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Field Strength measurements in the 2.5 – 2.69 GHz band from emissions in the Republic of Ireland and France

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Limitations

The results detailed in this report apply only to the tests made at that time, using the test equipment detailed and are indicative. They do not indicate that on another date an identical set of results may be achieved, due to changes in local environmental conditions or other factors which may or may not have an effect on the measurement results obtained at that future time. These results represent signal received under average propagation conditions; comparison with predictions that normally represent the worst 10% or 1% of time may not be appropriate.

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1 Introduction

The Regulatory Field Team was tasked by Spectrum Policy Group - Mobile Services Team with conducting field strength measurements in the 2500MHz to 2690MHz band of transmissions emanating from the Republic of Ireland (ROI) and France.

In Ireland, the 2500-2686MHz-frequency band is used for the Multichannel Multipoint Distribution Service (MMDS) service. This provides a subscription digital and analogue television distribution service throughout the ROI. The request required measurements to be made at sites in North Wales, Northwest England and on the border between Northern Ireland and the ROI. This last group of measurements were to be completed by the RMDF Team.

Location		site	NGR
number	name		
1	South Stack	RSPB car park	SH 210819
2	Capel Engedi	Telephone box lay-by	SH 362762
3	Southport	The Esplanade	SD 338186
4	Blackpool	North Parade	SD 312418
5	Parbold Hill	View Point (120 m a.s.l.)	SD 508107
6	Newry	44°9'20.3" N 06°22'1.1" E	-
7	Lisbellaw	54°19'0.7" N 07°32'35.4"E	-
8	Armagh	54°20'31.9"N 06°38'26.5"E	-

Table 1: Site locations for MMDS measurements

Using map software an estimation of the distances between the mainland measurement locations (numbers 1 to 5) in Table 1 and specific sites in the Republic of Ireland was completed as shown in Table 2.

	South Stack	Capel Engedi	Southport	Blackpool	Parbold Hill
Dundalk	86	96	140	137	153
Navan	87	96	151	149	163
Dublin	65	75	133	136	145
Wicklow	61	69	134	137	143
Canew	86	93	158	160	167

Table 2: Estimated distance between measurement sites and Irish locations in miles

The Commission for Communications Regulation has published the Technical conditions for the operation of analogue and digital programme services distribution systems in the frequency band 2500 – 2686 MHz band. The National Plan includes the channelling arrangements into groups as detailed in Table 3.

Channel Number	Channel Frequencies (MHz)	Channel Group
4	2524 - 2532	B
5	2532 - 2540	A
6	2540 - 2548	B
7	2548 - 2556	A
8	2556 - 2564	B
9	2564 - 2572	A
10	2572 - 2580	B
11	2580 - 2588	A
12	2588 - 2596	B
13	2596 - 2604	A
14	2604 - 2612	B
15	2612 - 2620	A
16	2620 - 2628	B
17	2628 - 2636	A
18	2636 - 2644	B
19	2644 - 2652	A
20	2652 - 2660	B
21	2660 - 2668	A

Table 3: MMDS Channel Plan (ComReg 98/65R2 & 9867R)

The 18 channels are subdivided into 2 separate groups of interleaved channels. Group A use the odd numbered channels and group B the even channels. Each group of channels may be used with either vertically or horizontally polarised antennas. Where a cell uses the even channels for the analogue service then the odd channels will be used for the digital service.

In France, the 2500-2690MHz frequency band is used mainly by the Gendarmerie Nationale for fixed and tactical (point to point) radio. A set of measurements was completed on the South Coast of England to assess any in-band activity originating from France.

Map of measurement locations

2 Contacts

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3 Equipment

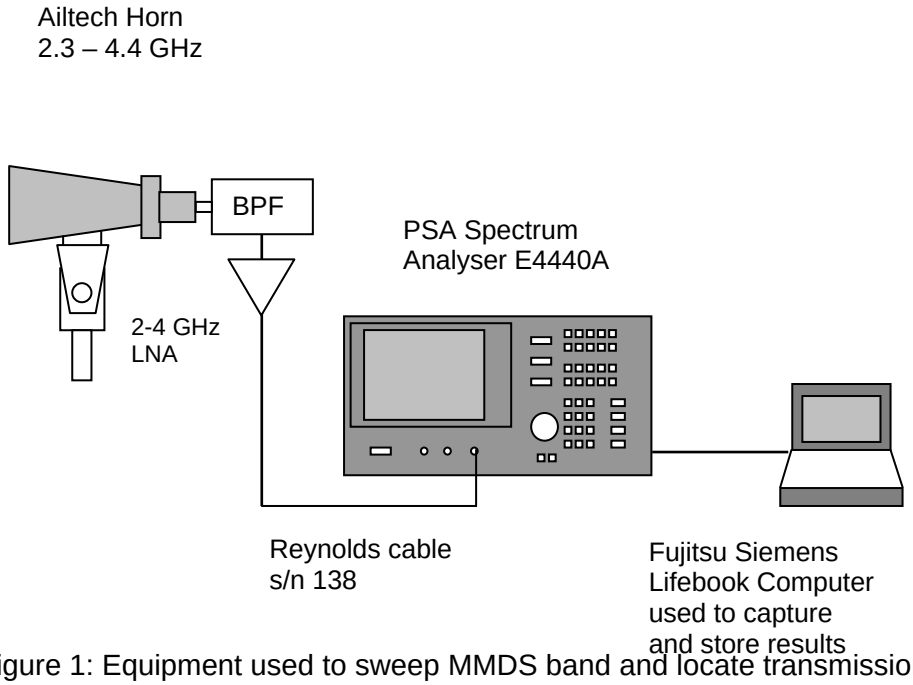

Figure 1: Equipment used to sweep MMDS band and locate transmissions in North Wales and Northwest England and French transmissions along the south coast.

The Ailtech Horn and LNA were mounted on the vehicles pneumatic mast and connected to the spectrum analyser with the Reynolds 12 metre coaxial cable. A band-pass filter was available to remove strong out of band transmissions at locations were they were detected in an initial broadband scan.

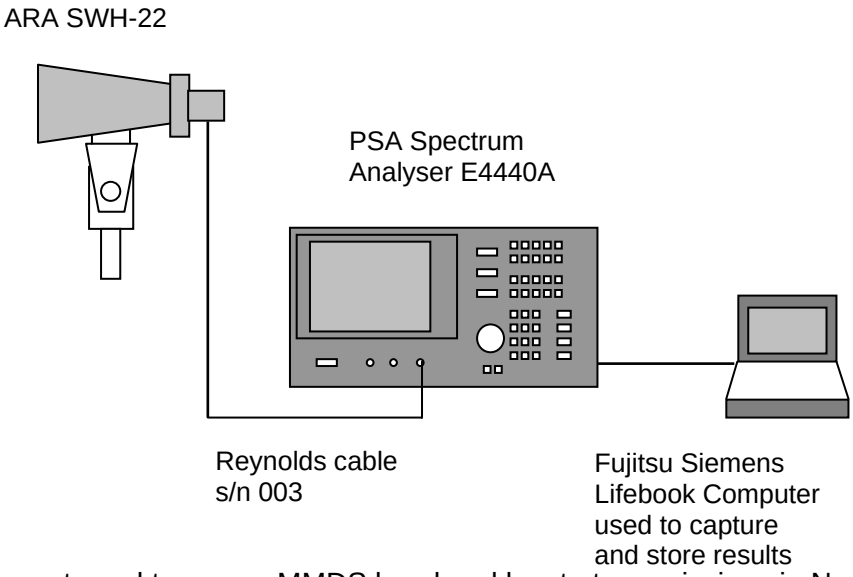

Figure 2: Equipment used to sweep MMDS band and locate transmissions in Northern Ireland

4 Method

4.1 MMDS Survey North Wales and Northwest England

The survey required measurements to be taken on the vehicle mast 9 metres above ground level across the whole 2.5 to 2.69 GHz band. If transmissions were detected a second set of measurements were to be recorded with the antenna tripod mounted 1.5 metres above ground level. To provide the best level of sensitivity a standard gain horn and low noise amplifier (LNA) was used in conjunction with the spectrum analyser.

At each location an initial scan was completed to assess any out of band activity. The most common out of band signals were detected from aeronautical radar (2.7 – 2.9 GHz) and/or maritime radar (2.9 – 3.1 GHz). At these measurement locations the band-pass filter was included between the horn and the LNA. The filter is tuneable between 2 and 4 GHz and exhibits a 30 MHz band-pass characteristic. With the filter inserted as shown in Figure 2 measurements were completed in 30 MHz segments from 2.5 to 2.7 GHz. At each segment the analyser was set on ‘max hold’ and the antenna rotated across a westerly arc.

4.2 Northern Ireland survey

Equipment used for measurements in Northern Ireland is shown in Figure 2. No Band pass filter or Low Noise amplifier were used at the Newry location but were introduced at the Armagh and Enniskillen location. This survey looked at the MMDS 2.5- 2.69GHz band only. Observations were made at three locations in Newry, Armagh and Enniskillen areas. The Newry location was approximately 5 Km North of the border and produced the most significant results with field strengths in the region of 57dBµV/m for an analogue emission and 39 dBµV/m(RBW) for the digital emissions. These emissions were believed to originate from the Mount Oriel transmitter site the analogue only MMDS system originating from Sligo in the republic of Ireland was observed at Lisbellaw near Enniskillen. No signals of interest were observed at the Armagh location.

4.3 South Coast Survey

The same equipment was used to measure any transmissions emanating from Continental Europe from three locations along the south coast. All measurements were completed with the horn raised to 9 metres above ground level.

At each location an initial scan was completed to assess any out of band activity. The most common out of band signals were detected from maritime radar (2.9 – 3.1 GHz). At these measurement locations the band-pass filter was included between the horn and the LNA. The filter is tuneable between 2 and 4 GHz and exhibits a 30 MHz band-pass characteristic. With the filter inserted as shown in Figure 2 measurements were completed in 20 MHz segments from 2.5 to 2.7 GHz.

Measurements were completed for both horizontal and vertical polarised signals. At each segment the analyser was set on ‘max hold’ and the antenna rotated from east to south. Only one in-band transmission was detected at Hythe on a bearing of 137 degrees magnetic (see Figure 23). No other signals were detected at either Dover or Hastings.

