GAS MATRIX PIEZOELECTRIC (GMP™)

CONTACT AND IMMERSION TRANSDUCERS
~50 kHz to >500 kHz

Modern dimension in ultrasound for tough industrial & bio-medical applications

the ultran group

redefining the limits of ultrasound

3100 Research Dr, State College, PA 16801 USA
Phone: +1.814.861.2001 Fax: +1.814.861.2045
Web: www.ultrangroup.com
Email: sales@ultrangroup.com

GAS MATRIX PIEZOELECTRIC (GMP™) CONTACT AND IMMERSION TRANSDUCERS ~50 kHz to >500 kHz

TABLE OF CONTENTS

the ultran group

3100 Research Dr, State College PA 16801 USA
Phone: +1.814.861.2001 Fax: +1.814.861.2045
Email: sales@ultrangroup.com Web: www.ultrangroup.com

EDITORIAL

ULTRAN is very well respected for our contributions in ultrasonic materials testing and analysis by creating the most novel transducers – the heart of ultrasound. To name some, transducers such as UNIPOLAR Lambda, dry coupling, air/gas propagation, non-contact, VHF longitudinal and shear wave, very high temperature – several patented and proprietary -- are synonymous to ULTRAN.

Long ago when we took the responsibility of developing ultrasound we only had materials – our customers – in our minds. We knew well then and now, we are serving the needs of the materials industry. It wants useful and easy-to-understand non-destructive method that helps in materials processing, quality control, assurance, and reliability. It is for such reasons Ultran is made up of materials and ultrasound scientists, mechanical and electronics engineers, and signal processing mathematicians. And to top it off, we are supported by always-to-help sales and administrative staff.

When we conceived the slogan, ***redefining the limits of ultrasound,*** even we did not know how true it really was! Ultrasound today bears little resemblance to the status-quo!

In this publication Ultran is pleased to address an immensely powerful advancement in ultrasound from our laboratory that is targeted at a specific sector of materials industry.

For ultrasonic testing of highly attenuative media such as concrete, thick and porous composites, super strength and large grain alloys, wood, lumber, and trees, construction materials, refractories, long distance under water naval applications; and bones and fatty tissue, it is necessary to use sub-megahertz frequencies. Those of us who have experienced ultrasound for such materials and conditions know too well the frustrations. We at Ultran know these issues extremely well.

In order to facilitate testing of highly attenuative materials a very important branch of ultrasound that falls between 50 to 500 kHz has also been a major subject of R&D in our laboratory for a very long time. This effort finally paid off in the summer of 2002, when we successfully created a new piezoelectric structure known as Gas Matrix Piezoelectric (GMP™) composite – US and International Patents Pending. Characteristics of this material are of a nature that seldom appear in the annals of science and technology. Though self-serving, such a statement is necessary because everything about GMP™ is best described in superlative terms!

In this catalog we are delighted to unleash the power of modern ultrasound through GMP™ for those applications of ultrasound that once appeared almost incomprehensible. *Imagination is truly unlimited!* What we do at Ultran is only one side of the story; it is what you accomplish with it that does wonders!

As always, our sales and applications staff will assist you with any questions you have. Establishment of beneficial friendship was our aim and we continue to build on this strength.

