MEG Response to Band-Passed Noise

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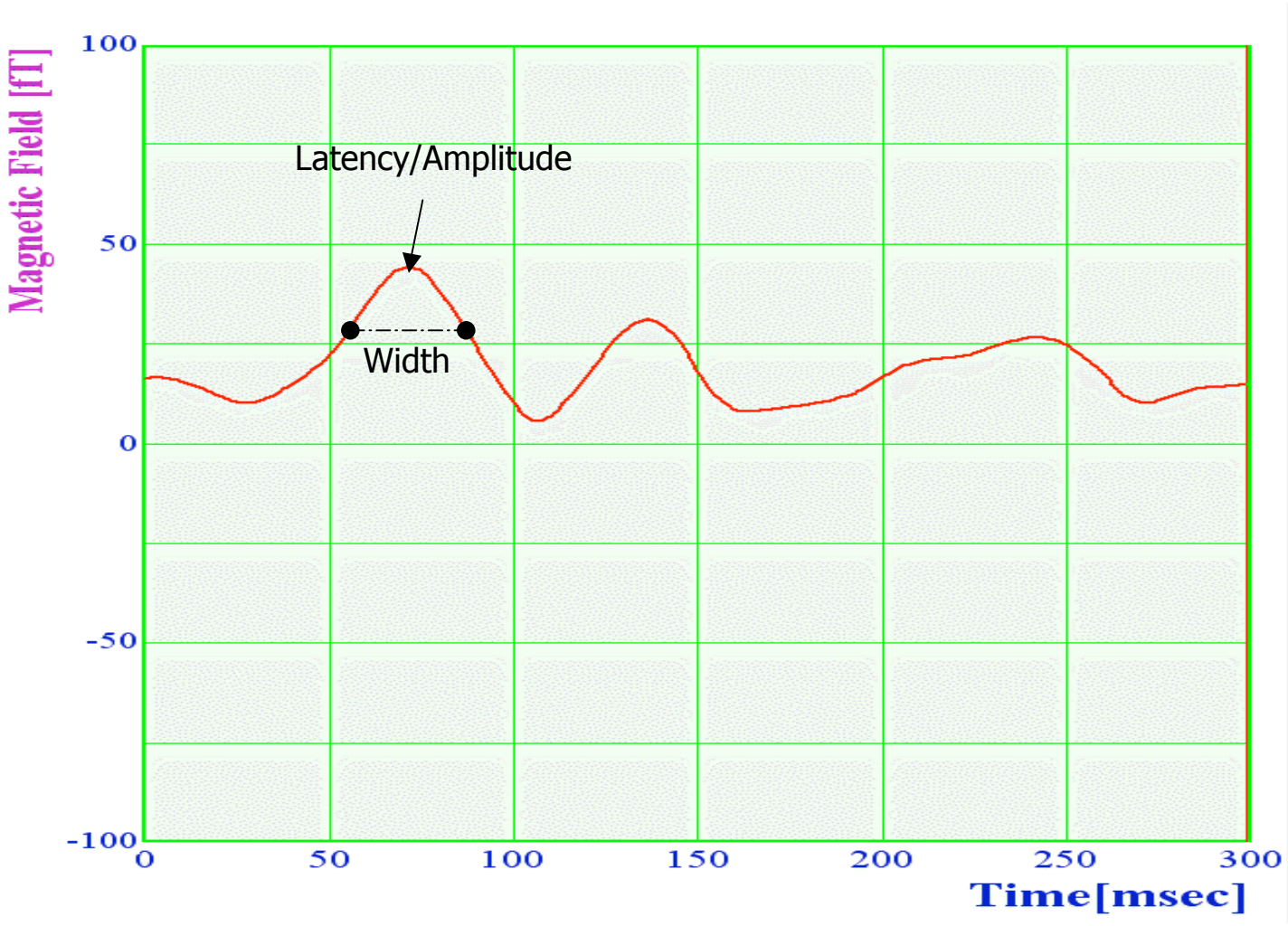
What is MEG?

- Magnetoencephelography (MEG) is the measurement of extracranial magnetic fields produced by electrical currents within the brain
- In MEG recordings, weak magnetic fields outside the head are detected with an array of sensors, and on the basis of the measured signals, the underlying cerebral currents are estimated.
- Since cerebral magnetic fields are extremely weak when compared, for example, with the Earth's magnetic field, special devices are needed to measure them. Development of sensitive SQUID (Superconducting Quantum Interference Device) sensors allows the detection of small changes in the magnetic fields.

Purpose of Experiment

- Compared to the visual system, the functional organization of the human auditory cortex is not well understood
- Research on non-human primate anatomy and physiology as well as recent human neuro-imaging work has generally skipped over studies on band-passed noise
- This experiment attempts to understand how the brain reacts to band-passed noise at different levels of bandwidth

Defining a Peak



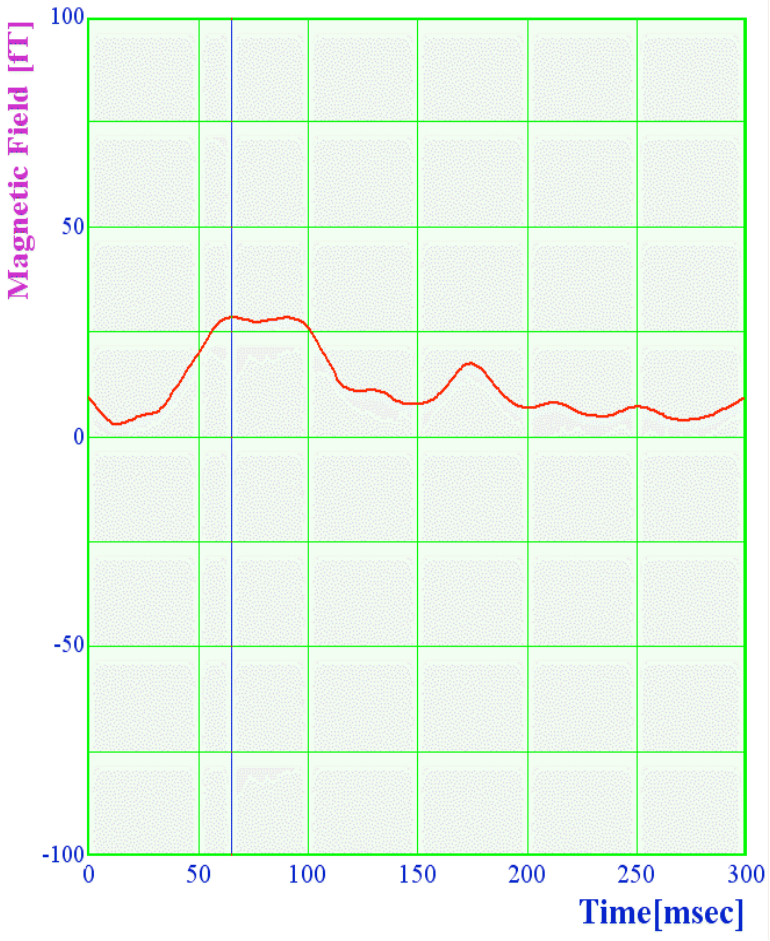
Defining the M Peaks

- M50: defined sink/source orientation with peak at ~35-70 ms
- M50b: same orientation but appearance anterior to the M50 and at a ~15ms delay
- M100: opposite orientation with peak at ~90-160 ms
- M150: same orientation as M50 with appearance at ~145-195 ms

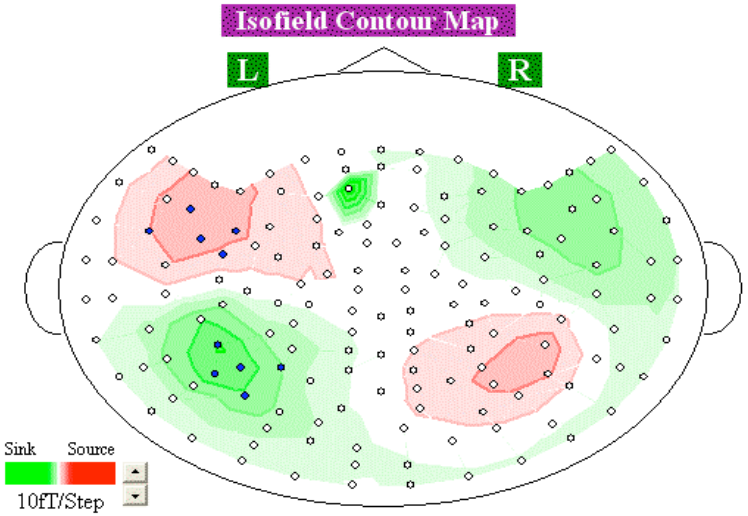
The M50b

Found in pure tone in just 1 of 24 cases

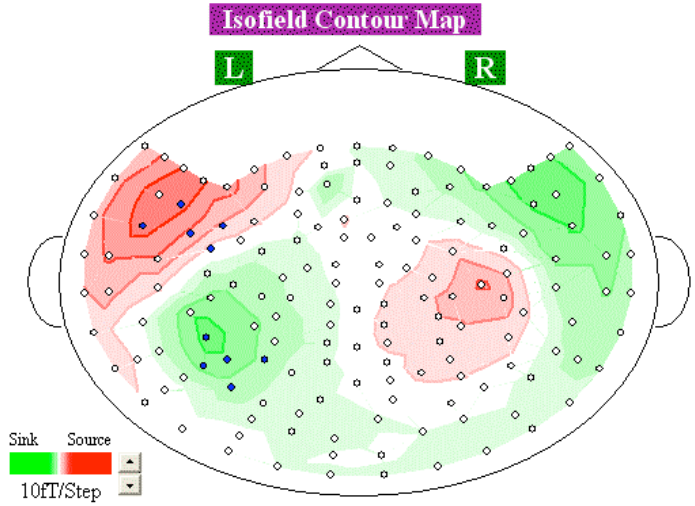
Found almost exclusively in band-passed noise (18 of 24 cases)