4.4 Scaling

In all cases the analyser band width was optimised to allow a detailed spectrum observation. Therefore the analyser plot may not report the full power in a single victim channel. An estimate of the field strength in a different bandwidth can be obtained by scaling the results according to:

Field Strength (dBuv/m)
= Observed Field Strength (dBuv/m) + 10*Log (signal bandwidth/Res BW)

In this report the results have been scaled to nominal bandwidth of 1MHz.

5 Results: Emissions from the Republic of Ireland

5.1 North West England

The MMDS results are shown for each location in the order in which they appear in Table 1. The system noise floor was found to be between 28 and 30 dBuV as recorded on the spectrum analyser. With the application of the correction factors this equates to a field strength of between 9.3 and 10.3 dBuV/m.

South Stack **NGR: SH 210819**

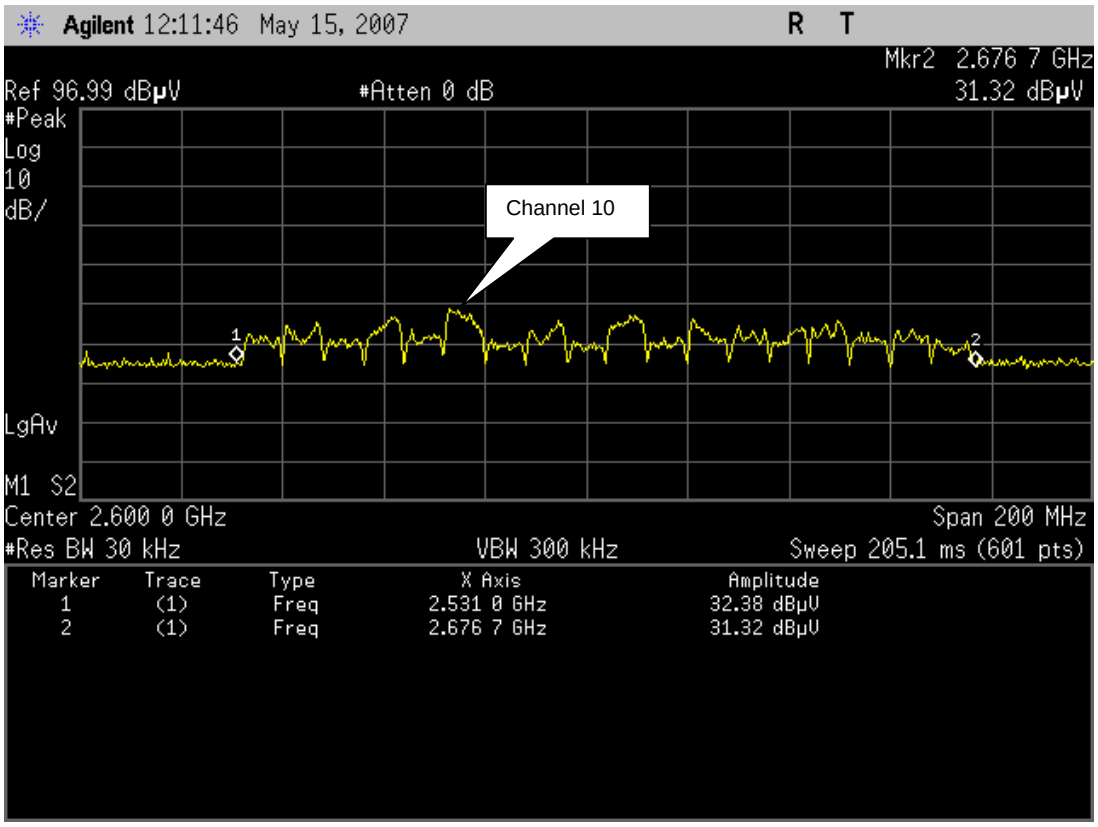

Figure 3: South Stack: MMDS transmission showing Channels 5 to 22 (Channel 10 is highlighted)

With the horn antenna/LNA raised to 9 metres a.g.l. a full band scan was completed which showed no strong out of band signals. The spectrum analyser span was then reduced to cover the MMDS band. No signals were seen with the horn polarisation set to vertical

Figure 3 shows the whole 18 channel group with the horn polarisation set to horizontal. The analogue channels (odd numbers) are interleaved with the digital channels. The digital channel number 10 is highlighted. The horn bearing was 256 degrees (magnetic). In an effort to capture the total single channel power, the span was reduced to 8 MHz centred on the MMDS Channel 10. Various resolution bandwidth settings were used as shown in Figures 4, 5 and 6.

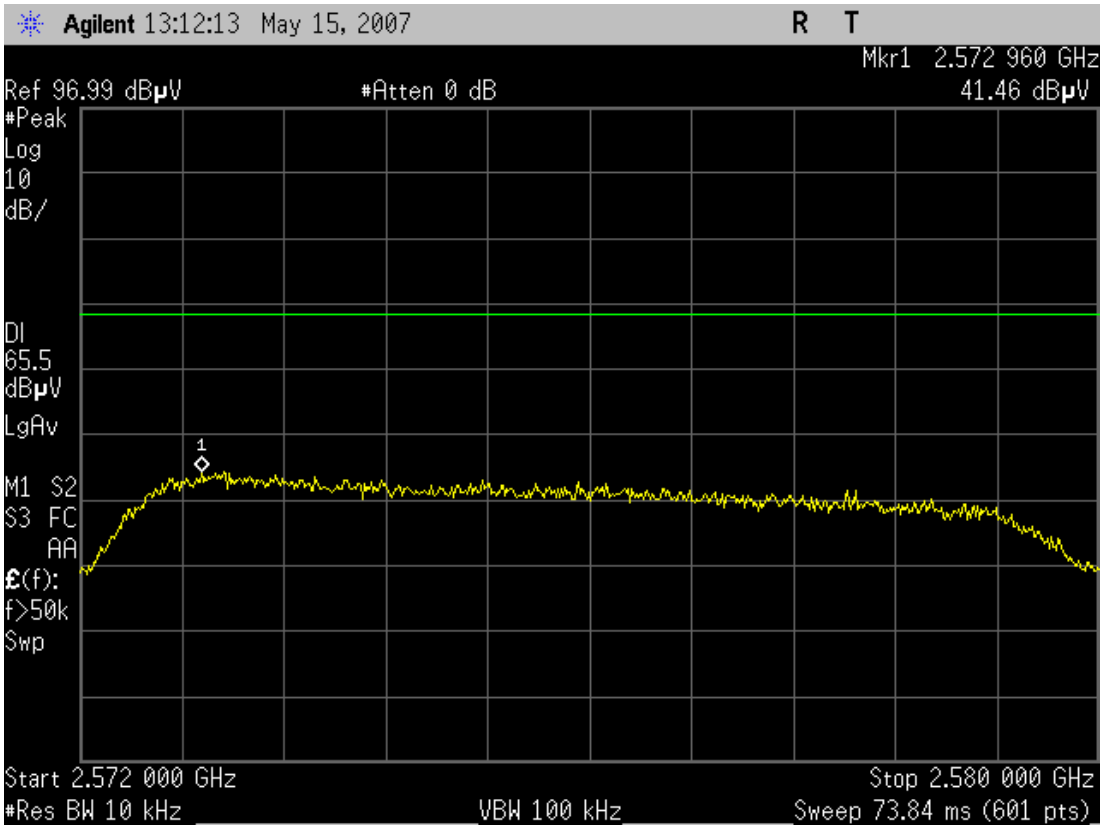

Figure 4: South Stack MMDS Channel 10 measured in 10 kHz resolution bandwidth

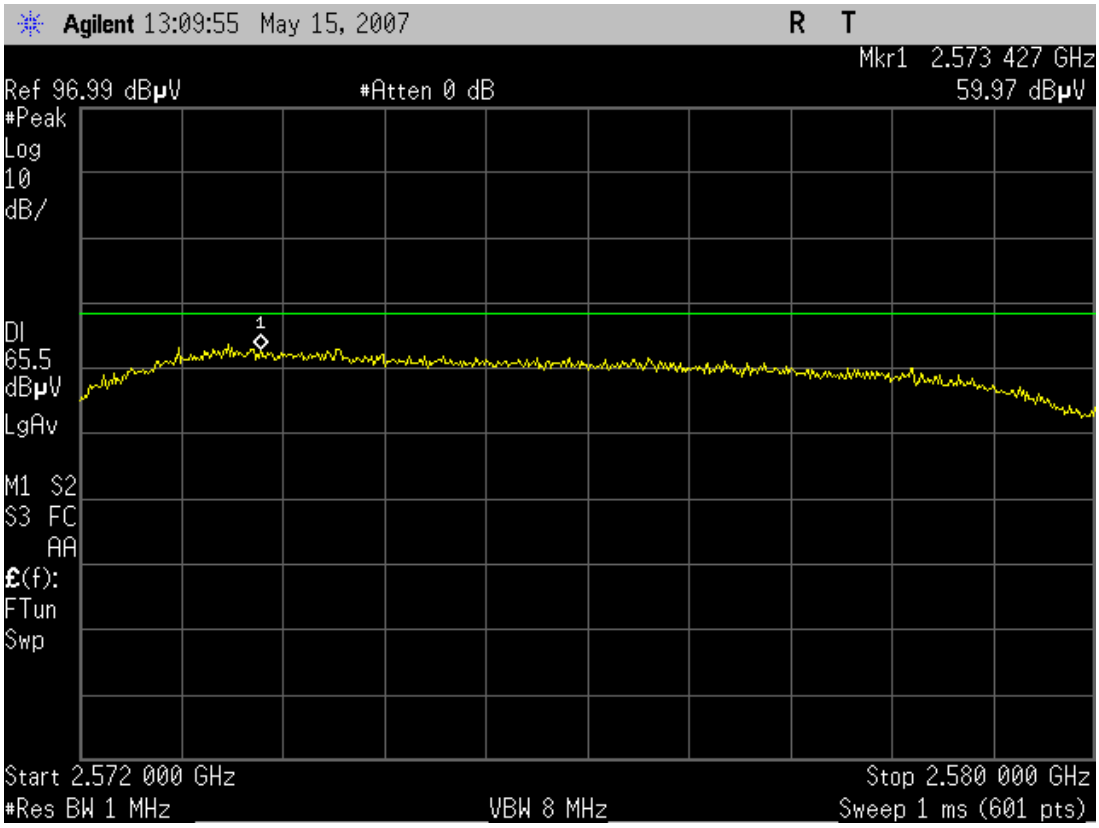

Figure 5: South Stack MMDS Channel 10 measured in 1 MHz resolution bandwidth

Field Strength = Trace + Cable loss + Antenna Factor – LNA gain dBuV/m
Field Strength = 59.97 + 5.1 + 22.3 – 48.06 dBuV/m
Field Strength = 39.31 dBuV/m