Mahesh C. Bhardwaj
Chief Technology Officer
The Ultran Group

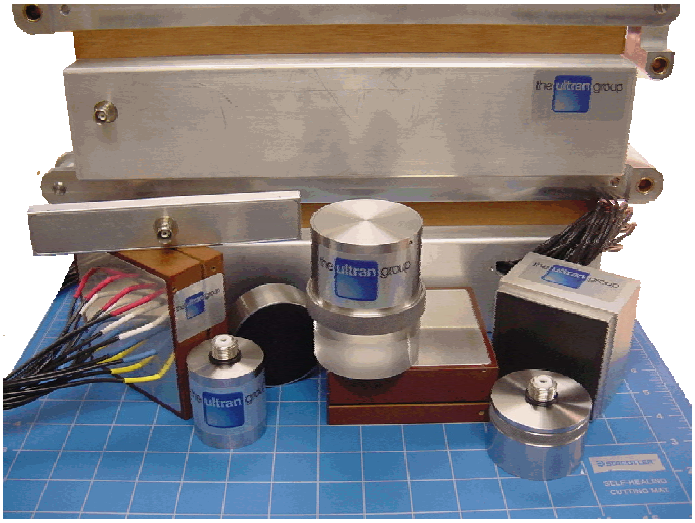
A WORD ABOUT GMP™

- **GMP™ preserves critical piezoelectric properties of solid piezoelectric material (spm), besides creating its own significant ones**
- **Thickness coupling, k_t is equal to k_{33} of spm, while PMP is ~70%**
- **Transducer devices based on it are 50% higher in efficiency relative to PMP**
- **Acoustic cross-talk is nearly ZERO, k_p near ZERO**
- **Very low dielectric constant**
- **Easily excited even at relatively low energy levels**
- **Excellent ultrasound receiving characteristics**
- **Q, <1, thus the bandwidth is intrinsically very high**
- **Density, <3 g/cc**
- **Relatively speaking, there is negligible pyroelectric charge development**
- **It is characterized by extremely high mechanical strength**
- **Its manufacturability allows construction of extremely large single and multi-element transducers; conceivably as big as rooms, even larger**
- **Its manufacturability further allows embedding of transducers permanently very easy**
- **And a lot more!**

While the history of Gas Matrix Piezoelectric (GMP™) composite is illuminated in the history of Ultran, yet it is sufficient to say this dream material is finally a reality.

As we say this we also must acknowledge the great strides in Polymer Matrix Piezoelectric (PMP) composites since 1980s. Ultran's technical staff also played a significant role in its development.

Concurrent with the nature of scientific advancements, GMP™ has taken us far beyond PMP, thus opening doors that were shut to the status-quo ultrasound.



Single and multi-element array devices based upon GMP™ have been successfully produced up to 250 mm – much larger dimensions, exceeding 1000 mm are also possible.

Ultran's transducers and mechanical design specialists are ready to assist you in making your most demanding ultrasonic applications real and much easier than ever before.

Each customer inquiry is handled with due diligence and care it demands.

