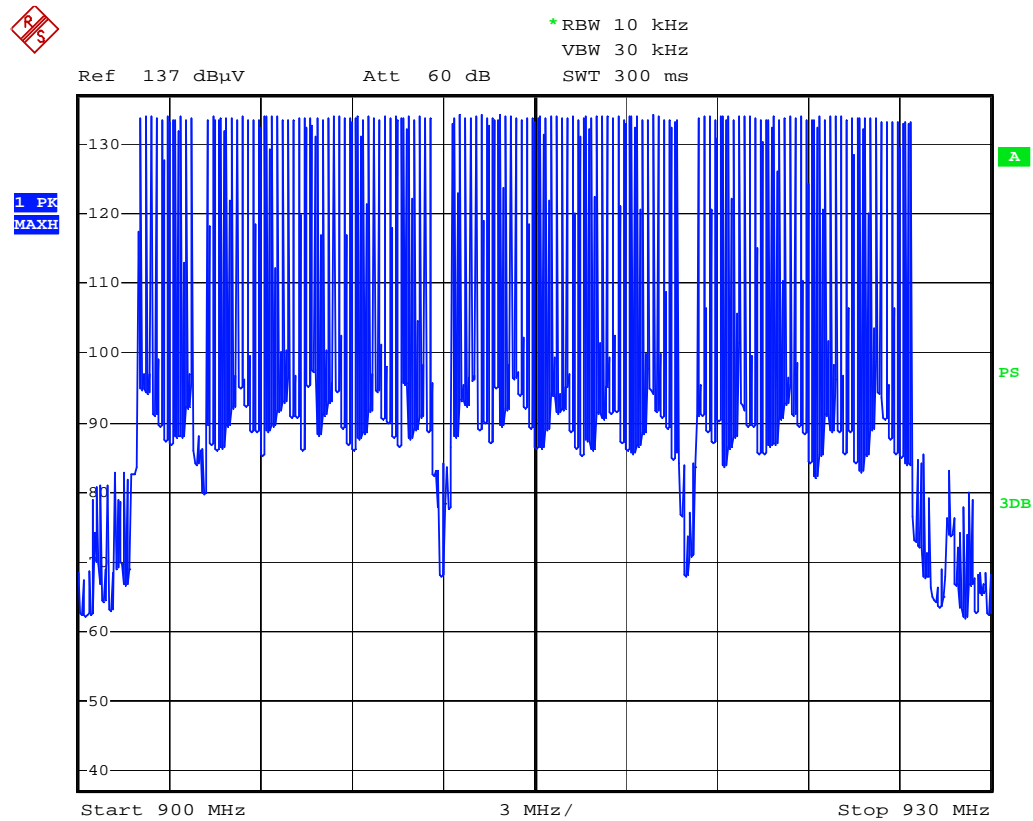


100 kHz RBW  
Date: 5.MAY.2010 11:51:13



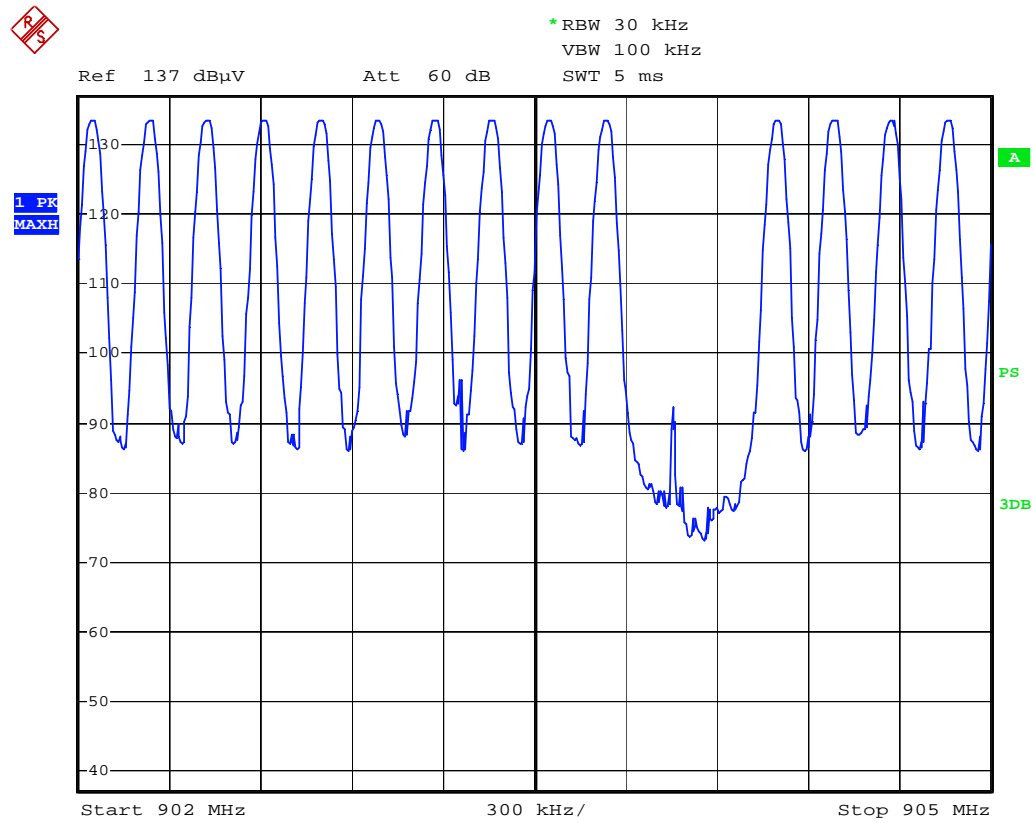
100 kHz RBW  
Date: 5.MAY.2010 11:55:05

## 4.4. Number of Hopping Channels



100 kHz RBW

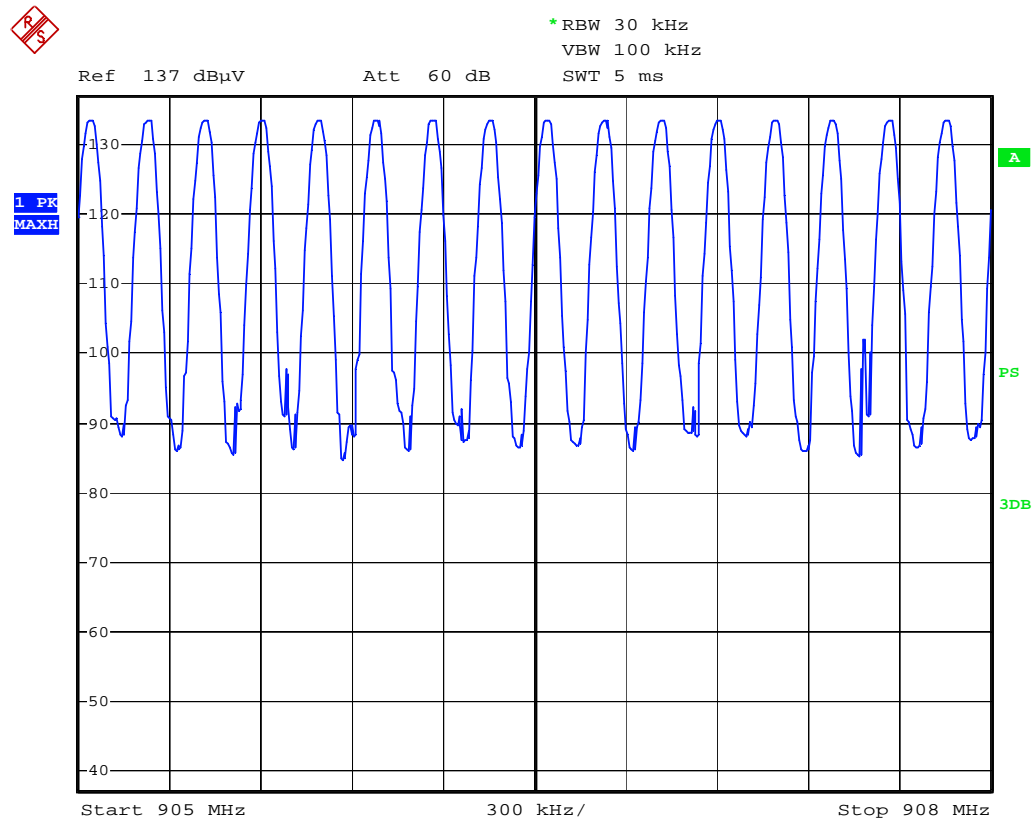
Date: 5.MAY.2010 12:48:51



100 kHz RBW

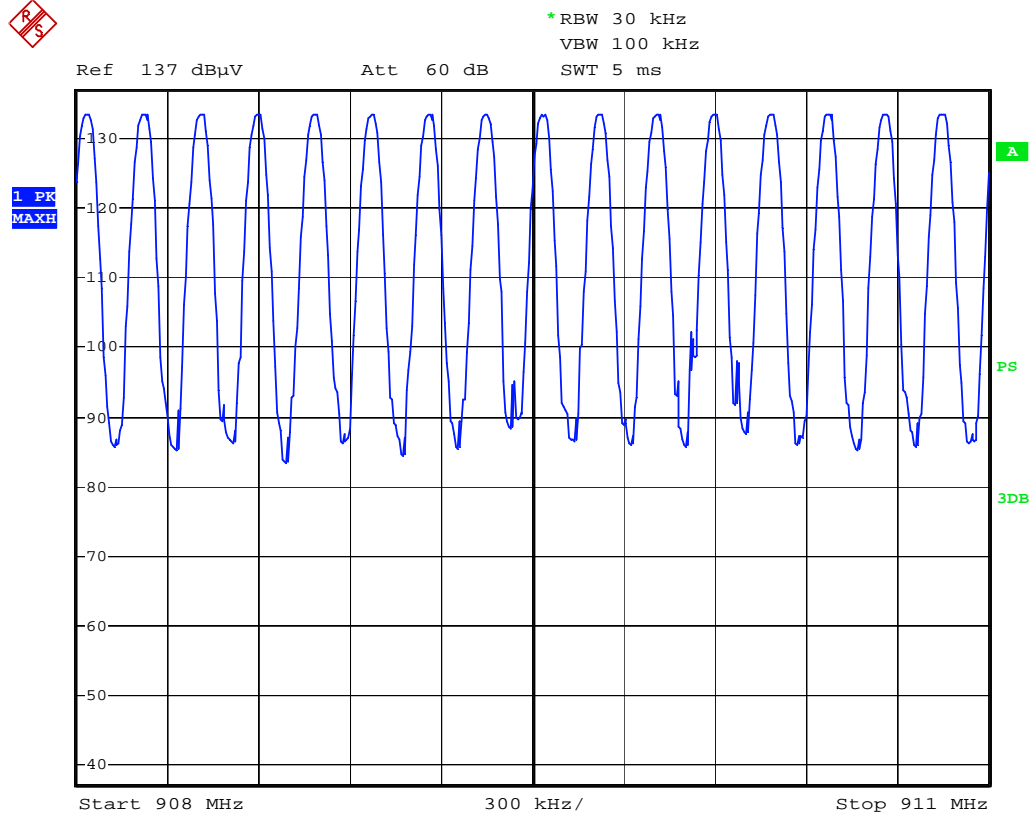
Date: 5.MAY.2010 12:59:46





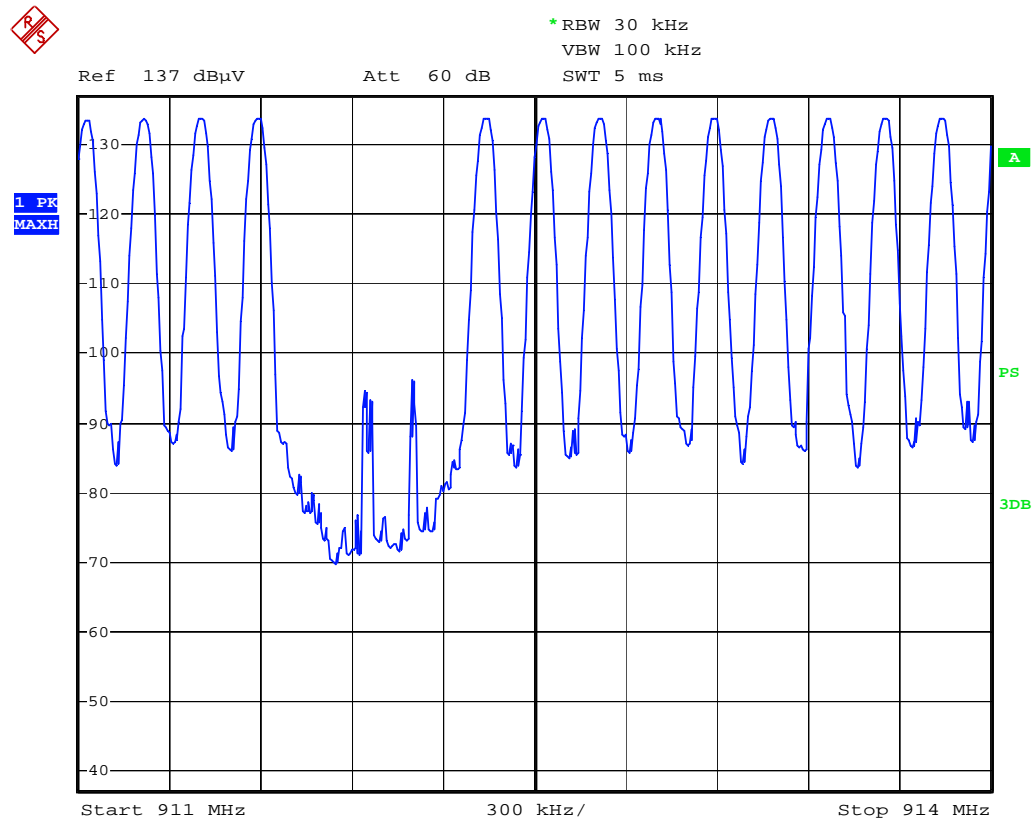
100 kHz RBW

Date: 5.MAY.2010 13:05:23



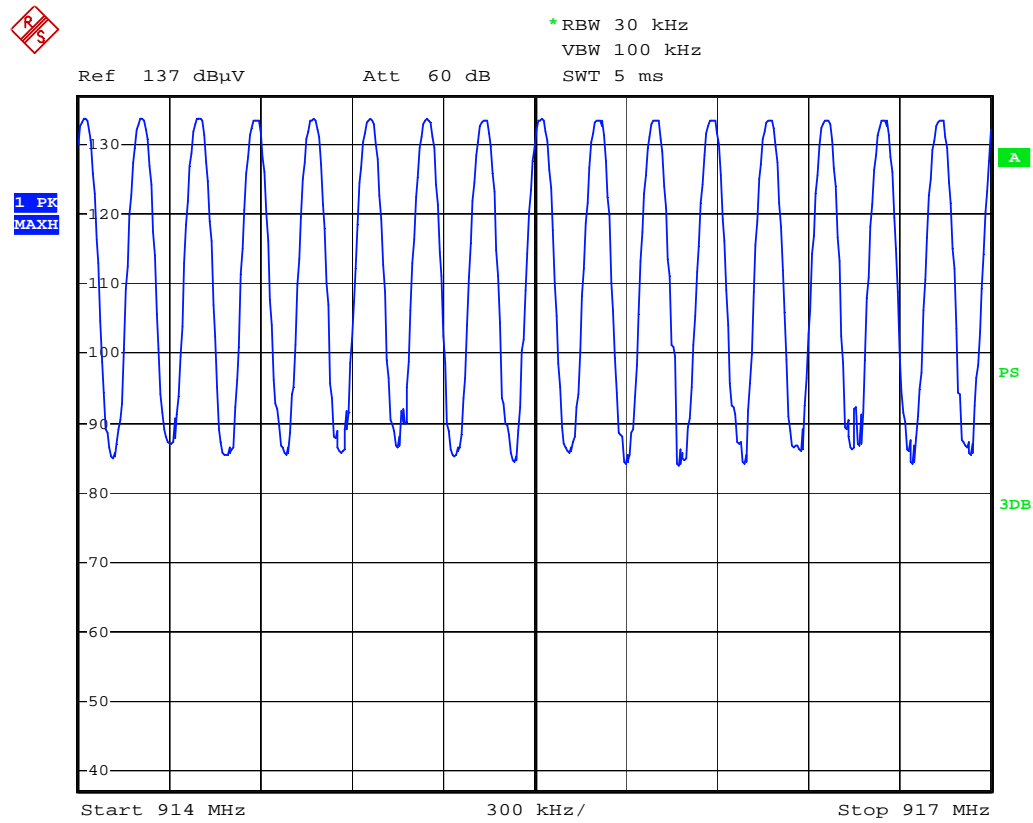
100 kHz RBW

Date: 5.MAY.2010 13:12:16



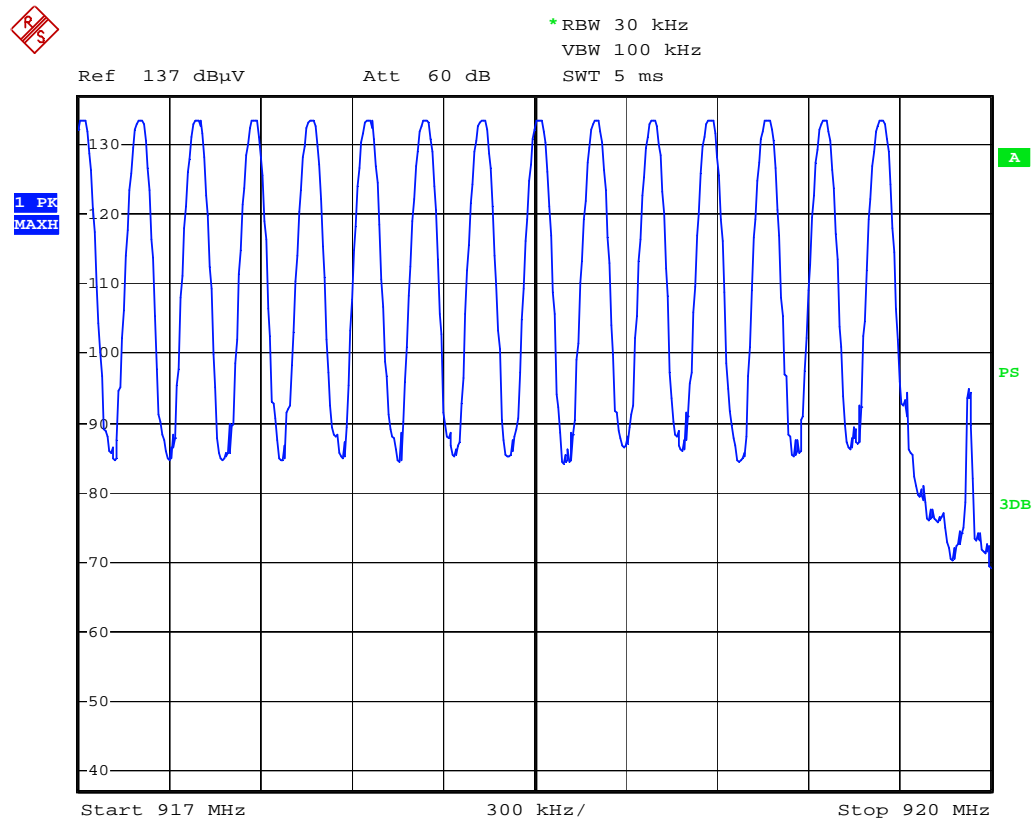
100 kHz RBW

Date: 5.MAY.2010 13:18:09



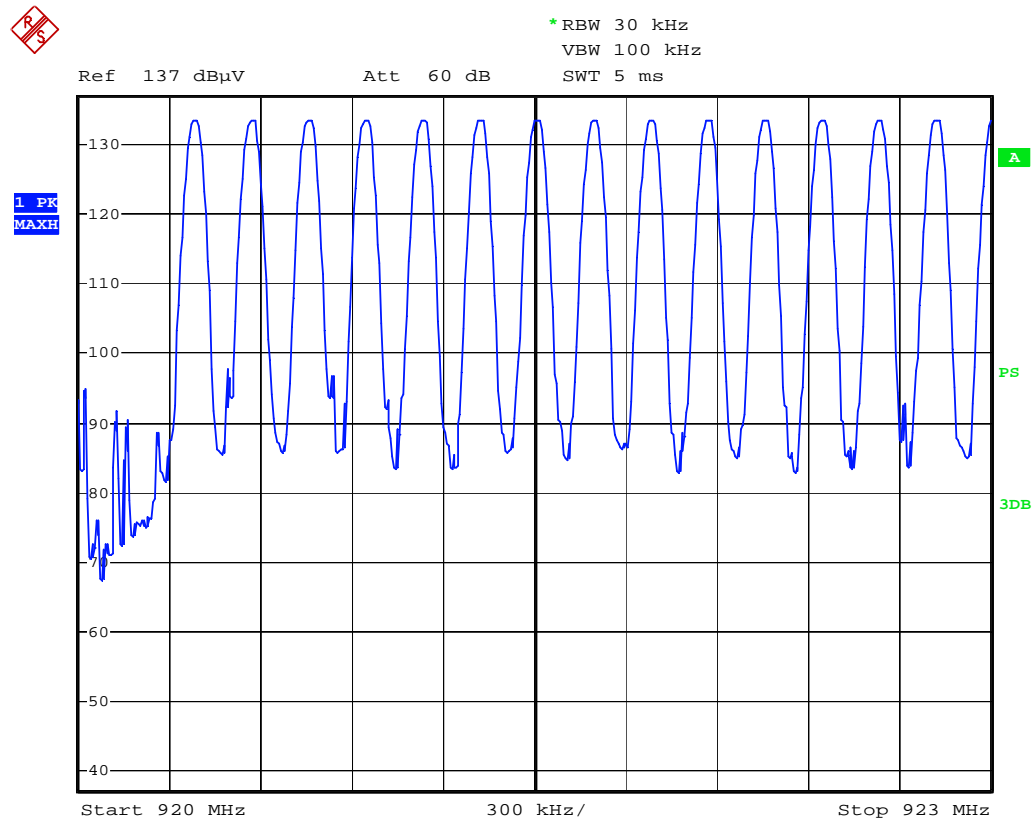
100 kHz RBW

Date: 5.MAY.2010 13:24:15



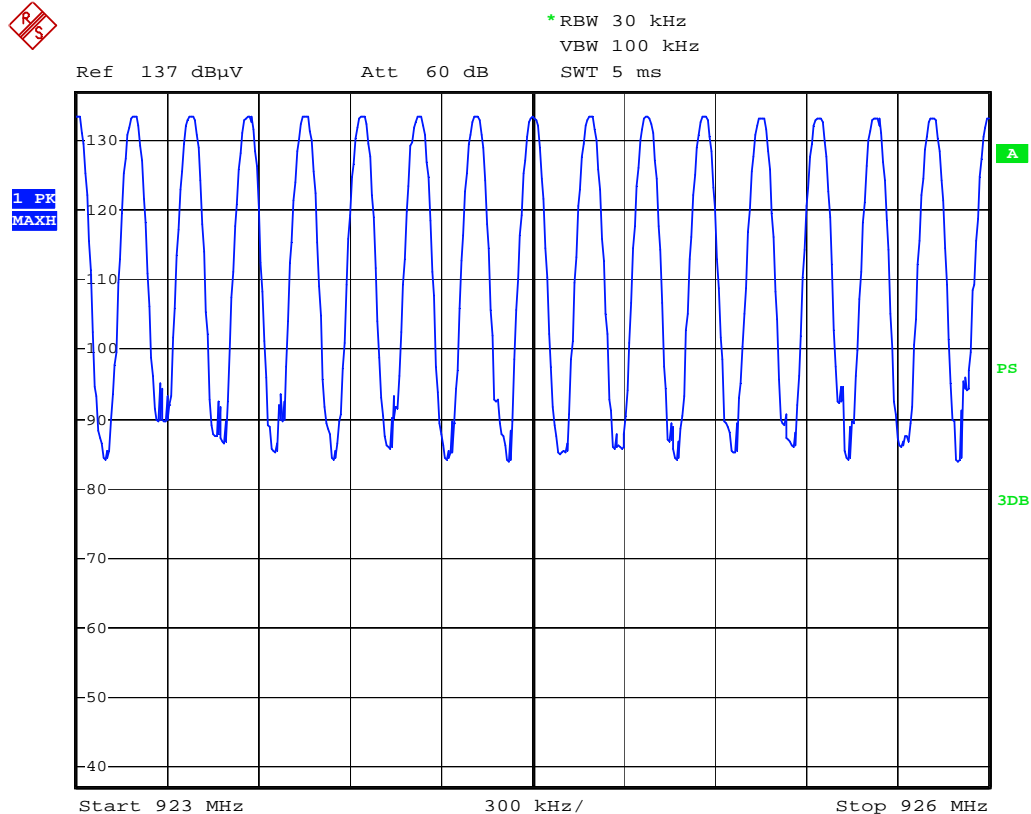
100 kHz RBW

Date: 5.MAY.2010 13:29:37



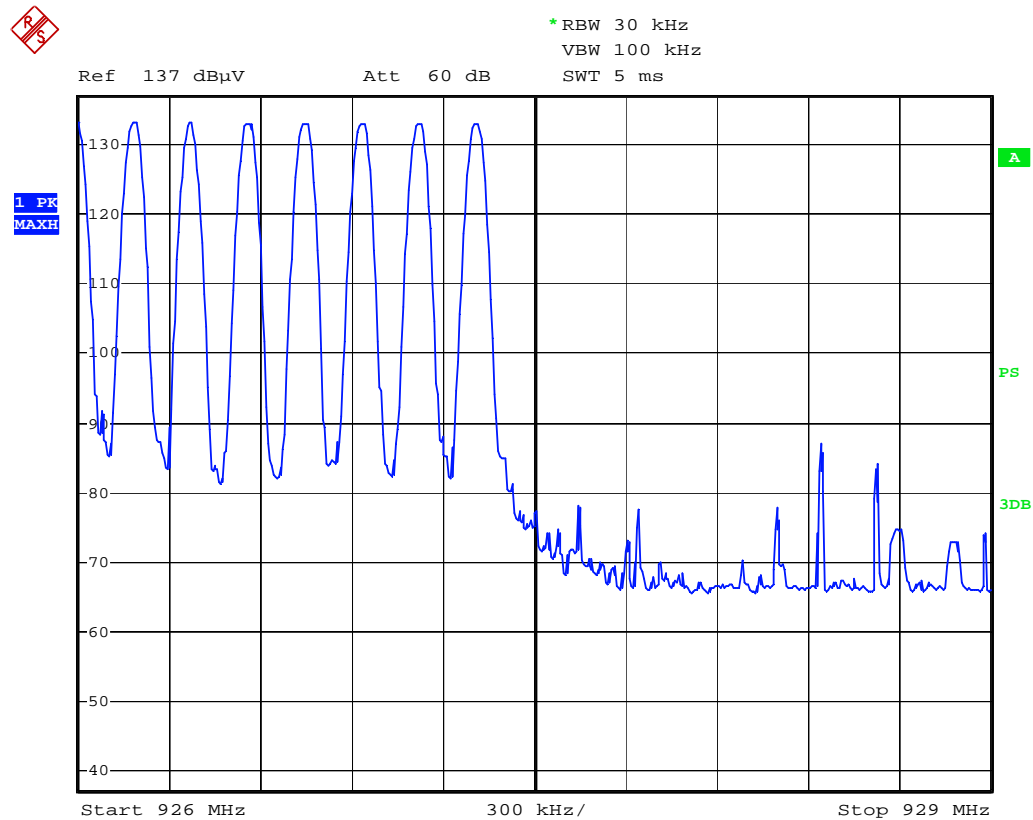
100 kHz RBW

Date: 5.MAY.2010 13:35:01



100 kHz RBW

Date: 5.MAY.2010 13:44:58



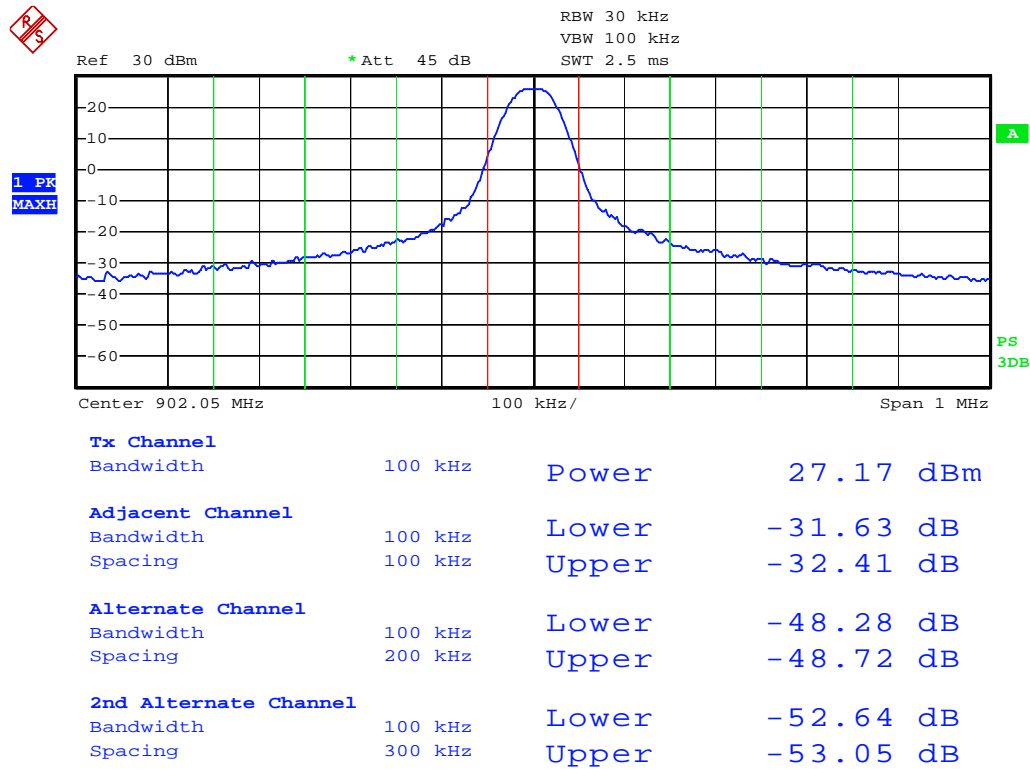
100 kHz RBW

Date: 5.MAY.2010 13:48:49



## 4.5. Band Edge Compliance

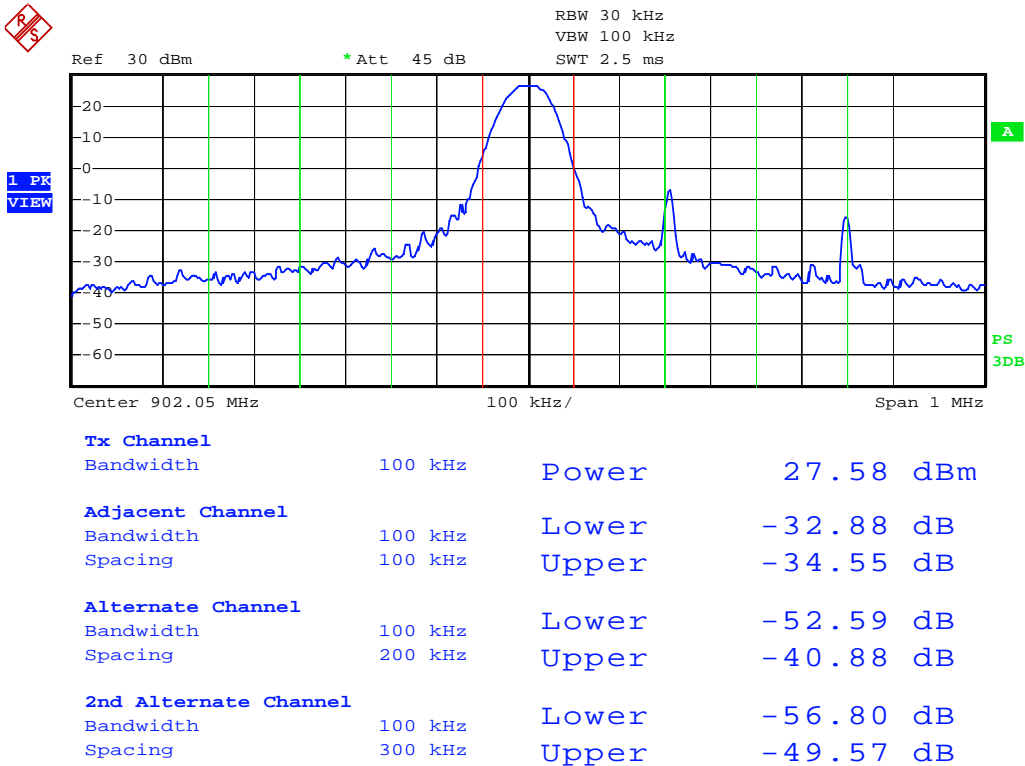
### Low end of band – Continuous Transmission



100 kHz RBW

Date: 5.MAY.2010 16:29:36

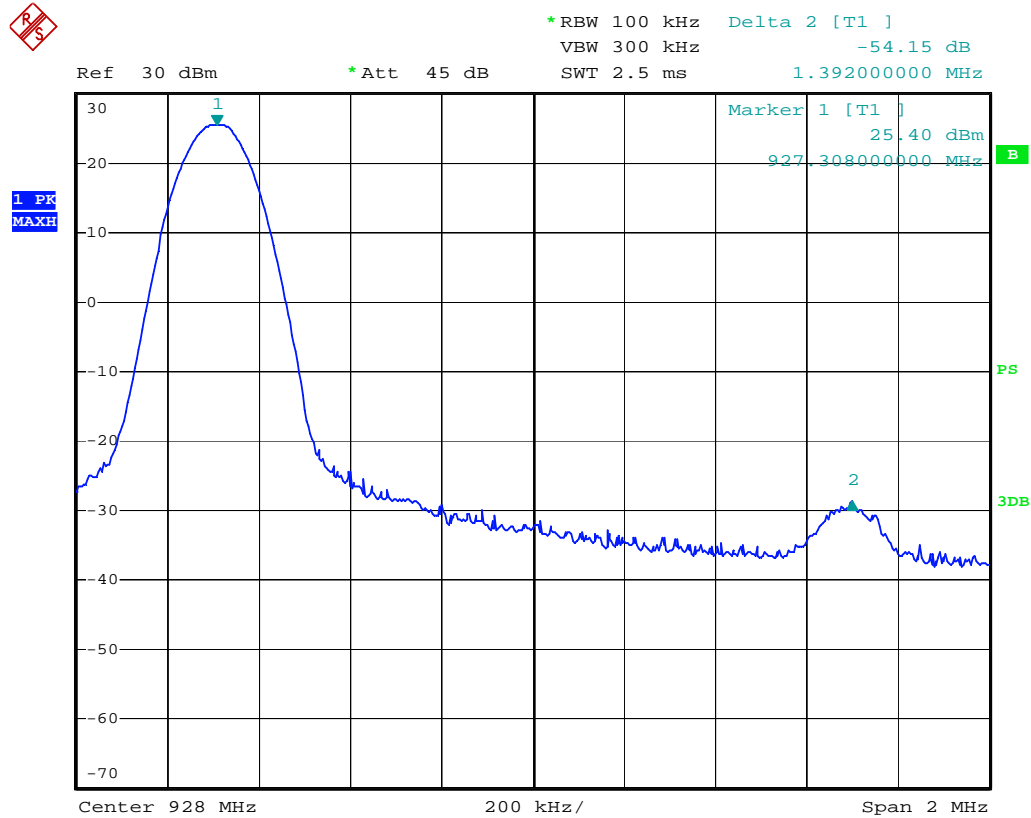
Low end of band – Hopping Transmission



100 kHz RBW

Date: 5.MAY.2010 16:17:07

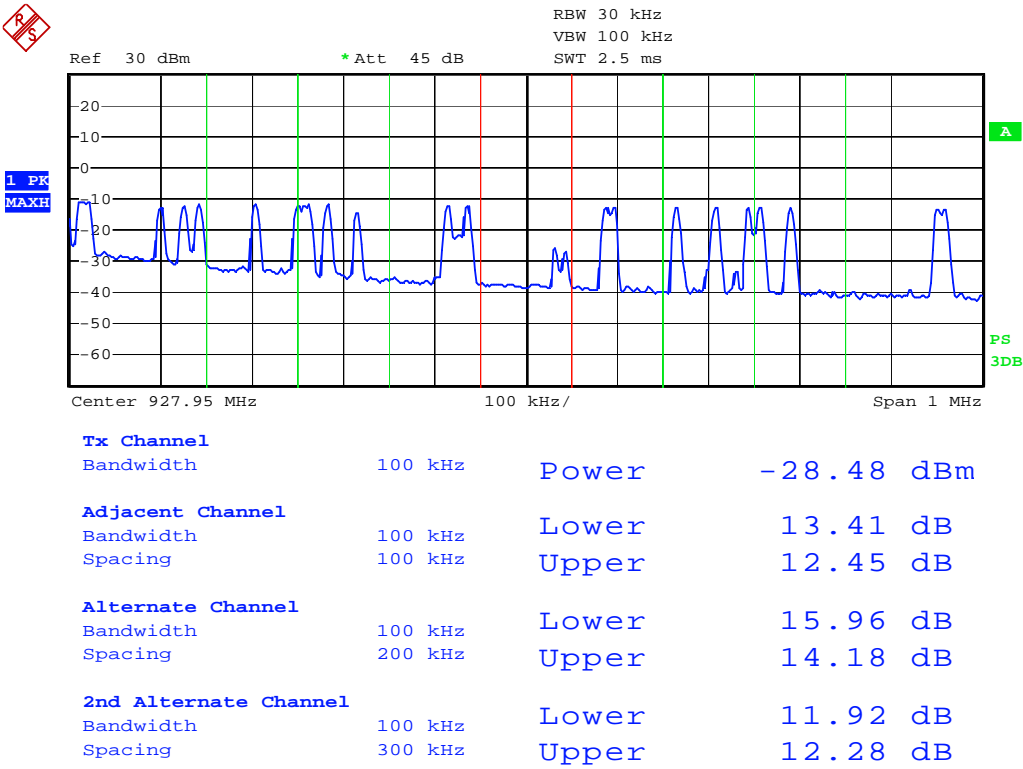
## High end of band – Continuous Transmission



100 kHz RBW

Date: 5.MAY.2010 16:27:35

High end of band – Hopping Transmission



100 kHz RBW

Date: 5.MAY.2010 16:20:00

## **5. RADIATED EMISSIONS < 1000MHZ**

### **5.1. Test Procedure**

These tests were carried out using an FCC registered test site at a distance of 3 metres and an automated test system covering the frequency range 30MHz to 1000MHz. Tests were carried out in both transmit and receive modes. These tests were carried out on the 26<sup>th</sup> November 2009.

There is an emission at 640MHz which is a pass within the uncertainty band.

The emissions at 640MHz results are below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance is more probable than non-compliance with the specification limit.

Table 2 and graph 1 shows the results for the ADRS Radio Modem RM013 in transmit mode.

Table 3 and graph 2 show the results for the ADRS Radio Modem RM013 in receive mode.

**Table 2**

EM0902278

26 Nov 2009 11:02

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Display face Lower Frequency - vertical Polz - Continuous cw  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278j.dat : ADRS Radio modem - FCC radiated emissions