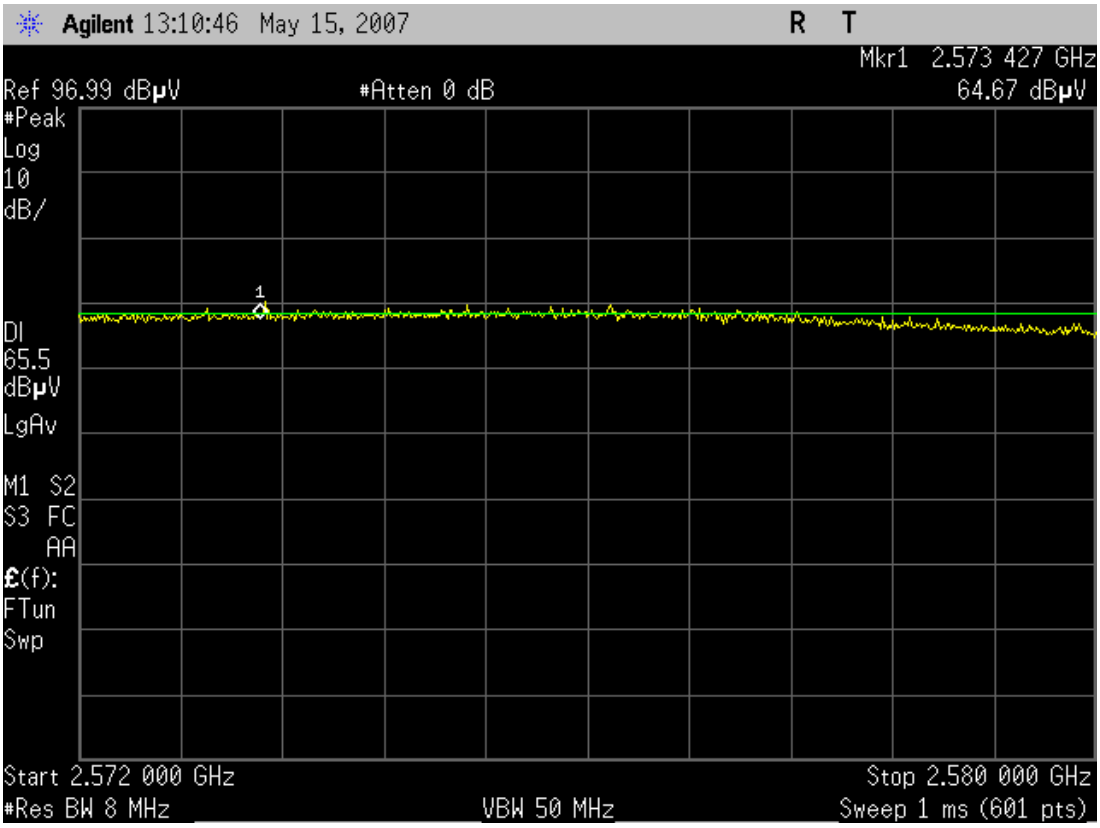

Figure 6: South Stack MMDS Channel 10 measured in 8 MHz resolution bandwidth

Finally the field strength was calculated using the correction factors shown below:

Field Strength = Trace + Cable loss + Antenna Factor – LNA gain dBuV/m
Field Strength = 65.5 + 5.1 + 22.3 – 48.06 dBuV/m
Field Strength = 44.01 dBuV/m
Estimated Field Strength in 1MHz = 34.98 dBuv/m

The horn was then mounted on a tripod 1.5 metres a.g.l. and a spectrum plot taken with horizontal polarisation on the same bearing.

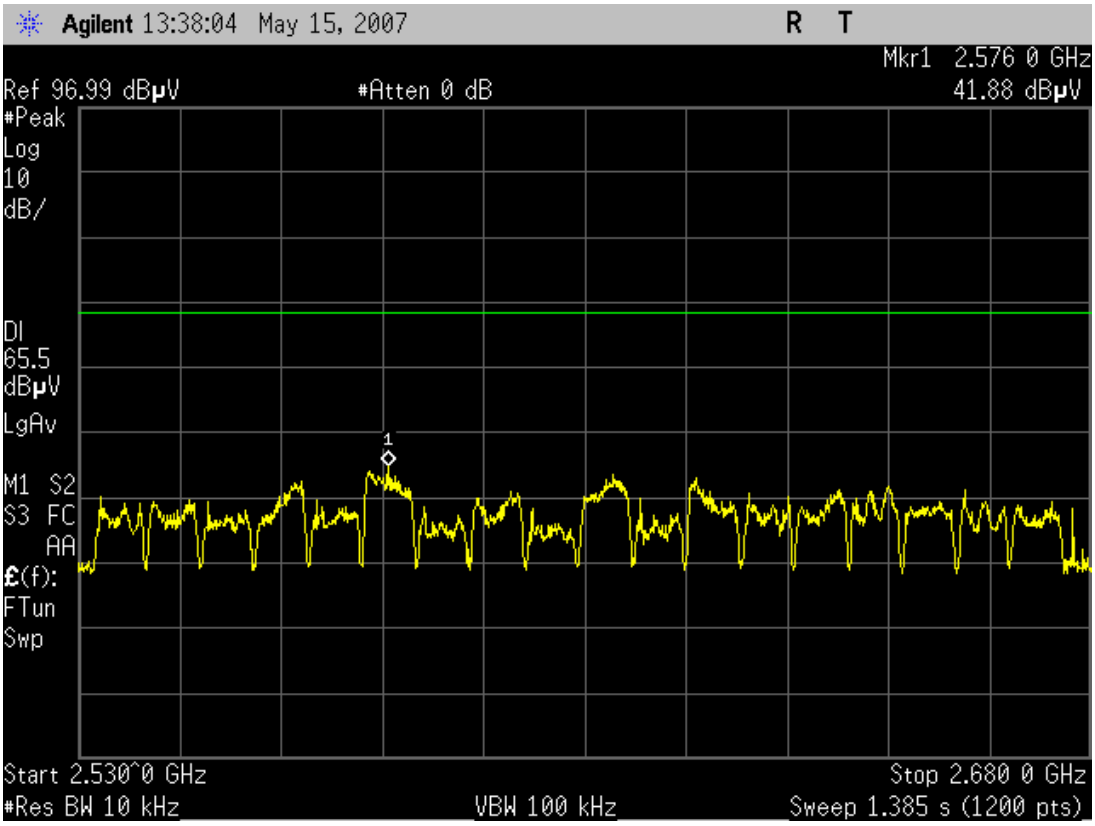

Figure 7: South Stack MMDS Channel 10 highlighted and measured in 10 kHz resolution bandwidth

Comparing Figures 4 and 7 shows that in a 10 kHz RBW the amplitude of the Channel 10 transmission varies between 41.46 and 41.88 dBuV with the measurement antenna lowered from 9 to 1.5 metres a.g.l.

Capel Engedi (10 miles inland from South Stack) **NGR: SH 362762**

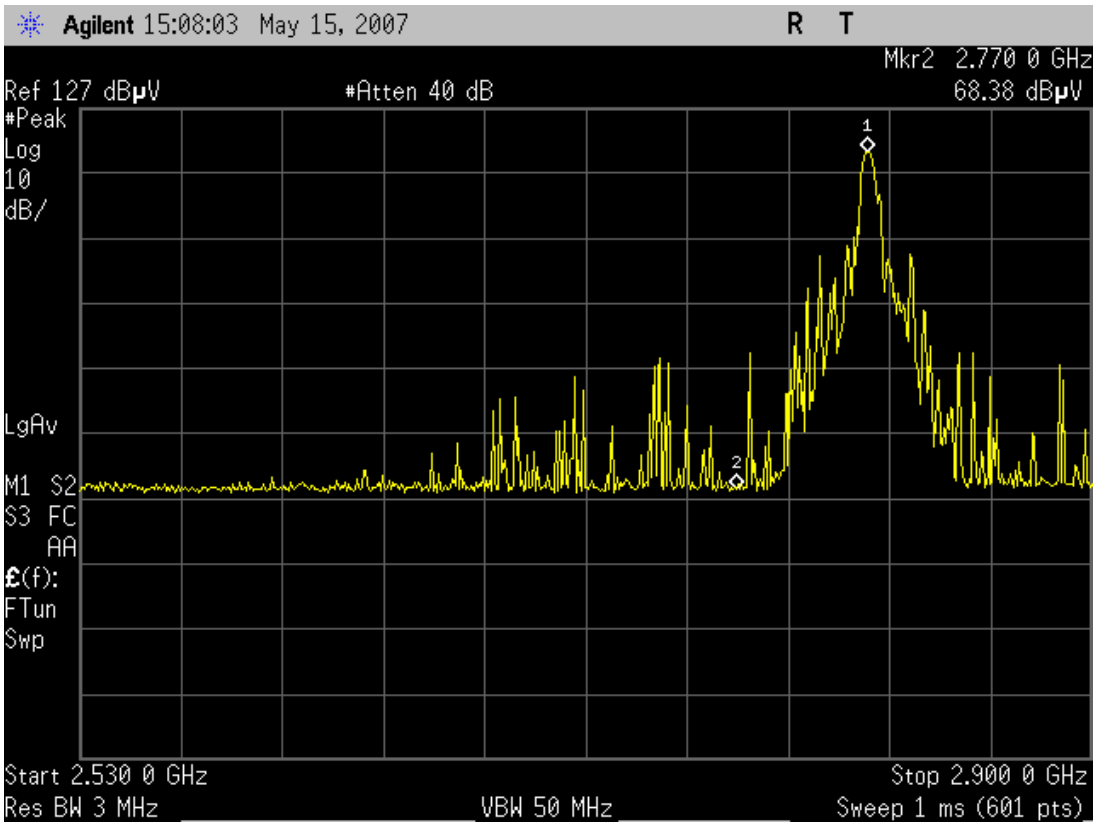

Figure 8: Capel Engedi Band scan from 2.53 – 2.9 GHz shows emissions possibly form aeronautical radar