65ms



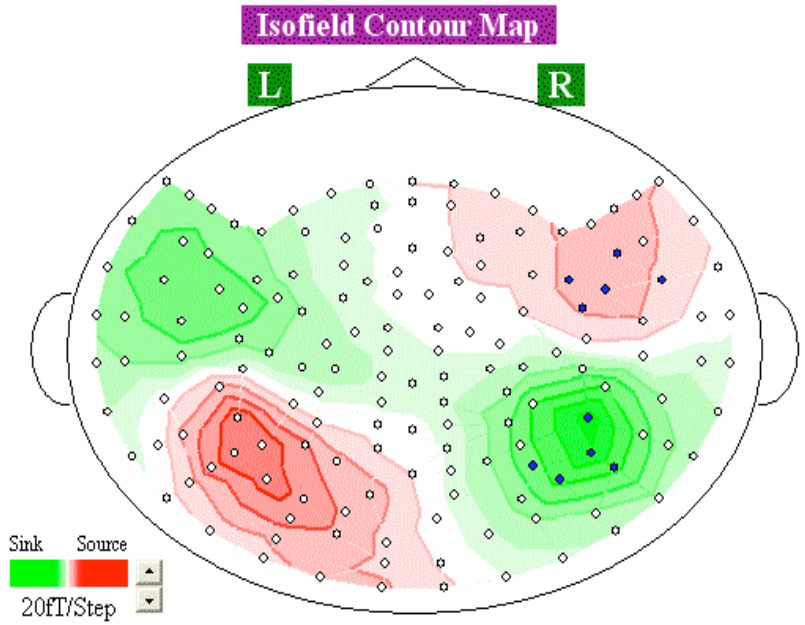
91ms



Methodology

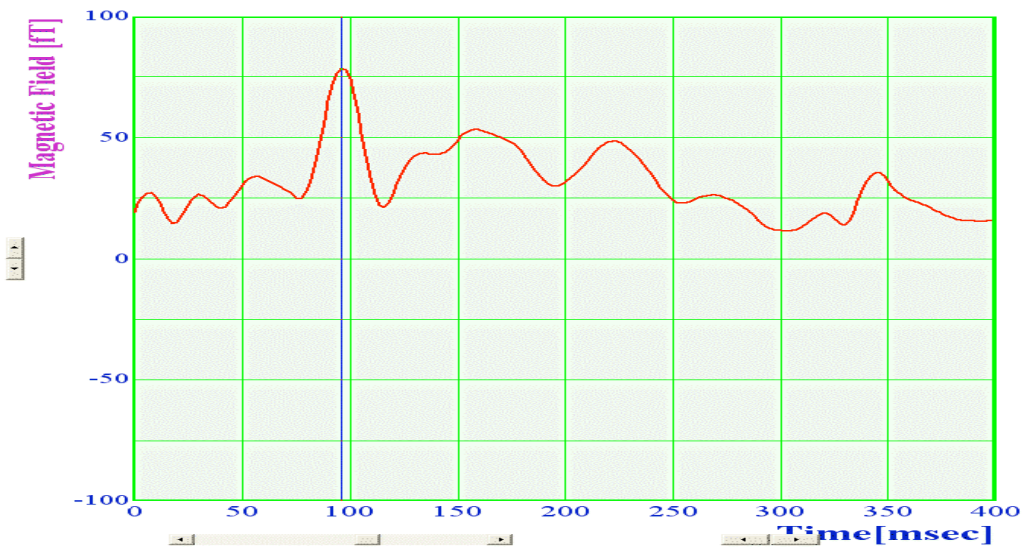
- 5 stimuli: 1000 hz tone, ¼ oct, ½ oct, 1 oct, 2 octs with center frequencies of 1000 hz
- 100 ms duration, 5 ms ramps
- 1000 repetitions
- Processing:
  - 1) De-Noising
  - 2) Epoch and Concatenation
  - 3) LPF at 30 hz
  - 4) Pre-trigger baseline correction

Defining the Channels



R0020 Localizer RH:

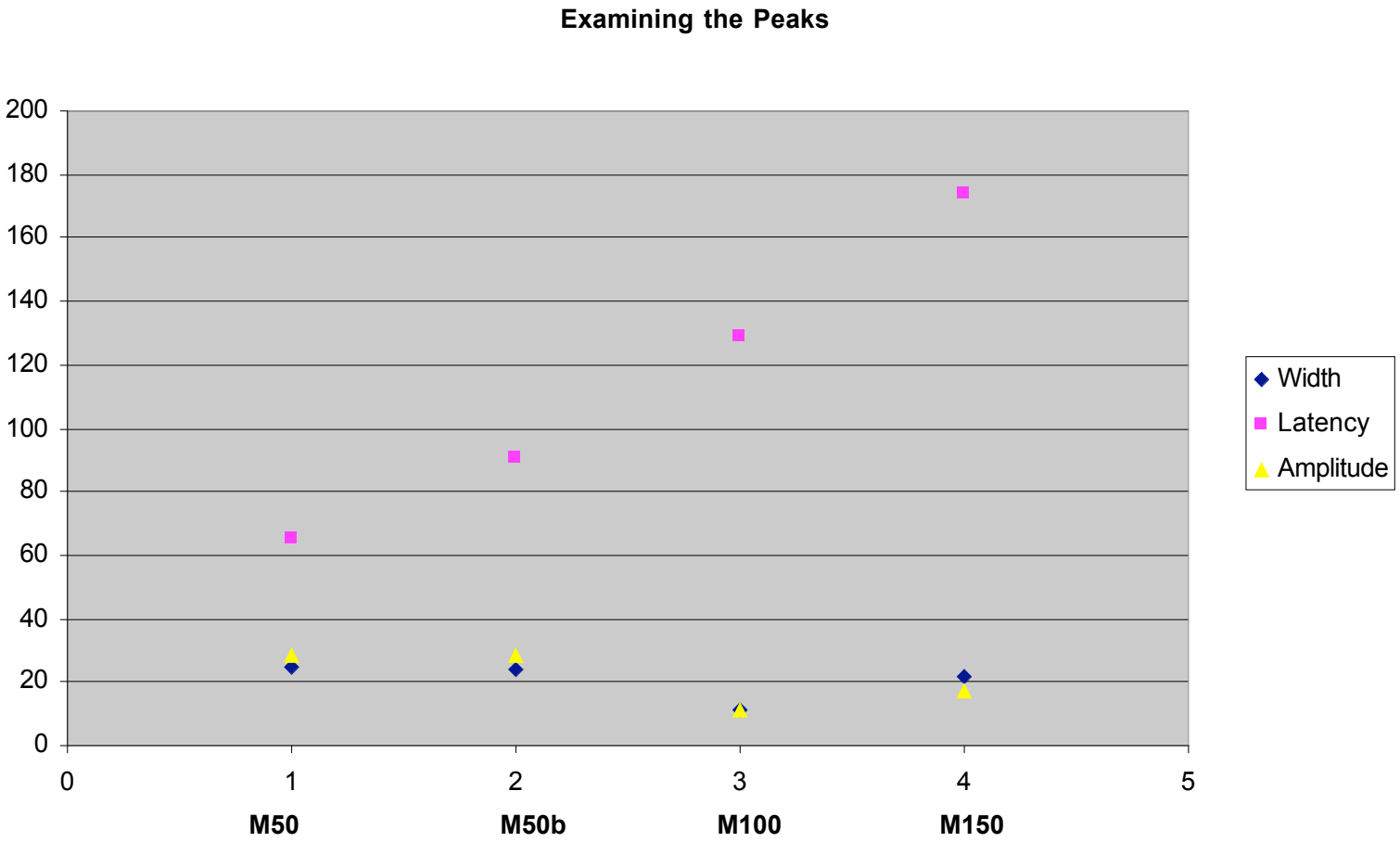
5 best Sink/Source



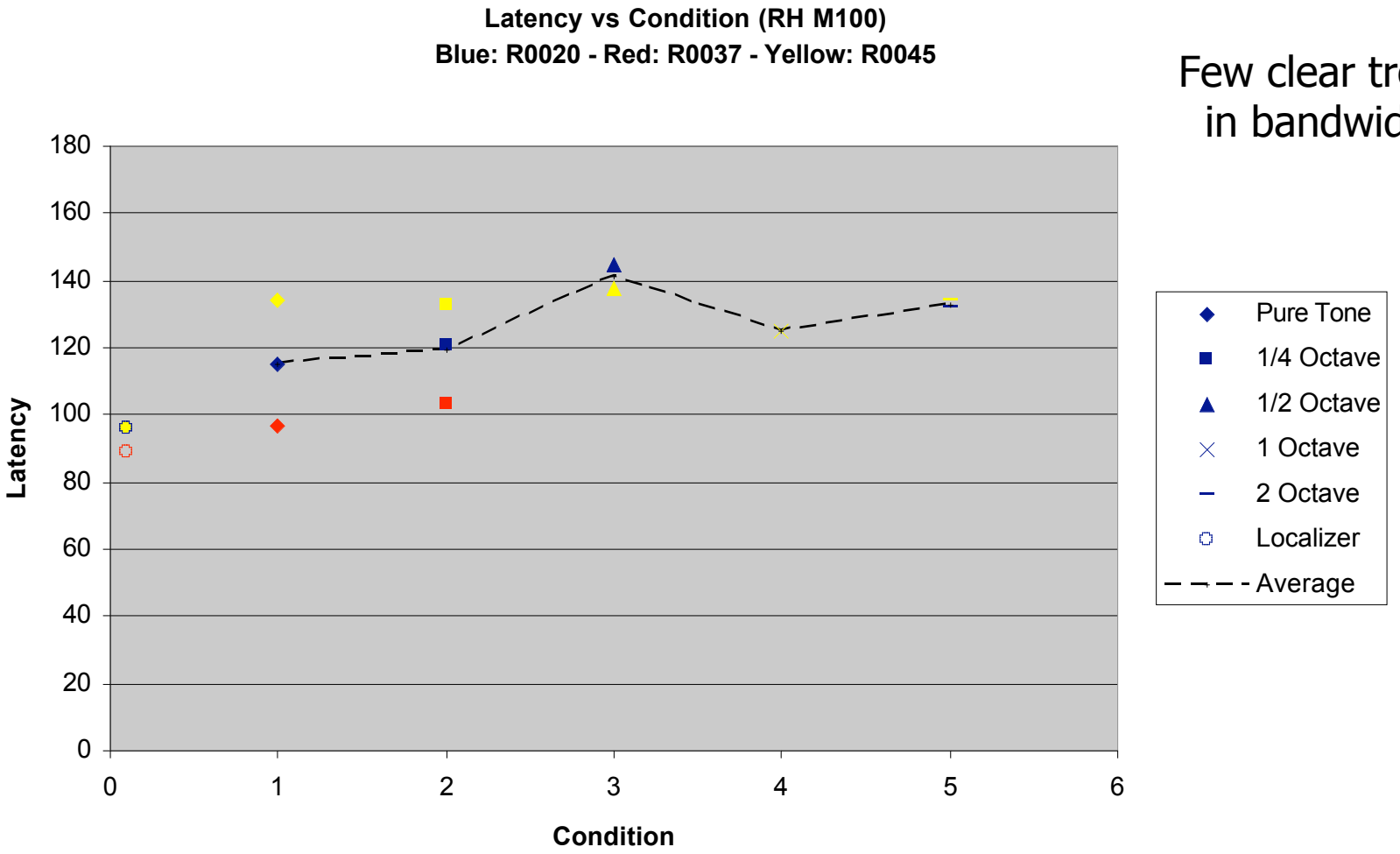
Results

- As bandwidth increases in the M100, amplitude decreases (with exception at 2 octaves)
- The M50 is amplitude-dominant in the LH
- M50b is consistently present solely in band-passed noise, effectively becoming more pronounced as bandwidth increases
- Waveform peak responses to noise are context dependant – the presence of noise causes a significant delay to the M50/M100/M150 for pure tone
- The location of these dipoles are decidedly anterior to the localizer dipoles