Scan Settings		(1 Range)		Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB

Transducer	No.	Start	Stop	Name
1	17	30MHz	1000MHz	7602
	18	30MHz	1000MHz	8183
	19	30MHz	1000MHz	7569
	21	30MHz	1000MHz	7287
	22	30MHz	1000MHz	8164

Final Measurement: Detector: X QP  
 Meas Time: 2sec  
 Subranges: 50  
 Acc Margin: 10 dB

**Final Measurement Results**

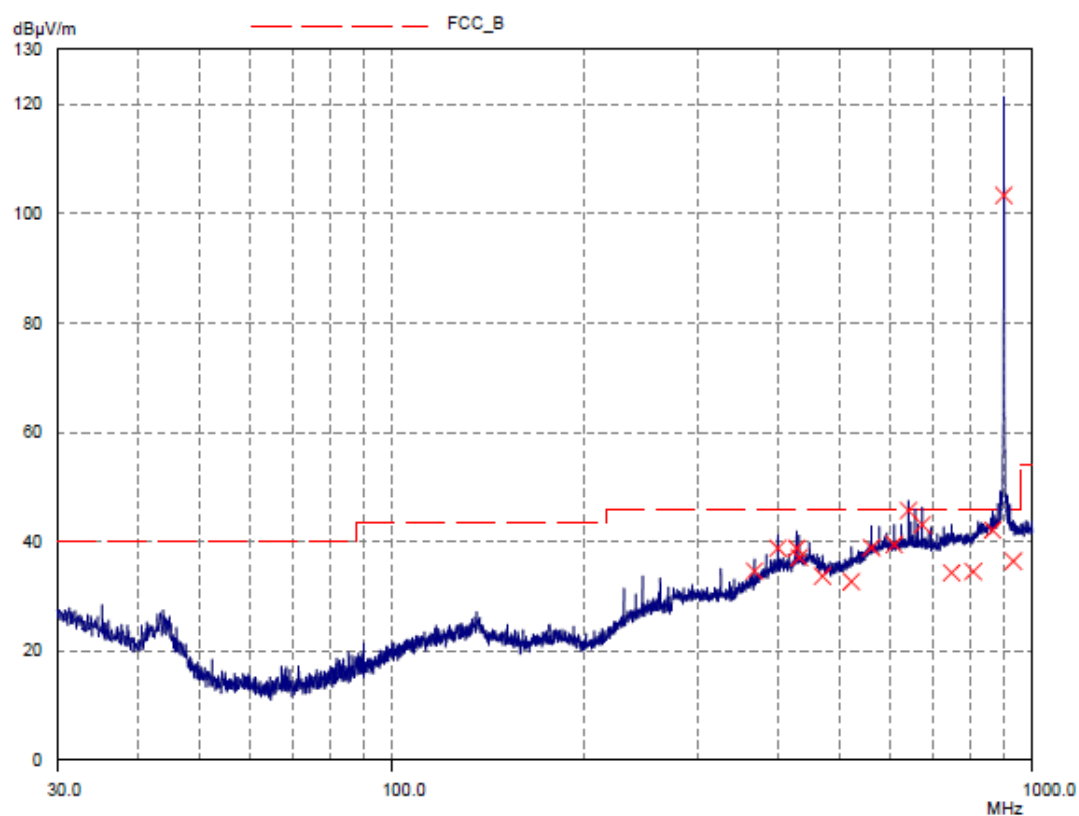
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
368.04	34.63	46.02	11.39
400.02	38.82	46.02	7.20
427.8	38.79	46.02	7.23
432.0	37.10	46.02	8.92
470.04	33.71	46.02	12.31
521.16	32.70	46.02	13.32
560.04	38.91	46.02	7.11
607.98	39.47	46.02	6.55
640.02	45.71	46.02	0.31
672.0	43.12	46.02	2.90
746.88	34.31	46.02	11.71
807.48	34.56	46.02	11.46
866.16	42.08	46.02	3.94
902.04	103.33*	46.02	-57.31
932.52	36.46	46.02	9.56

## Graph 1

Scan Settings			(1 Range)		Receiver Settings				
Start	Frequencies	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz		60kHz	120kHz	PK	20msec	Auto	ON	60dB

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:    2sec  
                                 Subranges:    50  
                                 Acc Margin:   10 dB



**Table 3**

EM0902278

26 Nov 2009 11:25

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Display face Middle Frequency - vertical Polz - Continuous cw  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278k.dat : ADRS Radio modem - FCC radiated emissions

Scan Settings		(1 Range)		Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB
Transducer	No.	Start	Stop	Name				
1	17	30MHz	1000MHz	7602				
	18	30MHz	1000MHz	8183				
	19	30MHz	1000MHz	7569				
	21	30MHz	1000MHz	7287				
	22	30MHz	1000MHz	8164				
Final Measurement:		Detector:	X QP					
		Meas Time:	2sec					
		Subranges:	50					
		Acc Margin:	10 dB					

**Final Measurement Results**

Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
36.3	18.22	40.00	21.78
37.8	17.44	40.00	22.56
274.98	33.98	46.02	12.04
368.04	34.31	46.02	11.71
400.02	37.92	46.02	8.10
427.8	36.90	46.02	9.12
432.0	36.86	46.02	9.16
480.0	31.63	46.02	14.39
521.16	32.70	46.02	13.32
560.04	38.03	46.02	7.99
576.0	40.25	46.02	5.77
640.02	45.44	46.02	0.58
672.0	42.29	46.02	3.73
738.96	38.86	46.02	7.16
769.5	34.39	46.02	11.63
866.94	40.62	46.02	5.40
915.0	103.34*	46.02	-57.32
941.04	39.90	46.02	6.12

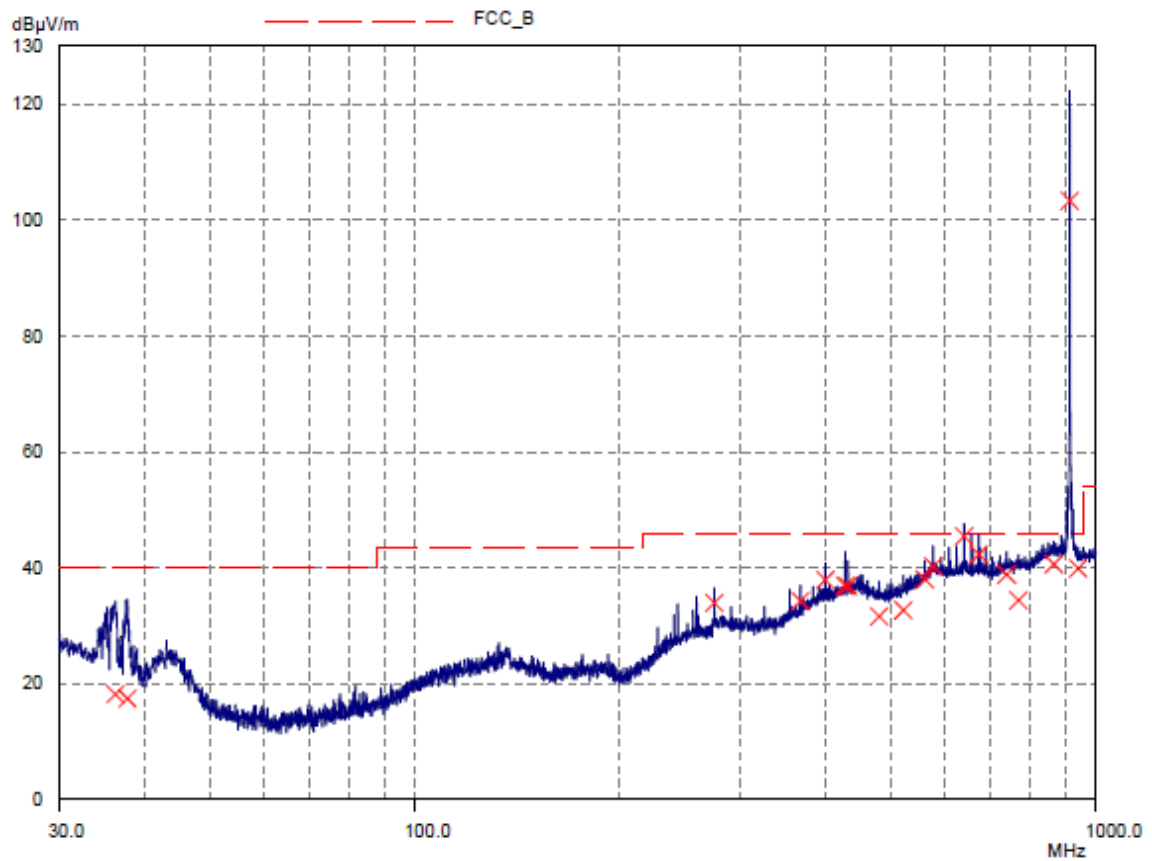


## Graph 2

Scan Settings			(1 Range)		Receiver Settings				
Frequencies									
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB	

