
NON-CONTACT ULTRASOUND (NCU)

**PHENOMENALLY HIGH EFFICIENCY
TRANSDUCERS -- 50 kHz to >5.0 MHz**



Modern ultrasound for materials process analysis, bio-medical,
liquid-sensitive materials, sensing, and other applications

the **ultran** group

redefining the limits of ultrasound

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NON-CONTACT ULTRASOUND TRANSDUCERS

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EDITORIAL

ULTRAN is well respected for contributions in ultrasonic materials testing and analysis by creating novel transducers, the heart of ultrasound. Transducers such as UNIPOLAR Lambda, dry coupling, air/gas propagation, non-contact, VHF longitudinal and shear wave, very high temperature are synonymous with ULTRAN (U.S. & International Patents, Patents Pending).

When we took on the responsibility of developing ultrasound long ago, we had our customers in mind. We knew well that we were serving the needs of the materials industry: easy-to-understand non-destructive methods that help in materials processing, quality control, assurance, and reliability. Ultran is composed of materials and ultrasound scientists, mechanical and electronics engineers, and signal processing mathematicians. We are also supported by our sales and administrative staff.

When we conceived the motto **“redefining the limits of ultrasound,”** even we did not know how true it was. Ultrasound today bears little resemblance to the status-quo then.

In this catalog we are delighted to unleash the power of modern ultrasound through the introduction of Non-Contact Ultrasound (NCU) transducers. We are now able to do non-destructive analysis of materials in early stages of processing (composite prepregs, plastics, rubber, tires, green ceramics, powder metals), liquid-sensitive materials (food, pharmaceutical, bio-medical, porous and consolidated powders), wood, construction, or where contact with materials is simply a nuisance.

Our ultimate objective is the same as that of the materials industry: to stop the defects in the early stages and confirm their absence after production and assembly. This modality and philosophy is not in the realm of conventional ultrasound.

Practical and time-tested comprehensive NCU advancements from our laboratory have now made it easy to apply ultrasound all the way from early to final stages of a material's production line as well as off-line QC analysis and R&D functions.

What we do at Ultran is only one side of the story. It is what you accomplish with it that does wonders.

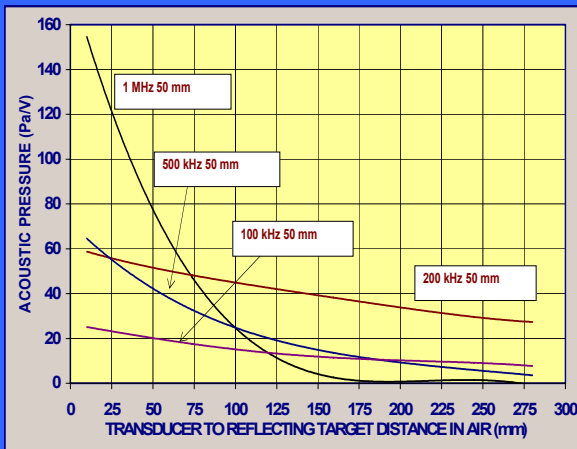
Since NCU is the new field advanced by Ultran, we can offer the materials industry twenty-eight years of valuable experience. We not only transfer technology but also the science that is directly focused on our customers' needs.

As always, our sales and applications staff will assist you with any questions you have. We look forward to establishing a beneficial relationship with you.

Mahesh C. Bhardwaj
Chief Technology Officer
The Ultran Group

A WORD ABOUT NCU TRANSDUCERS*

- Phenomenally high transduction efficiency in ambient air: typically, -65 to -30 dB for 50 kHz to 5.0 MHz
- Overall sensitivity is between 12 to 30 dB lower in comparison to contact transducers' contact mode sensitivity
- Frequency range: ~50 kHz to >5.0 MHz
- Dimensional range: 1 to 250 mm, extremely large dimensions, >1000 mm, also possible
- Single and multi-element arrays
- Very light weight