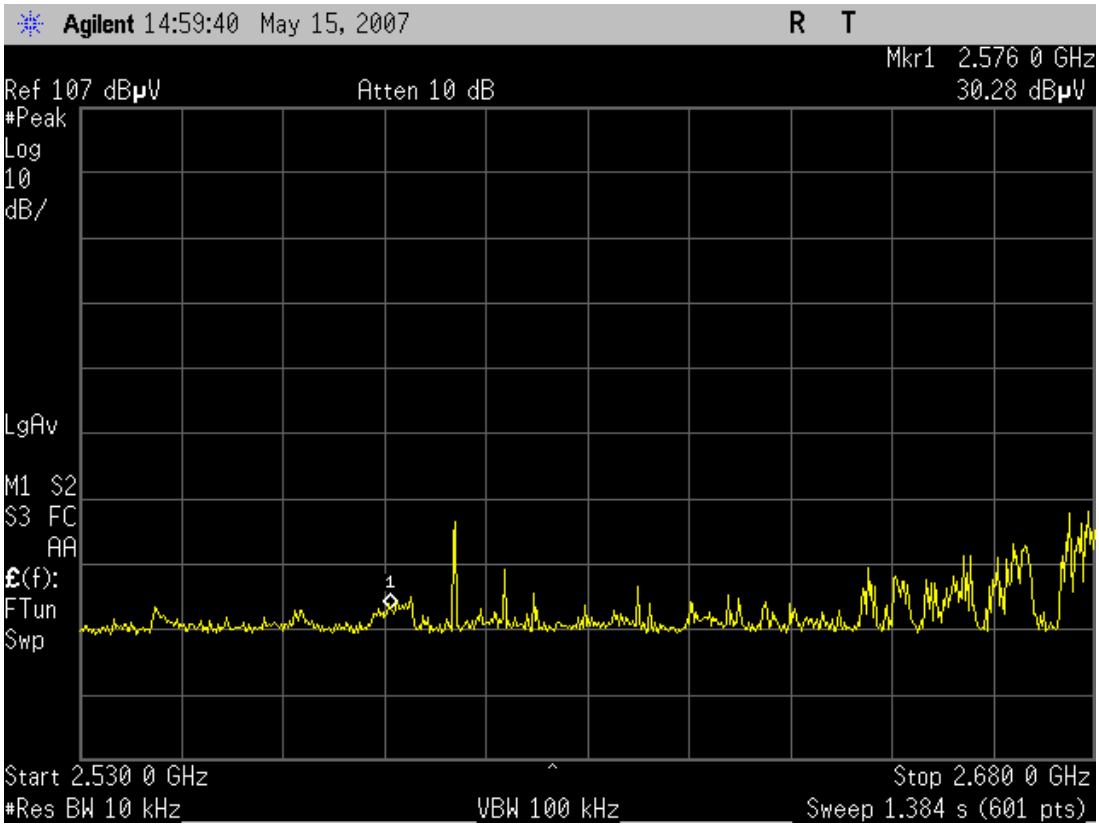

Figure 9: Capel Engedi MMDS Channel 10 visible just above the noise floor in 10 kHz RBW (10 dB RF attenuation)

Field Strength = Trace + Cable loss + Antenna Factor – LNA gain dBuV/m
Field Strength = 30.28 + 5.1 + 22.3 – 48.06 dBuV/m
Field Strength = 7.38 dBuV/m
Estimated Field Strength in 1MHz = 27.38 dBuV/m

Southport Esplanade **NGR: SD 338186**

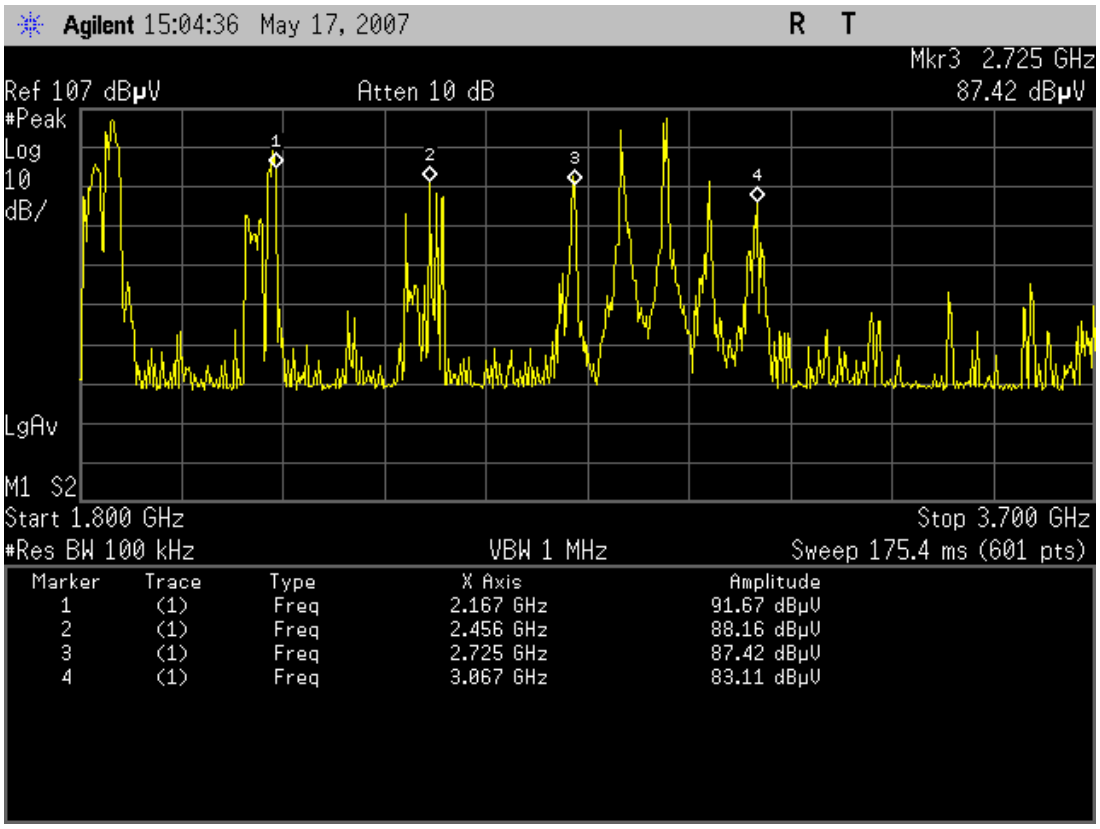

Figure 10: Southport Esplanade Bandscan showing 2G, UMTS, 2.4 GHz, aeronautical and maritime radar activity.

Figure 10 shows the out of band activity with the horn antenna set on a westerly bearing. The 2.4 GHz activity appeared to be from an oil platform visible on the horizon. Also shows emissions possibly from an aeronautical radar bearing (335 degrees magnetic).

The band pass filter was included in the horn/LNA set and the 2.5 – 2.7 GHz band measured in 30 MHz segments with horizontal polarisation. No MMDS signals were seen from this location. Even with the band pass filter in circuit some radar intrusion was detected above 2.68 GHz (see Figure 11).

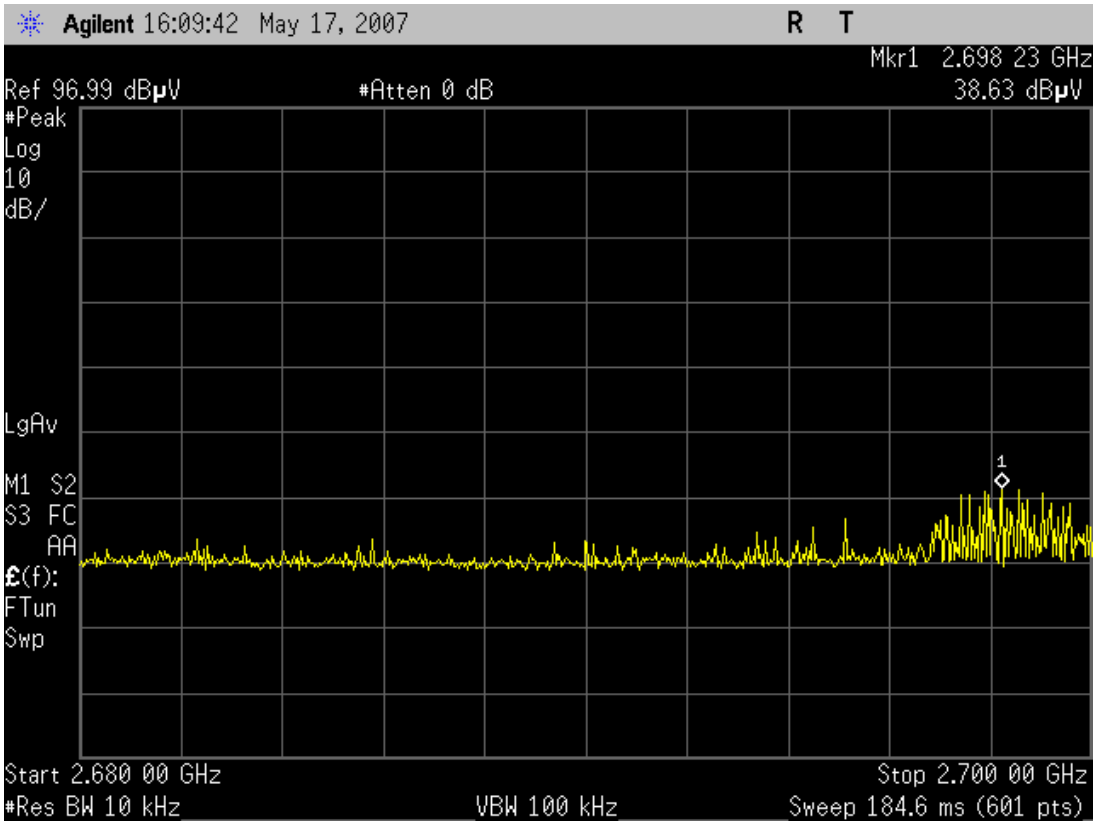

Figure 11: Southport Esplanade – possible aeronautical radar intrusion bearing (335 degrees magnetic).