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:      2sec  
                                 Subranges:      50  
                                 Acc Margin:      10 dB



**Table 4**

EM0902278

26 Nov 2001

**Radiated Emissions**

EUT: ADRS Modem RM 013  
Manuf: Smiths Detection  
Op Cond: 12VDC Power Supply  
Operator: D A Legge  
Test Spec: CFR47 Part15 -247  
Comment: Display face Upper Frequency - vertical Polz - Continuous cw  
Laptop connected as Basestation 1.5m connection lead  
Result File: 2278l.dat : ADRS Radio modem - FCC radiated emissions

**Scan Settings (1 Range)**

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto

Transducer	No.	Start	Stop	Name
1	17	30MHz	1000MHz	7602
	18	30MHz	1000MHz	8183
	19	30MHz	1000MHz	7569
	21	30MHz	1000MHz	7287
	22	30MHz	1000MHz	8164

Final Measurement: Detector: X QP  
Meas Time: 2sec  
Subranges: 50  
Acc Margin: 10 dB

**Final Measurement Results**

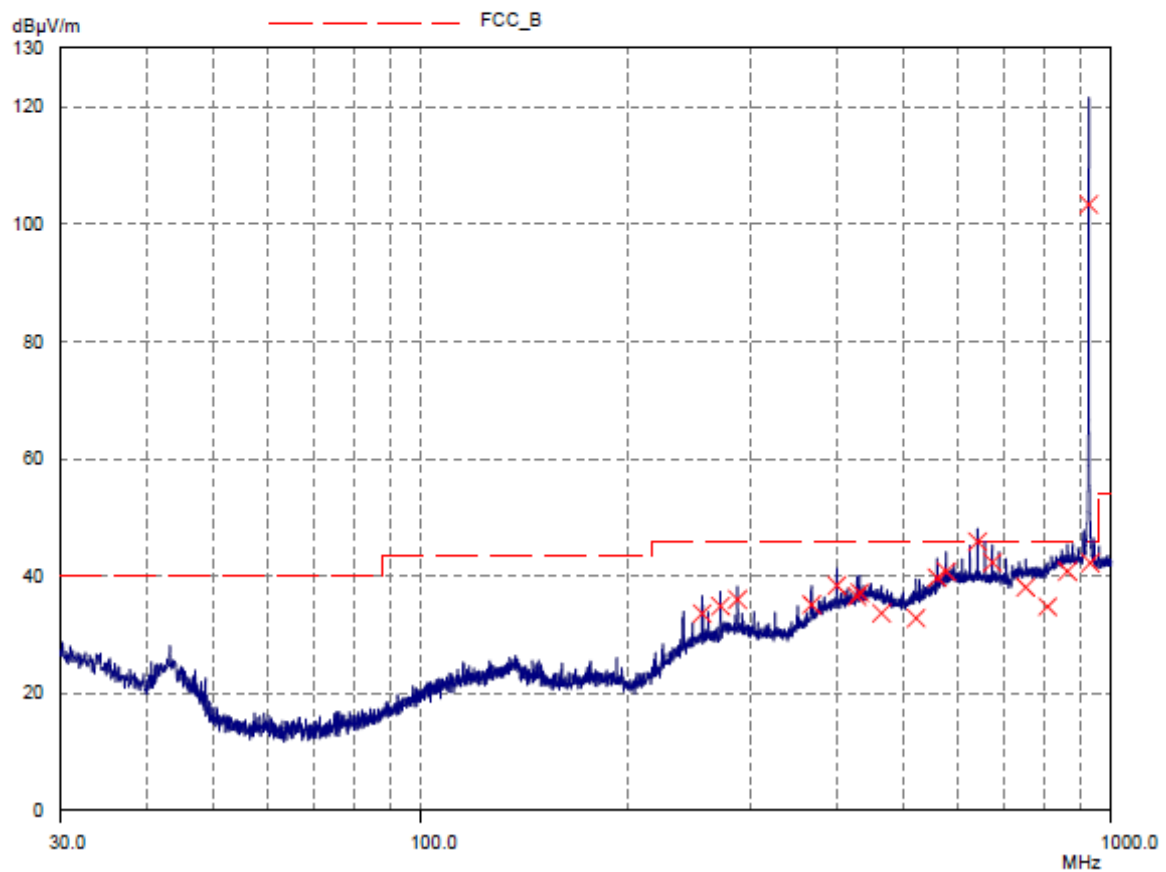
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
255.3	33.62	46.02	12.40
271.32	34.88	46.02	11.14
287.34	36.02	46.02	10.00
368.04	35.15	46.02	10.87
400.02	38.42	46.02	7.60
427.8	36.54	46.02	9.48
432.0	37.16	46.02	8.86
464.7	33.69	46.02	12.33
521.16	32.84	46.02	13.18
559.32	39.73	46.02	6.29
576.0	40.75	46.02	5.27
640.02	45.87	46.02	0.15
672.0	42.31	46.02	3.71
751.32	38.09	46.02	7.93
808.08	34.79	46.02	11.23
863.28	40.82	46.02	5.20
927.3	103.36*	46.02	-57.34
932.28	42.25	46.02	3.77

## Graph 4

Scan Settings			(1 Range)			Receiver Settings			
Frequencies									
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB	

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:    2sec  
                                 Subranges:    50  
                                 Acc Margin:   10 dB



**Table 5**

EM0902278

26 Nov 2009 12:16

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Display face Lower Frequency - vertical Polz - Burst Data  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278m.dat : ADRS Radio modem - FCC radiated emissions

**Scan Settings (1 Range)**

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB

Transducer	No.	Start	Stop	Name
1	17	30MHz	1000MHz	7602
	18	30MHz	1000MHz	8183
	19	30MHz	1000MHz	7569
	21	30MHz	1000MHz	7287
	22	30MHz	1000MHz	8164

Final Measurement: Detector: X QP  
 Meas Time: 2sec  
 Subranges: 50  
 Acc Margin: 10 dB

**Final Measurement Results**

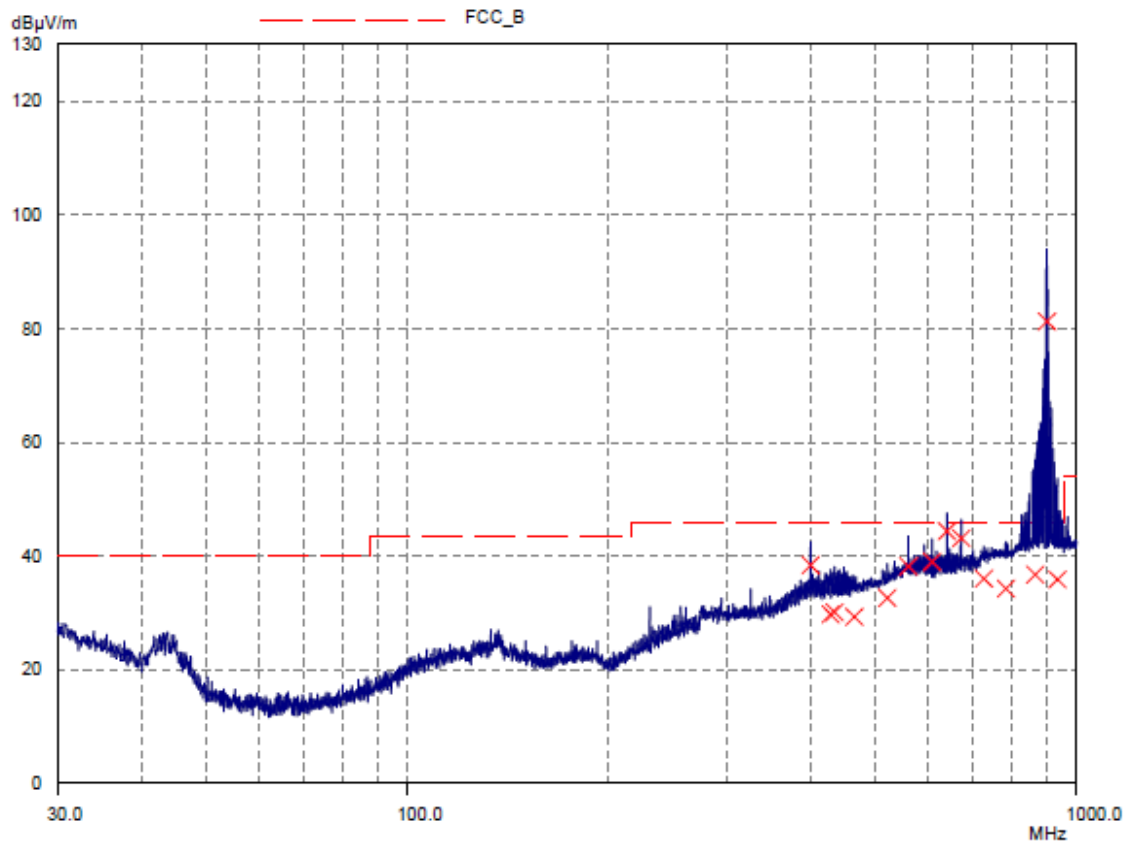
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
400.02	38.42	46.02	7.60
428.64	29.77	46.02	16.25
434.76	30.14	46.02	15.88
465.0	29.31	46.02	16.71
521.16	32.64	46.02	13.38
560.04	38.21	46.02	7.81
608.04	38.99	46.02	7.03
640.02	44.39	46.02	1.63
672.0	43.14	46.02	2.88
726.12	36.04	46.02	9.98
783.72	34.28	46.02	11.74
866.52	36.73	46.02	9.29
902.28	81.27*	46.02	-35.25
935.82	35.90	46.02	10.12

## Graph 5

Scan Settings			(1 Range)		Receiver Settings				
Frequencies									
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB	

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:      2sec  
                                 Subranges:      50  
                                 Acc Margin:      10 dB



**Table 6**

EM0902278

26 Nov 2009 1

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Display face Middle Frequency - vertical Polz - Burst Data  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278n.dat : ADRS Radio modem - FCC radiated emissions

**Scan Settings (1 Range)**

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB

Transducer	No.	Start	Stop	Name
1	17	30MHz	1000MHz	7602
	18	30MHz	1000MHz	8183
	19	30MHz	1000MHz	7569
	21	30MHz	1000MHz	7287
	22	30MHz	1000MHz	8164

Final Measurement: Detector: X QP  
 Meas Time: 2sec  
 Subranges: 50  
 Acc Margin: 10 dB

**Final Measurement Results**

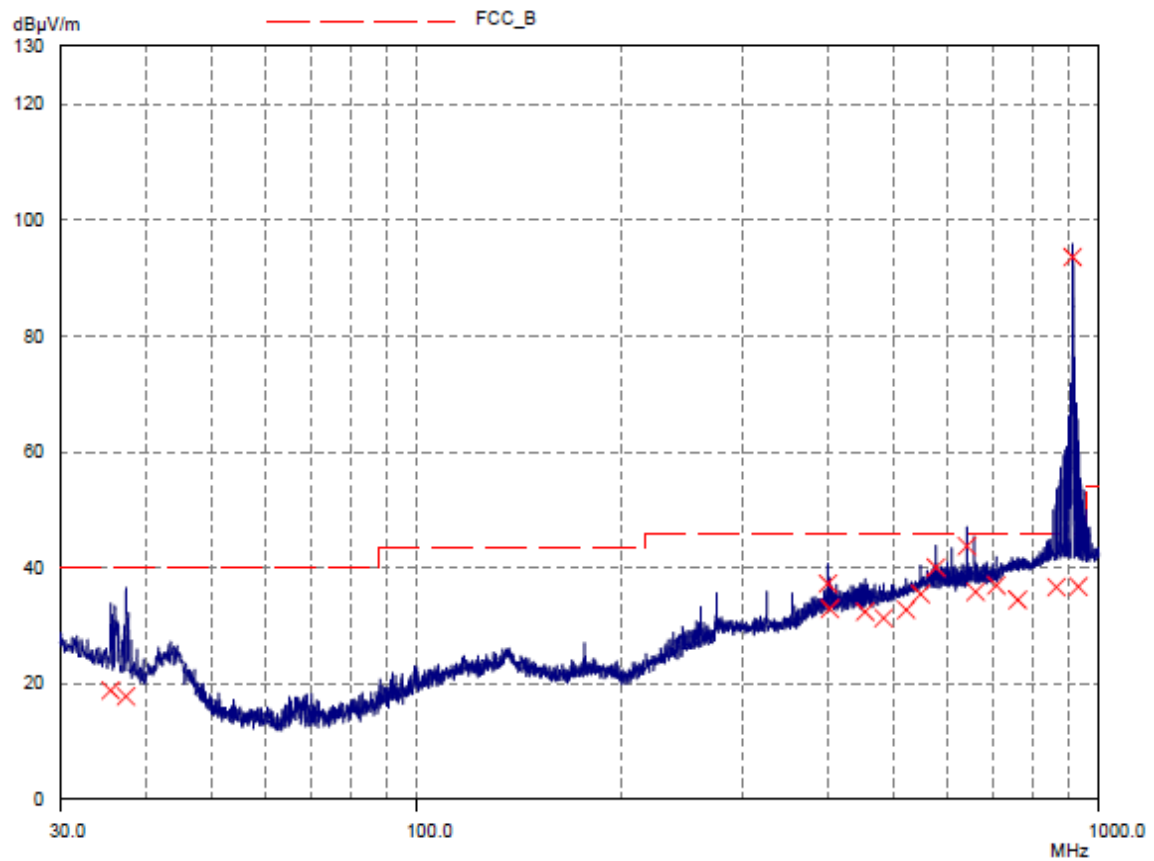
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
35.58	18.84	40.00	21.16
37.44	17.84	40.00	22.16
400.02	37.27	46.02	8.75
402.96	32.93	46.02	13.09
453.9	32.44	46.02	13.58
482.94	31.32	46.02	14.70
521.16	32.76	46.02	13.26
546.96	35.46	46.02	10.56
576.0	40.07	46.02	5.95
640.02	43.75	46.02	2.27
658.92	35.85	46.02	10.17
706.98	36.97	46.02	9.05
759.42	34.47	46.02	11.55
866.1	36.65	46.02	9.37
914.82	93.60*	46.02	-47.58
932.28	36.78	46.02	9.24

## Graph 5

Scan Settings			(1 Range)		Receiver Settings				
Frequencies									
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB	

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:      2sec  
                                 Subranges:      50  
                                 Acc Margin:      10 dB



**Table 7**

EM0902278

26 Nov 2009 1

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Display face Upper Frequency - vertical Polz - Burst Data  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278o.dat : ADRS Radio modem - FCC radiated emissions

Scan Settings		(1 Range)		Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB
Transducer	No.	Start	Stop	Name				
1	17	30MHz	1000MHz	7602				
	18	30MHz	1000MHz	8183				
	19	30MHz	1000MHz	7569				
	21	30MHz	1000MHz	7287				
	22	30MHz	1000MHz	8164				
Final Measurement:		Detector:	X QP					
		Meas Time:	2sec					
		Subranges:	50					
		Acc Margin:	10 dB					

**Final Measurement Results**

Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
287.28	33.19	46.02	12.83
367.98	33.25	46.02	12.77
384.0	34.06	46.02	11.96
415.98	32.76	46.02	13.26
458.64	30.14	46.02	15.88
464.46	29.76	46.02	16.26
521.16	32.66	46.02	13.36
560.34	32.17	46.02	13.85
608.04	40.26	46.02	5.76
640.02	44.39	46.02	1.63
671.34	39.24	46.02	6.78
753.12	34.37	46.02	11.65
784.08	34.44	46.02	11.58
859.08	36.24	46.02	9.78
927.18	95.53*	46.02	-49.51
933.0	41.75	46.02	4.27

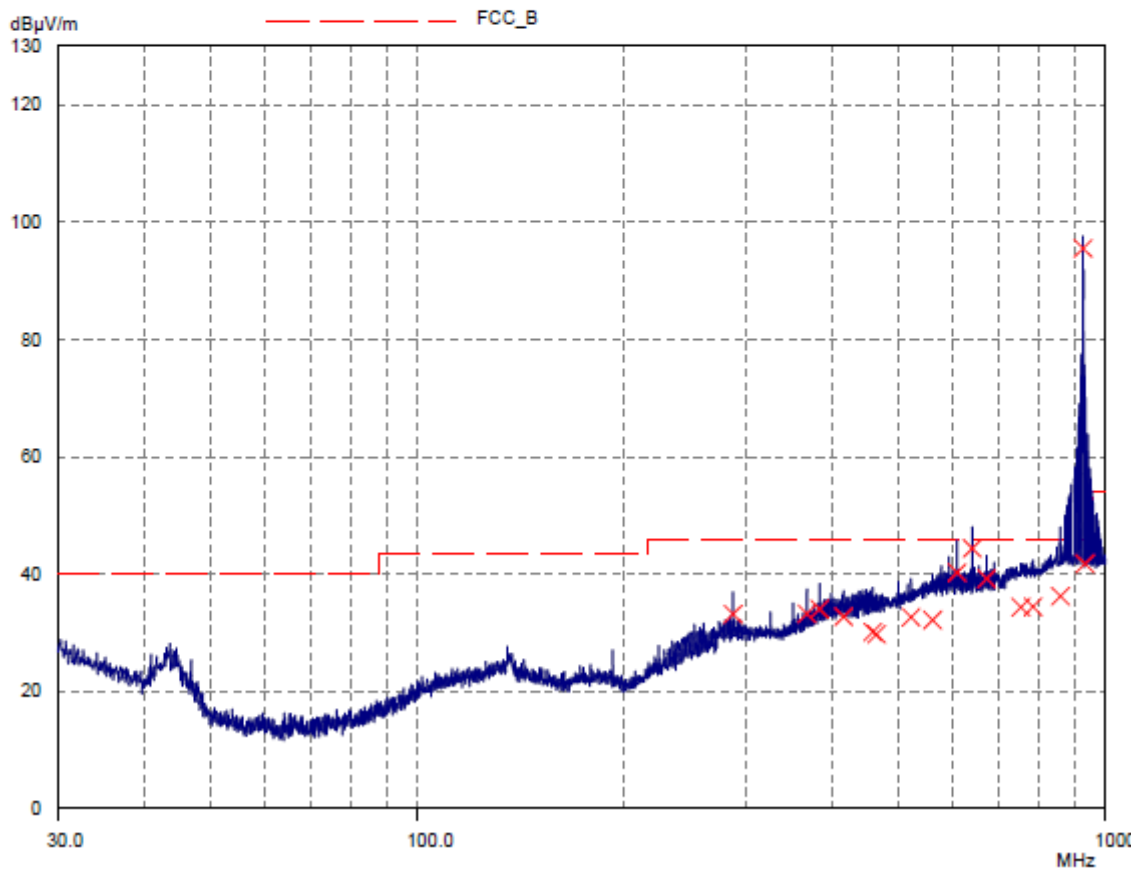


## Graph 6

Scan Settings			(1 Range)		Receiver Settings				
Frequencies									
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB	

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:      2sec  
                                 Subranges:      50  
                                 Acc Margin:      10 dB



**Table 8**

EM0902278

26 Nov 2009 13:36

**Radiated Emissions**

EUT: ADRS Modem RM 013  
Manuf: Smiths Detection  
Op Cond: 12VDC Power Supply  
Operator: D A Legge  
Test Spec: CFR47 Part15 -247  
Comment: Back face Lower Frequency - vertical Polz - Constant CW  
Laptop connected as Basestation 1.5m connection lead  
Result File: 2278p.dat : ADRS Radio modem - FCC radiated emissions

Scan Settings		(1 Range)		Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB
Transducer	No.	Start	Stop	Name				
1	17	30MHz	1000MHz	7602				
	18	30MHz	1000MHz	8183				
	19	30MHz	1000MHz	7569				
	21	30MHz	1000MHz	7287				
	22	30MHz	1000MHz	8164				
Final Measurement:		Detector:	X QP					
		Meas Time:	2sec					
		Subranges:	50					
		Acc Margin:	10 dB					

