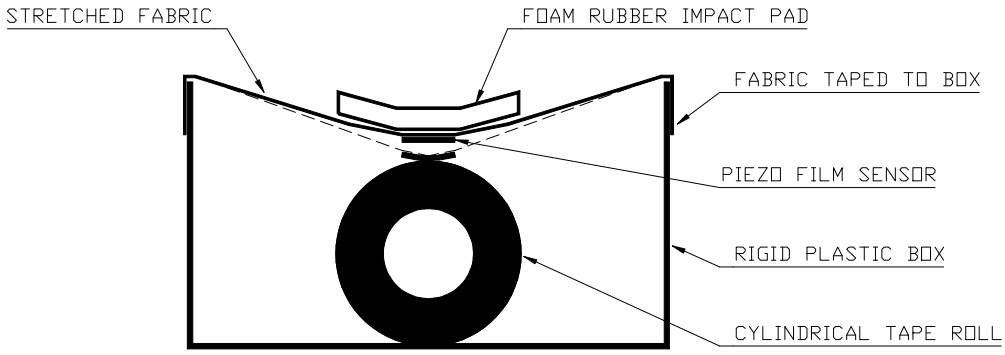
Impact Sensor - Experimental Arrangement

A piezo film sensor (MSI p/n 0-1001777-0) was attached to the underside of a thin fabric sheet (cleaning cloth, overall dimensions 55 x 36 cm, type "Wisch Wunder", Vileda GmbH) stretched over an open rigid plastic box in the general arrangement shown below. The compliance of the fabric was such that vertical impacts could be delivered which "just missed" contact with the tape roll underneath, or "just hit" the roll with slightly higher force.

The film sensor was connected to a digital signal analyser, through a x100 probe (100 megohm impedance), and then through a x1 probe (1 megohm). Signals corresponding to the "just miss" and "just hit" conditions were recorded.



IMPACT SENSOR TEST ARRANGEMENT
R H BROWN 10.03.00

Subsequently, a second identical film sensor was bonded to the upper side of the fabric, and the outputs of the two sensors were connected (hard-wired) in reverse polarity. Once again, both x100 and x1 probes were used

Observations

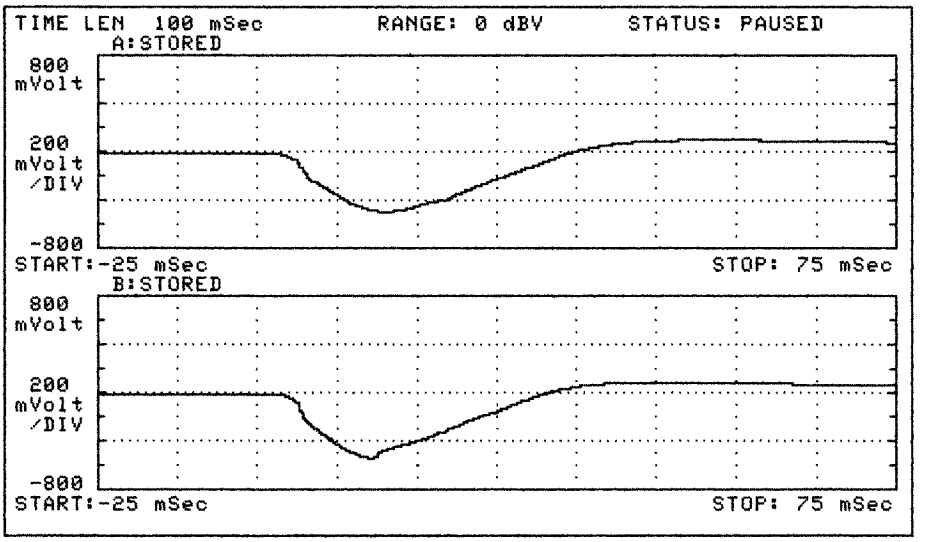
Using the x100 probe, the time constant of the measurement is approximately 120 ms (for single sensor case), and therefore the recorded waveform can be assumed to be quite close to the true strain signal. The moment of contact with the cylindrical tape roll can be seen as a very small "step" superimposed on the slower, high-amplitude signal from the general stretching of the fabric. Using x1 arrangement, the time constant is reduced by a factor of 100, to 1.2 ms, and therefore the waveform gives almost a differentiation with respect to time. The contact is seen as a "glitch" in the waveform, but is still rather hard to detect.

Using the two reverse-connected sensors, the magnitude of the "just miss" waveform using x100 probe is reduced by more than a factor of 2. A "just hit" event shows as a distinct peak, superimposed on the slower stretching curve. Using x1 connection, the contact event shows up as an isolated positive-going pulse, clearly resolvable from the start and stop of the stretching event.

Conclusion

The use of a differential pair minimises the "common mode" unwanted stretching signal. Further refinement could allow a single film element with two patterned electrode areas, to be mounted on a single surface of the fabric.

