NONCONTACT ULTRASONICS

Spectacular Ultrasonic Revolution for Major Industrial & Biomedical Uses and for Further Business Development

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INTRODUCTION

Since founding Ultran in 1978, among other things, I have been actively involved in R&D aimed at eliminating liquid couplants and transducer contacts with test materials. At that time these ideas were called, *"crazy and illogical!" I still hear similar echoes!*

In this introductory document I am pleased to provide the foundation of this revolutionary advancement in modern ultrasound. **The sole function of this introduction is to provoke serious thoughts among those who may be desirous of establishing business partnership with us, including financial support.**

PROCESS OF EVOLUTION

Dry coupling and air/gas propagation transducers and techniques are not new to us - they were developed by the author in 1982. In the early stage they were extensively used by Brunk[1] for the development of dry coupling techniques for plate thickness measurements and for noncontact profilometry - all by using frequencies between ~1 to >10MHz. Dry coupling techniques are now state-of-the-art for characterization of green and consolidated, partly sintered and fully sintered, and porous and low density composites, as well as other materials.[2]

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1 **This work was done from 1983 to 1986 while Brunk was with Allied Corporation, Kansas City Division, Kansas City, MO., and later at Ultran in 1986-87. Presently he is a private consultant.**

2 1. Bhardwaj, M.C. and Trippett, K., "Nondestructive Characterization of Green and Sintered Ceramics," Proceedings of the First International Symposium of Engineering Ceramics, eds. S. Kimura and K. Niihara, Koda, Aichi-Prefecture, Japan, October 21-25, 1991, The Ceramic Society of Japan.
2. Kulkarni, N., Moudgil, B. and Bhardwaj,M., "Ultrasonic Characterization of Green and Sintered Ceramics: I, Time Domain," Am. Cer. Soc., Cer. Bull, Vol. 73, No. 6, (1994).
3. Kulkarni, N., Moudgil, B. and Bhardwaj,M., "Ultrasonic Characterization of Green and Sintered Ceramics: II, Frequency Domain," Am. Cer. Soc., Cer. Bull, Vol. 73, No. 7, (1994).

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However, from a practical standpoint, air coupling at high frequencies (200KHz to ~5MHz) is a major challenge. When we superimpose the condition that air coupling must be accomplished under ordinary ambient conditions -- no pressurization of air, or utilization of other gases -- this challenge, obviously becomes indomitable! On the other hand, the significance and need for noncontact propagation through materials are obvious and vital for achieving the goal of Total Materials Quality (from early to final stages of materials manufacture) and major improvements in noninvasive biomedical applications of modern ultrasound.

THE RESULT

Notwithstanding apparent difficulties, we experienced significant success with noncontact air propagation through several low Z materials, although analysis of high Z media remained a formidable task. We are pleased to report that this, too, has been overcome recently. Table-I provides chronology of this major development. New transducers have been tested between 200kHz to ~2.0MHz.

TABLE-I. Chronology of advancements in high frequency transduction in air.

TRANSDUCER	APPROX. RELATIVE SENSITIVITY (dB)
Our 1983 design	~-94
Our Advanced design #1 (1994)	<-78
Our Advanced design #2 (1994)	-68
Our Advanced design #3 (1995)	-55

POSSIBILITIES

Experiments performed during 1994-95 prove that this efficiency is high enough to EASILY overcome several orders of acoustic impedance barrier between air and materials, thus opening the doors for the analysis of all three states of matter without transducer contact. This development and transducers are proprietary, for which several patent applications are on file or are in process.

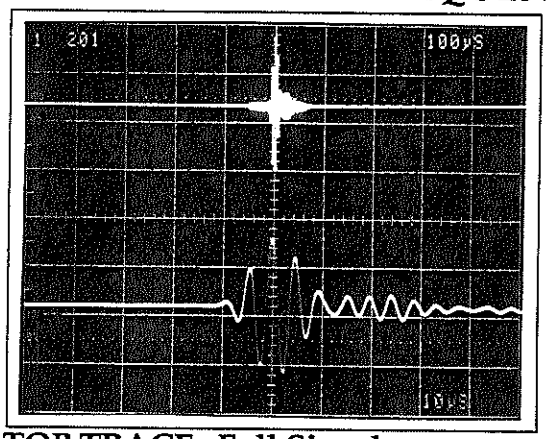
For hard-copy evidence of high frequency transduction in air and non-contact analytical feasibility for a number of materials, please see the enclosed material.