TIME, FREQUENCY, AND SENSITIVITY ANALYSIS OF GMP™ CONTACT AND IMMERSION APPLICATIONS TRANSDUCERS

See Table below for more details

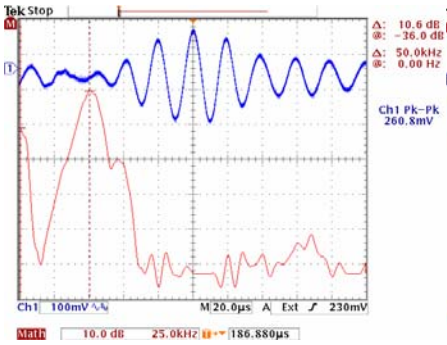


Fig. 1 50 kHz 25 mm

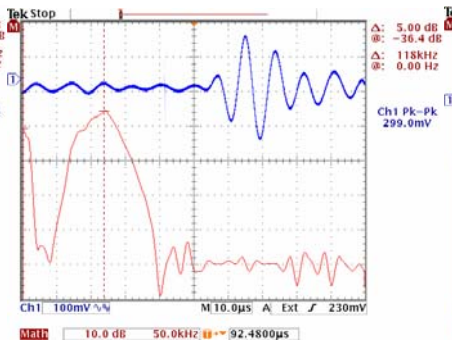


Fig. 2. 100 kHz 25 mm

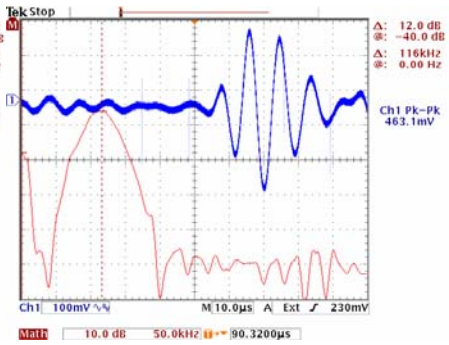


Fig. 3. 100 kHz 38 mm

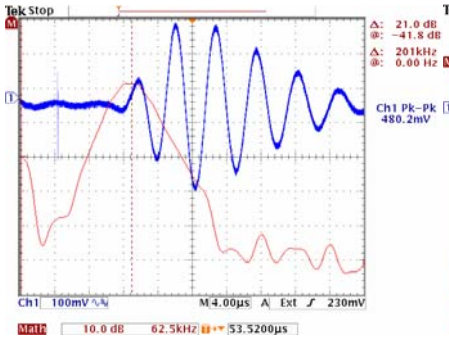


Fig. 4. 200 kHz 25 mm

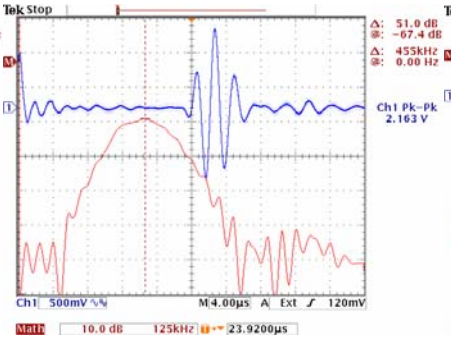


Fig. 5. 500 kHz 25 mm

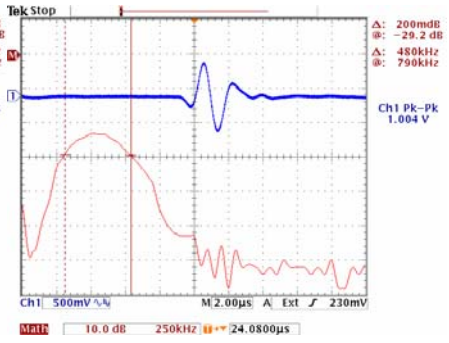


Fig. 6. 500 kHz Extremely broadband version, 25 mm

Observations provided in figures 1 to 6 were obtained by exciting the transducer with a single pulse of 28 volt sine wave with no amplification of the received signal from the bottom surface of polystyrene reflector

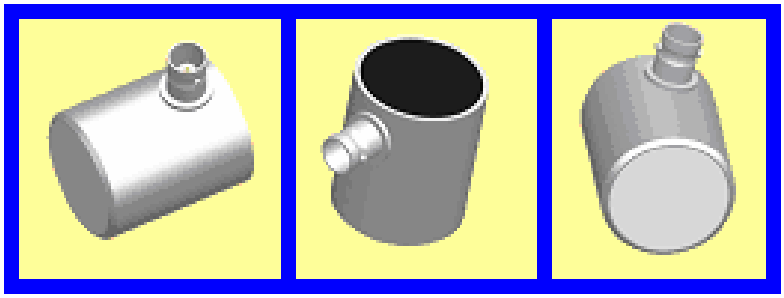
FREQUENCY (kHz)	ACTIVE DIMENSIONS (mm)	BANDWIDTH @ -6 dB (% bcf)	TWO WAY SENSITIVITY (dB)
50 – Fig. 1	25x25[1]	**20 kHz (40)**	**-40**
100 – Fig. 2	25x25[1]	**65 kHz (60)**	**-39**
100 – Fig 3	50 diameter[2]	**65 kHz (55)**	**-36**
200 – Fig 4	25 diameter[3]	**90 kHz (45)**	**-35**
500 – Fig. 5	25x25[4]	**250 kHz (55)**	**-22**
500 – Extremely Broadband – Fig. 6*	25 diameter[4]	**500 kHz (100)**	**-29**

[1]Dual mode 100 mm polystyrene [2]Pulse-echo 100 mm polystyrene

GMP transducers are characterized by superb combination of bandwidth and sensitivity. However, the bandwidths of these devices can be further increased, Fig. 6. Should your applications demand such characteristics, please contact Ultran.