A Typical Response

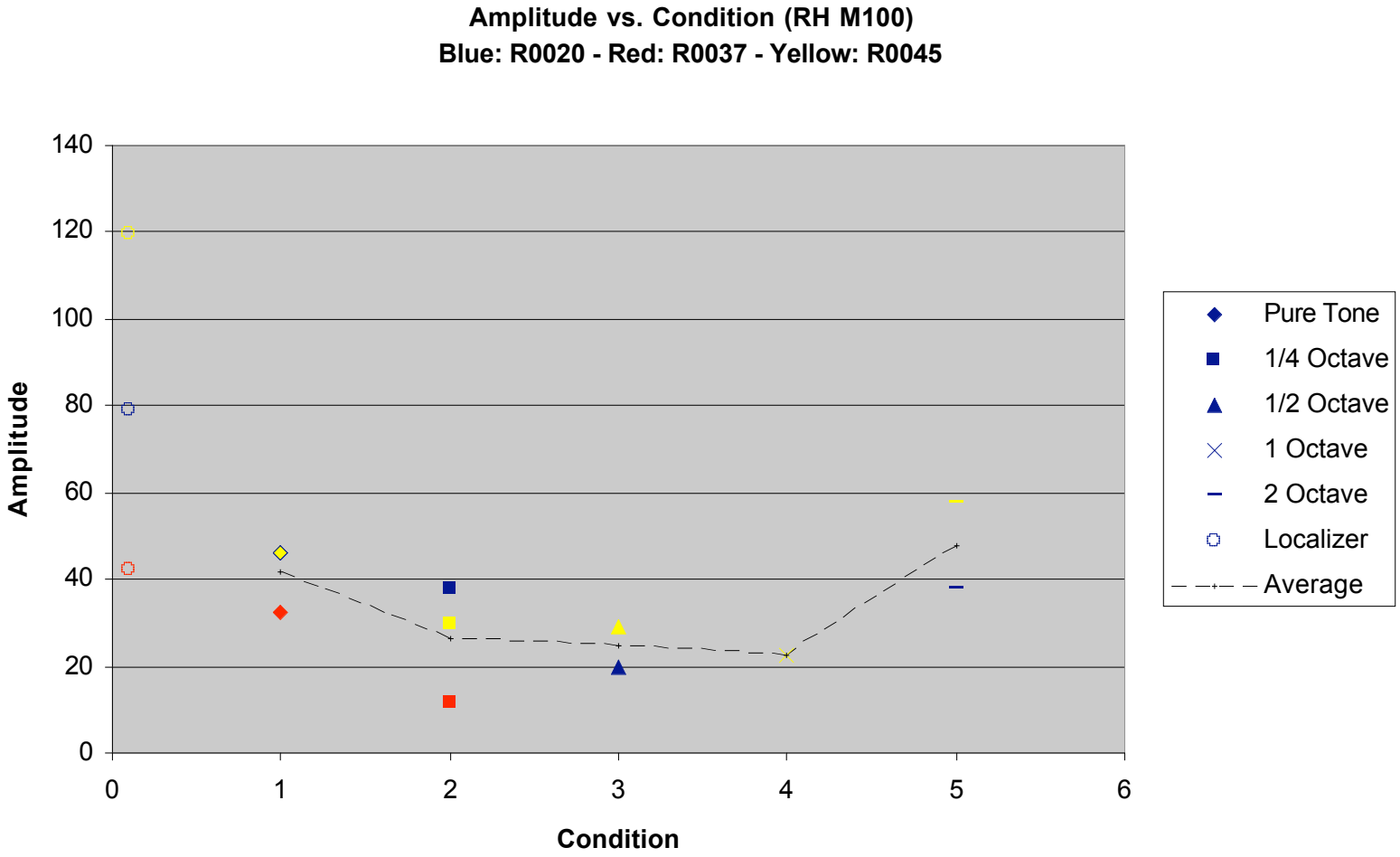


Latency vs. Condition

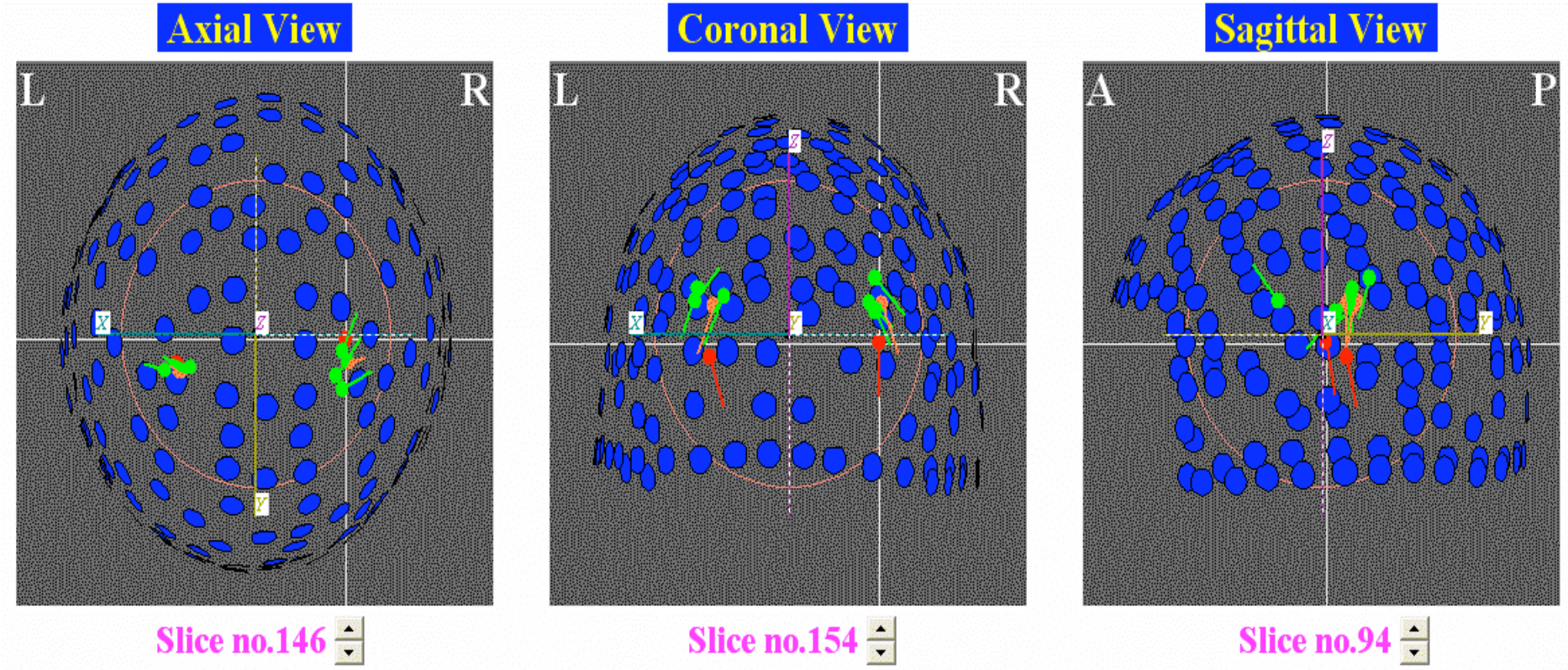


Few clear trends in bandwidth

Amplitude Vs Condition

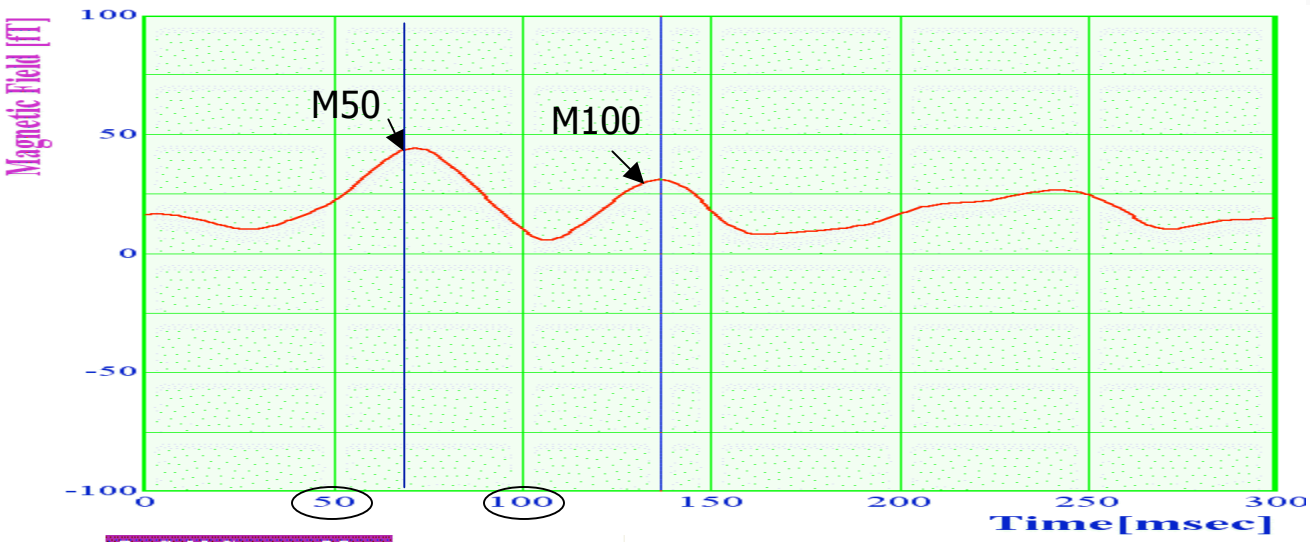


Vs the Localizer (Spatial Domain)

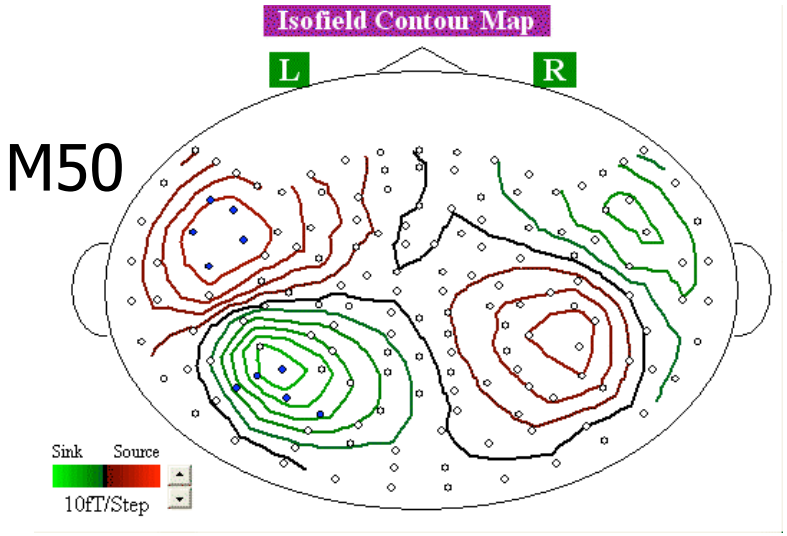


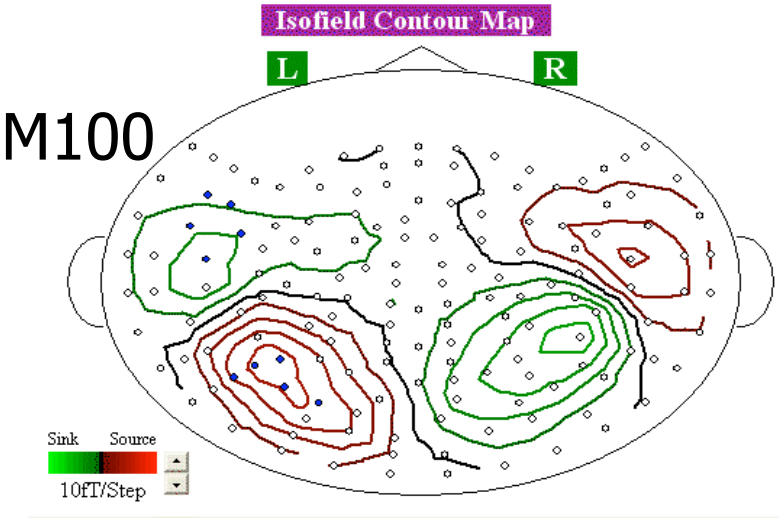
Localizer Dipoles in Red, Pure Tone in Orange