If you are interested, in new business possibilities based upon modern ultrasound, please contact the author.

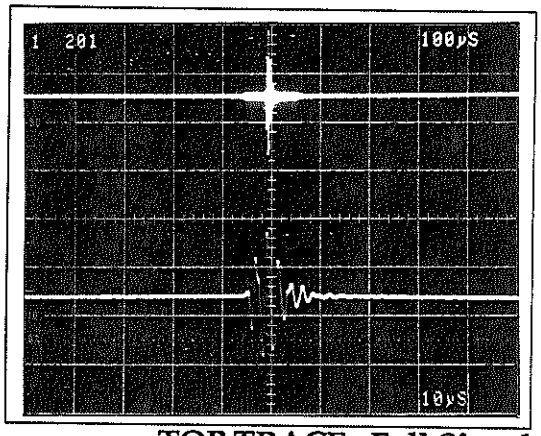
MCB: cbm

NONCONTACT ULTRASONICS
Dreams in action

PROPAGATION IN AIR AT RTP
LOW FREQUENCY EXAMPLES -- <750kHz



TOP TRACE: Full Signal
BOTTOM TRACE: Amplified H.S.
250kHz
A.S. -- 170mm



TOP TRACE: Full Signal
BOTTOM TRACE: Amplified H.S.
750kHz
A.S. 170mm

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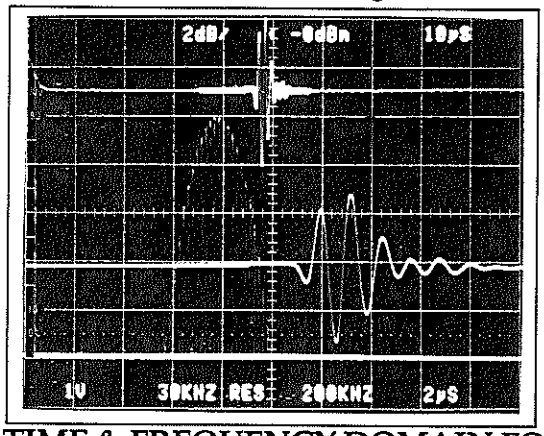
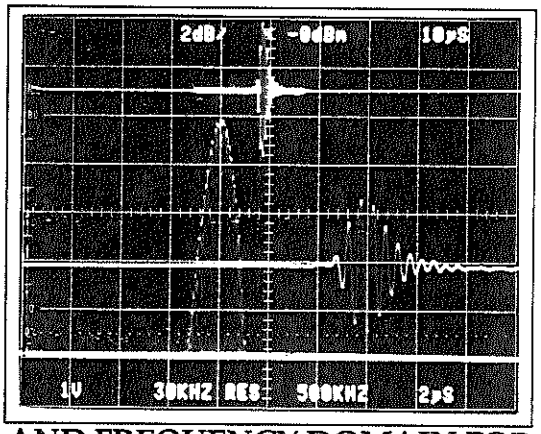
Dreams in action

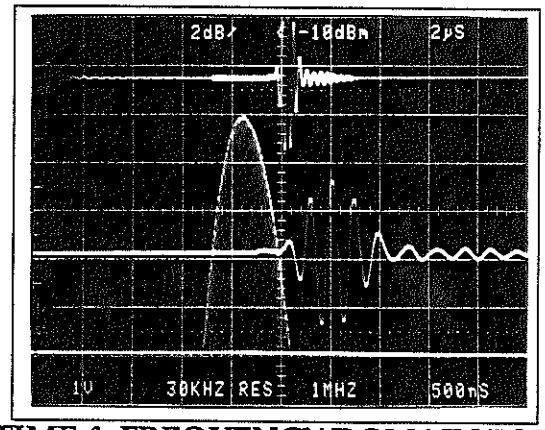
PROPAGATION IN AIR AT RTP
HIGH FREQUENCY EXAMPLES -- ~1.0MHz to 5MHz



TIME & FREQUENCY DOMAIN FOR
1MHz. Measured Frequency: 800kHz.
Bandwidth: 380kHz. A.S. -- 16mm.



TIME AND FREQUENCY DOMAIN FOR
2MHz. Measured Frequency: 2MHz
Bandwidth: 600kHz. A.S. -- 16mm



TIME & FREQUENCY DOMAIN FOR
5MHz. Measured Frequency: 4.0MHz.
Bandwidth: 1.5MHz. A.S. -- 3.5mm.