**Final Measurement Results**

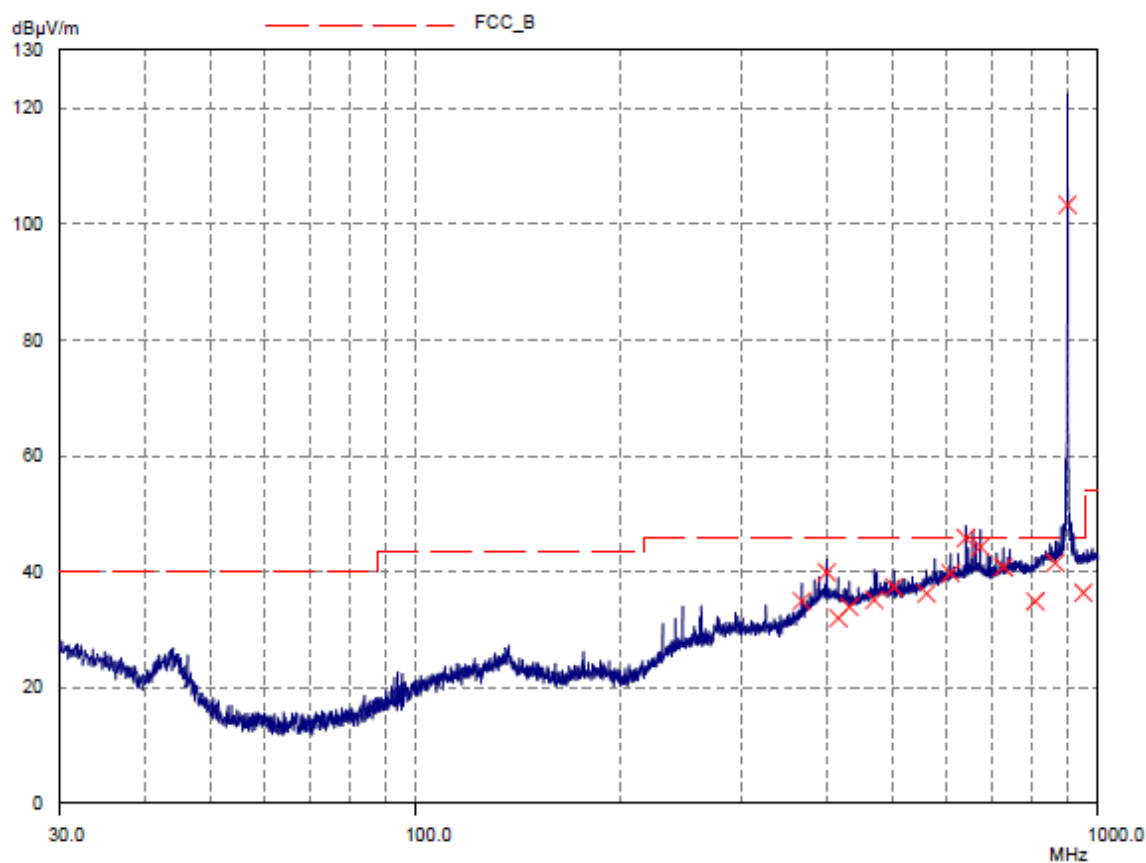
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
368.04	34.97	46.02	11.05
400.02	39.94	46.02	6.08
416.04	32.03	46.02	13.99
432.0	33.95	46.02	12.07
470.1	35.11	46.02	10.91
502.08	37.35	46.02	8.67
560.04	36.26	46.02	9.76
608.04	39.76	46.02	6.26
640.02	45.79	46.02	0.23
672.0	44.32	46.02	1.70
726.06	40.81	46.02	5.21
809.22	34.89	46.02	11.13
866.16	41.54	46.02	4.48
902.04	103.33*	46.02	-57.31
951.6	36.40	46.02	9.62

## Graph 7

Scan Settings			(1 Range)		Receiver Settings			
Frequencies								
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:      2sec  
                                 Subranges:      50  
                                 Acc Margin:      10 dB



**Table 9**

EM0902278

26 Nov 2009 13:53

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Back face Middle Frequency - vertical Polz - Constant CW  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278q.dat : ADRS Radio modem - FCC radiated emissions

Scan Settings		(1 Range)		Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB
Transducer	No.	Start	Stop	Name				
1	17	30MHz	1000MHz	7602				
	18	30MHz	1000MHz	8183				
	19	30MHz	1000MHz	7569				
	21	30MHz	1000MHz	7287				
	22	30MHz	1000MHz	8164				

Final Measurement: Detector: X QP  
 Meas Time: 2sec  
 Subranges: 50  
 Acc Margin: 10 dB

**Final Measurement Results**

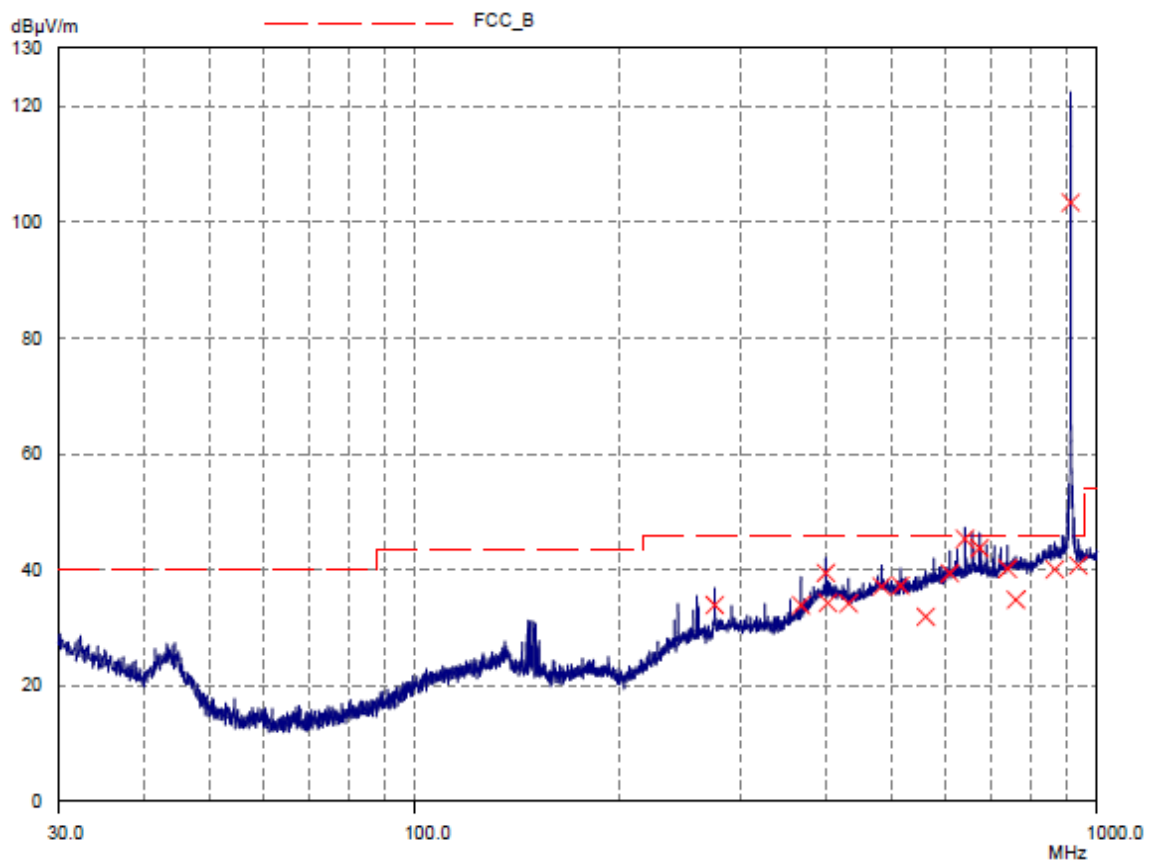
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
274.98	33.92	46.02	12.10
367.98	33.89	46.02	12.13
400.02	39.44	46.02	6.58
402.96	34.25	46.02	11.77
432.0	34.19	46.02	11.83
482.94	37.14	46.02	8.88
514.98	37.26	46.02	8.76
560.7	31.91	46.02	14.11
608.04	39.40	46.02	6.62
640.02	45.32	46.02	0.70
672.0	43.74	46.02	2.28
738.96	40.20	46.02	5.82
760.32	34.84	46.02	11.18
866.94	40.08	46.02	5.94
915.0	103.36*	46.02	-57.34
936.9	40.78	46.02	5.24

## Graph 8

Scan Settings			(1 Range)		Receiver Settings				
Frequencies									
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB	

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:    2sec  
                                 Subranges:    50  
                                 Acc Margin:   10 dB



**Table 10**

EM0902278

26 Nov 2009 14:12

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Back face Upper Frequency - vertical Polz - Constant CW  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278r.dat : ADRS Radio modem - FCC radiated emissions

**Scan Settings (1 Range)**

Frequencies					Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB
Transducer	No.	Start	Stop	Name				
1	17	30MHz	1000MHz	7602				
	18	30MHz	1000MHz	8183				
	19	30MHz	1000MHz	7569				
	21	30MHz	1000MHz	7287				
	22	30MHz	1000MHz	8164				

Final Measurement: Detector: X QP  
 Meas Time: 2sec  
 Subranges: 50  
 Acc Margin: 10 dB

**Final Measurement Results**

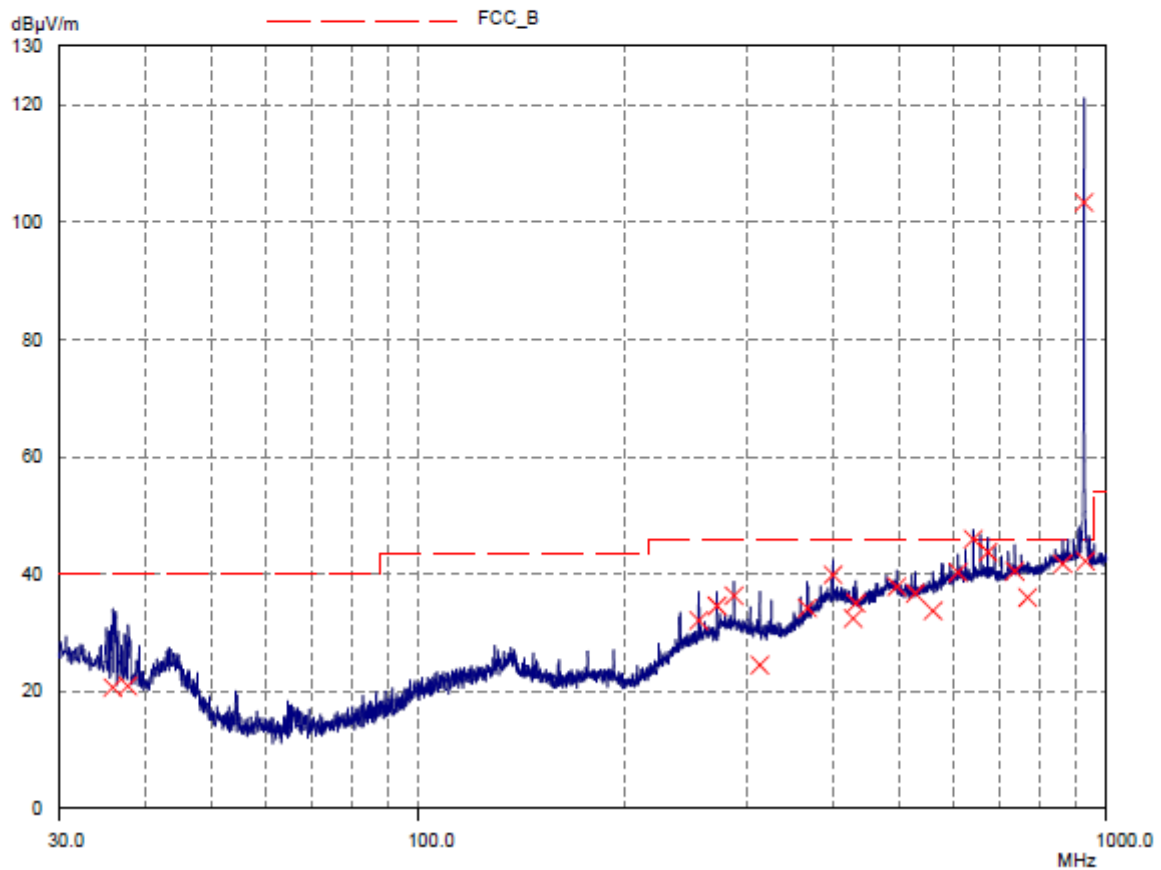
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
35.94	20.66	40.00	19.34
37.8	20.92	40.00	19.08
255.36	32.11	46.02	13.91
271.32	34.58	46.02	11.44
287.34	36.34	46.02	9.68
313.32	24.49	46.02	21.53
367.32	34.21	46.02	11.81
400.02	39.88	46.02	6.14
427.8	32.46	46.02	13.56
432.0	35.03	46.02	10.99
495.3	37.85	46.02	8.17
527.34	36.74	46.02	9.28
559.26	33.73	46.02	12.29
608.04	40.28	46.02	5.74
640.02	45.93	46.02	0.09
672.0	43.74	46.02	2.28
735.36	40.48	46.02	5.54
768.06	36.01	46.02	10.01
863.34	41.76	46.02	4.26
927.3	103.36*	46.02	-57.34
932.28	42.19	46.02	3.83

## Graph 9

Scan Settings		(1 Range)		Receiver Settings				
Frequencies		Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
Start	Stop							
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB

See following page for transducer set listing.

Final Measurement:      Detector: X QP  
Meas Time: 2sec  
Subranges: 50  
Acc Margin: 10 dB



**Table 11**

EM0902278

26 Nov 2009 09:31

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Back face Lower Frequency - vertical Polz - Burst data  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278s.dat : ADRS Radio modem - FCC radiated emissions

**Scan Settings (1 Range)**

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB

Transducer	No.	Start	Stop	Name
1	17	30MHz	1000MHz	7602
	18	30MHz	1000MHz	8183
	19	30MHz	1000MHz	7569
	21	30MHz	1000MHz	7287
	22	30MHz	1000MHz	8164

Final Measurement: Detector: X QP  
 Meas Time: 2sec  
 Subranges: 50  
 Acc Margin: 10 dB

**Final Measurement Results**

Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
367.98	32.58	46.02	13.44
384.06	32.96	46.02	13.06
427.8	40.61	46.02	5.41
460.14	30.28	46.02	15.74
486.06	32.78	46.02	13.24
518.04	33.60	46.02	12.42
560.04	36.06	46.02	9.96
592.08	32.88	46.02	13.14
646.08	37.99	46.02	8.03
672.0	45.24	46.02	0.78
726.06	39.83	46.02	6.19
801.0	33.92	46.02	12.10
865.44	36.02	46.02	10.00
900.18	58.79*	46.02	-12.77
935.1	35.36	46.02	10.66

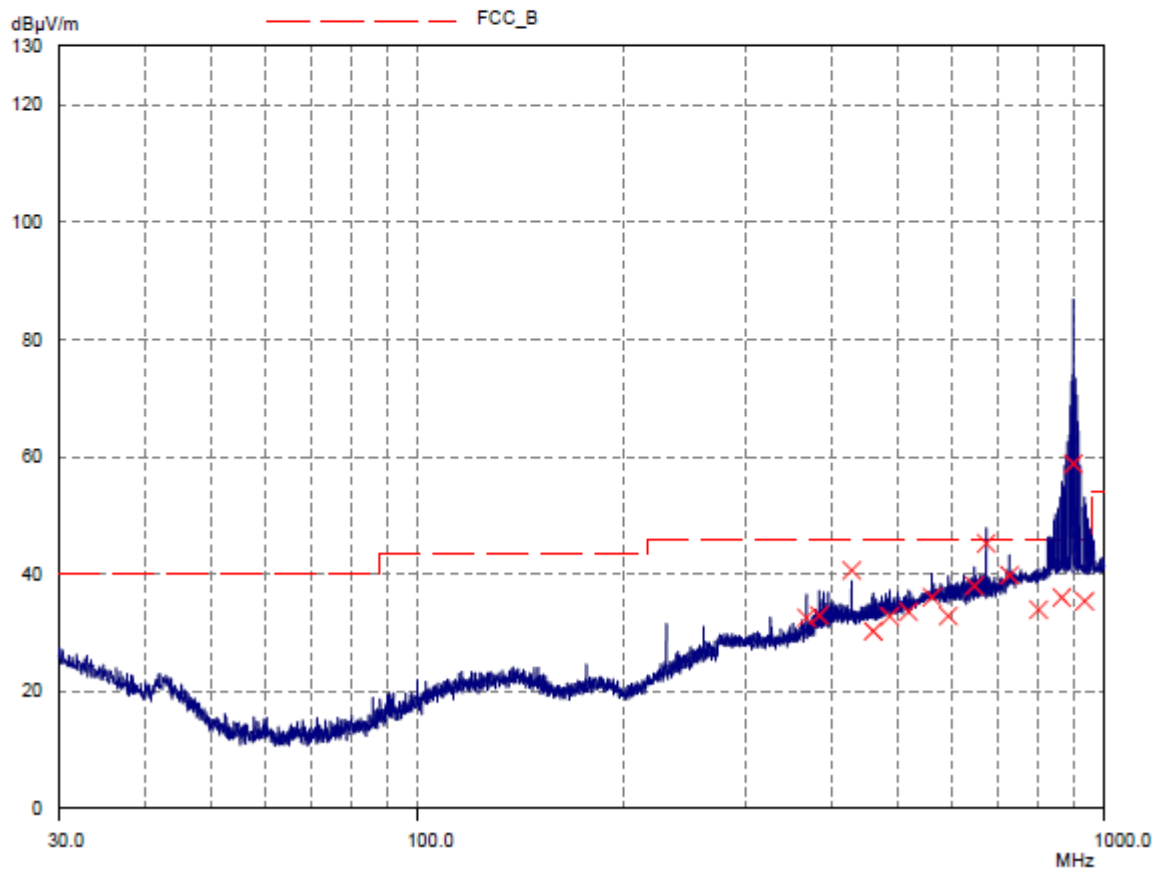


## Graph 10

Scan Settings			(1 Range)		Receiver Settings				
Frequencies									
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB	

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:    2sec  
                                 Subranges:    50  
                                 Acc Margin:   10 dB



**Table 12**

EM0902278

26 Nov 2009

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Back face Middle Frequency - vertical Polz - Burst data  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278t.dat : ADRS Radio modem - FCC radiated emissions

**Scan Settings (1 Range)**

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB

Transducer	No.	Start	Stop	Name
1	17	30MHz	1000MHz	7602
	18	30MHz	1000MHz	8183
	19	30MHz	1000MHz	7569
	21	30MHz	1000MHz	7287
	22	30MHz	1000MHz	8164

Final Measurement: Detector: X QP  
 Meas Time: 2sec  
 Subranges: 50  
 Acc Margin: 10 dB

**Final Measurement Results**

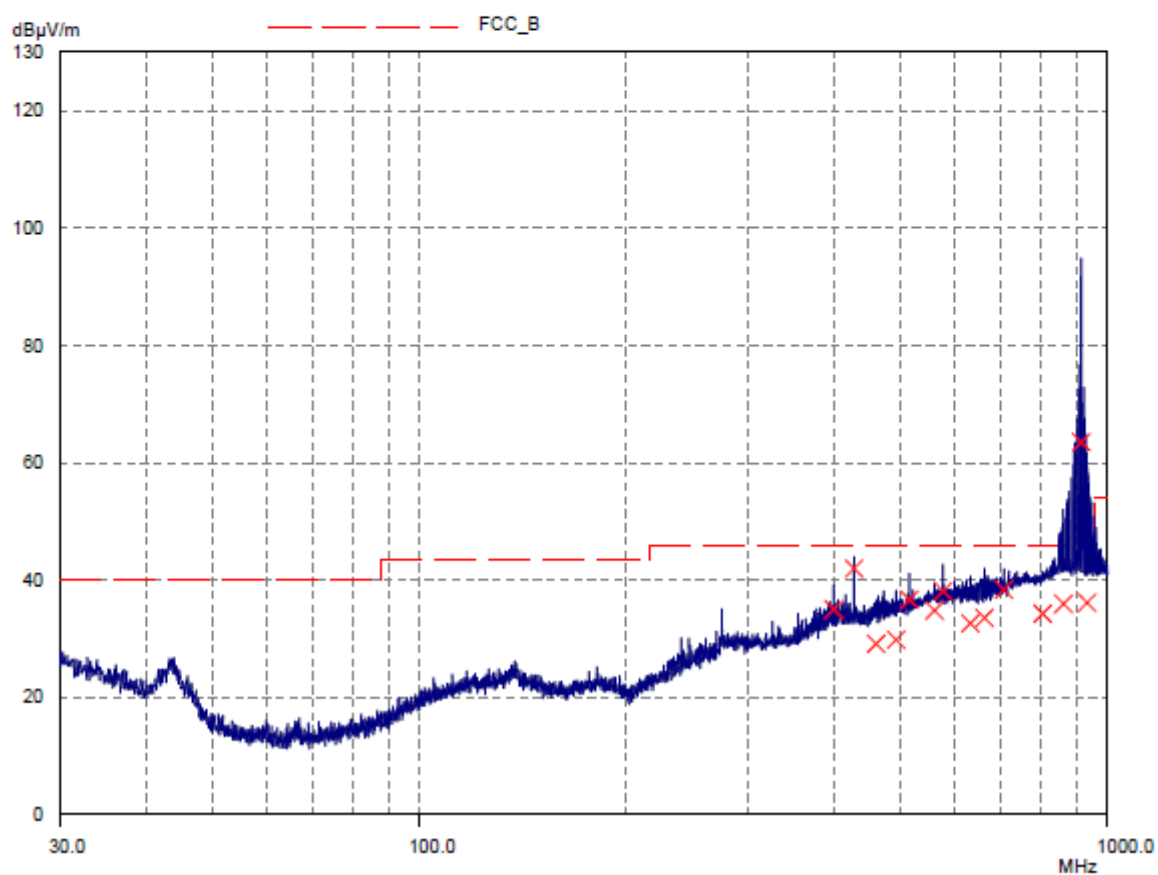
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
399.96	35.01	46.02	11.01
427.8	41.97	46.02	4.05
460.5	29.15	46.02	16.87
492.66	29.85	46.02	16.17
514.98	36.66	46.02	9.36
560.04	34.82	46.02	11.20
576.0	38.12	46.02	7.90
631.56	32.64	46.02	13.38
661.86	33.56	46.02	12.46
706.98	38.36	46.02	7.66
804.24	34.27	46.02	11.75
862.68	35.97	46.02	10.05
915.42	63.50*	46.02	-17.48
933.54	36.15	46.02	9.87

## Graph 11

Scan Settings			(1 Range)			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB	

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:    2sec  
                                 Subranges:    50  
                                 Acc Margin:   10 dB



**Table 13**

EM0902278

26 Nov 2009 10:38

**Radiated Emissions**

EUT: ADRS Modem RM 013  
 Manuf: Smiths Detection  
 Op Cond: 12VDC Power Supply  
 Operator: D A Legge  
 Test Spec: CFR47 Part15 -247  
 Comment: Back face Upper Frequency - vertical Polz - Burst data  
 Laptop connected as Basestation 1.5m connection lead  
 Result File: 2278u.dat : ADRS Radio modem - FCC radiated emissions

Scan Settings		(1 Range)		Receiver Settings				
Frequencies								
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB
Transducer	No.	Start	Stop	Name				
1	17	30MHz	1000MHz	7602				
	18	30MHz	1000MHz	8183				
	19	30MHz	1000MHz	7569				
	21	30MHz	1000MHz	7287				
	22	30MHz	1000MHz	8164				

Final Measurement: Detector: X QP  
 Meas Time: 2sec  
 Subranges: 50  
 Acc Margin: 10 dB

**Final Measurement Results**

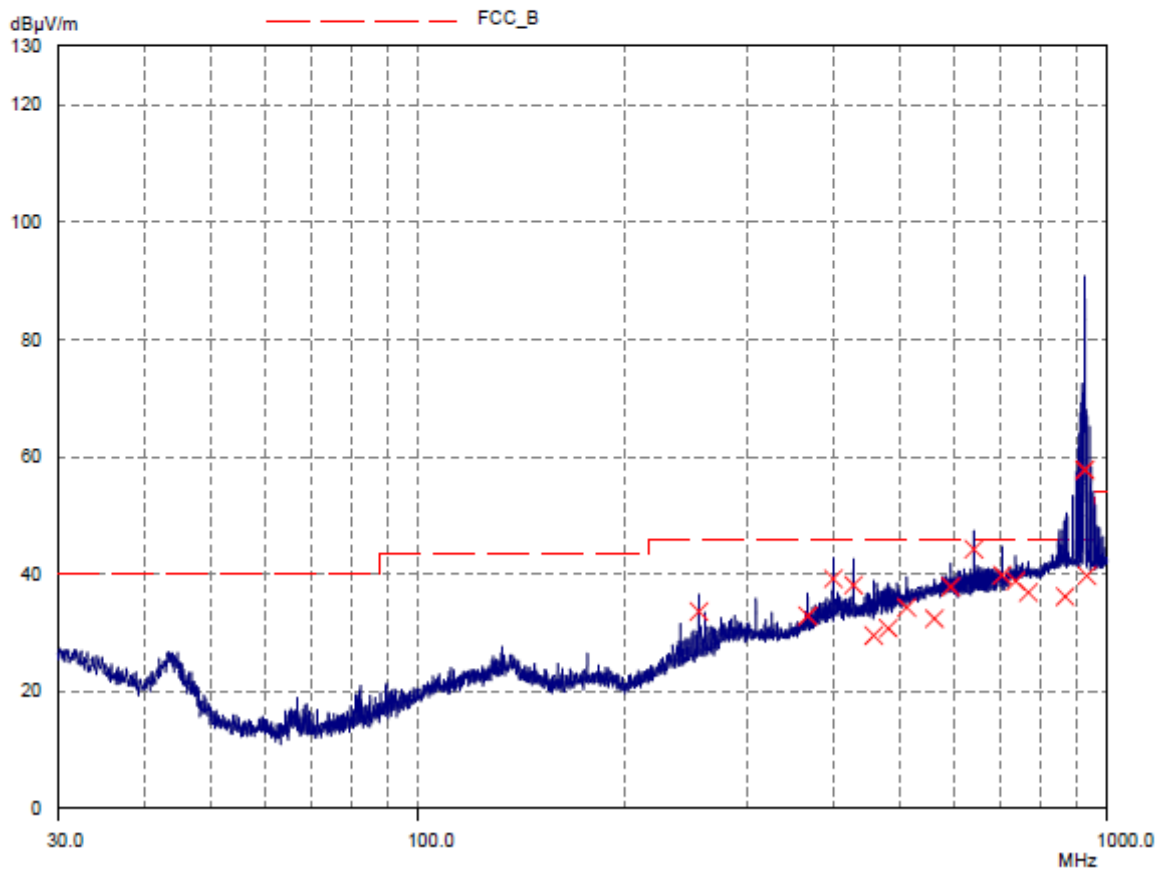
Frequency MHz	QP Level dBµV/m	QP Limit dBµV/m	QP Delta dB
255.36	33.64	46.02	12.38
367.32	32.90	46.02	13.12
400.02	39.22	46.02	6.80
427.8	38.11	46.02	7.91
458.1	29.53	46.02	16.49
480.48	30.76	46.02	15.26
511.32	34.32	46.02	11.70
560.7	32.43	46.02	13.59
592.02	37.83	46.02	8.19
640.02	44.25	46.02	1.77
703.32	39.83	46.02	6.19
735.36	38.80	46.02	7.22
767.34	36.88	46.02	9.14
868.08	36.17	46.02	9.85
926.34	57.76*	46.02	-11.74
933.78	39.73	46.02	6.29

## Graph 12

Scan Settings			(1 Range)		Receiver Settings			
Frequencies								
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30MHz	1000MHz	60kHz	120kHz	PK	20msec	Auto	ON	60dB

See following page for transducer set listing.

