Woodsonics Experimental Procedure

Repeat the following experiment for Four transducers pairs:

- 250kHz; use large Alba device as Tx
- 100kHz; remove perspex front face
- 50kHz; typically used as transmitters – not convinced will work efficiently as Rx
- 38kHz; use large device as Tx

Excitation procedure:

- Use Arbitrary Function Generator (AFG) and key in 1-10 cycle tone burst and approximate transducer frequency
- Set AFG to lowest amplitude
- Use T-piece BNC adaptor and 1:100 (or 1:10) scope probe to measure power amplifier output drive voltage. Do not exceed 200V in any case.
- Connect AFG to ENI power amplifier
- Slowly increase amplitude through AFG
- Tune excitation frequency in each experiment to obtain maximum received amplitude.
- Take care not to exceed power amplifier power rating. Determine if window function on the AFG is necessary[i].

Basic experimental setup:

- Pitch-catch setup
- Use couplant
- Identify appropriate pre-amplifier to use in reception – one of the pulser-receiver units? Problem may be low frequency transducers. Ask Walter for advice. Record the serial number of equipment used and it's settings
- Carefully align transducers, then tune frequency to maximise SNR
- Use 1-, 5-, 10-, cycle excitation and measure through transmission response - record peak voltage amplitude on reception

Question: how to 'normalise' each experiment to determine relative attenuation/frequency characteristic?

Possible solution: use same transducer pairs on a test (glass or steel) block (this may need to be quite large due to low frequency and long pulse length[ii]). Measure the drive voltage and receive voltage to work out insertion loss in 'clean' material. Note, we could work out pulse-echo response in clean material to determine attenuation at a specific frequency. Then relate insertion loss in wood to insertion loss in test block. Need to be careful about thickness of each test material and attenuation usually expressed in dB/cm. – COMMENTS.

2nd Phase experimental setup (same basic configuration as above):

- Soak wood overnight
- Repeat experiments

3rd Phase experimental setup (same basic configuration as above):

- Align 'best' transducer pair on wood sample, ensuring rigidly held in place
- Introduce drill hole from side starting at small diameter, say 1mm, and increase until defect signal appears in received signal

4th Phase experimental setup

- Try 3 different transducer combinations: 250kHz Tx and 100kHz Rx; 100kHz Tx and 50kHz Rx; 50kHz Tx and 38kHz Rx

Q: What is "best" transducer pair? Possible answer: one that yields shortest received pulse while keeping good SNR (back wall at least 40dB above noise floor?)

Q: Might be worthwhile to think about building our own +- 300V, 1MHz programmable coded pulse exciter? Shouldn't' be too expensive, for example, http://uk.farnell.com/nxp/phc2300-118/mosfet-np-ch-300v-sot96-1/dp/1758128RL and could be driven with a simple microcontroller (eg. from the STM Discovery series...), power limited from low-side of the voltage multiplier. - this could also be outsourced.

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[i] triangular-raise window may reduce power draw from the power amplifier, otherwise not recommended - Jurek.

[ii] for 38kHz and 6800m/s wave speed, pitch-catch, 10cycles+20% reserve, no repeated propagation, the block size must be not smaller than 0.7metre :
http://www.wolframalpha.com/input/?i=%286300m%2Fs+%2F++38kHz+*+%2810+%2B+2%29++%2F+3%29
The same assuming 1 cycle drive + 300% reserve yields 0.25m . We should be able to find 0.7m long glass rods or steel rods.