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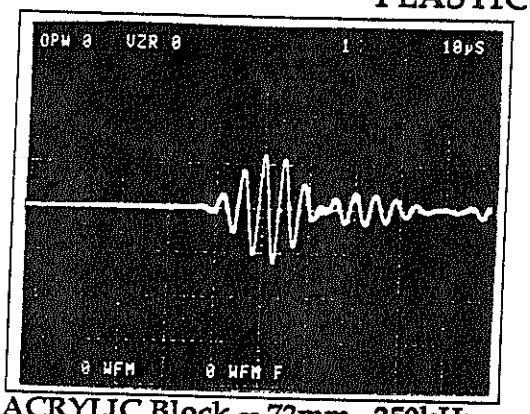
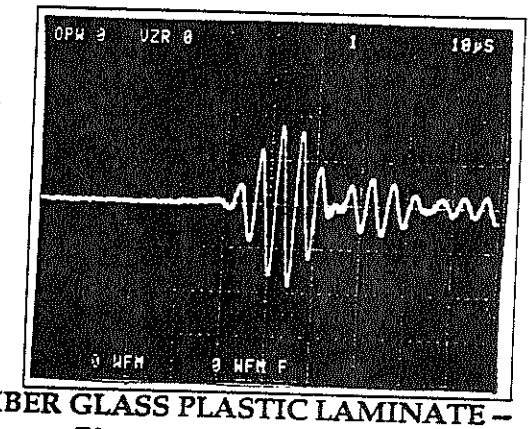
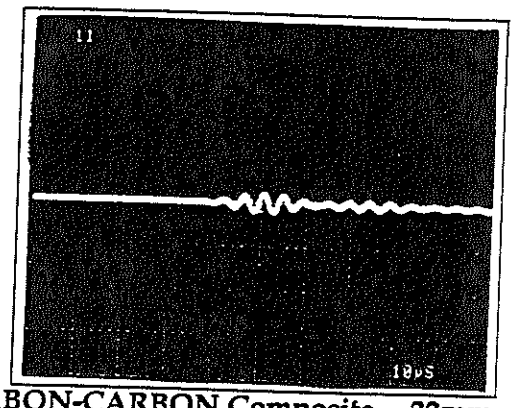
PLASTICS & COMPOSITES



ACRYLIC Block – 72mm. 250kHz.
A.S. – 150mm



FIBER GLASS PLASTIC LAMINATE –
70mm. 250kHz. A.S. – 150mm



2-D CARBON-CARBON Composite – 22mm. 250kHz.
A.S. – 150mm

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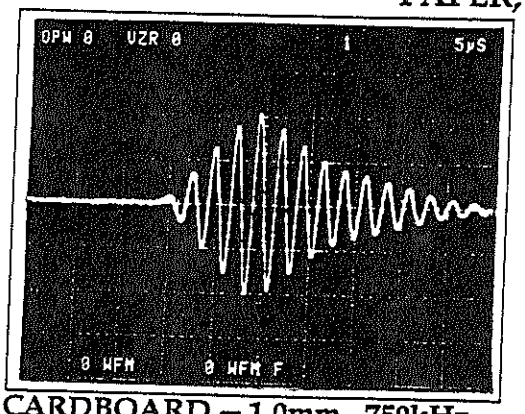
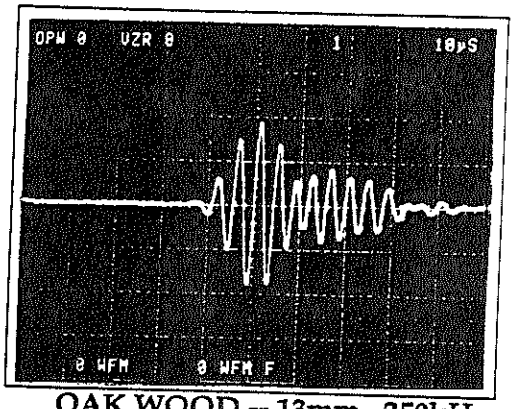
Dreams in action