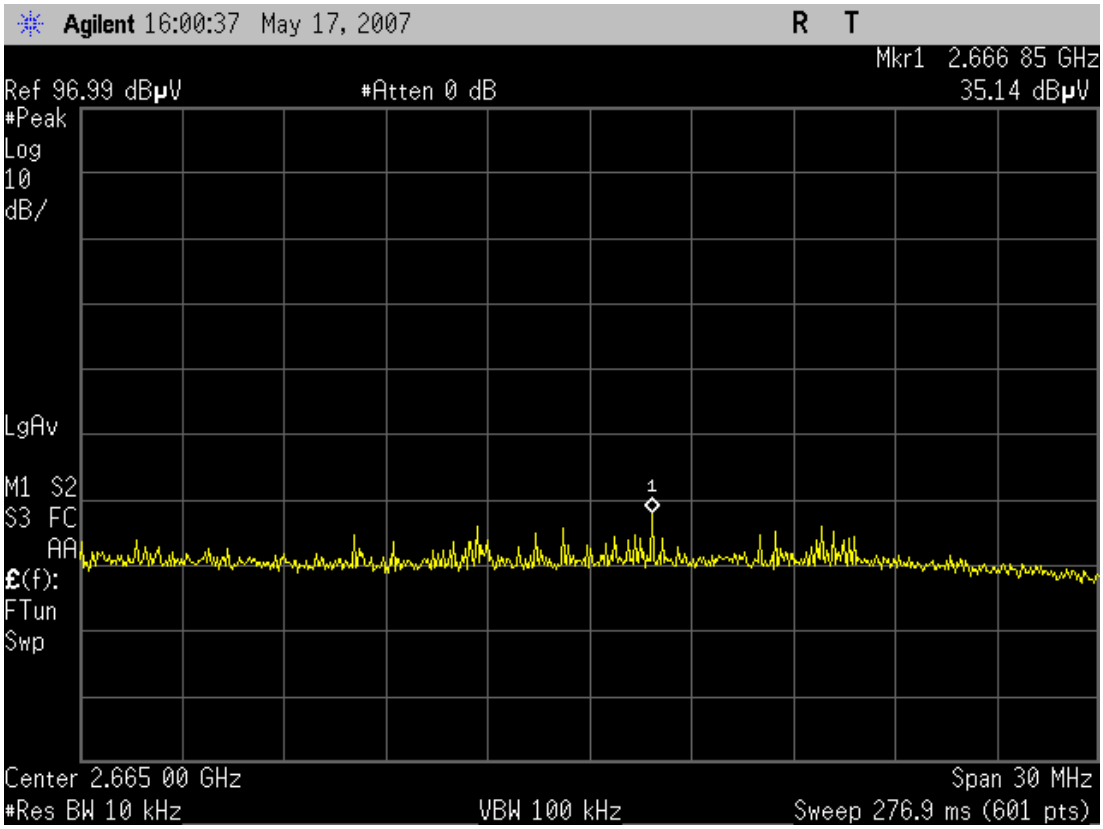

Figure 12: Southport Esplanade possible radar artefact on same bearing (335 degrees magnetic).

Blackpool North Parade **NGR: SD 312418**

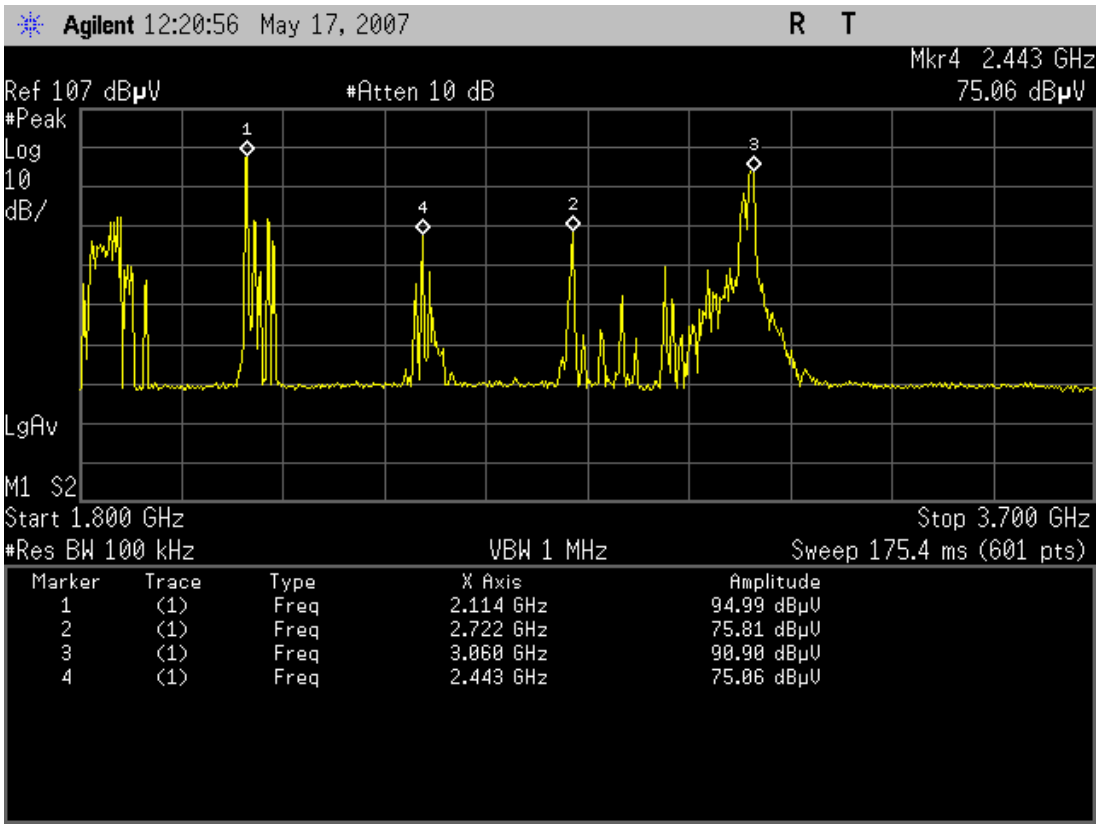

Figure 13: Blackpool North Parade Bandscan showing 2G, UMTS, 2.4 GHz, aeronautical and maritime radar activity.

The band pass filter was included in the horn/LNA set and the 2.5 – 2.7 GHz band measured in 30 MHz segments with horizontal polarisation. No MMDS signals were seen from this location.

Parbold Hill (10 miles inland from Lancashire coast) **NGR: SD 508107**

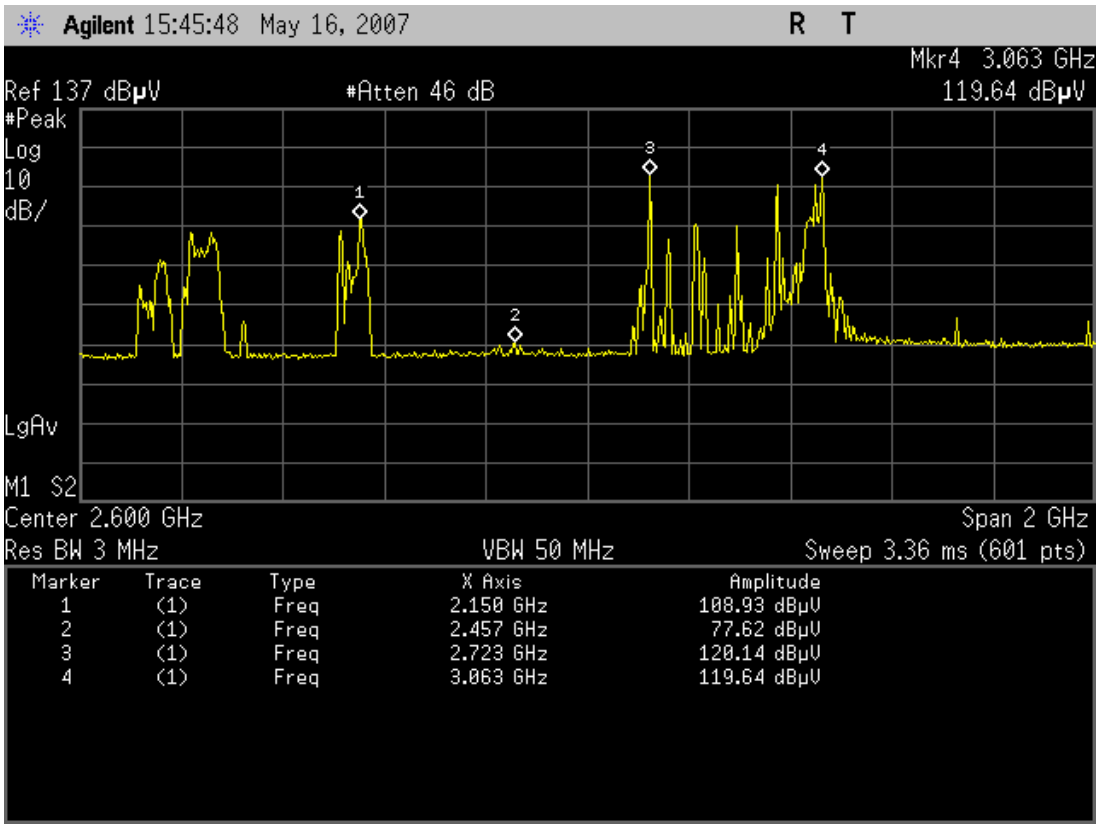

Figure 14: Parbold Hill Bandscan showing 2G, UMTS, aeronautical and maritime radar activity.

This was an elevated site on Parbold Hill. The vehicle was parked in the view point lay-by next to the 120 metre a.s.l. trig. Point.

The band pass filter was included in the horn/LNA set and the 2.5 – 2.7 GHz band measured in 30 MHz segments with horizontal polarisation. No MMDS signals were seen from this location. The busy A5209 road passing the measuring site did provided some in-band ignition noise.