The Delayed Response

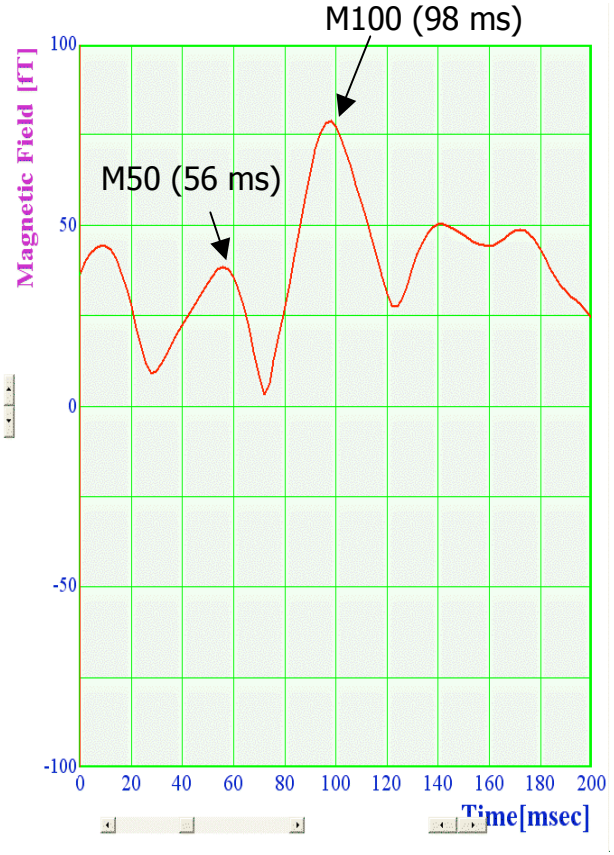


R0045 LH
½ Octave

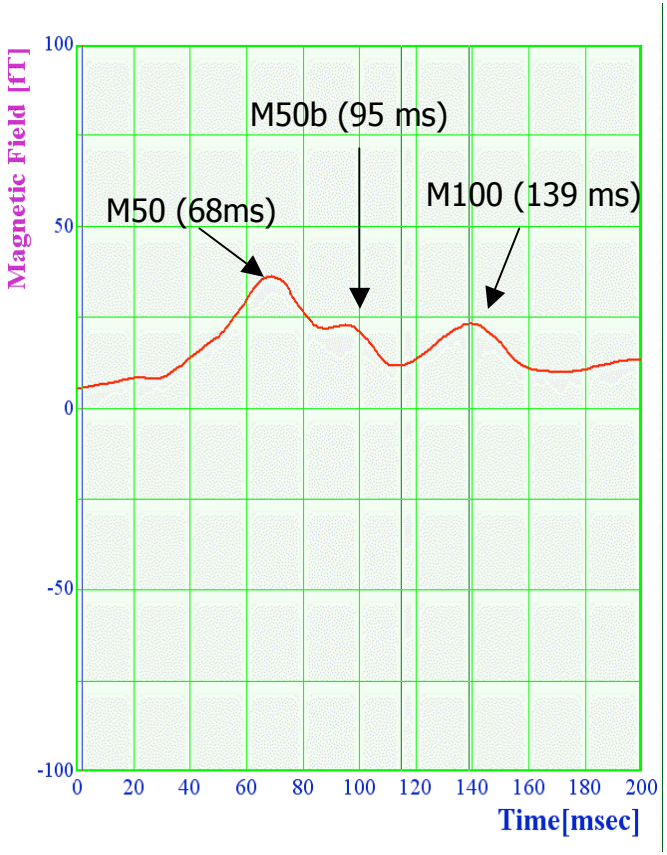




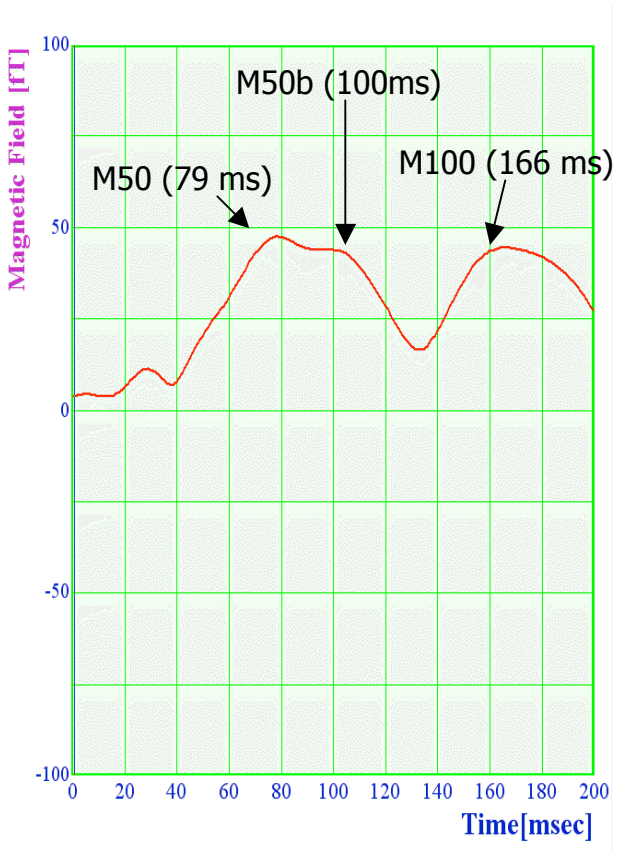
Vs the Localizer (Time Domain)



R0020 LH Localizer



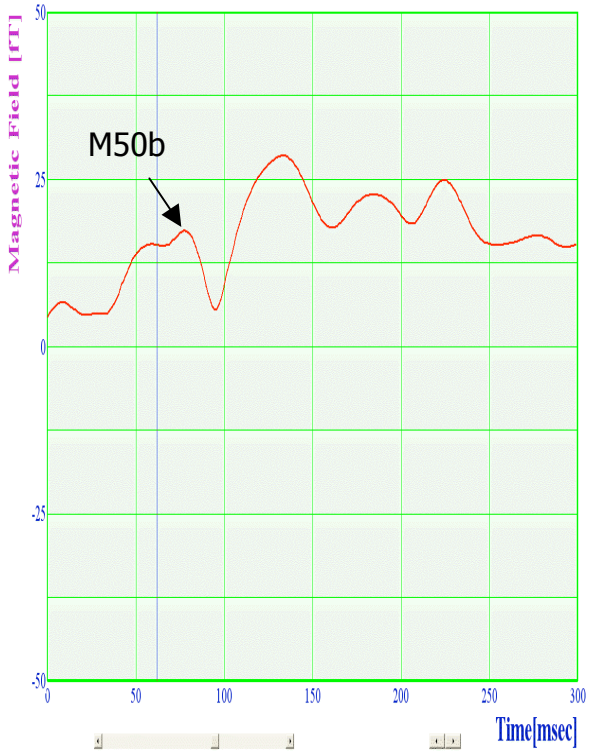
R0020 LH Pure Tone



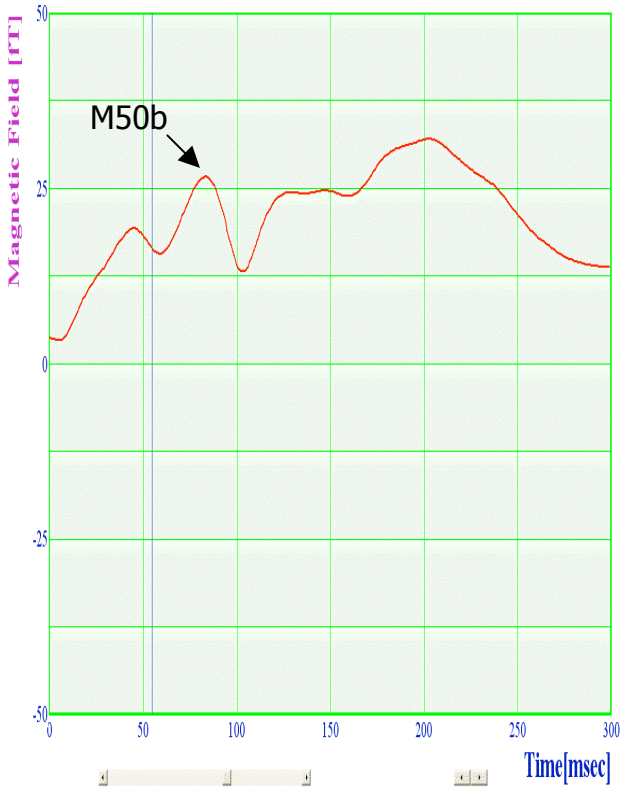
R0020 LH 2 Octave

The M50b

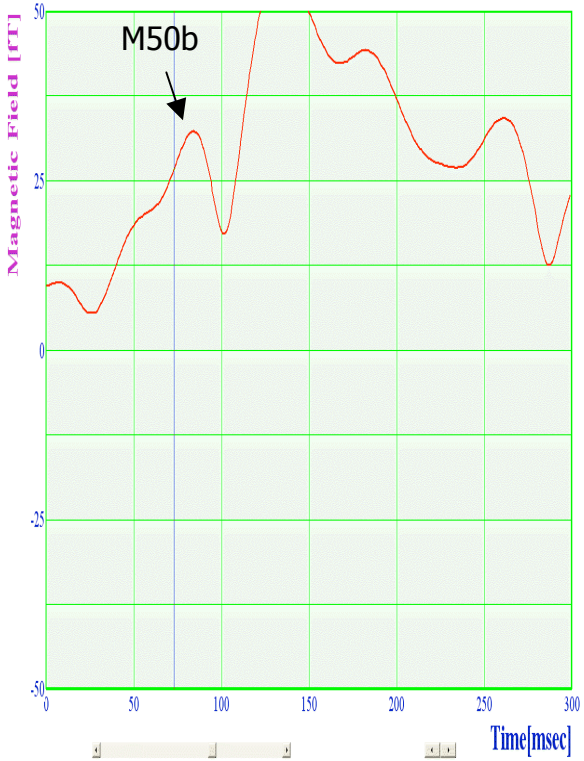
Width and Amplitude increase with bandwidth