GMP™ STRAIGHT CONTACT TRANSDUCER ORDERING INFORMATION

For defect detection, thickness & velocity measurements
Suitable for hard, high acoustic impedance materials



CATALOG #	FREQUENCY (kHz)	ACTIVE DIAMETER (mm)
GC500-D13	500	12.5
GC500-D19		19.0
GC500-D25		25.0
GC300-D13	300	12.5
GC300-D19		19.0
GC300-D25		25.0
GC200-D19	200	19.0
GC200-D25		25.0
GC200-D38		38.0
GC200-D50		50.0
GC140-D19	140	19.0
GC140-D25		25.0
GC140-D38		38.0
GC140-D50		50.0
GC100-D25	100	25.0
GC100-D38		38.0
GC100-D50		50.0
GC50-D25	50	25.0
GC50-D38		38.0
GC50-D50		50.0

Hard Alumina wear face
Side mounted BNC
Stainless steel housing
Suitable between -20 to 70° C

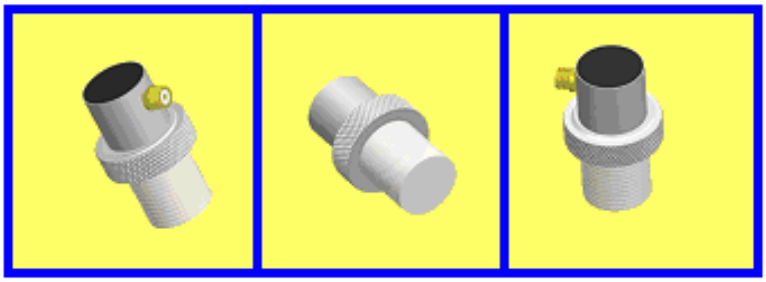
All transducers are furnished with acoustic characterization reports, including special instructions, if any

For special needs, consult Ultran

GMP™ DELAYED CONTACT TRANSDUCER ORDERING INFORMATION

For defect detection, thickness & velocity measurements

Suitable for thick composites, concrete, rough surface and like materials



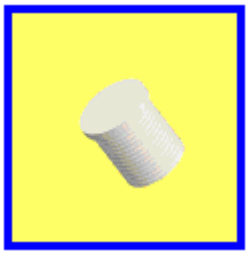
CATALOG #	FREQUENCY (kHz)	ACTIVE DIAMETER (mm)
GRD500-D13	500	12.5
GRD500-D19		19.0
GRD500-D25		25.0
GRD300-D13	300	12.5
GRD300-D19		19.0
GRD300-D25		25.0
GRD200-D19	200	19.0
GRD200-D25		25.0
GRD200-D38		38.0
GRD200-D50		50.0
GRD140-D19	140	19.0
GRD140-D25		25.0
GRD140-D38		38.0
GRD140-D50		50.0
GRD100-D25	100	25.0
GRD100-D38		38.0
GRD100-D50		50.0
GRD50-D25	50	25.0
GRD50-D38		38.0
GRD50-D50		50.0

Multi-layer Z matching
Short replaceable protective delay
Can also be used without delay
Side mounted MICRODOT for 12.5 & 19 mm diameter transducers and BNC for 25mm and higher diameters
Stainless steel housing
Suitable between -20 to 70° C

All transducers are furnished with acoustic characterization reports, including special instructions, if any

For special needs, consult Ultran

Extra Delay Ordering

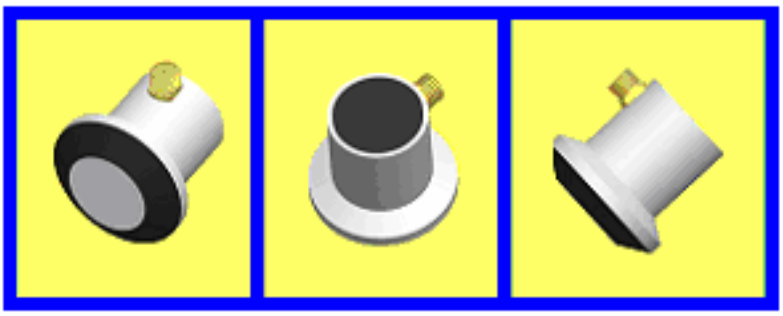


TRANSDUCER ACTIVE DIAMETER (mm)	ROOM TEMPERATURE	HIGH TEMPERATURE
12.5	DL13	HDL13
19.0	DL19	HDL19
25.0	DL25	HDL25
38.0	DL38	HDL38
50.0	DL50	HDL50