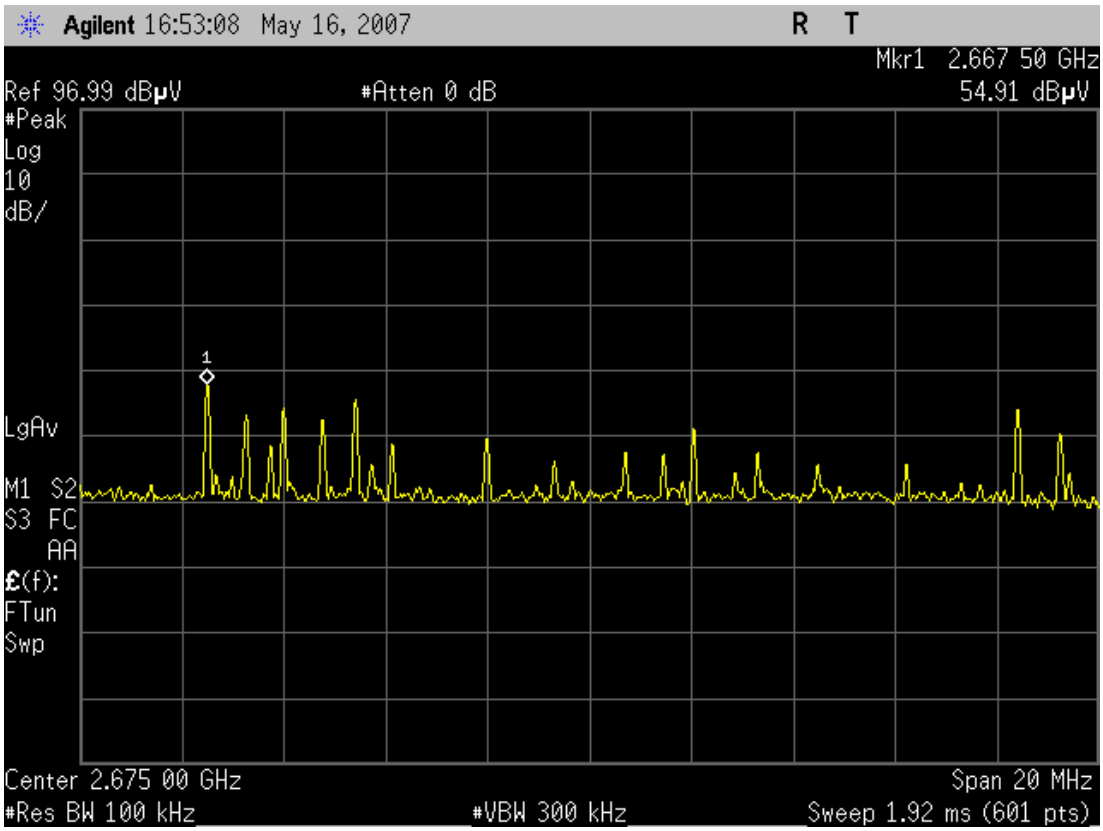

Figure 15: Parbold Hill Ignition noise from motor vehicles passing across the horn aperture during ‘max hold’ measurements.

5.2 Northern Ireland

Newry **lat 44°9'20.3" N Long06°22'1.1" East**

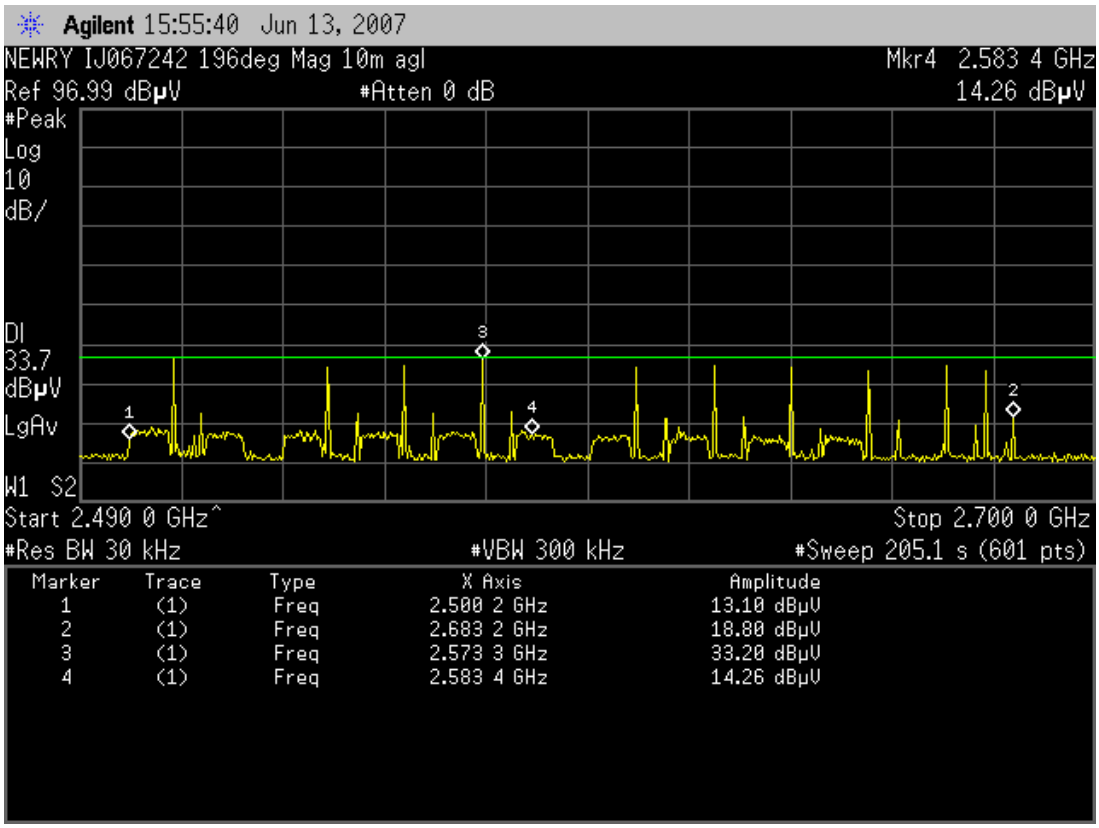

Figure 16: Newry MMDS band observed from the Newry location at height of 208m a.s.l. 10m a.g.l. Horn antenna horizontally polarised on a magnetic bearing of 196deg.

This shows a typical interleaved Analogue and Digital spectrum.

Digital MMDS emission (4)

Field Strength = Trace+cable Loss +Antenna Factor
Field strength = 14.26+5+20
Fieldstrength = 39.26dBµV/m(RBW)
Estimated Field Strength in 1MHz = 54.49 dBuv/m

Analogue MMDs emission (3)

Field Strength = Trace+cable Loss +Antenna Factor
Field Strength = 33.2 +5+20
Field Strength = 58.2dBµV/m
Estimated Field Strength in 1MHz = 73.43 dBuv/m

Lisbellaw, Enniskillen **lat 54°19'0.7" N Long 07°32'35.4"East**

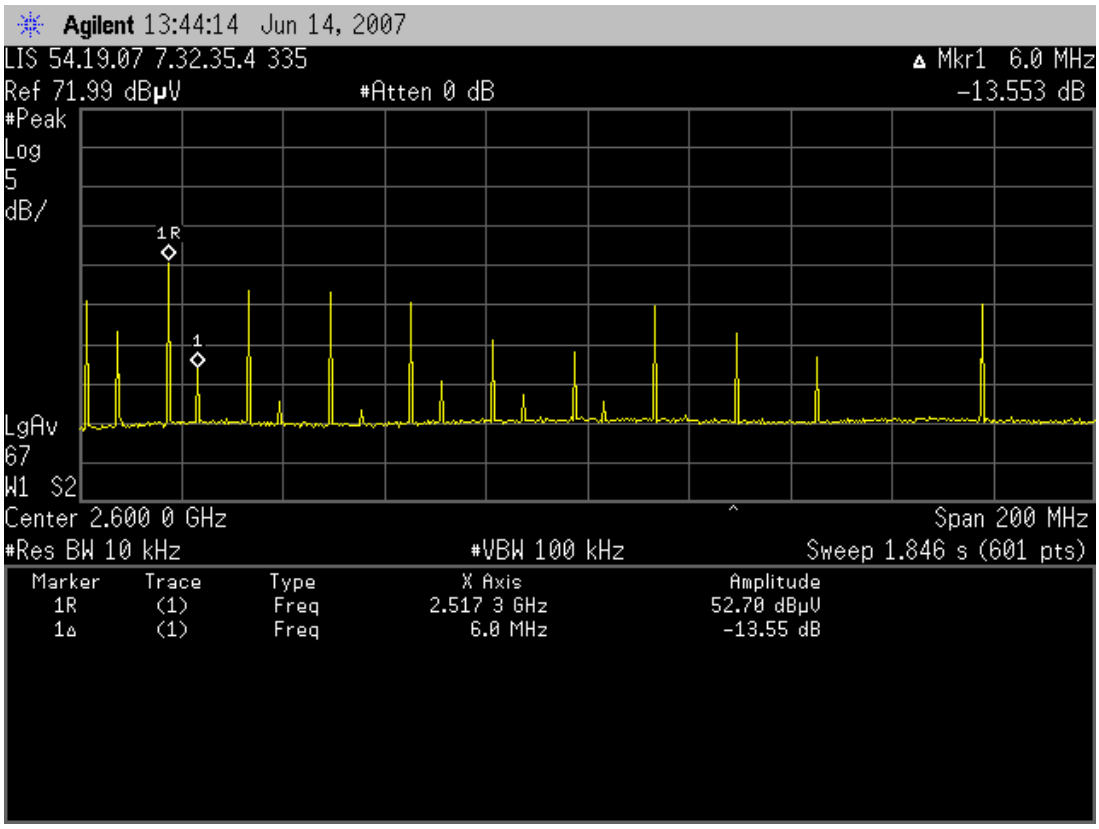

Figure 17: Enniskillen MMDS band observed from the Lisbellaw, Ennskillen location at a height of 110m a.s.l. 10m a.g.l. Horn antenna horizontally polarised on a magnetic bearing of 260deg.

