

## TIME OF ARRIVAL GAGES FOR LOW AMPLITUDE WAVES

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The measurement of time of arrival (TOA) of compression waves has been a long pursued goal in blast and shock experimentation. A significant amount of information can be derived from TOA measurements if enough locations are available. Therefore, multiple low cost measurement systems are required. Many organizations have TOA measurement systems but they have many shortcomings in their range of application. Very low amplitude compression waves are difficult to measure, the costs associated with the current sensor manufacture are rising, and multiple measurements lead to unacceptable success ratios due to channel crosstalk.

A new method has been developed and tested to measure time of arrival of low amplitude compression waves in both the free air and in soil. The system was developed due to the inability of standard piezoelectric crystals to produce a sufficient signal amplitude during the wave/crystal interaction to stop a count channel on a Time of Arrival System (TOADS). The new method involves the use of a piezoelectric polymer film called Poly-Vinylidene Fluoride(PVDF). The film yields a charge output which is proportional to an input pressure on the film. This charge is then electrically conditioned to provide a light pulse output which is coupled via fiber optic cable to an optical detector/signal conditioner. The output from the signal conditioner is then used as an input pulse on the TOADS unit to provide the stop pulse to the clock countdown channel.

The system developed minimizes crosstalk between channels by utilizing the fiber optic link. The electronic circuitry provides a TTL pulse output (5vDC) whenever the sensing film output rises above a present level. Sufficient signal amplitude is produced to trigger this system by the sensing device at very low overpressures (less than 690 Pa). The system also has very good frequency response with rise times on the order of 5 microseconds obtainable. The system has been tested in a laboratory shock tube, on a free field high explosive simulation, and in a soils simulant in a free field test. The results have been more than encouraging and have inexpensively improved the range of application of existing TODS units.