Unless specified otherwise, all delays are 10 mm thick
High temperature delays can be used intermittently up to 300° C

GMP™ DRY CONTACT TRANSDUCER ORDERING INFORMATION

For defect detection, thickness & velocity measurements Suitable for composites, plastics, porous, food, pharmaceutical, bio-medical, and liquid-sensitive materials



CATALOG #	FREQUENCY (kHz)	ACTIVE DIAMETER (mm)
GD500-D13	500	12.5
GD500-D19		19.0
GD300-D13	300	12.5
GD300-D19		19.0
GD200-D19	200	19.0
GD200-D25		25.0
GD140-D19	140	19.0
GD140-D25		25.0

Multi-layer Z matching
Solid compliant DC front layer
Side mounted MICRODOT for 12.5 & 19 mm diameter transducers and BNC for 25mm and higher diameters
Stainless steel housing
Suitable between -20 to 70° C

All transducers are furnished with acoustic characterization reports, including special instructions, if any

For special needs, consult Ultran

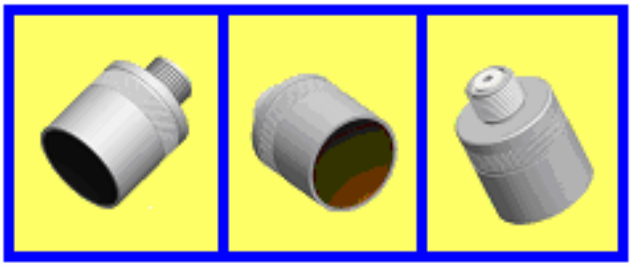
GMP™ ANGLEBEAM AND DUAL T-R CONTACT TRANSDUCERS

Since GMP can be produced in any shape and in large dimensions, it provides us enormous flexibility in transducer designs for complex applications. For example, applications such as weld detection in super-strength and thick alloys used in nuclear reactor vessels and power generating steam or hydro-electric turbines can now be greatly enhanced on account of extraordinary characteristics of GMP Similarly, evaluation of concrete structures, very thick epoxy and rubber based composites, wood and lumber can also be easily accomplished with GMP dual transducers. We ask the interested customers to provide Ultran the transducer specifications or contact us for assistance.

GMP™ IMMERSION TRANSDUCERS ORDERING INFORMATION

For defect detection, thickness & velocity measurements, tracking of objects far away in liquids, for very long distance travel in water, remote sensing

Suitable for extremely wide ranging applications in water as well as for testing of materials that are not affected by water



CATALOG #	FREQUENCY (kHz)	ACTIVE DIAMETER (mm)	FOCAL LENGTH (mm)
GS500-D19	500	19	Planar
GS500-D25		25	Planar
GS500-D25-P50		25	50
GS500-D50		50	Planar
GS500-D50-P500		50	500
GS300-D19	300	19	Planar
GS300-D25		25	Planar
GS300-D25-P50		25	50
GS300-D50		50	Planar
GS300-D50-P500		50	500
GS200-D25	200	25	Planar
GS200-D25-P50		25	50
GS200-D50		50	Planar
GS200-D50-P500		50	500
GS140-D25	140	25	Planar
GS140-D50		50	Planar
GS140-D50-P500		50	500
GS140-D100		100	Planar
GS100-D25	100	25	Planar
GS100-D50		50	Planar
GS100-D50-P500		50	500
GS100-D100		100	Planar
GS50-D25	50	25	Planar
GS50-D50		50	Planar
GS50-D50-P500		50	500
GS50-D100		100	Planar

Multi-layer Z matched to water
Stainless steel housing
Axially-mounted water-proof UHF connector

All transducers are furnished with acoustic characterization reports

GMP™ immersion transducers are also available in square or rectangular active area in planar or cylindrically focused configurations. All transducers can also be produced in very large dimensions as single or multi-element array devices. Please inquire or discuss your needs with our engineering staff.

the ultran group

3100 Research Dr, State College PA 16801 USA
Phone: +1.814.861.2001 Fax: +1.814.861.2045
Email: sales@ultrangroup.com Web: www.ultrangroup.com