¼ Octave

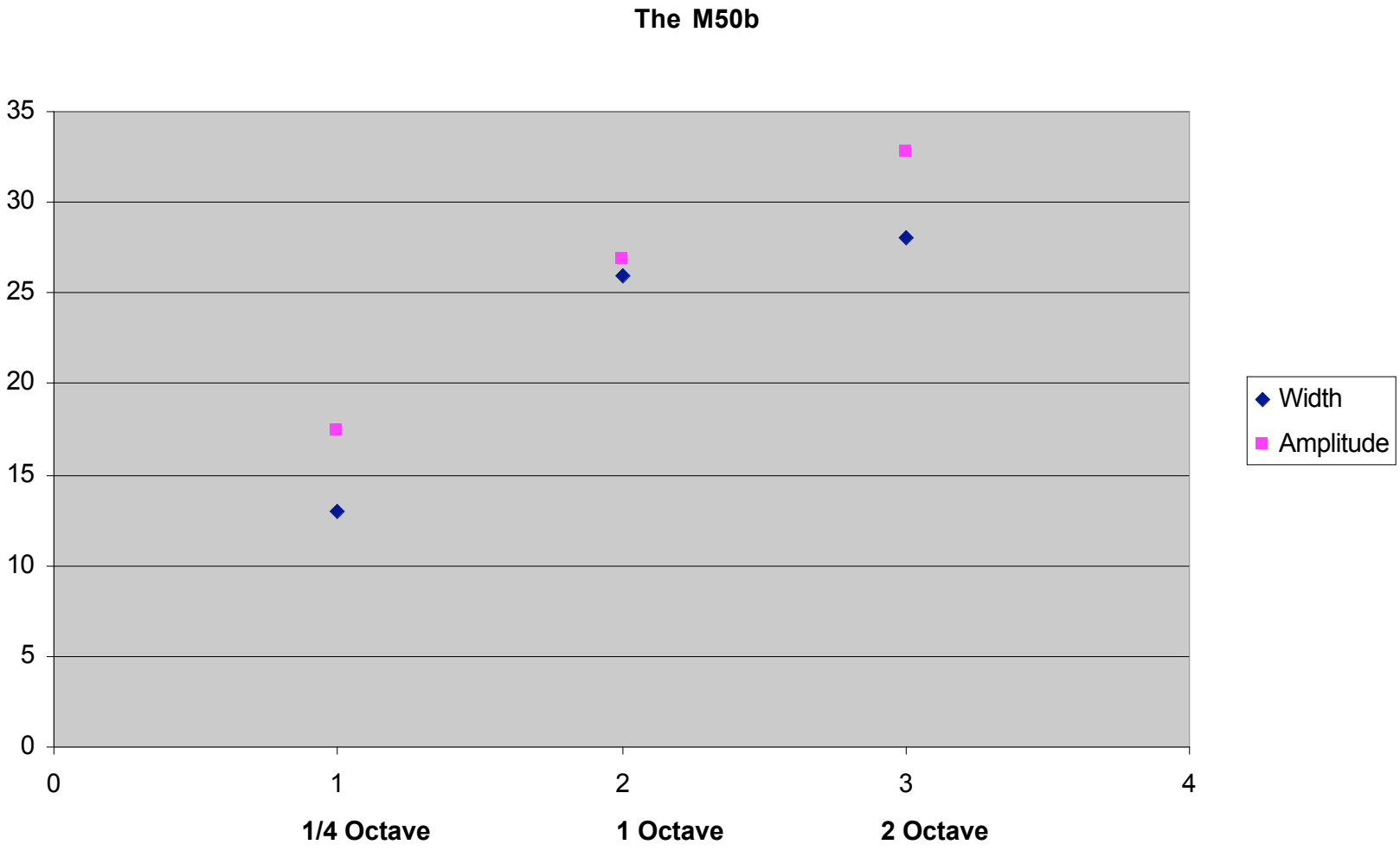


1 Octave

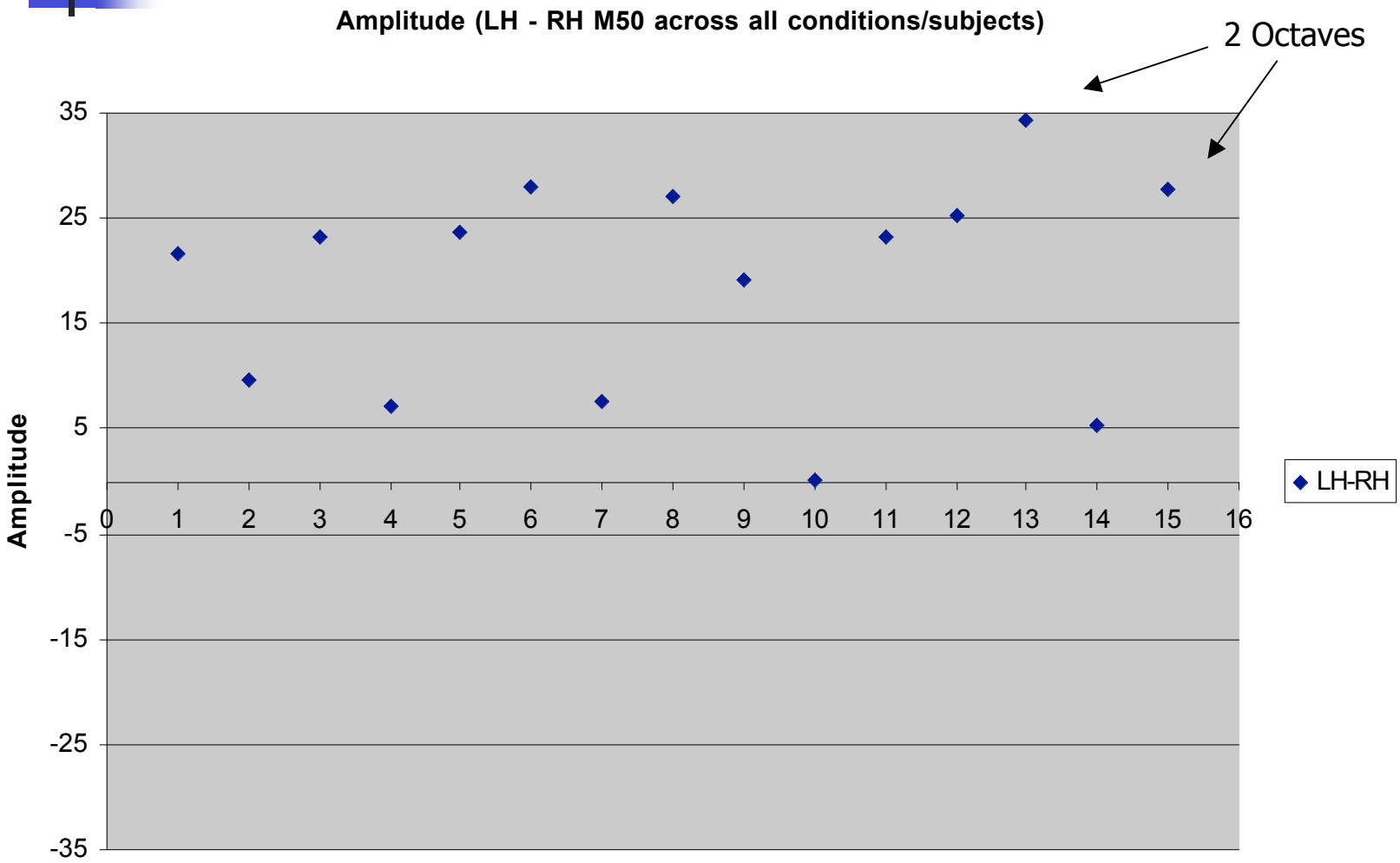


2 Octave

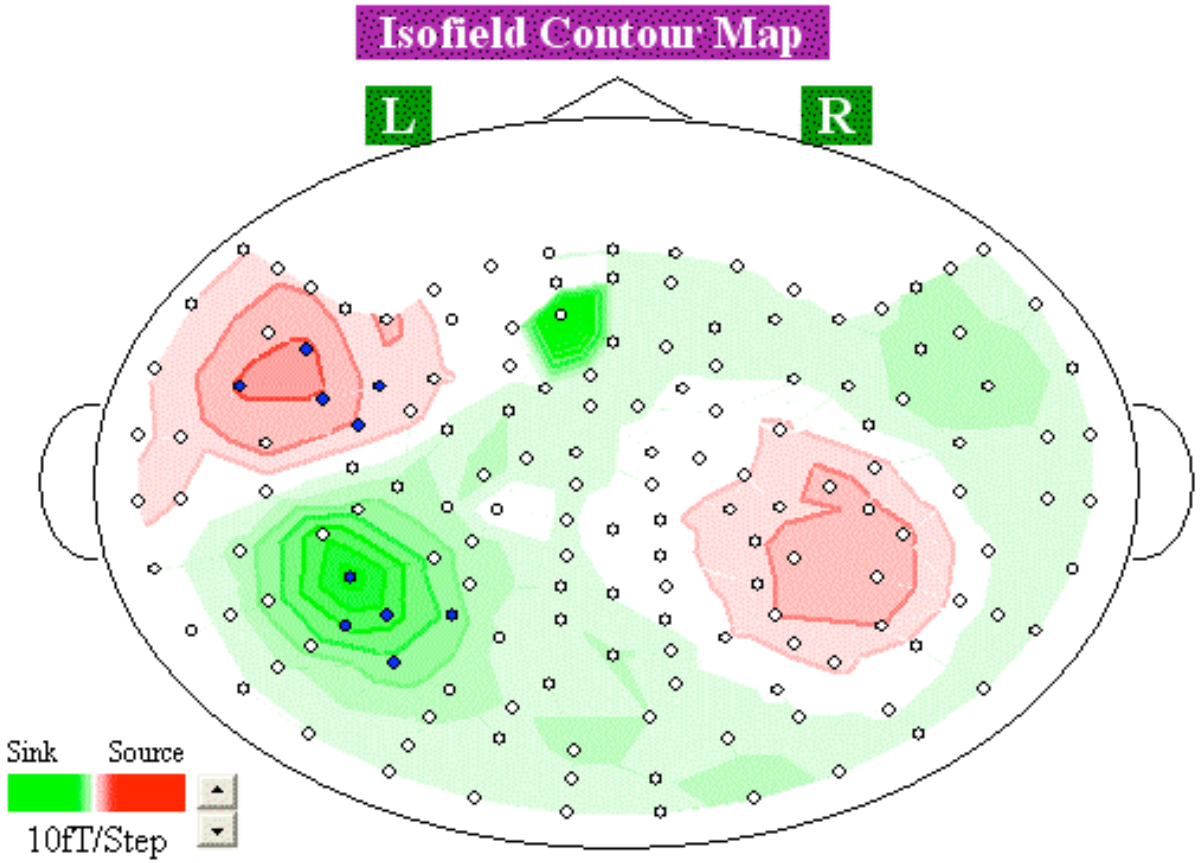
M50b Width/Amplitude



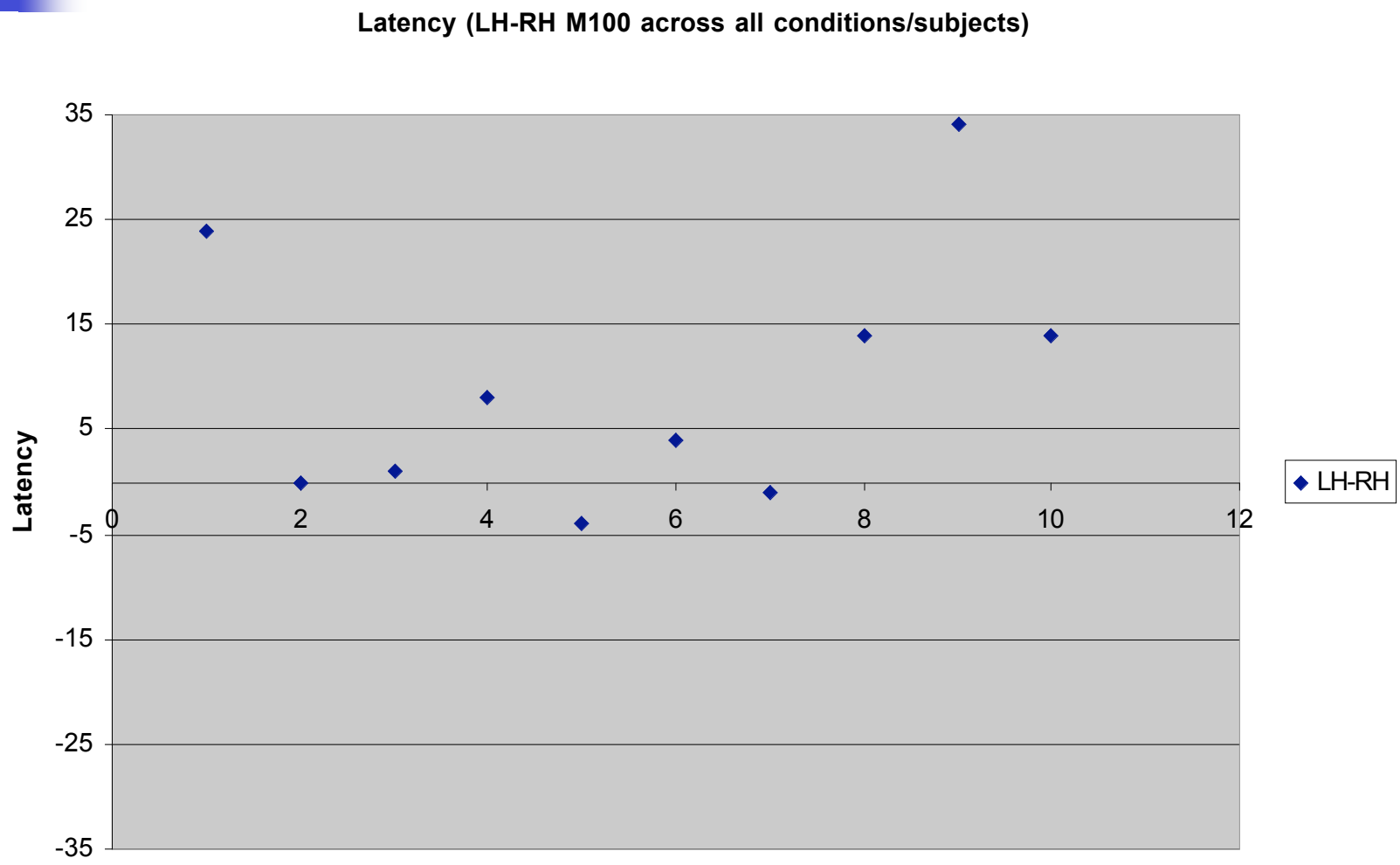
M50 LH-RH Amplitude



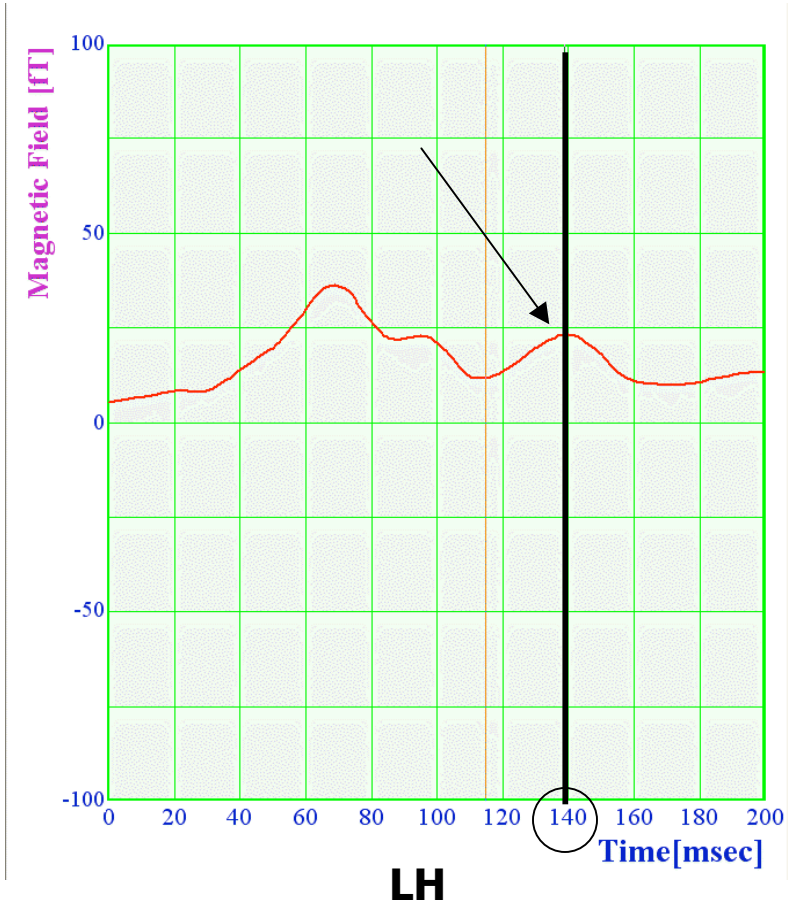
M50 LH vs RH Amplitude

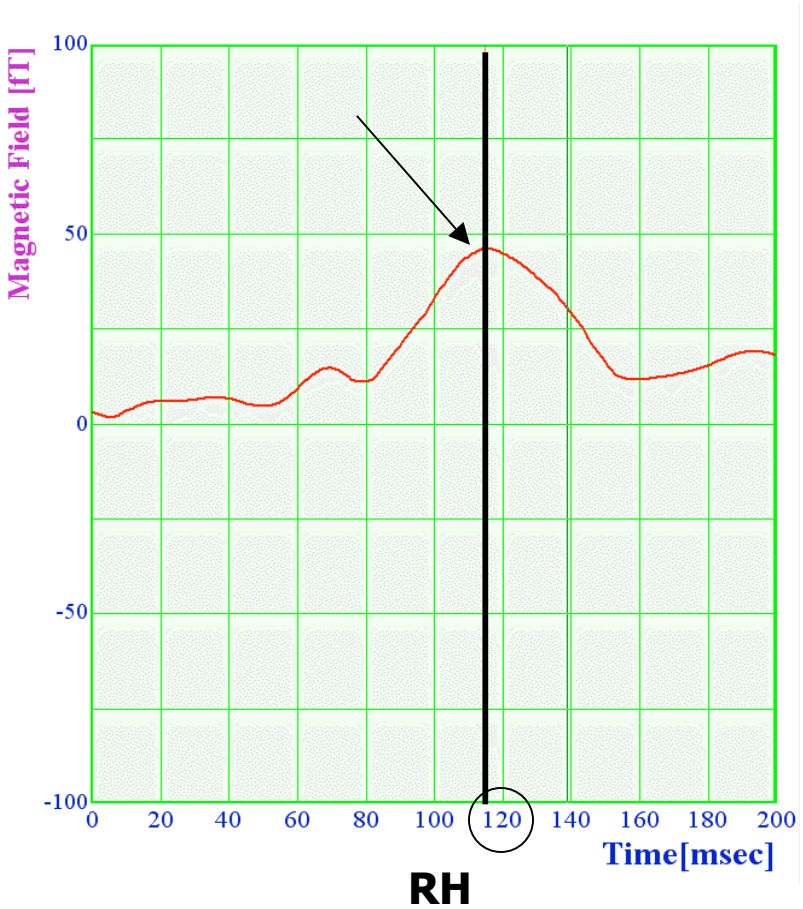


M100 LH-RH Latency

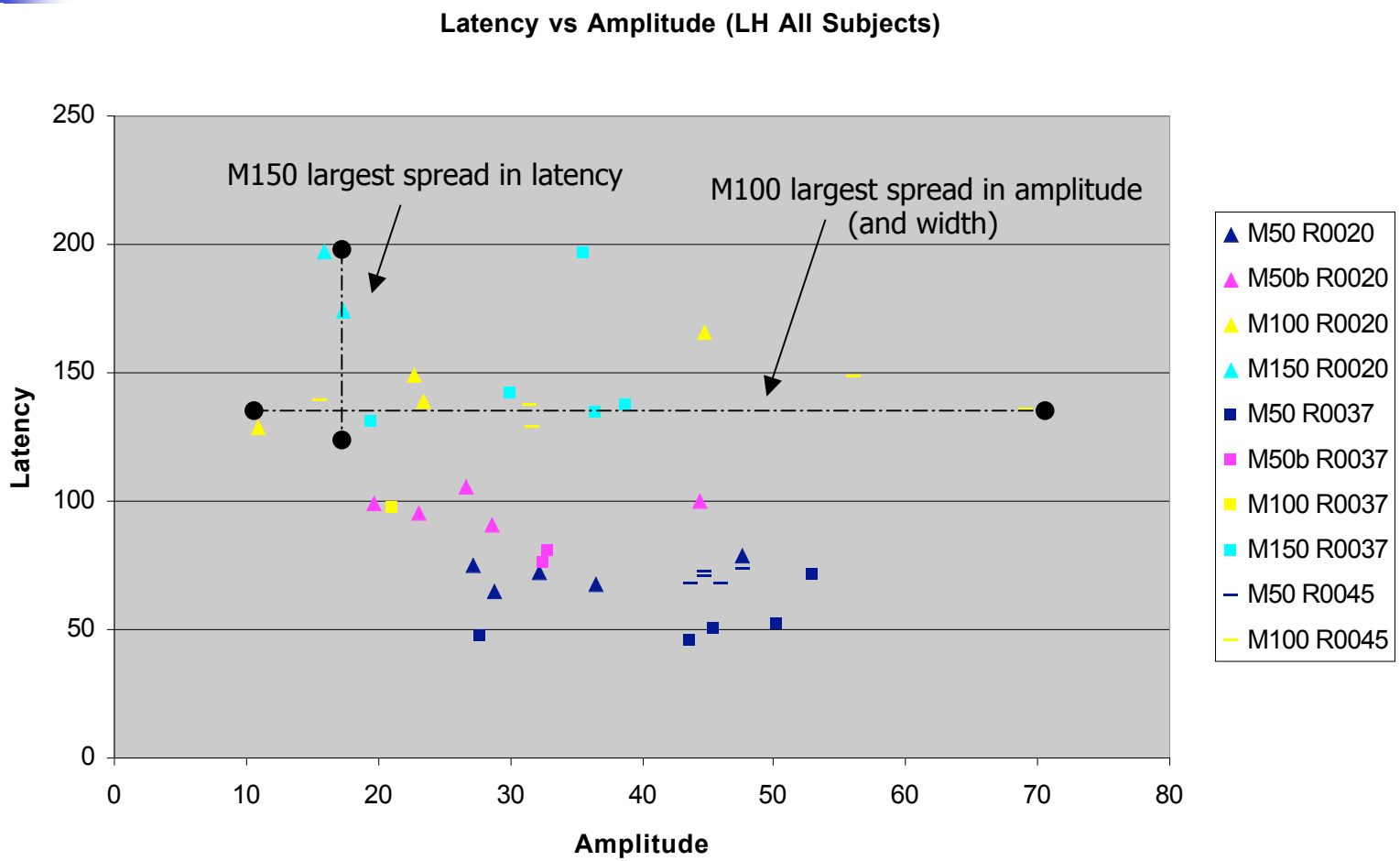


M100 LH vs RH Latency

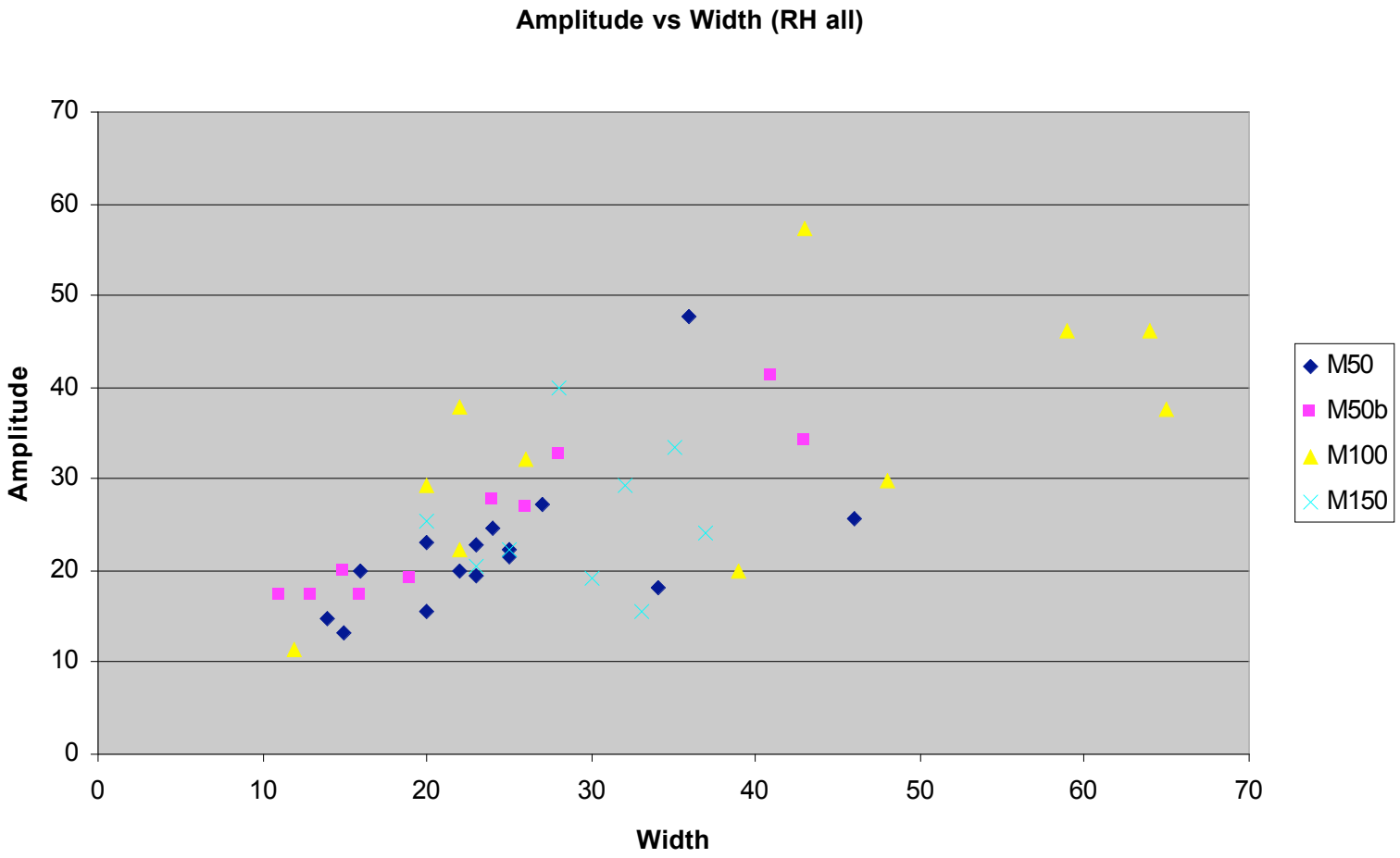




Trends

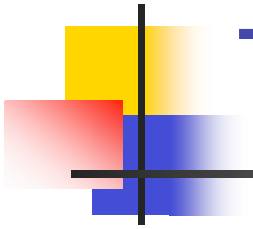

Latency vs Amplitude (LH All Subjects)
M150 largest spread in latency
M100 largest spread in amplitude (and width)
Latency
Amplitude
0
50
100
150
200
250
0
10
20
30
40
50
60
70
80
M50 R0020
M50b R0020
M100 R0020
M150 R0020
M50 R0037
M50b R0037
M100 R0037
M150 R0037
M50 R0045
M100 R0045

Trends


Amplitude vs Width (RH all)
Amplitude
Width
0
10
20
30
40
50
60
70
M50
M50b
M100
M150

Conclusions

- Dominance of LH M50 consistent with previous studies on all types of band-passed noise
- M50b is consistently present solely in band-passed noise, effectively becoming more pronounced as bandwidth increases
- Waveform peak responses to noise are context dependant – the presence of noise causes a significant delay to the M50/M100/M150 for pure tone
- The location of these dipoles are decidedly anterior to the localizer dipoles



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