Analogue MMDs emission (1R)

Field Strength = Trace+cable Loss +Antenna Factor –LNA gain
Field Strength = 52.7 +5+20 -48
Field Strength = 29.8dBµV/m
Estimated Field Strength in 1MHz = 49.8 dBuv/m

Armagh **lat 54°20'31.9"N Long 06°38'26.5"East**

No signals of interest were observed at the Armagh location.

6 Results: Emissions from France

Dover (A258 Edinburgh Hill) **NGR: TR 327 425)**

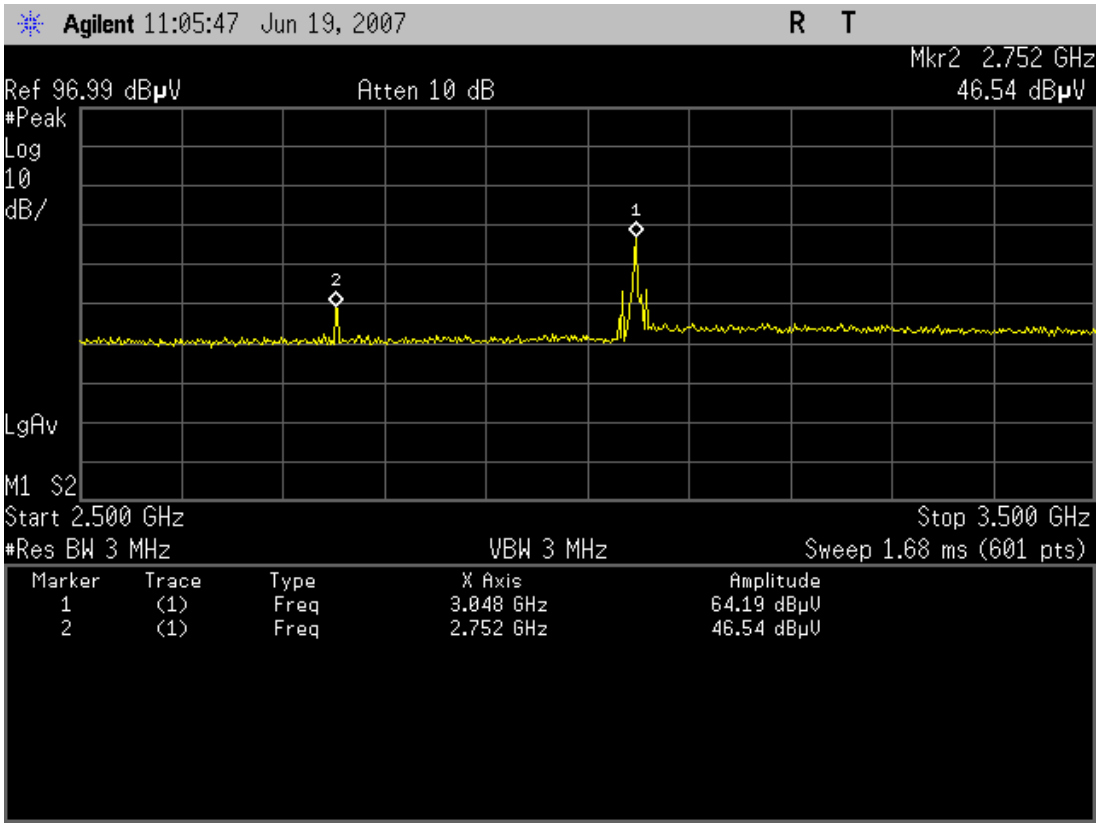

Figure 18: Dover Vertically polarised Bandscan.

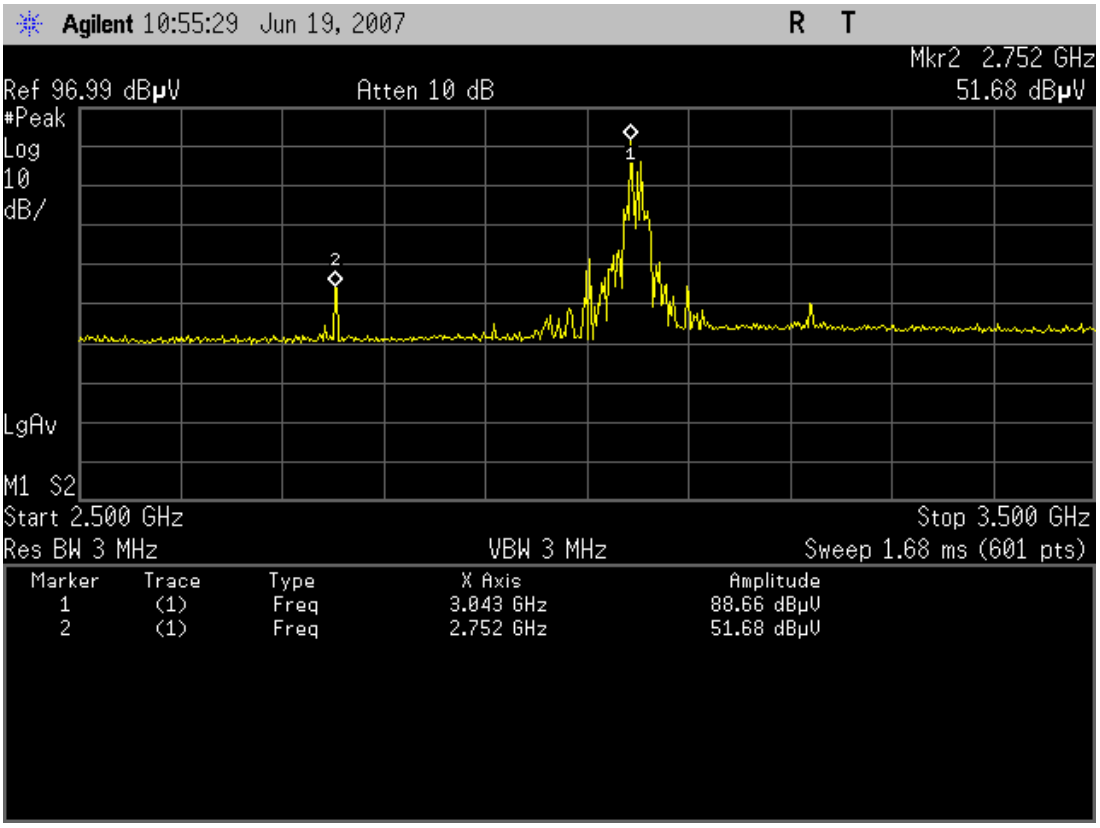

Figure 19: Dover Horizontally polarised Bandscan.

Hastings (Hastings Country Park) **NGR: TQ 861 116**

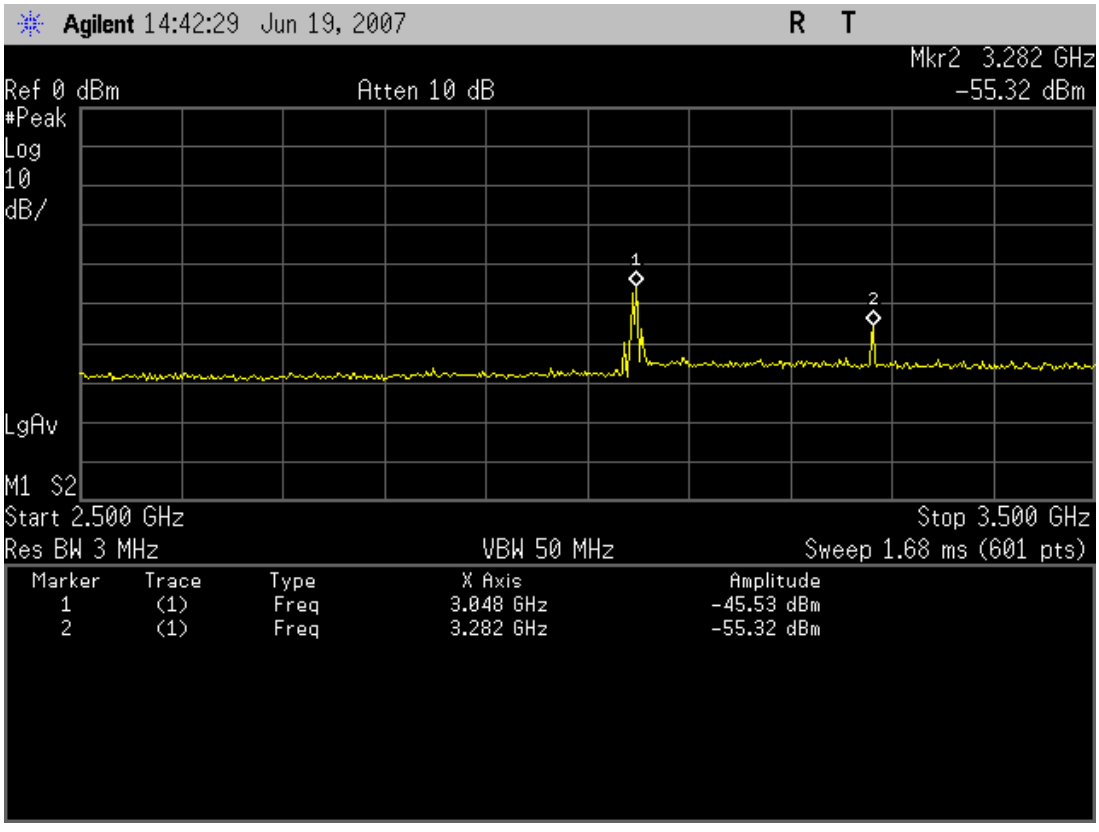

Figure 20: Hastings Vertically polarised Bandscan.

