

# **BPL Interference Investigation—Hobart**

## **Overview:**

This investigation was undertaken in response to a formal complaint made by a local Radio Amateur on 11/9/2006.

This report should be read in conjunction with previous reports assessing the impact of BPL operations at Mt Nelson and at Tolmans Hill.

The measurements were conducted approximately five metres from the LV power lines in the driveway of a residence on Mt Nelson Road. This location was chosen as it was the most practical place to make the measurements:

## **Measurement techniques:**

The measurements were conducted in the frequency range 150 kHz to 30 MHz with the antenna orientated in the X, Y and Z planes on 24/11/2005. Subsequent measurements were taken with the antenna orientated in the X plane only. Equipment used for these measurements were;

Rohde & Schwarz FSH3 Spectrum Analyser – Serial Number 100995, calibrated 13 February 2004  
Rohde & Schwarz ESH2 Field Strength Receiver – Serial Number 879342/018, calibrated 2 October 2001.

Rohde & Schwarz Active HF loop antenna  
EMCO Model 3110B High Performance BiConical antenna

Spectrum analyser plots were saved in the form of 'dataset files'. The saved data can be displayed on either an FSH3 spectrum analyser or a PC using the FSH view program. The data consists of 301 individual samples which can be converted into the following formats, graphic files (.BMP, .PNG, PCX), Windows Metafiles (.WMF), RSS files (.RSS,.RSD) and ASCII files (.CSV, .TXT). FSH View displays the data in the form of 'frequency verses amplitude' typical of a spectrum analyser display.

A copy of FSH View software can be downloaded from the following website (using their site search):  
<http://www.rohde-schwarz.com.au/>

Note that markers can be added to any screen results and moved to assist in checking levels.

Several scans can be displayed simultaneously in order to make direct comparisons of measurements by using the *Tile Horizontal* option on the 'Window' task bar (see the example attached).

Note that much better resolution and more accurate readings can be attained by examination of spectrum analyser scans which depict a small amount of frequency spectrum (these measurements were made on 28/6/2006). The wideband scans are useful to gain a general overview and for comparative purposes. Spectrum analysis files recorded on 14/7/2006 during the operational time of the CADI contain the suffix '+i'.

## **Observations:**

The initial complaint of BPL interference was made by in November 2005 to both Aurora and the ACMA. Measurements were undertaken on 24/11/2005 to check the validity of the complaint, and a brief

preliminary report was prepared (see attachment 1). Checks conducted from Quoin Ridge HF monitoring station (20km away), using a Baldock directional antenna, detected BPL at various frequencies.

Aurora has confirmed that the network configuration in the area has changed since the initial measurements were made in 2005.

Further measurements were made on 28/6/2006, and again on 14/7/2006 when two sets of measurements were made in each frequency range. As noted in the assessment of the impact of BPL operations at Mt Nelson, the Ionospheric Prediction Service operates two ionosondes from a site approximately 1.6 km away at South Lea (Mt Nelson). Measurements were made when the CADI ionosonde was operational and when in quiet time (the 5D sonde is operational for 30 seconds of this two minute 'quiet time'). This was done to illustrate the signal component due to the IPS ionosonde.

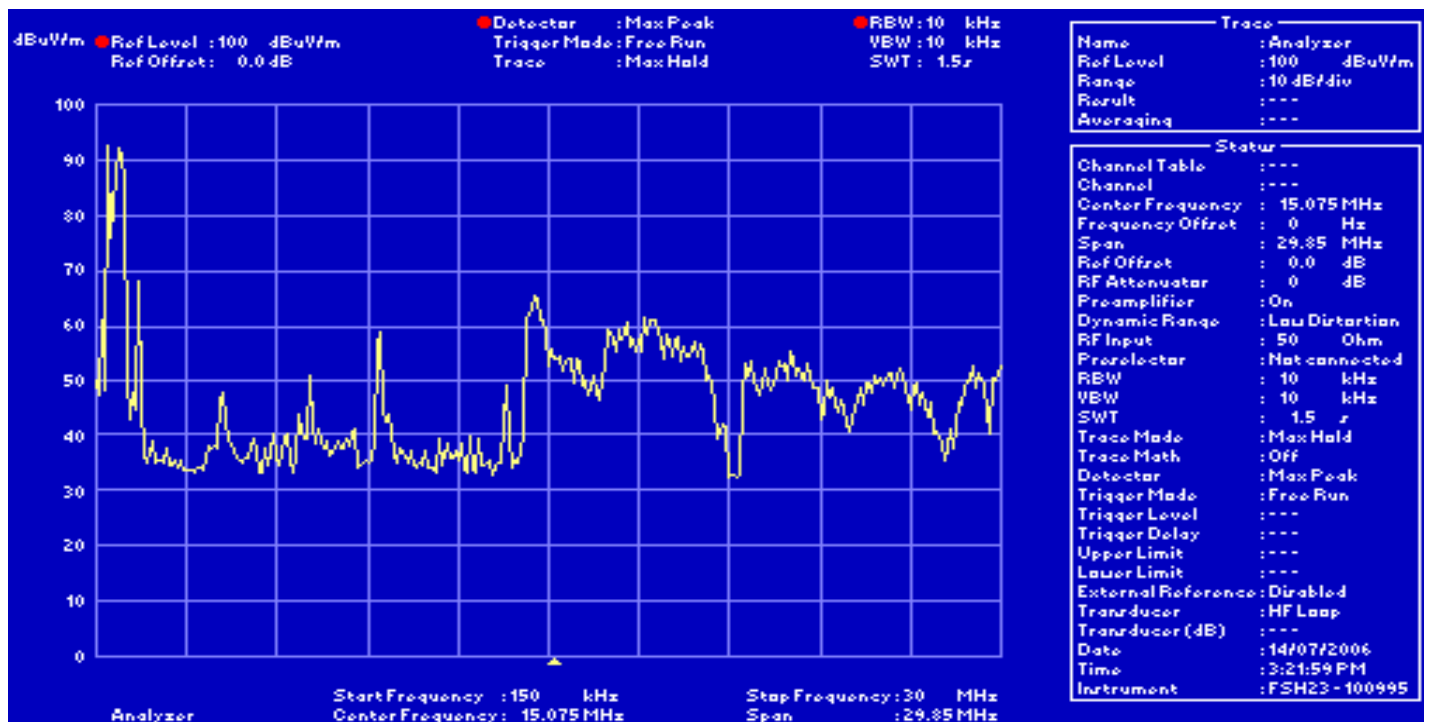
The complainant has used the RST (Readability, Strength and Tone) code which is based on his receiver signal strength meter reading, to illustrate the level of interference across the bands. Strength is measured on a scale of 1 to 9. A reading of 1 denotes a faint, barely perceptible signal, 3 a weak signal, 5 a fairly good signal and 9 a very strong signal. A reading of 20/9 implies that the signal strength meter reading is +20 dB above s9 (at full scale meters read to +60dB over s9).