Final Measurement:      Detector:      X QP  
                                 Meas Time:      2sec  
                                 Subranges:      50  
                                 Acc Margin:      10 dB



## 5.2 Radiated Emissions > 1000MHz

The testing was performed as required by CFR47 Part15:247d in a FCC registered test site. Testing was carried out at a distance of 3 metres with the appropriate antenna's connected to a pre amplifier and spectrum analyser situated outside the test chamber. The transducer factors for the Antenna, cables and preamplifier are automatically calculated into the test results and the results are presented with data corrected.

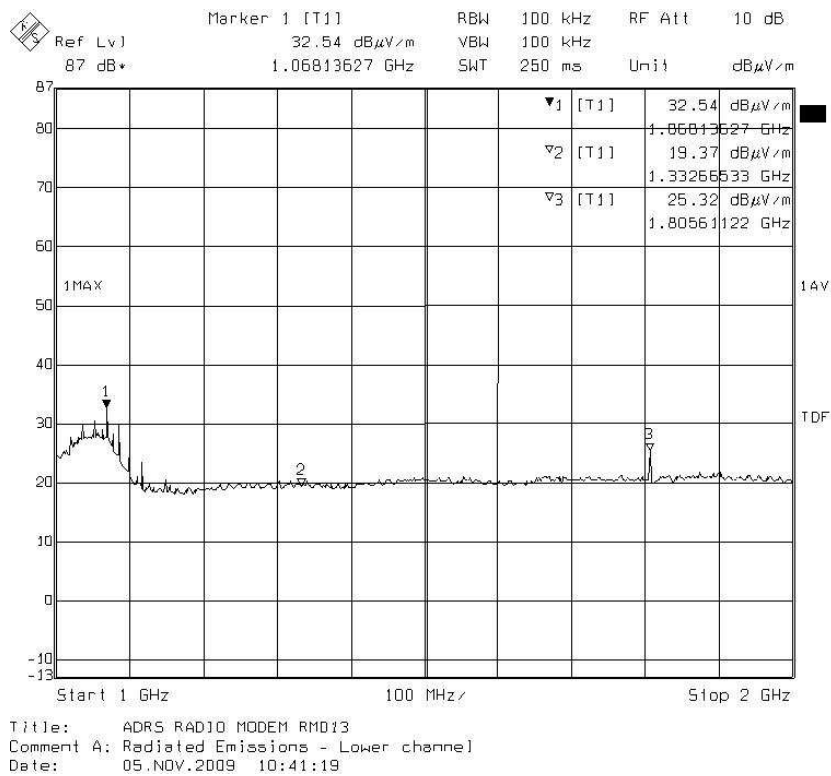
The Smiths Detection (Watford) ADRS Radio Modem RM013 was tuned to frequencies of 902MHz, 915MHz and 927MHz at maximum power output. The frequencies were scanned over the frequency range of 1GHz to 10GHz. Any frequencies with amplitudes above the measuring system noise were recorded. These measurements were carried out with a Resolution bandwidth of 100kHz using average detector and peak detectors.

All frequencies with amplitudes recorded were found to be more than 20 dB below the intentional frequency amplitude levels.

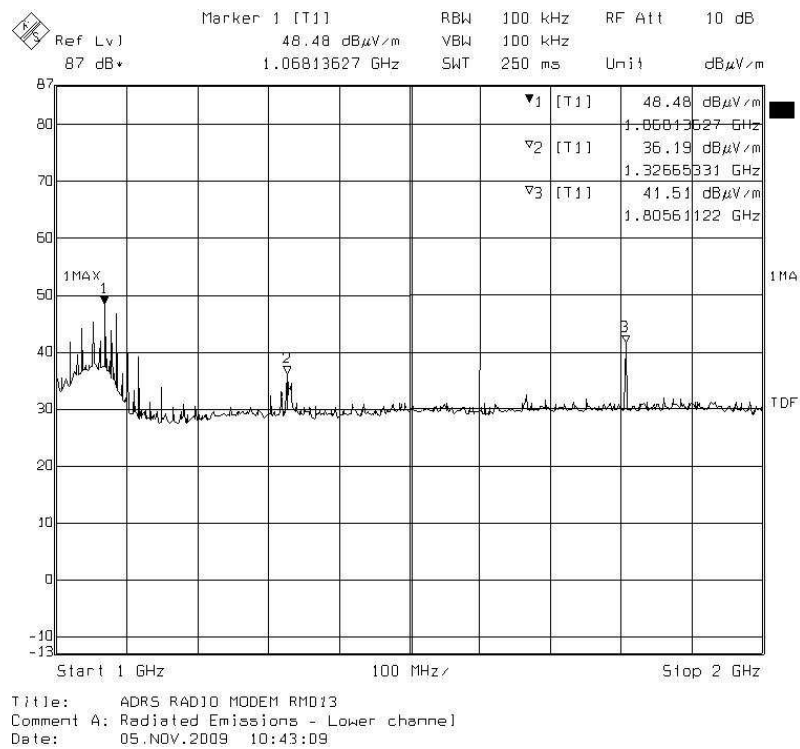
The table below gives the page numbers for the plots for test frequencies.