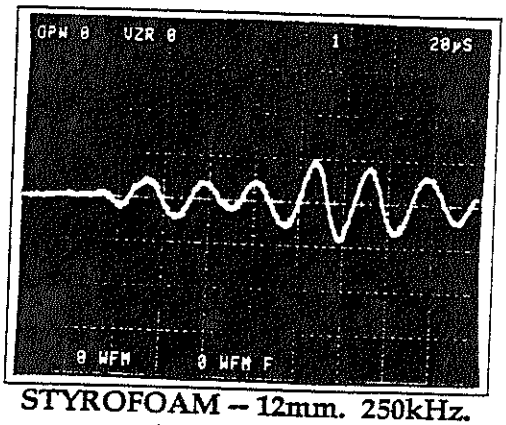
PAPER, WOOD, & FOAM



CARDBOARD – 1.0mm. 750kHz.
A.S. – 25mm



OAK WOOD -- 13mm. 250kHz.
A.S. -- 150mm



STYROFOAM – 12mm. 250kHz.
A.S. – 150mm

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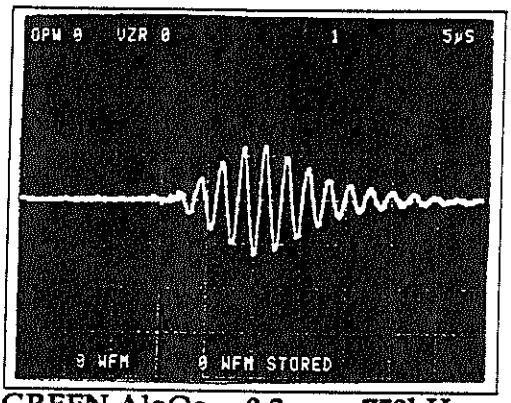
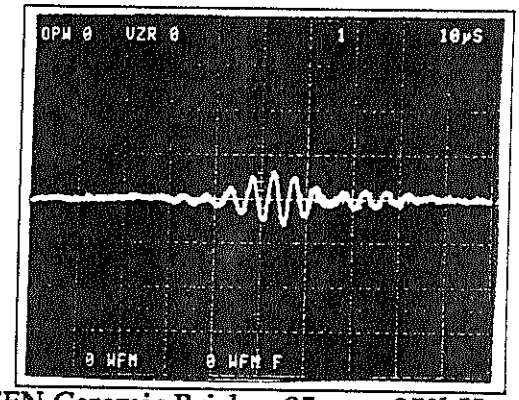
GREEN CERAMICS