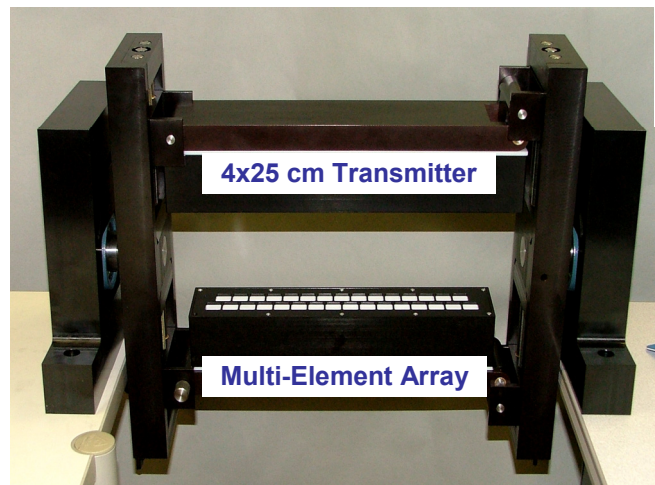
- Planar, point, and cylindrical beam configuration
- Extremely rugged construction
- Environment-proof models also available
- Suggested distance in ambient air for materials testing: <math><5\text{ to }>50\lambda</math> in air
- Suggested smallest size for materials testing: between 4 to 6 λ in air
- Superb high frequency acoustic antenna

*U.S. & International Patents, Patents Pending.

Since the advent of practical ultrasound in the 1930s, it has been stifled by transducer contact with materials, generally through a liquid.

In 1983 we commercialized the air/gas propagation transducers. These were fine devices, but not enough to cover all materials testing without any contact.

In 1997 our relentless pursuit of Non-Contact Ultrasound produced devices characterized by extremely high efficiency in air. This advancement has ushered in the era of Non-Contact Ultrasound.



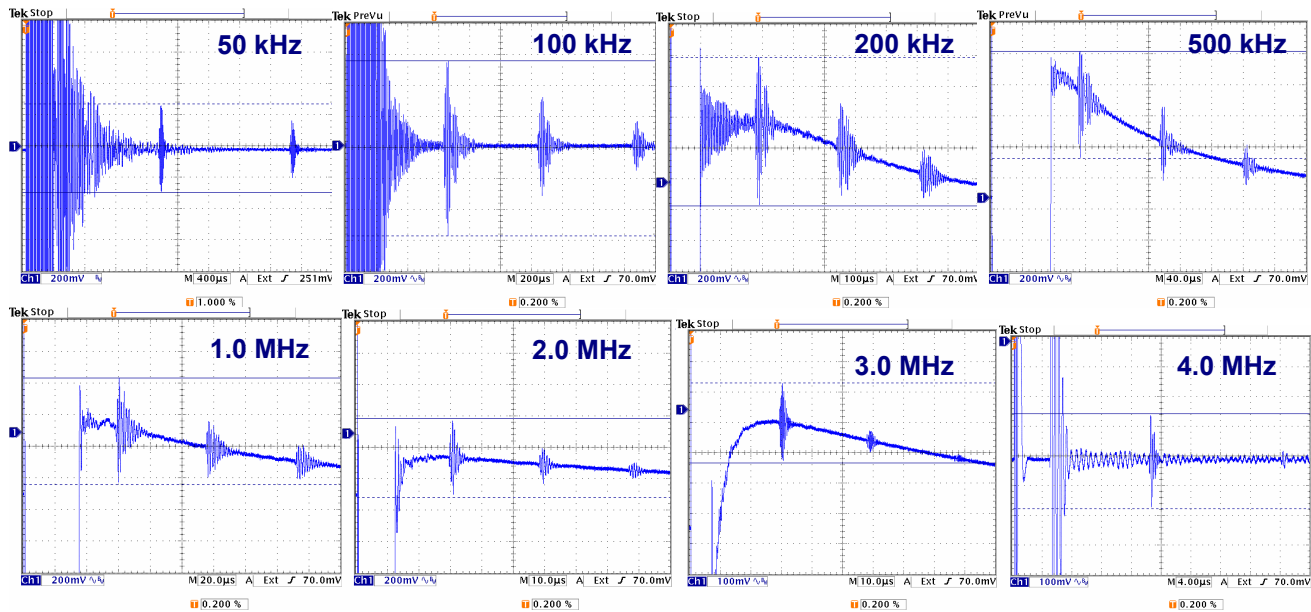
Single and multi-element array NCU devices have been successfully produced up to 250 mm. Much larger dimensions exceeding 1000 mm are also possible.