The table below summarises the maximum levels of BPL measured.

Frequency Band (MHz)	Measurements 24/11/2005		Measurements 28/6/2006		Measurements 14/7/2006		Analyser range	Complainant's Signal level & comments
	dBuV/m	MHz	dBuV/m	MHz	dBuV/m	MHz		
1.8 - 1.875	55.7	1.84	33.3	1.84	35.0	1.84	Wideband span	
3.5 - 3.7	55.7	3.63	41.2	3.63	34.1	3.53	Wideband span	5/9 Data noise Clicking signal
	55.1	3.67	35.6	3.60	64.0 *	3.56	2 - 6 MHz span	
3.776 - 3.8	45.6	3.77	34.2	3.77	36.4	3.79	2 - 6 MHz span	
7.0 - 7.3	46.4	7.22	38.8	7.22	51.1	7.22	Wideband span	3/9 Data noise Intermods.
	44.0	7.26	39.1	7.26	42.4	7.25	6 - 10 MHz span	
10.1 - 10.15	46.0	10.10	34.1	10.10	34.8	10.10	Wideband span	
	42.1	10.12	35.3	10.12	n/a	n/a	5 - 11 MHz span	
	42.7	10.14	43.1	10.10	35.0	10.12	10 - 15 MHz span	
14.0 - 14.35	47.5	14.18	35.3	14.28	40.3	14.28	Wideband span	20/9 Noise and tones
	41.8	14.0	40.2	14.34	43.9	14.34	10 - 16 MHz span	
18.068-18.168	34.9	18.16	54.6	18.16	55.4	18.16	Wideband span	
	33.8	18.15	43.9	18.16	n/a	n/a	15 - 19 MHz span	
	34.9	18.13	50.3	18.16	41.4	18.15	16 - 23 MHz span	
21.0 - 21.45	35.2	21.15	47.8	21.44	46.5	21.44	Wideband span	3/9 Data Almost clear
	35.8	21.42	38.4	21.45	34.3	21.44	16 - 23 MHz span	
24.89 - 24.99	33.2	24.93	32.7	21.44	42.2	24.93	Wideband span	
	31.8	24.9	31.7	21.45	34.6	24.89	23 - 30 MHz span	
28.0 - 29.7	33.8	28.80	32.4	29.0	52.6	29.1	Wideband span	20/9 Data noise
	33.8	28.50	33.2	28.67	53.3	29.0	23 - 30 MHz span	

\* Large single spike, similar to the spike at 2.81 MHz – may not be BPL

The spectrum analyser screen captured below illustrates the levels measured from 150 kHz to 30 MHz on 14/7/2006 during the ionosonde 'quiet time'.



**Assessment of measurements in each band:** (note - not all of the measurements referred to below have been correlated from the analysis above – refer to the .rsd files in the attached folders FSH1, 2 & 3).

1.800–1.875 The carrier seen at 1.84 MHz on 24/11/2005 can probably be attributed to an experimental transmission by an amateur operator. BPL does not extend below 3 MHz.