Frequency MHz	Page numbers
902	46 - 47
915	48 – 49
927	50 - 51

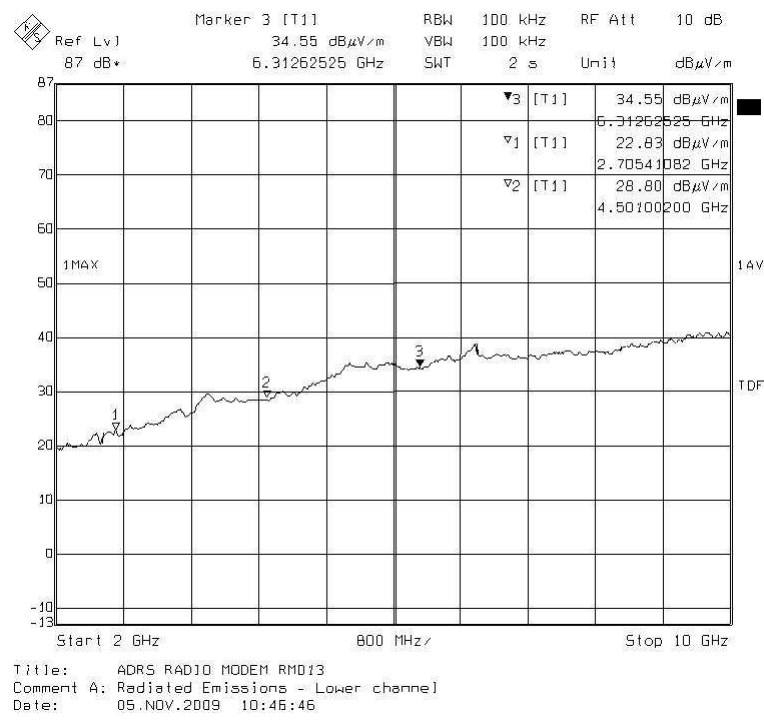
902 MHz



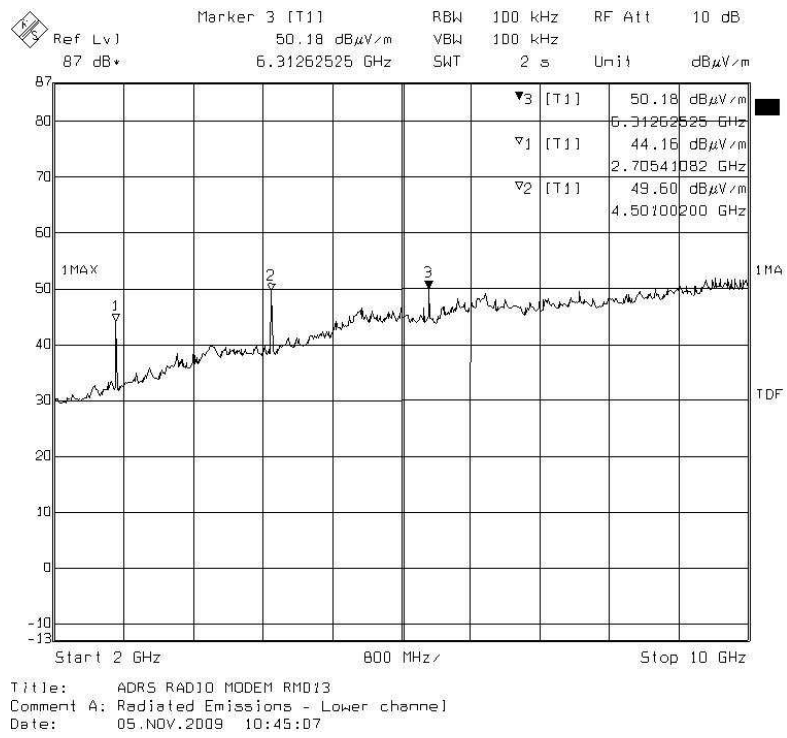
Average



Peak



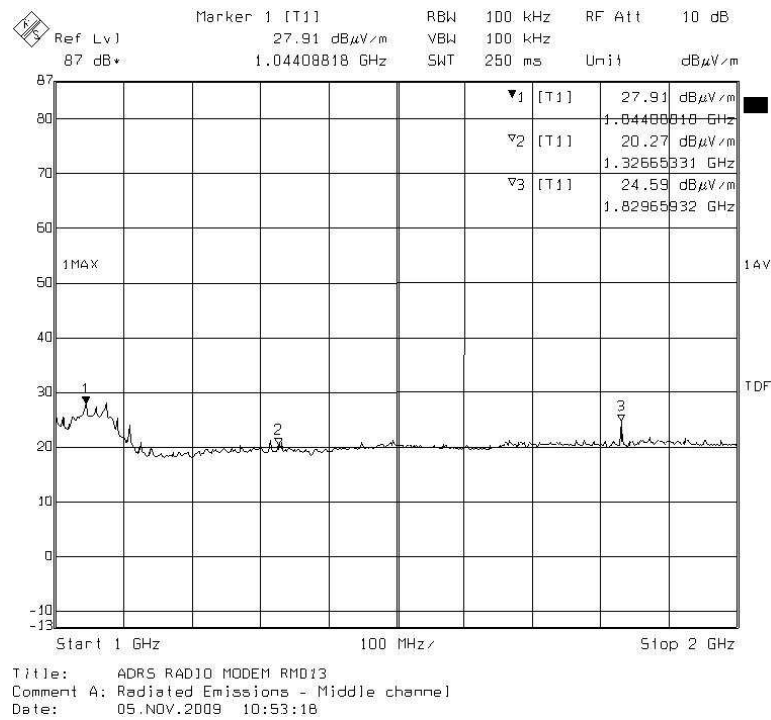
Average



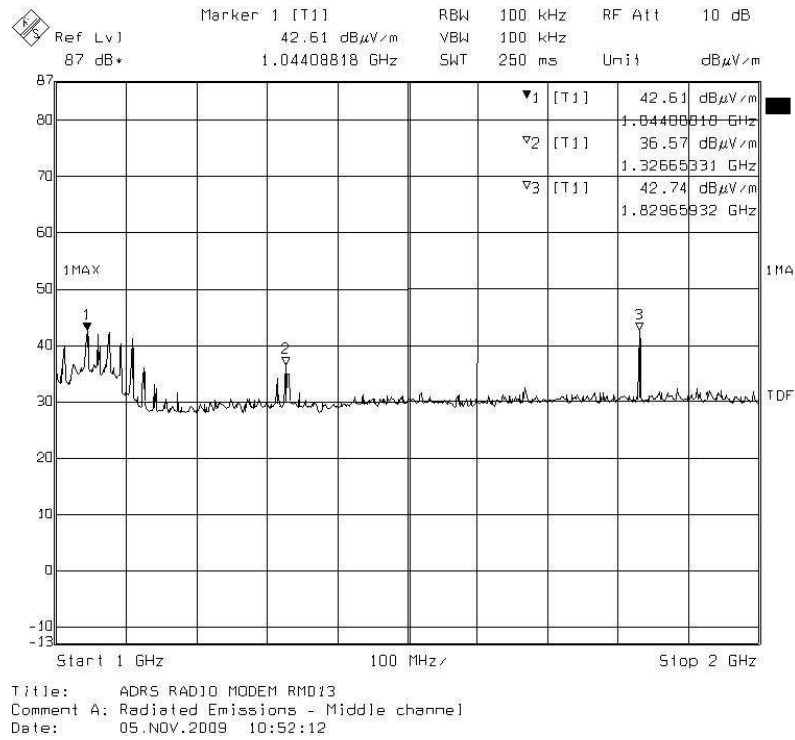
Peak



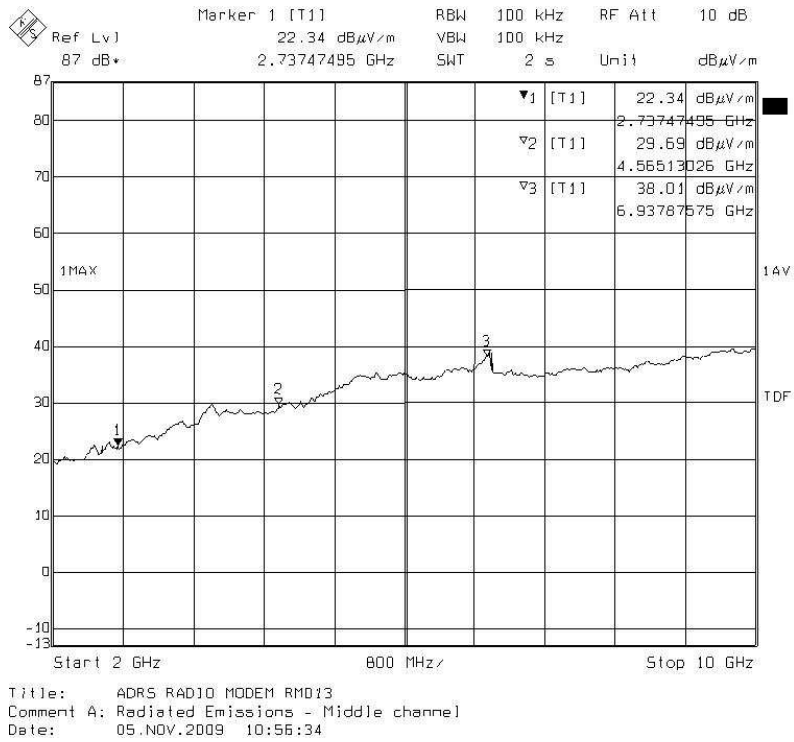
915MHz



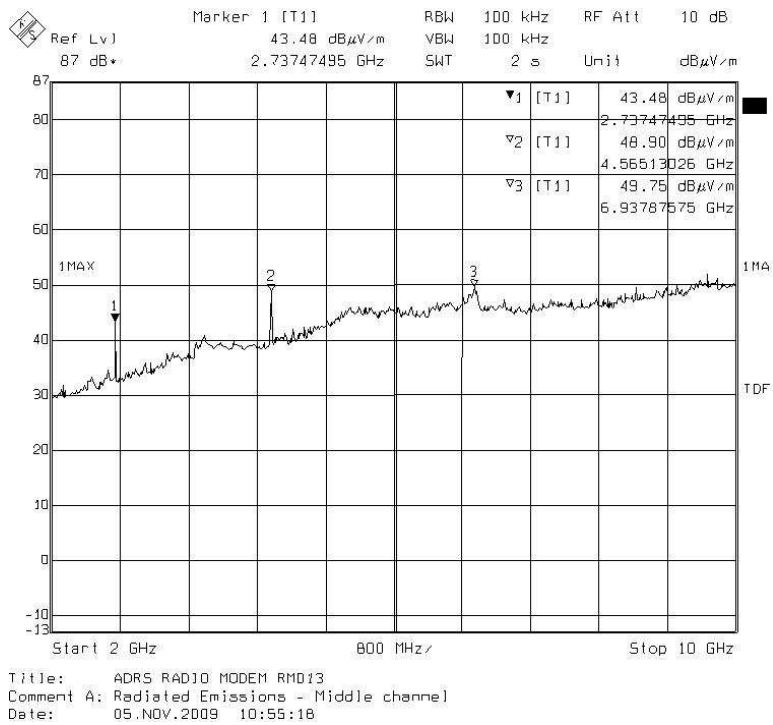
Average



Peak

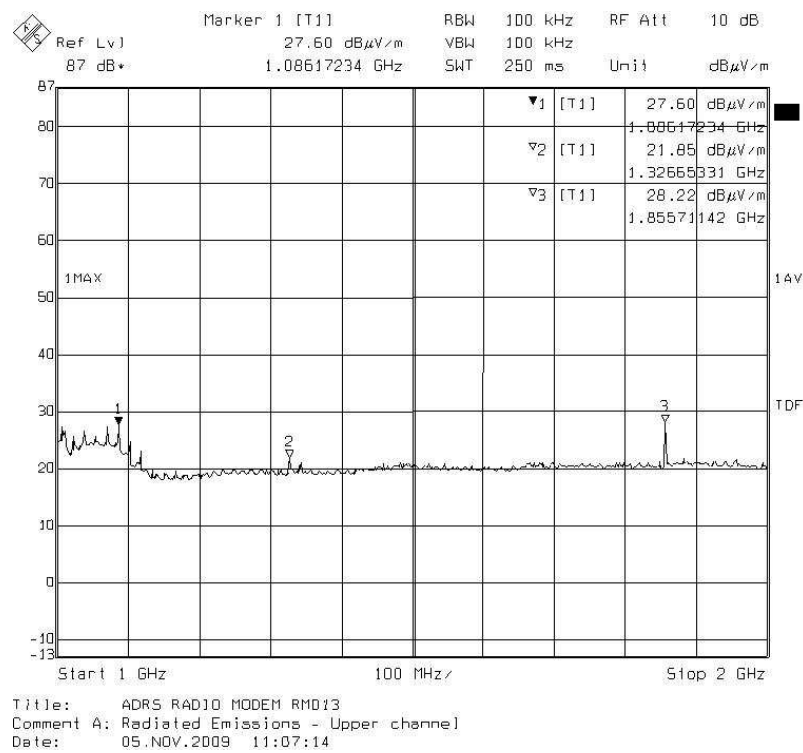


Average

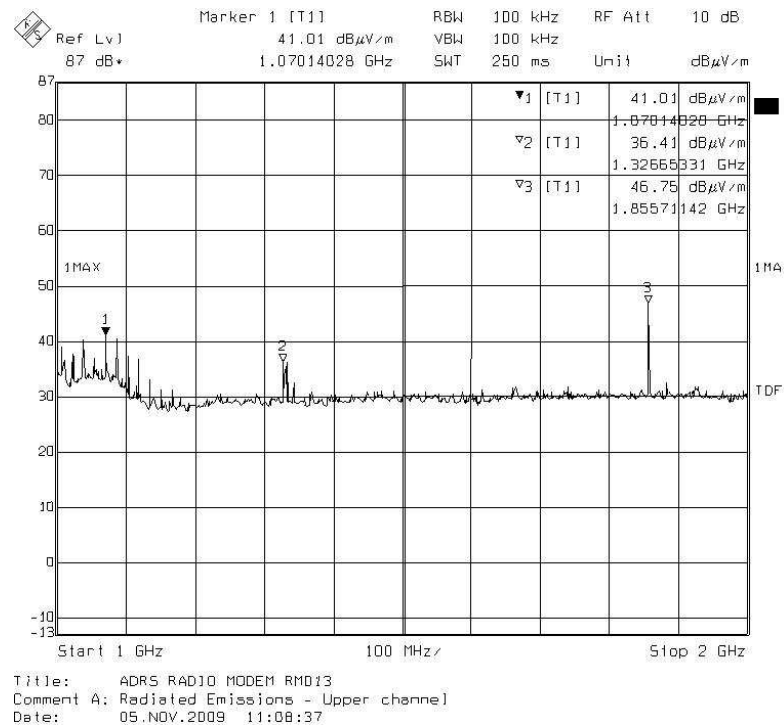


Peak

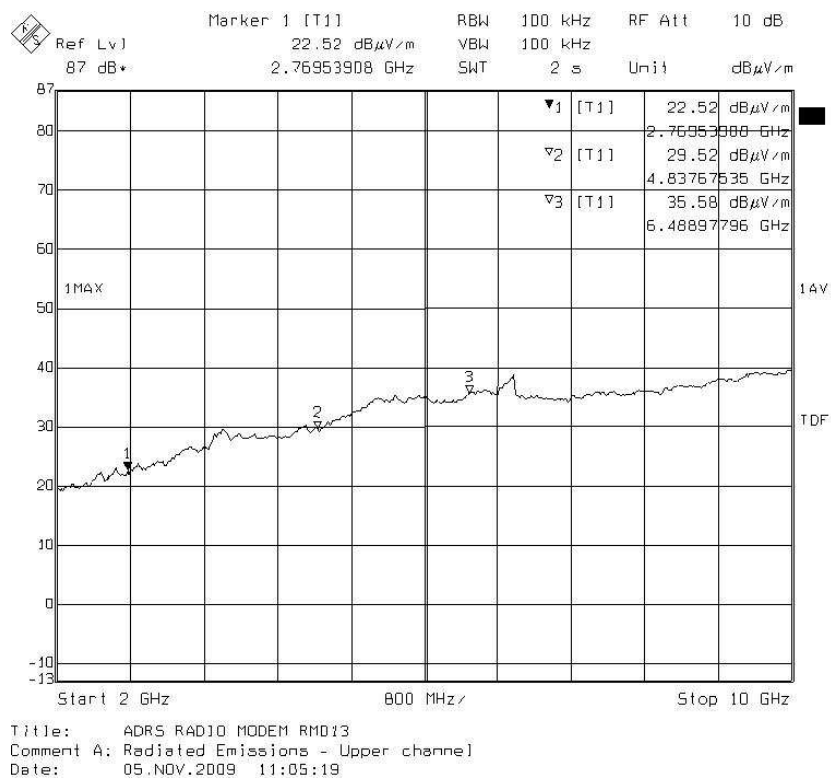
927 MHz



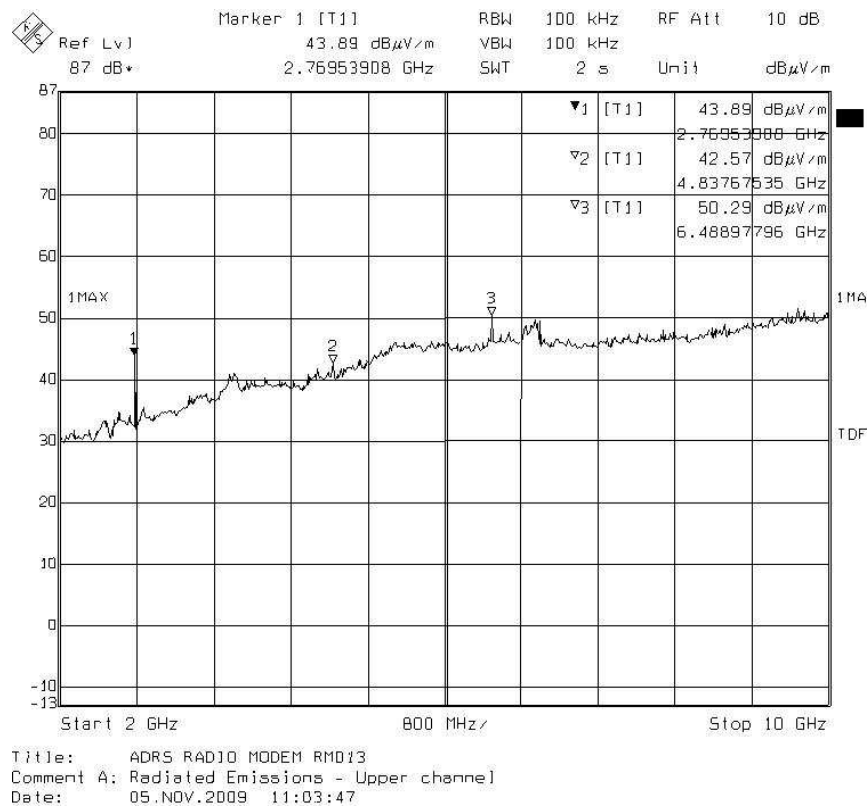
Average



Peak



Average



Peak

## **6. RADIATED EMISSIONS CFR47 PART15:205**

### **6.1. Test Procedure – Restricted Bands**

The ADRS Radio Modem RM013 was set to 902MHz, 915MHz and 927MHz in turn, with the transmitter set to maximum output. The frequency ranges from 2.4835 to 2.5 GHz, 4.5 to 5.15GHz and 7.25 to 7.75GHz were scanned using a spectrum analyser using an average detector. All cable, antenna and preamplifier transducer factors are automatically calculated into the test results.

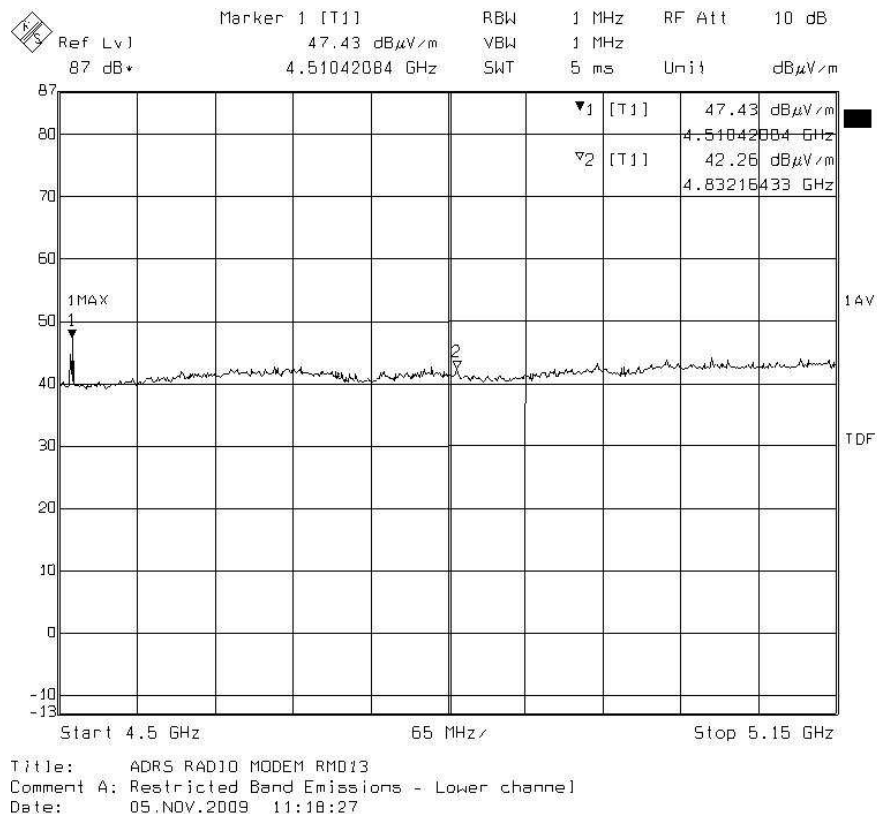
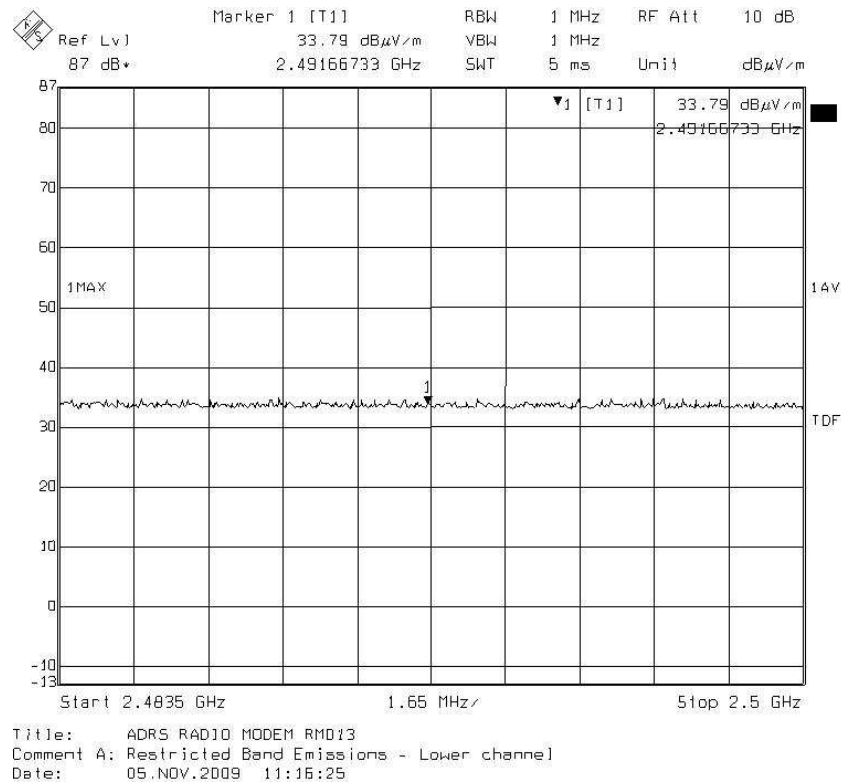
These tests carried out using a 1.0MHz RBW and a VBW of 3MHz as required by Part 15:205.

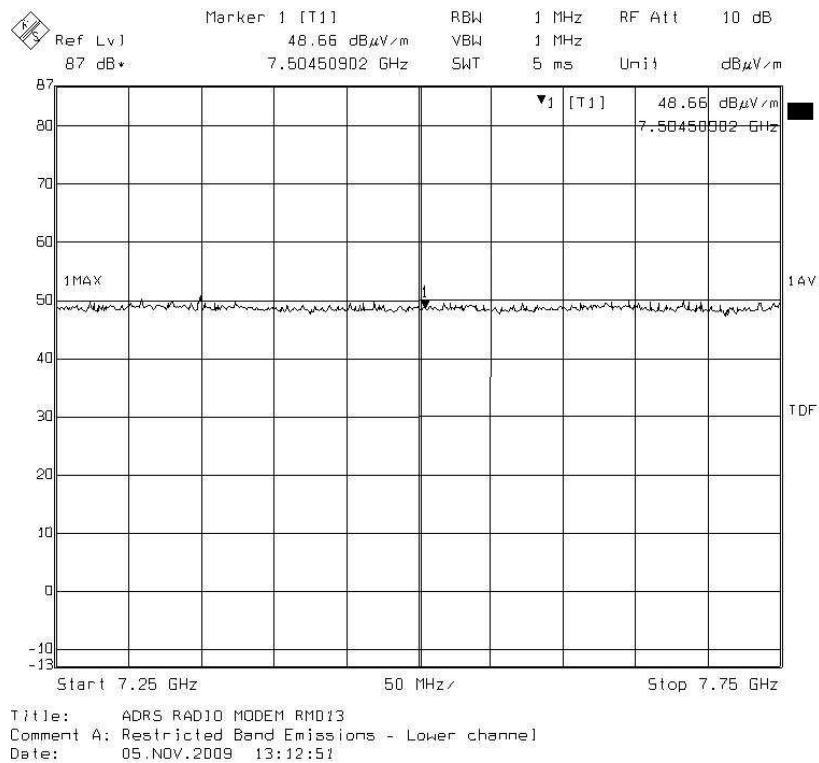
Plots of emissions from 1 to 10GHz are included in section 5.2.

Plots of these tests are shown in section 6.2.

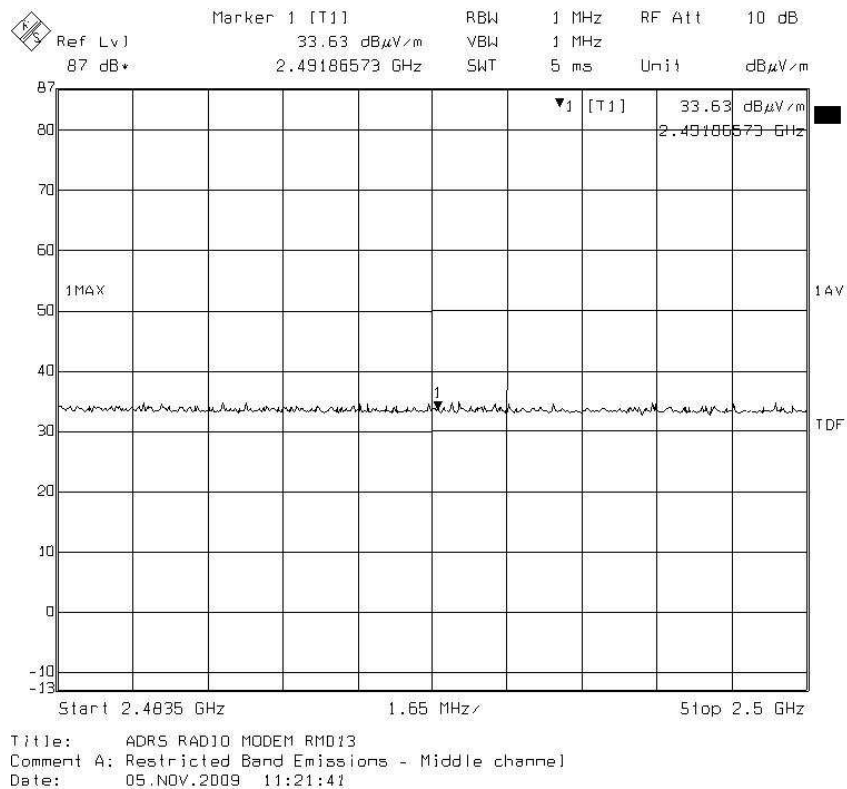
## 6.2. Plots of Restricted Bands

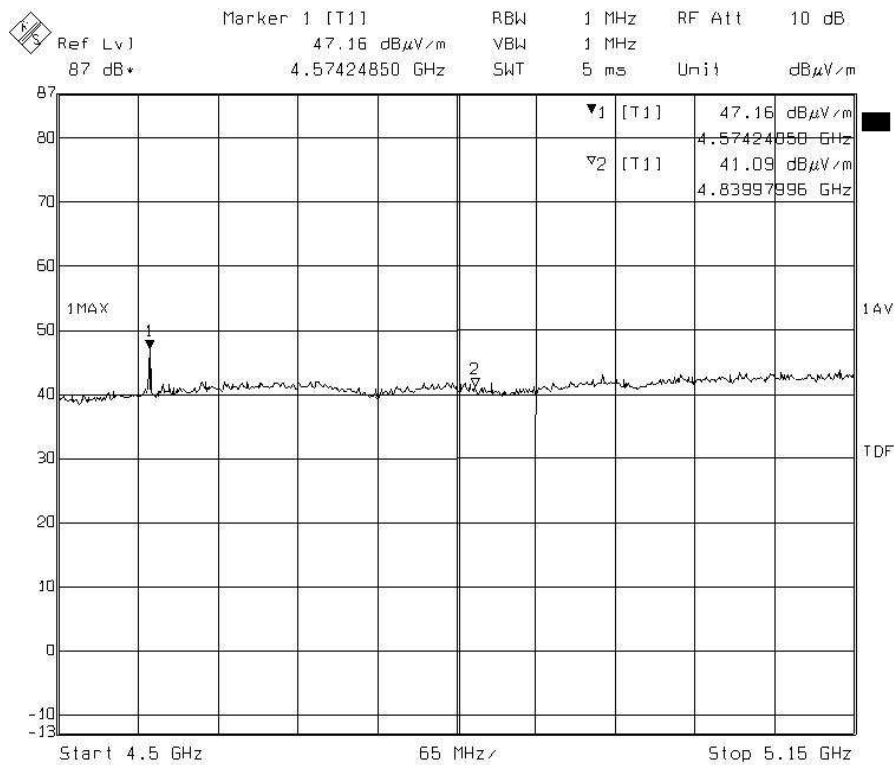
### 902MHz





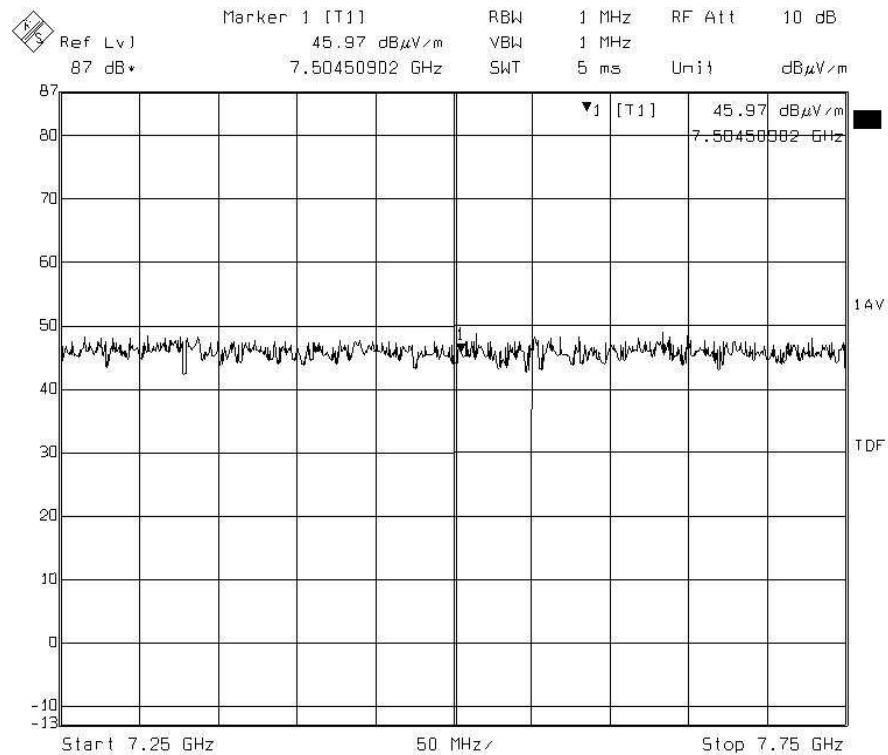
## 915 MHz





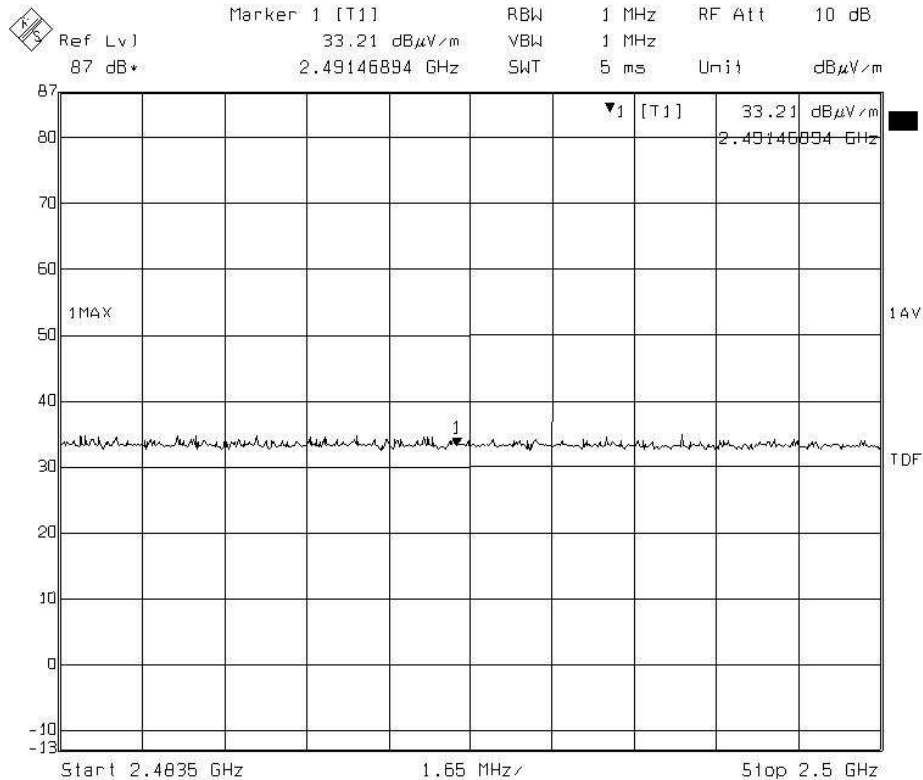
Title: ADRS RADIO MODEM RM013  
Comment A: Restricted Band Emissions - Middle channel  
Date: 05.NOV.2009 11:23:00



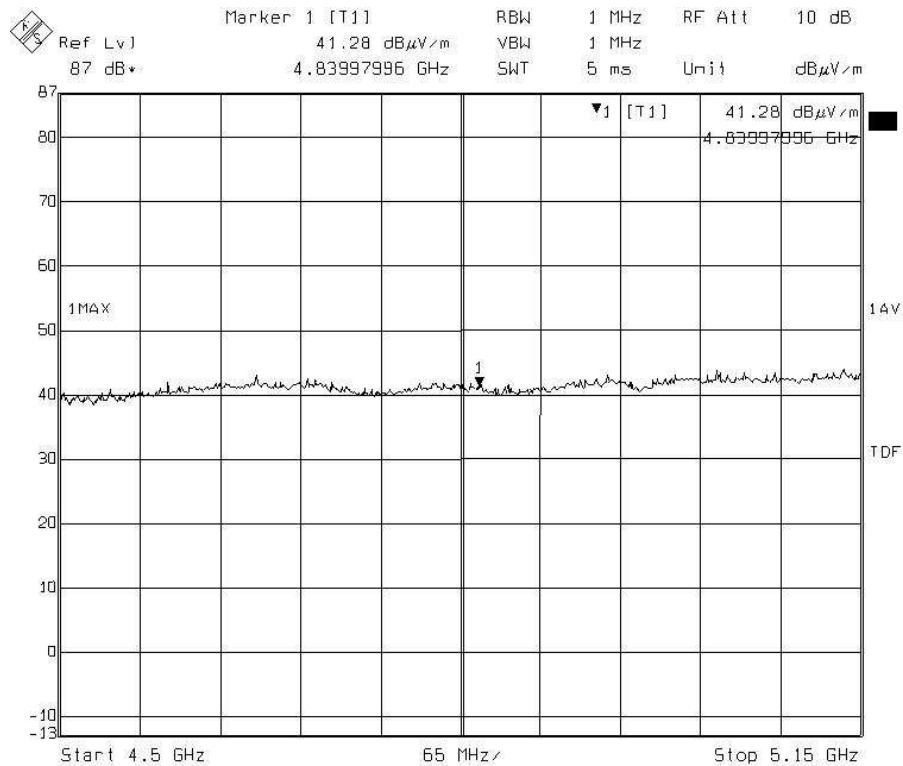


Title: ADRS RADIO MODEM RM013  
Comment A: Restricted Band Emissions - Middle channel  
Date: 05.NOV.2009 13:15:15