Since NCU is a new field, we take the responsibility of not only technology transfer but also science transfer targeted to customer applications.

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

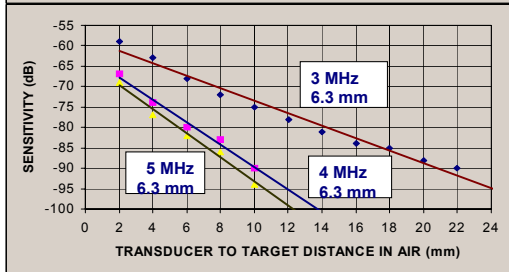
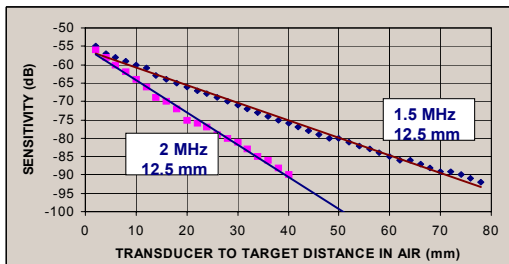
PULSE-ECHO CHARACTERISTICS OF NCU TRANSDUCERS IN AMBIENT AIR

See table below for more details



Observations provided here were obtained by exciting the transducer with a single pulse square wave corresponding to transducer frequency wave, with no amplification of the received signal from the surface of flat steel.

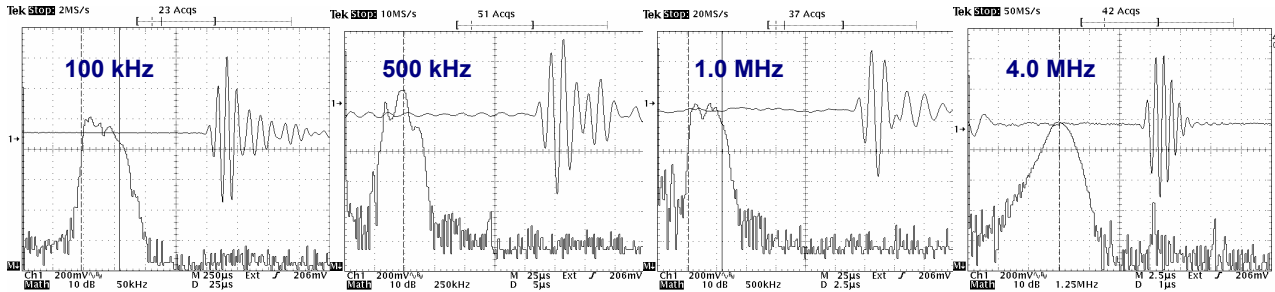
FREQUENCY	ACTIVE AREA (mm)	AIR COLUMN (mm)	D/ λ ACTIVE DIMENSION WAVELENGTH RATIO IN AIR	TWO WAY INSERTION LOSS (dB)
50 kHz	50x50	300	7	-62
100 kHz	38x38	200	11	-57
200 kHz	25x25	100	15	-58
500 kHz	19x19	20	27	-61
1.0 MHz	12.5 dia.	10	35	-61
2.0 MHz	12.5 dia.	5	70	-64
3.0 MHz	12.5 dia.	5	108	-69
4.0 MHz	12.5 dia.	3	139	-69