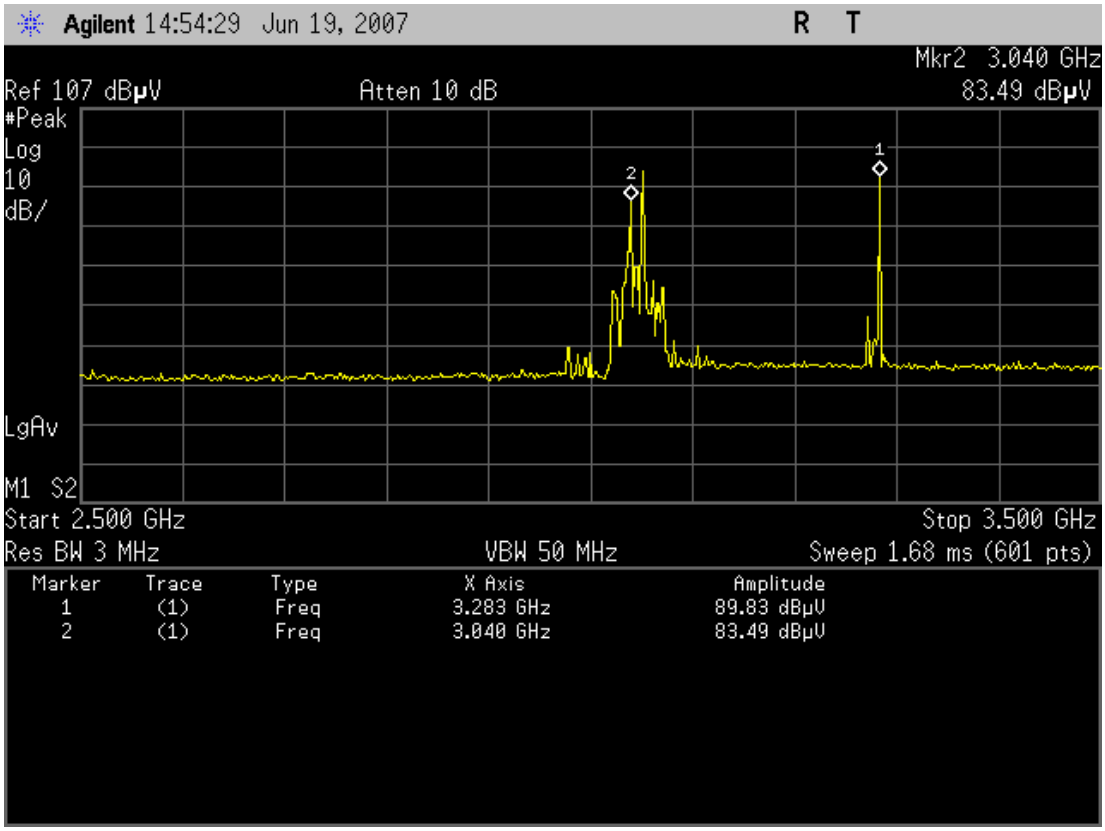

Figure 21: Hastings Horizontally polarised Bandscan.

Hythe (Princes' Parade) **NGR: TR 178 346**

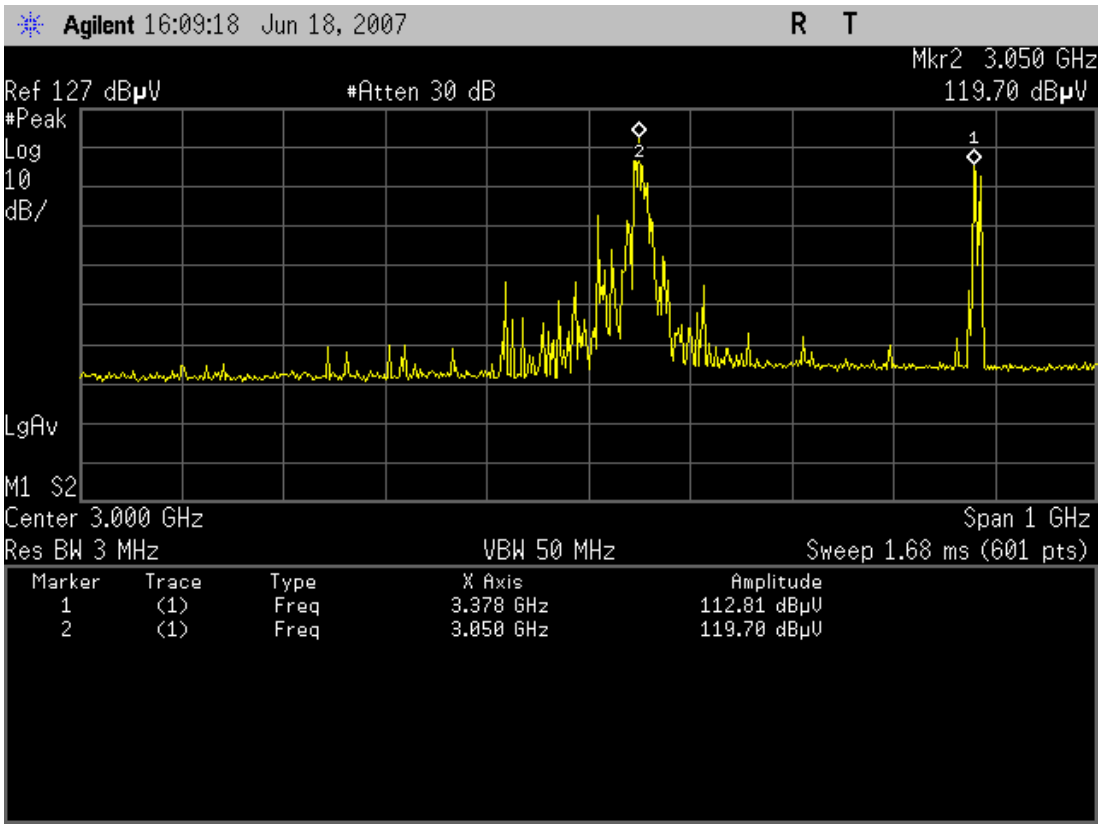

Figure 22: Hythe Horizontally polarised Bandscan showing maritime radar activity.

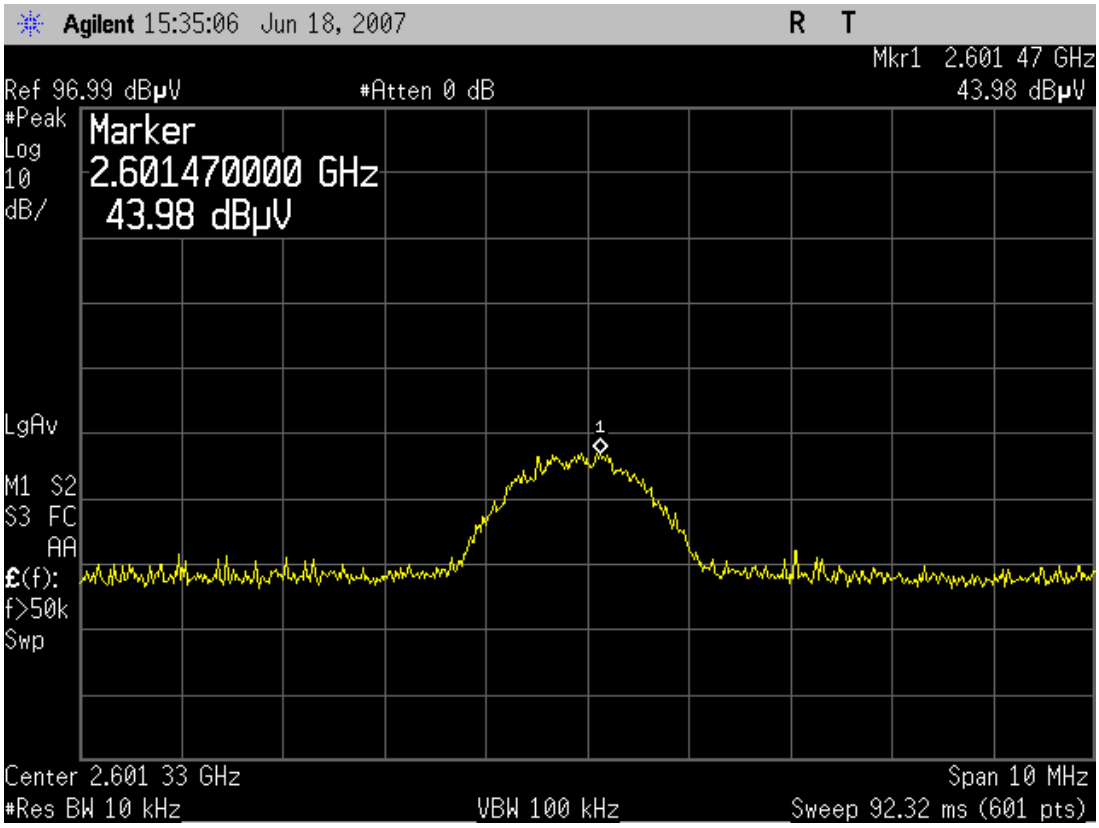

Figure 23: Hythe Signal seen bearing 137 degrees magnetic.

7 Summary

A1.1 The measurements undertaken by Ofcom suggest that the 2500-2690MHz band may, in practice, be usable over much of Northern Ireland and North West England. In particular it should be noted that interference from MMDS transmitters was not detected at Armagh, Southport Esplanade, Blackpool North Parade Parbold hill.

Summary of MMDS measurements

Location	MMDS activity	Other activity
Newry	Analogue (58.2 dBuv/m/30KHz) and Digital (39.26 dBuv/m/30KHz) signals observed	None
Armagh	None	None
Enniskillen	Analogue (29.3 dBuv/m/10KHz) signals observed	None
South Stack	Digital (44.84 dBuv/m/8MHz) signals observed	None
Capel Engedi	Digital (7.38 dBuv/m/10KHz) signal observed	Radar spurious
Southport Esplanade	None	Radar spurious
Blackpool North Parade	None	None
Parbold hill	None	Ignition noise

A1.2 In general there was little interference observed along the South Coast. Which supports our current understanding that 2500-2690MHz band is lightly used in France.

8 Equipment

Description	Model	Serial No
Spectrum Analyzer	E4440A PSA	US44302576
R&S Receiver	ESCS30	100101
Miteq LNA	AMF-4F-020040	541438
Miteq LNA	AMF-4F-020040	310847
K&L Band pass filter	4FCT-2000/4000	UT076-1A
Horn antenna	SWH-22	1015
Horn antenna	Ailtech 91889-1	W13/3P/N17
Reynolds 12m cable	219-0214 3703	003
Reynolds 12m cable	219-0088 0201	138
Fujitsu computer	lifebook	YBFBO23599

End of Report