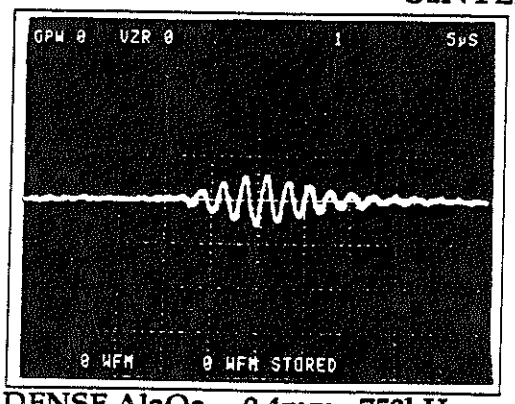


GREEN Al_2O_3 – 0.3mm. 750kHz.
A.S. – 25mm

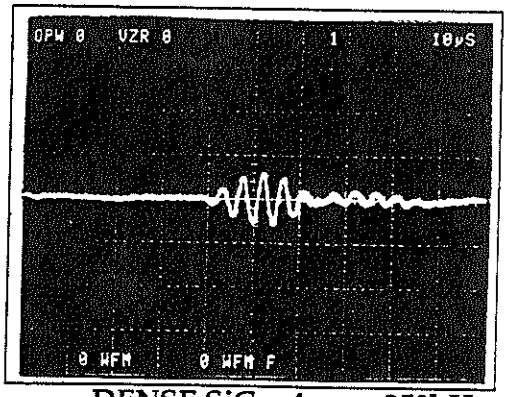


GREEN Ceramic Brick – 85mm. 250kHz.
A.S. – 150mm

SINTERED CERAMICS



DENSE Al_2O_3 – 0.4mm. 750kHz.
A.S. – 25mm



DENSE SiC – 4mm. 250kHz.
A.S. – 150mm

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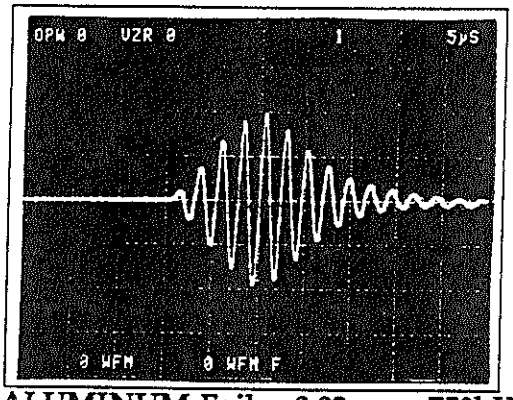
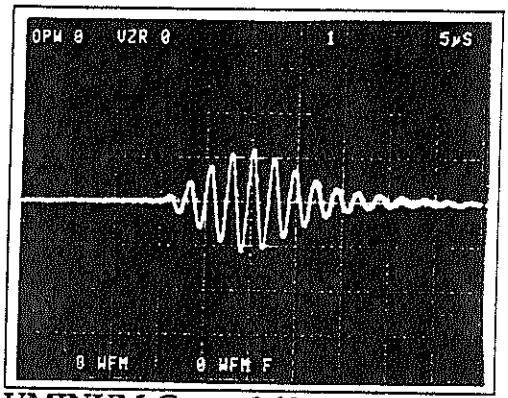
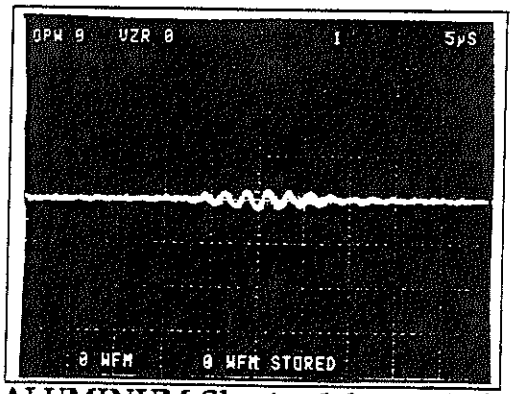
METALS



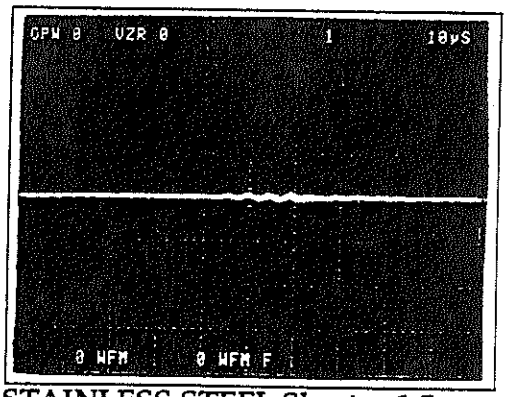
ALUMINUM Foil – 0.02mm. 750kHz.
A.S. – 25mm



ALUMINUM Can – 0.12mm. 750kHz.
A.S. – 25mm



ALUMINUM Sheet – 1.6mm. 750kHz.
A.S. – 25mm



STAINLESS STEEL Sheet – 1.5mm.
250kHz. A.S. – 150mm

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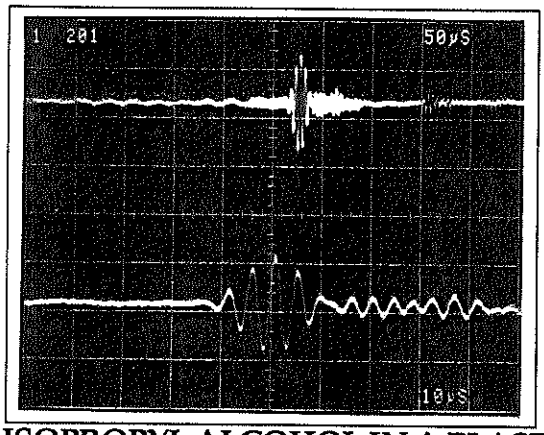
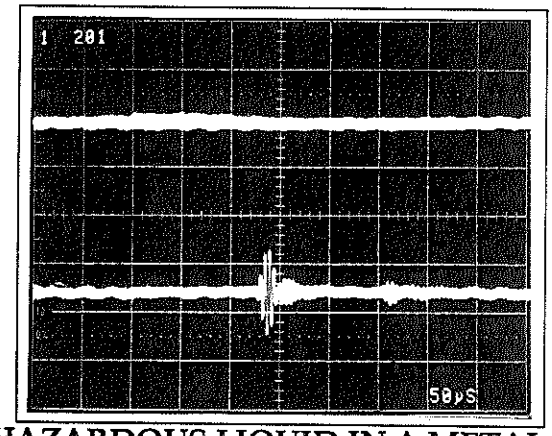
INDUSTRIAL LIQUIDS



ISOPROPYL ALCOHOL IN A PLASTIC CONTAINER -- 150mm. 250kHz
A.S. -- 180mm



HAZARDOUS LIQUID IN A METAL CONTAINER -- 76MM
A.S. -- 180MM

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