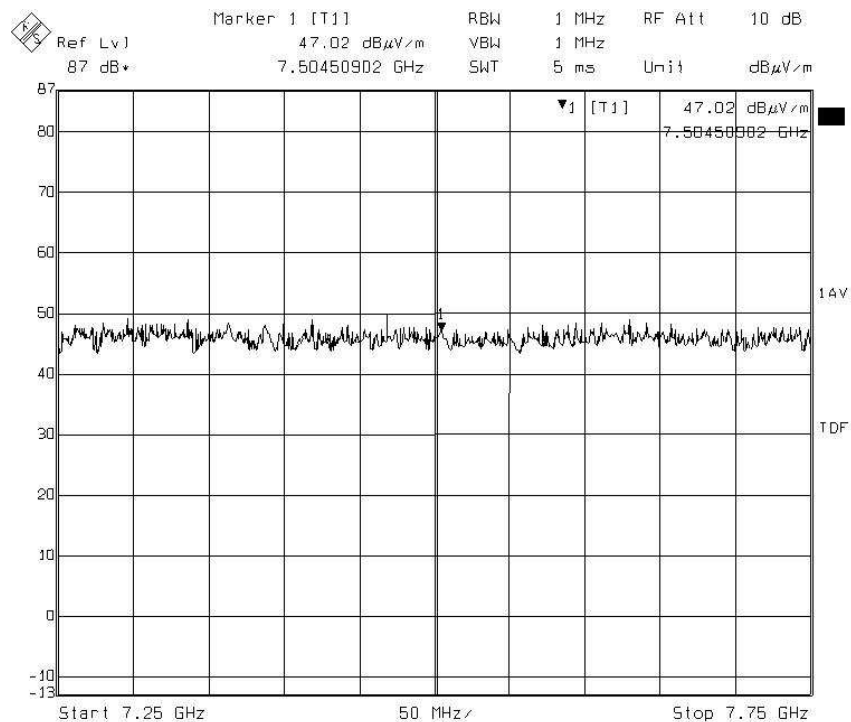
### 927 MHz



Title: ADRS RADIO MODEM RM013  
Comment A: Restricted Band Emissions - Upper channel  
Date: 05.NOV.2009 11:25:09



Title: ADRS RADIO MODEM RM013  
Comment A: Restricted Band Emissions - Upper channel  
Date: 05.NOV.2009 11:26:14



Title: ADRS RADIO MODEM RM013  
Comment A: Restricted Band Emissions - Upper channel  
Date: 05.NOV.2009 13:17:03

### Uncertainty Budget Calculation

Symbol	Source of Uncertainty	Value	Probability distribution	Divisor	$c_i$	$u_i(y)$	$(u_i(y))^2$	$v_i$ or $v_{eff}$	$u_i^4(y)$
$RI$	Receiver Indication	0.05	normal 2	2.000	1	0.03	0.001	$\infty$	0
$dV_{sw}$	Receiver Sine Wave	1.60	normal 2	2.000	1	0.80	0.640	$\infty$	0
$dV_{pa}$	Receiver Pulse Amplitude	1.60	normal 2	2.000	1	0.80	0.640	$\infty$	0
$dV_{pr}$	Receiver Pulse repetition	1.60	normal 2	2.000	1	0.80	0.640	$\infty$	0
$dV_{nf}$	Noise Floor Proximity	1.60	normal 2	2.000	1	0.80	0.640	$\infty$	0
$AF$	Antenna Factor Calibration	1.20	normal 2	2.000	1	0.60	0.360	$\infty$	0
$CL$	Cable Loss	0.50	normal 2	2.000	1	0.25	0.063	$\infty$	0
$AD$	Antenna Directivity	3.00	rectangular	1.732	1	1.73	3.000	$\infty$	0
$AH$	Antenna Factor Height Dependence	1.00	rectangular	1.732	1	0.58	0.333	$\infty$	0
$AP$	Antenna Phase Centre Variation	0.50	rectangular	1.732	1	0.29	0.083	$\infty$	0
$AI$	Antenna Factor Frequency Interpolation	0.68	rectangular	1.732	1	0.39	0.154	$\infty$	0
$SI$	Site Imperfections	4.00	triangular	2.449	1	1.63	2.667	$\infty$	0
$DV$	Measurement Distance Variation	0.60	rectangular	1.732	1	0.35	0.120	$\infty$	0
$F_{step}$	Frequency step error	0.00	rectangular	1.732	1	0.00	0.000	$\infty$	0
$M$	Mismatch	-1.99	U-shaped	1.414	1	-1.41	1.990	$\infty$	0
	Receiver VRC	0.216	-						0
	Antenna +Cable VRC	0.95	-						0
$R_s$	Measurement System Repeatability	0.96	normal 1	1.000	1	0.96	0.922	13	0.0 653 343 51
$R_{EUT}$	Repeatability of EUT	0.00	normal 1	1.000	1	0.00	0.000		0
$u_c(F_s)$	Combined Standard Uncertainty		normal			3.50	12.25 2	229 8	0.0 653 343 51
$U(F_s)$	Expanded Uncertainty		normal k=	1.64		5.7		229 8	

## **7. CONDUCTED EMISSIONS CFR 47 PART15:247**

### **7.1. Test Procedure**

The ADRS RM013 was set to 902,915 and 927MHz In turn, with the transmitter set to maximum output and a CW carrier. The Radio Modem was connected to the measuring analyser via a band stop filter of a minimum of 36dB loss over the frequency range 900MHz to 935MHz. The frequency ranges from 30MHz to 1GHz and 1GHz to 10GHz were scanned using a spectrum analyser with peak and average detectors.

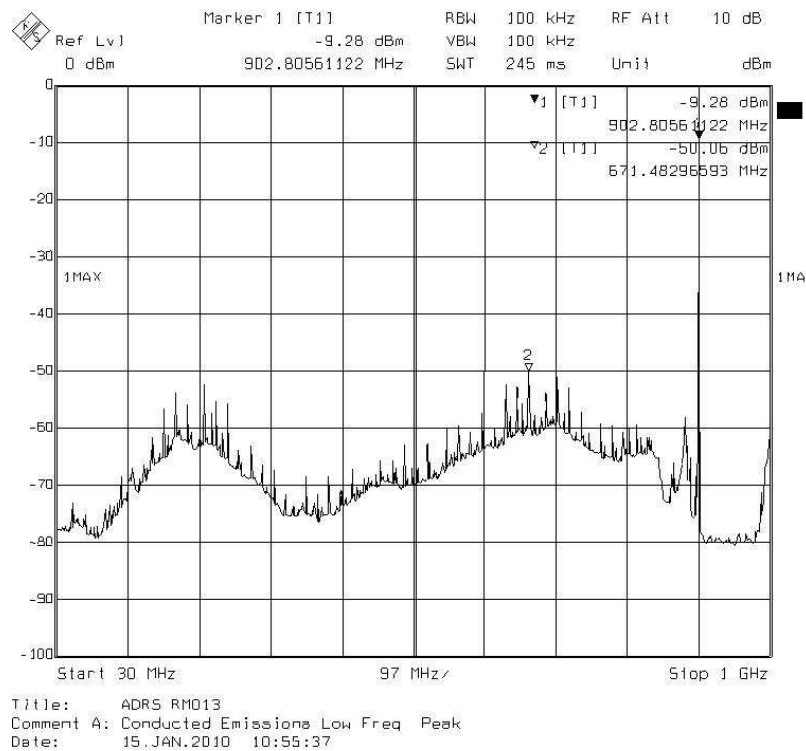
Test were also carried out with the Radio Modem set to the receive mode. These tests were carried using a peak detector only.

These tests carried out using a 100kHz RBW and a 100kHz VBW as required by Part 15:247.

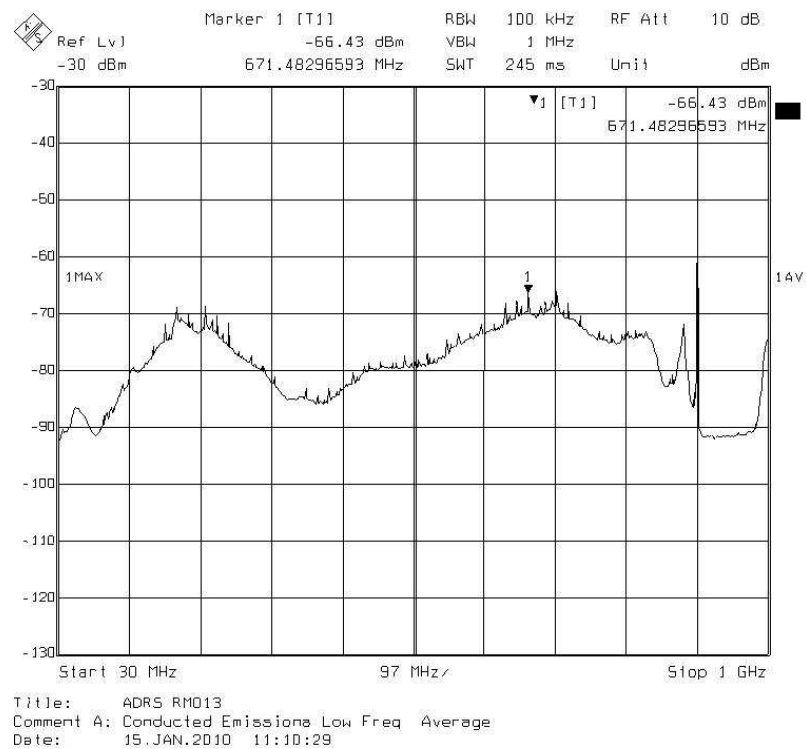
Plots of these tests are shown in section 7.2 with the levels recorded a minimum of 30dB down from the peak conducted power measurements as shown in Section 3.3.