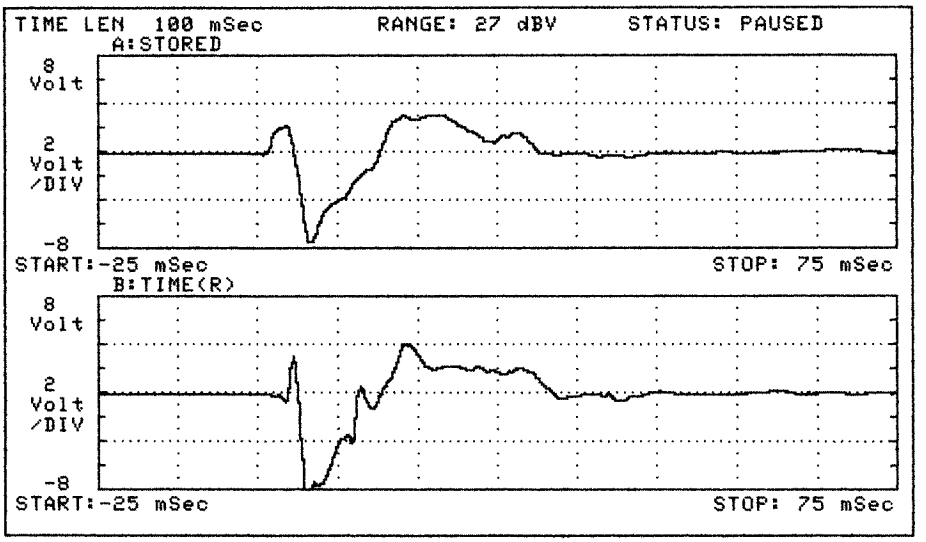
FIG ①: SINGLE SENSOR, 100MΩ



JUST MISS

JUST HIT

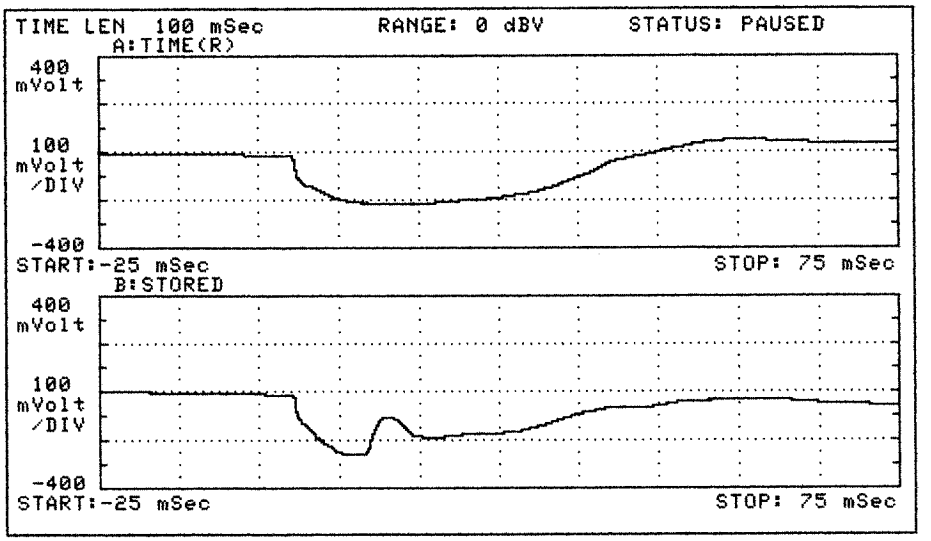
FIG ②: SINGLE SENSOR, MR



JUST MISS

JUST HIT

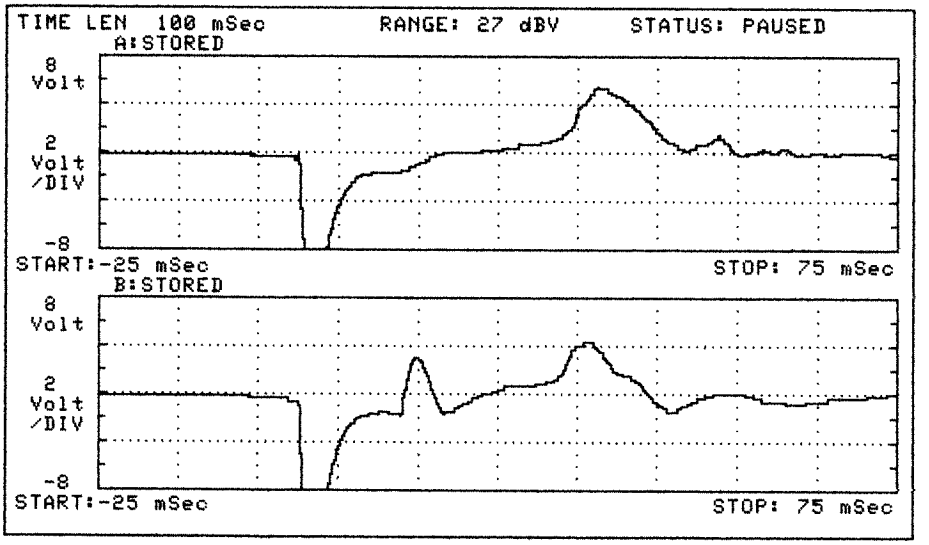
FIG (3): DUAL SENSOR, 100M_2



JUST MISS

JUST HIT

FIG (4): DUAL SENSOR, IMR



JUST MISS

JUST HIT

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