3.500–3.700 The large spike (64 dBuV/m) captured in measurements on 14/7/2006 may be from the 5D sonde or another source (measurement taken during CADI sonde quiet time). However, the narrow band scan from 3.5 to 3.7 MHz shows other several spikes ranging from 50 to 66 dBuV/m. Although the transmit frequencies of the ionosondes are known (see attachment–IPS Ionosonde), it is not possible to positively identify the source of individual carriers from this data. The spacing of BPL carriers is approximately 6.5 kHz.

BPL was heard at low level using the ESH2 receiver. Spectrum analysis confirms that BPL rises from below the noise floor within the band.

3.776–3.800 No high level carriers were detected. The measurement results were similar to those in the adjacent band. BPL was again audible using the ESH2 receiver. There was only one sample in the spectrum analysis data to evaluate.

7.000–7.300 Wideband spectrum analysis clearly shows BPL emissions throughout the entire band, ranging in level from 40 to 51 dBuV/m. There is no evidence of software notching being deployed in this band.

10.100–10.150 This 50 kHz wide spectrum appears to be free from BPL emissions, although a peak of 57 dBuV/m was observed at 10.16 MHz during a measurement scan (5 to 11 MHz on 28/6/2006).

The carrier measured at 43.1 dBuV/m on 28/6/2006 is possibly from an ionosonde. No BPL was heard on the ESH2 receiver during monitoring.

14.000–14.350 If software notching is in use, it is ineffective. The influence of BPL can be seen from about 14.25 MHz upwards. A level of 43.9 dBuV/m was recorded at 14.34 MHz. This magnitude of level was also confirmed using the ESH2 receiver (41 dBuV/m at 14.35 MHz). The complainant reported a signal of 20 over 9 in this band.

18.068–18.168 The level reading of 55.4 dBuV/m in the wideband span is an anomaly due to instrument resolution / notch width. Examination of the analyser scan from 16 to 23 MHz taken on 14/7/2006 clearly shows software notching employed within a block of BPL spectrum. The notching produces a reduction in level of about 20 dB to 38.5 dBuV/m (5 to 6 dB above the normal noise floor). The notch is not wide enough to be effective across the entire band; at 18.17 MHz (only 2 kHz above the band) the level is 48.6 dBuV/m.

21.000–21.450 Software notching has been deployed and is effective, however it does not extend quite high enough within the band (a level of 36.4 dBuV/m was measured at 21.45 MHz).

24.890–24.990 Software notching has been used effectively in this band. A close examination of the narrow band scan from 25 to 25.25 MHz produces a slightly better result than the lowest level shown in the table (34.1 dBuV/m at 24.897 MHz).

28.000–29.700 Since BPL was not evident in this band on 28/6/2006, narrow band spectrum analysis was not undertaken. BPL is evident however in the spectrum from 23 to 30 MHz measured on 14/7/2006. This shows that software notching has been implemented for only a 100 kHz sector of the band from 29.5 to 29.6 MHz. The measured level is consistently above 50 dBuV/m. This supports the signal strength report given by the complainant of 20 over 9.

## **Conclusions and recommendations:**

BPL can no longer be detected at Quoin Ridge—the source of emissions was located at the intersection of Mt Nelson Road and Olinda Grove, several hundred metres away from the complainant's residence. Since 2005 Aurora Energy has employed class licensed links in this and other sections of the backbone feed. As a consequence, the modes of operation in this and adjacent sections of the network have changed. These changes are reflected in the BPL spectrum and level plots from 2005 to 2006.

There was no evidence to suggest that Aurora have utilised the Jeizer network management software to ensure that the BPL system operates at lowest practical power levels in the vicinity of the complainants residence.

Transmissions from the ionosonde were heard at 11.3 MHz using the AOR receiver fitted to the vehicle. The demodulated audio is quite distinct and can be heard as a fast succession of pulses. The number of pulses heard and the frequency at which they are detected can be used to positively identify them.

The influence of the ionosondes becomes more difficult to identify at higher frequencies. It is also masked by the BPL emissions from about 14 MHz upwards.

There was also intermittent interference across the HF band possibly from an arcing thermostat in an electrical appliance located in close proximity. This type of interference is readily distinguishable from BPL when demodulated.

There are very few options available for the complainant to reduce the effects of interference from BPL.

The selectivity (the ability to reject signals adjacent to the tuned signal) of a communications receiver must be considered when deciding the degree of software notching to be implemented. Manufacturers prefer to evaluate their products at 50 kHz or even 100 kHz channel spacings, as they can achieve far better figures in their specifications. The selectivity figures for receivers in “real” world situations are far worse than those specified.

Another problem is that sensitive communications receivers (as used in amateur radio), can be overloaded or swamped when used in an environment where there are strong out of band signals. Pre selector filters can be used to reduce or prevent receiver front end overload and inter-modulation distortion (these will not prevent unwanted signal mixing in the antenna and feeder system).

Also, if an adjacent signal is strong enough and close enough in the band, it will desensitise the receiver and weak signals will not be heard (this mechanism is also known as gain compression).

In conclusion, this report substantiates the claim made by the complainant that the Aurora BPL system is causing interference and greatly reducing his ability to operate licensed amateur radio equipment.

David Long  
Compliance Officer  
ACMA – Hobart Operations Centre