## 7.2. Plots of conducted emissions

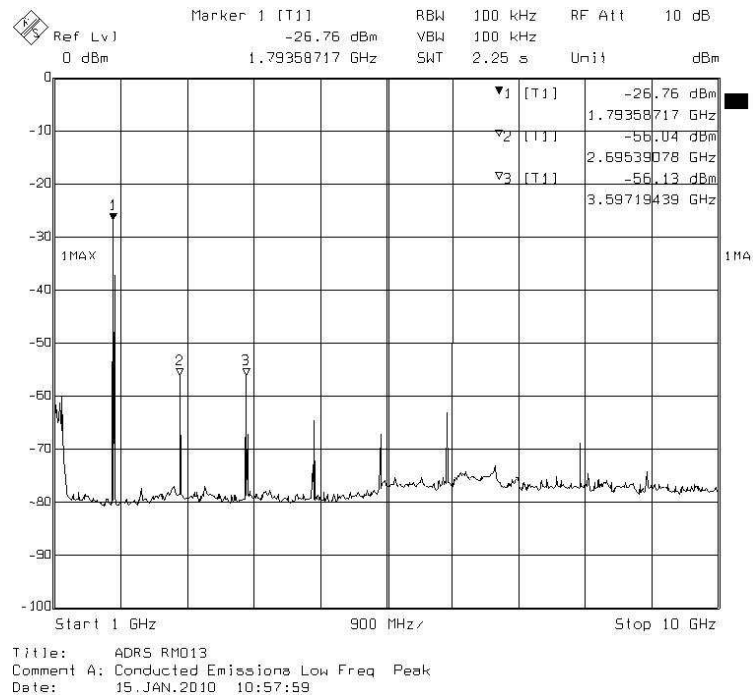
### CW Transmissions – 902MHz



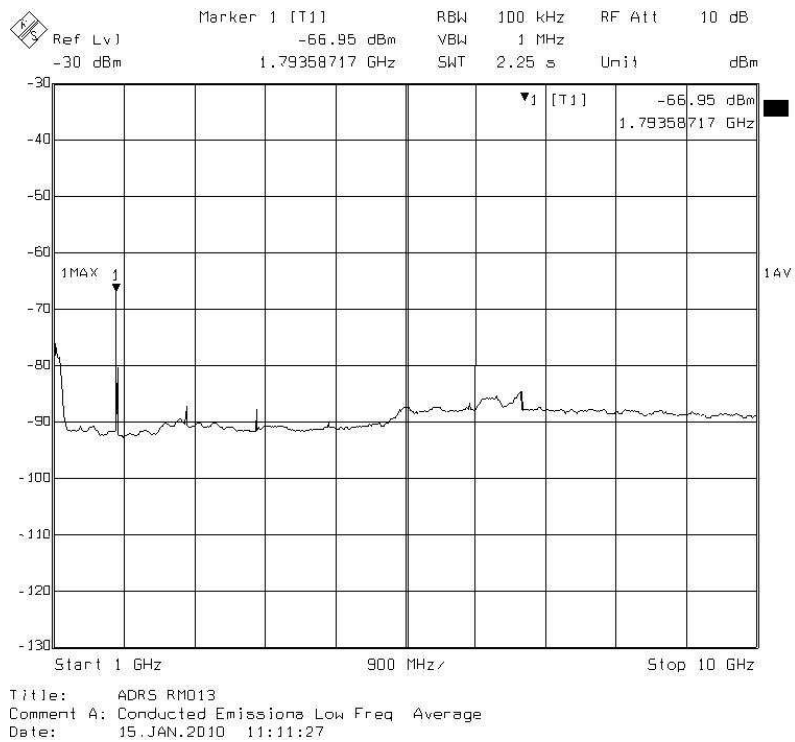
### Peak



### Average

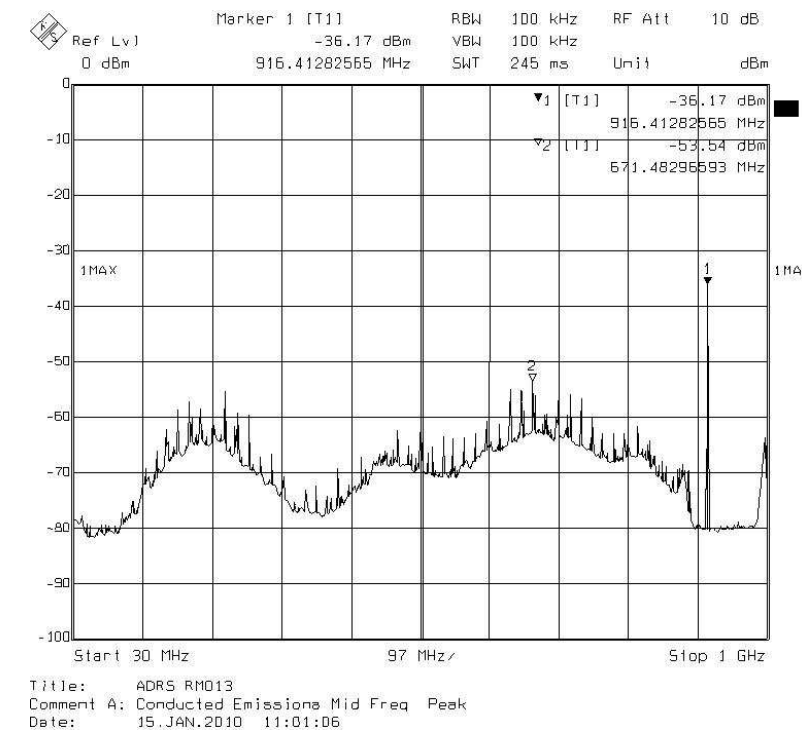


### Peak

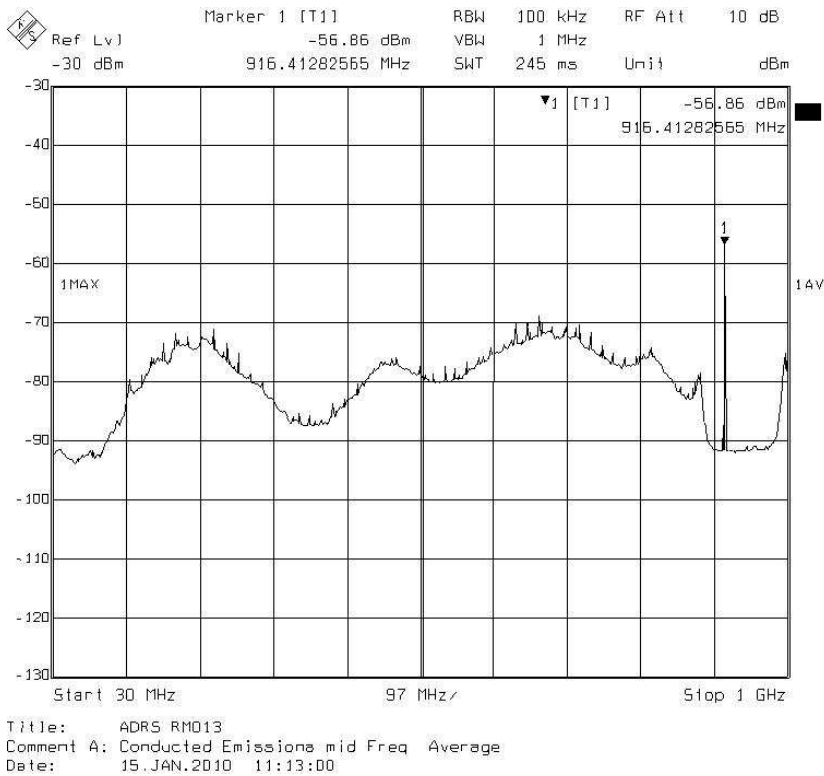


### Average

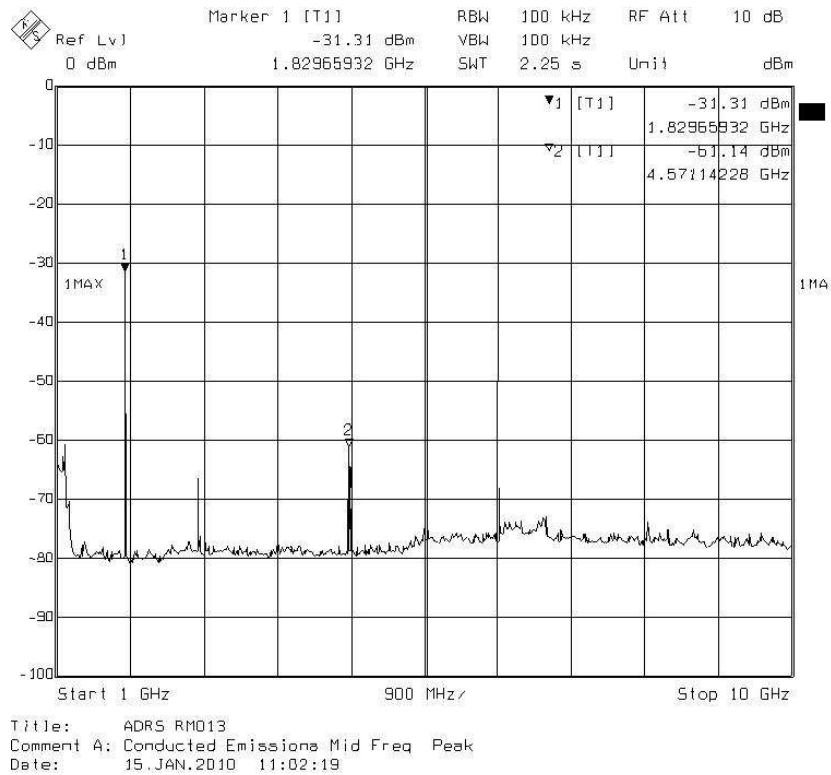
915MHz



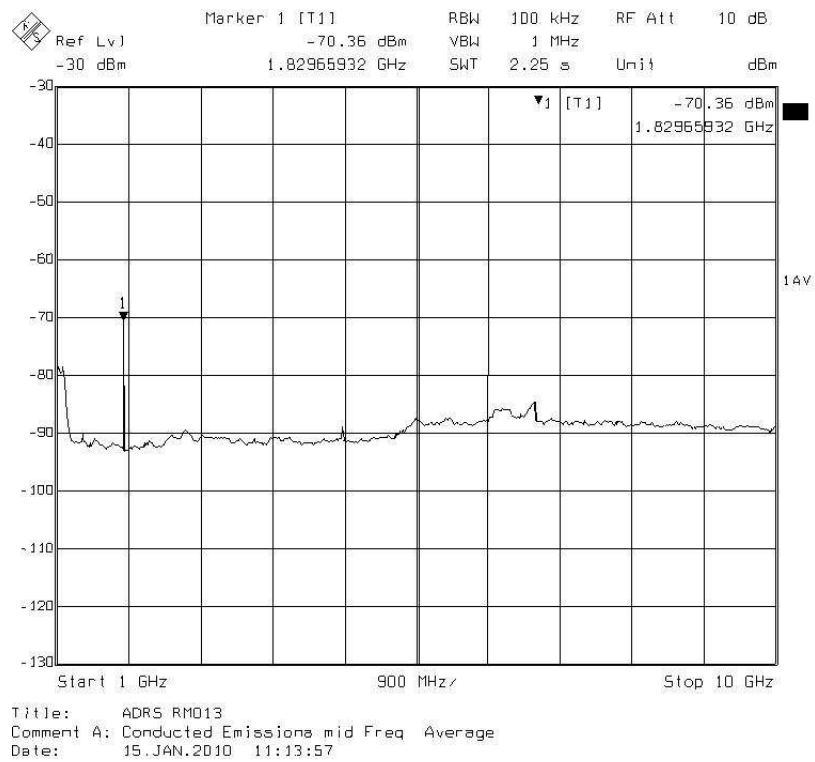
Peak



Average



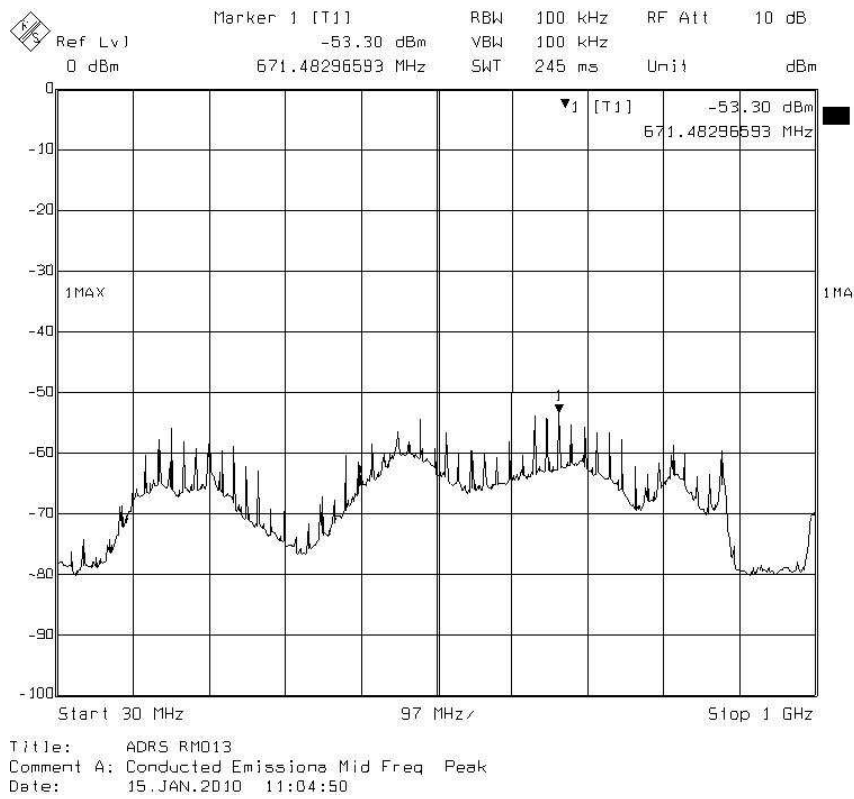
Peak



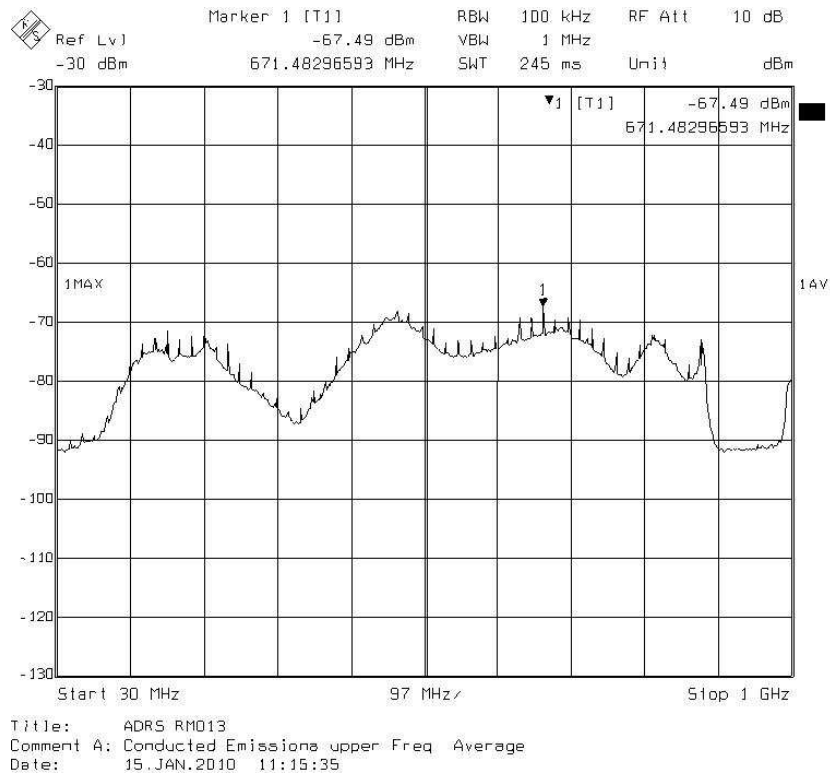
Average



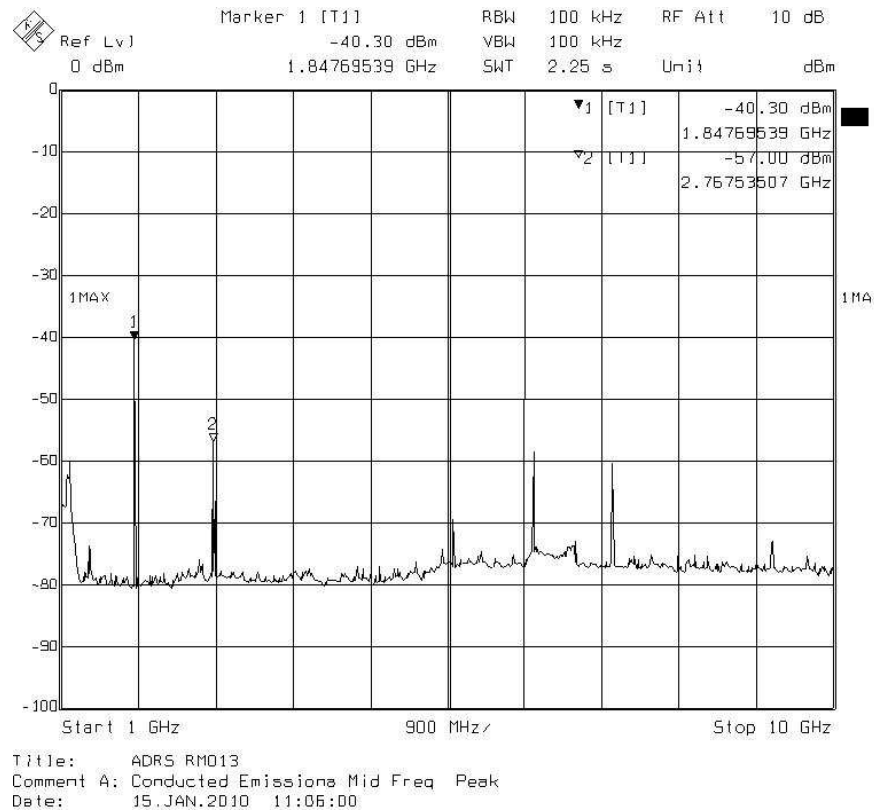
927 MHz



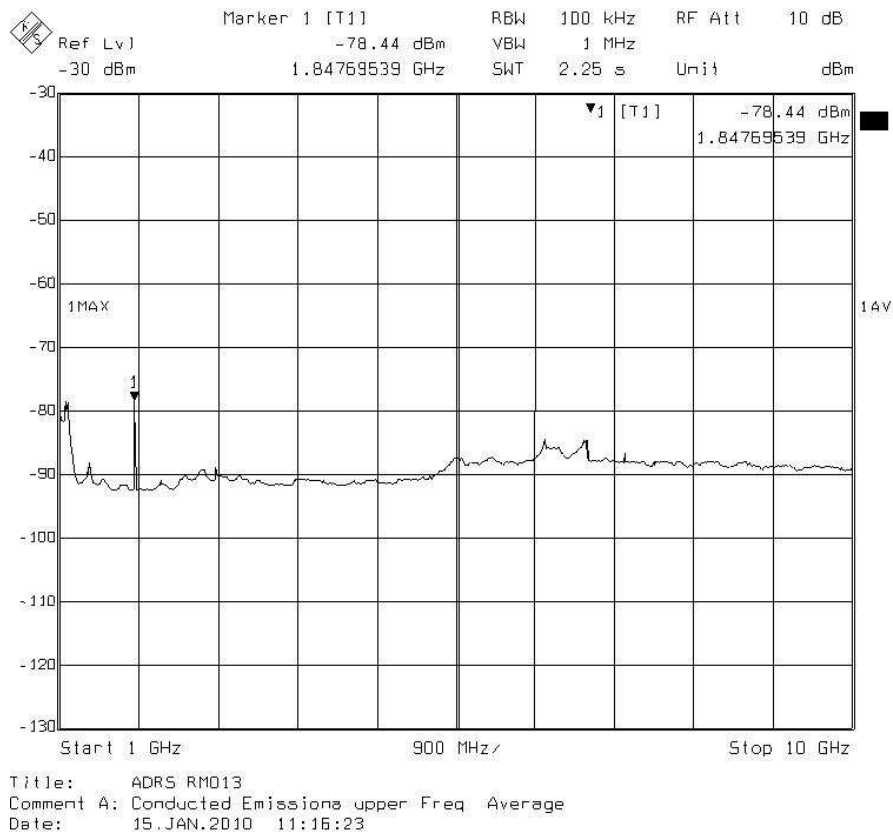
Peak



Average

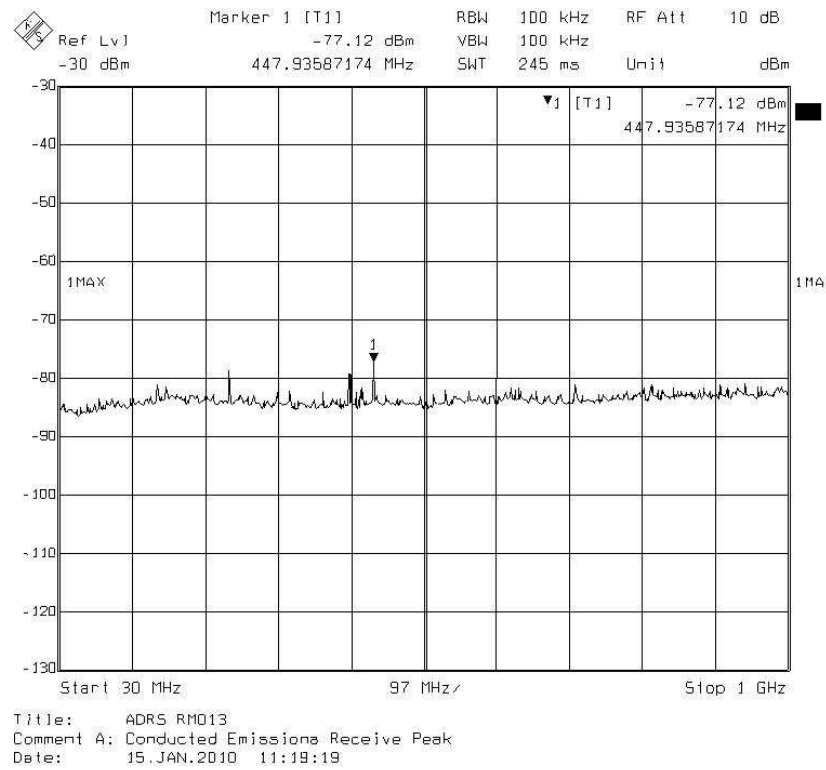


### Peak

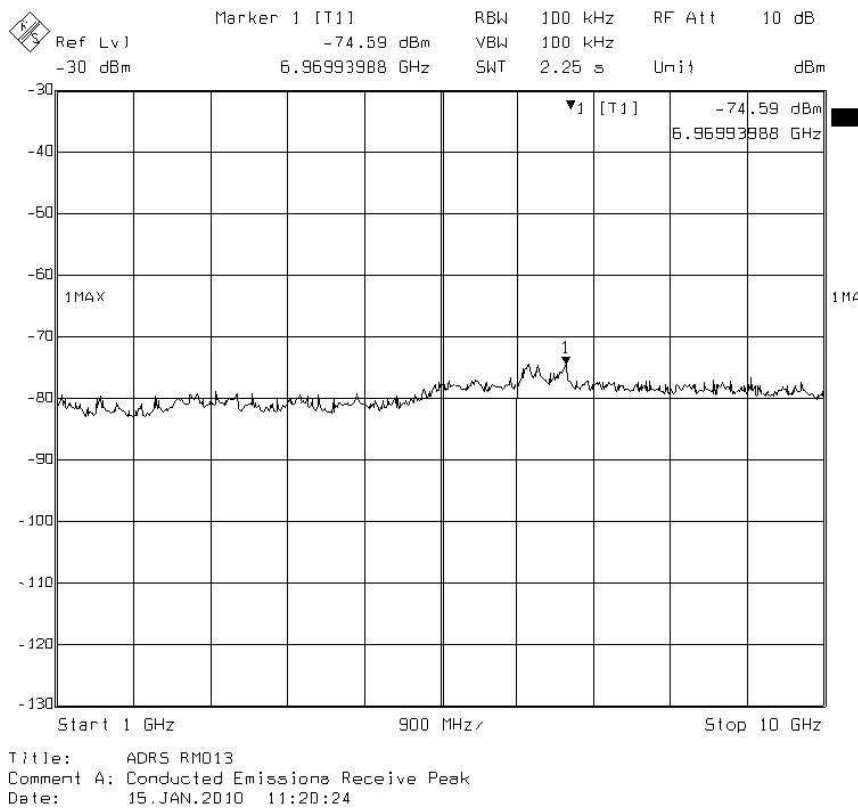


### Average

Modem in Receive mode

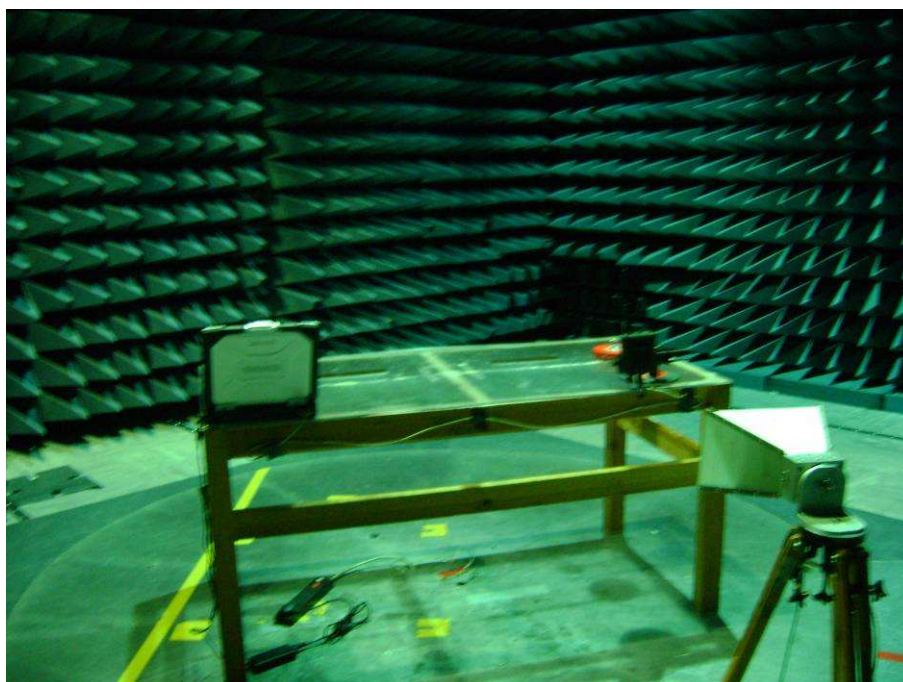
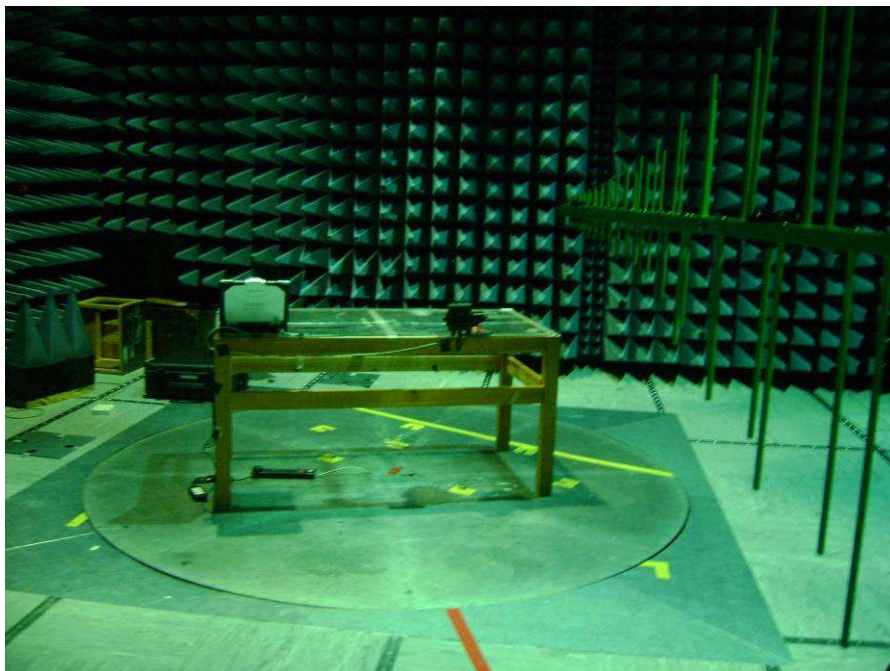


Peak



Peak

## 8. PHOTOGRAPHS OF TEST SETUP



Radiated Emissions



**Conducted Power**



**Conducted Emissions**

## 9. TEST EQUIPMENT

Equipment	Type	ID
Test Bay 1	Environment	7400
Chase Bilog	Antenna	8164
3115 Horn	Antenna	7512
Rohde & Schwarz FSEK	Spectrum Analyser	7811
Rohde & Schwarz FSH3	Spectrum Analyser	DM006916
Marconi Pre-amp	54432-010A	7772
ERA Microwave Pre-amp	WBA3-4	7534
Aerial Facilities Limited	Band Stop Filter	8289
Oregon Scientific	Environmental Sensor	7916
Cable N Type	10m	7063
Cable N Type	4m	7968
Cable N Type	1m	8185
Cable N Type	1m	8186
Cable microwave	5m	8247
Cable microwave	4m	7177
Cable microwave	2m	7405

All test equipment used was within its calibration period.

## 10. FCC ACCREDITATION

### FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division  
7435 Oakland Mills Road  
Columbia, MD 21046

March 27, 2009

Registration Number: 737726

Intertek  
Unit D,  
Imperial Park,  
Leatherhead, KT22 7TS  
United Kingdom

Attention: David Peasey

Re: Measurement facility located at Leatherhead, United Kingdom

Date of Listing: March 27, 2009

Dear Sir or Madam:

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. Please also note that this registration does not recognize the measurement facility to perform testing for products authorized under the Declaration of Conformity (DoC) process. In order to test products subject to DoC authorization process, a measurement facility must be accredited and recognized by the FCC.

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](http://www.fcc.gov) under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,



Katie Hawkins  
Electronics Engineer

## **11.**

## **RF EXPOSURE LEVELS**



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## Technical Note

Subject: **FCC Submission - RF Radiation Exposure Levels for ADRS Modem**

Date: 30 Nov 2009

Document ref: H6T030 01

### 1 Summary

This document outlines RF radiation exposure level calculations for the ADRS modem. Levels are specified as a power density.

For the exposure calculations the ADRS modem can be considered as a mobile device as defined in FCC § 2.1091 part (b) because it is generally operated at a distance of >20 cm from a person and although it is used in fixed locations, it can potentially be moved.

Limits are those defined in FCC § 1.1310 *Radiofrequency radiation exposure limits*. The limits for uncontrolled exposure have been applied.

In summary, the RF radiation exposure levels at a distance of 20 cm are below the specified FCC limits.

### 2 FCC § 1.1310 Limits

#### 2.1 Limits for General Population/Uncontrolled Exposure

Limit:

$$PD_{\text{lim}} = \frac{f}{1500} \text{ mW/cm}^2, \text{ where } f \text{ is the frequency in MHz.}$$

At 902 MHz, the limit is 0.601 mW/cm<sup>2</sup>.

### 3 RF Radiated Exposure Calculations

#### 3.1 Power Density Expression

The power density,  $PD$ , at a range  $R$  from the transmitter with an effective isotropic radiated power  $EIRP$ , is given by:

$$PD = \frac{EIRP}{4\pi R^2}.$$

To calculate the closest range at which the power density reaches the FCC limits, the following expression is used.

$$R = \sqrt{\frac{EIRP}{4\pi PD_{\text{lim}}}}.$$

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### **3.1.1 Power Density at 20 cm**

A worst case peak EIRP of 2 W is assumed. The worst case transmit duty cycle when averaged over 30 minutes is 20% giving an average EIRP of 400 mW. At 20 cm, the power density is  $0.08 \text{ mW/cm}^2$ , which is below the FCC limit of  $0.601 \text{ mW/cm}^2$ . This is based on a transmit duty cycle of 100%.

### **3.1.2 Closest Range**

Assuming a worst case average EIRP of 400 mW the power density meets the FCC limit of  $0.601 \text{ mW/cm}^2$  at a range of 7.3 cm.

## **12. OPERATIONAL DESCRIPTION**

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# Technical Note

## FCC Submission - Operational Description for the ADRS Modem

Date: 30 Nov 2009 Document ref: H6T031 01

### 1 Introduction

This technical note provides an operational description of the Smiths Detection ADRS Modem, which is required as part of the FCC certification process. The structure of this document is also to address key points in the FCC document DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems" (dated 30th March, 2000) to show that the modem unit meets the requirements of FCC § 15.247.

### 2 Description

The ADRS system consists of a number of chemical detector devices (up to 100), each physically connected to a modem unit which communicates wirelessly in the 902 – 928 MHz band with a basestation unit. The modem can operate as either an outstation or basestation depending on whether it is connected to a detector or a laptop computer respectively.

Referring to the block diagram in H6E03B01, the modem unit comprises three PCBs; The main modem PCB, a GPS/battery connector PCB and an EMP filter PCB. The EMP filter PCB and the GPS/Battery PCB connect to the main modem PCB and these are fitted to a chassis which provides a common ground.

The antenna connects to a TNC connector on the top of the enclosure.

The main modem contains the radio, the microcontroller and power supply regulators. This PCB contains a ground plane on an inner layer which acts as the main reference plane.

The unit can be powered from a battery pack which contains four AA cells, or alternatively, an external DC supply. The DC connection is fed to the EMP filter PCB where it is filtered before being routed to the main modem PCB via an inter-board connector. A switch-mode power supply then takes this and produces a constant 8V which is fed into a power supply switch. This switch detects whether the external DC supply is connected and if so, will use this supply and disconnect the battery input. Two more switch-mode power supplies are used: one for the PA and the other for all other circuitry. The outputs of these are then linearly regulated before being fed to the various blocks.

On the left side of the block diagram there is a communications interface connector, which is for the serial interface between the modem and detector unit.

The GPS/battery PCB contains a GPS module and the battery connectors. This has a flexi-PCB connection to the main modem board. The GPS module is used to speed-up the initial network set-up by providing current-time information.

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### 3 Location of Intended Use

The ADRS modem is a portable device, intended for deployment at outside locations in Canada and United States of America.

The personnel deploying, operating and maintaining an ADRS system will be professional military, first responder or other government personnel. ADRS operators will have been trained in the use of the ADRS system by Smiths Detection, by an agent of Smiths Detection or by other trained government personnel.

When a deployment is required, a set of ADRS modems (typically 20 but up to 100) will be transported to a location where an ADRS system is required. One ADRS modem will be placed in a central outdoor location as the basestation. All other ADRS modems will be deployed within 3km and within line of sight of this location. The system will be used in this configuration for as long as required.

The ADRS modem is not designed to be operated on the move. If any part of an ADRS system needs to be relocated then that part will be deactivated before being moved.

### 4 Antenna

The modem unit is used in conjunction with an off-the-shelf antenna, namely the Panorama Antennas CD900 which has a TNC RF connector. This is permitted by §15.203 as the equipment must be professionally installed.

### 5 Modulation Scheme (§ 2.202)

The emission designator for this device is 16K0F1D. The parameters are as follows:

Necessary Bandwidth: 16kHz (Bandwidth designator = 16K0)  
Modulation scheme: 2-FSK (Designator = F, Frequency Modulation)  
Type of modulating signal: Single channel (Designator = 1)  
Type of transmitted information: Telemetry (designator = D)

The system also uses frequency hopping as required by §15.247.

### 6 Frequency Hopping Spread Spectrum

The following points describe how the modem when communicating over the air with another modem meets the definition of a frequency hopping spread spectrum system as found in FCC § 2.1 Terms and definitions.

#### 6.1 Carrier Frequency Separation

The carrier frequency separation is no less than 187.1kHz. This is greater than the 20 dBc bandwidth.

#### 6.2 Time of Occupancy

The time of occupancy on any frequency is 400 ms, which includes transmitter turn-on and turn-off times.

#### 6.3 Hop Sequence

There are a total of 128 hopping channels split into two groups of 64. The device uses a pseudo-random sequence on one of the set of 64 channels (Group A) and then after the 64 hops switches to the second set (Group B) for another 64 hops. It then returns to the original set of channels

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again and alternates every 64 slots. The pattern alternates between channel groups, with each run through a set of 64 channels being different to the one before, to produce a long sequence of 8192 hops which is guaranteed never to return to any given channel within a 20 second window.

### **6.4 Equal Hopping Frequency Use**

Using the pseudo-random sequencing on two alternating groups of hopping channels, as described in section 6.3 above, means that all 128 hop frequencies will be used equally on average.

## **6.5 Receiver**

### **6.5.1 System Receiver Input Bandwidth**

The receiver input bandwidth is matched to the transmitted signal bandwidth.

### **6.5.2 System Receiver Hopping Capability**

The modem receiver shifts in synchronisation with a transmit signal from another modem unit. The radio synthesizer deploys a phase-lock loop (PLL), whose settings are reprogrammed for each hop in the sequence.

## **6.6 Transmitter**

### **6.6.1 Peak EIRP**

When in transmit mode, the modem always operates at full power (2W peak EIRP). This power level is well below the limit given in § 15.247.

### **6.7 Regarding § 15.247(g)**

In the event that the outstation was required to receive or transmit continuously, the outstation would utilise all 128 frequencies.

### **6.8 Regarding § 15.247(h)**

The modem unit is configured with a fixed hop sequence. It does not contain the knowledge of other frequency hopping systems and does not have the ability to scan or communicate with other frequency hopping systems for the purpose of co-ordinating hop frequencies.