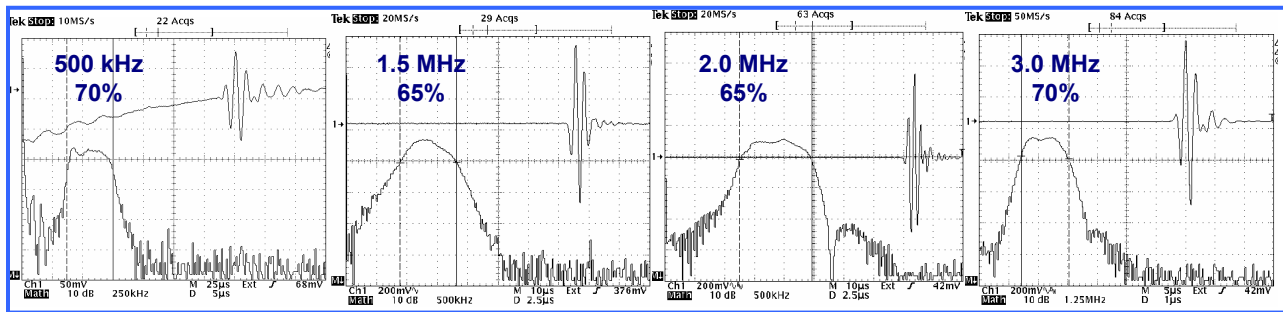
THROUGH TRANSMISSION CHARACTERISTICS OF NCU TRANSDUCERS IN AMBIENT AIR

See table below for more details

Standard NCU Transducers



Special Broadband



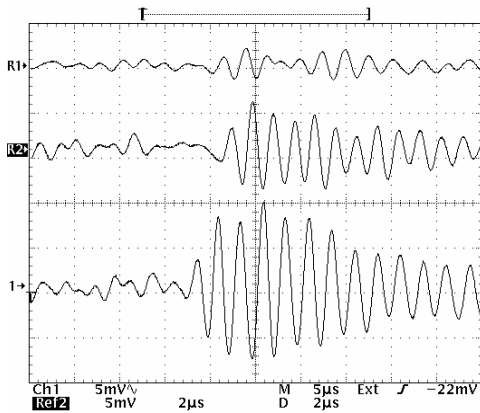
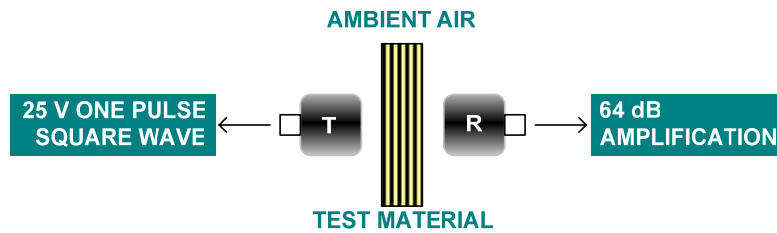
**NCU transducers are characterized by a combination of bandwidth and sensitivity.*

NCU transducers are also available with much higher bandwidths.

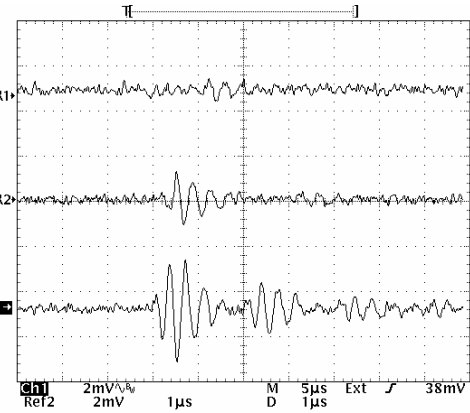
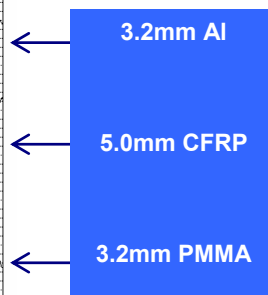
Please specify or contact Ultran.

FREQUENCY	ACTIVE AREA DIMENSIONS (mm)	AIR COLUMN (mm)	BANDWIDTH (% F)	ONE WAY INSERTION LOSS (dB)
50 kHz	50x50	200	30 – 40	-48
100 kHz	50x50	100	35 – 50	-36
200 kHz	25 dia	50	35 – 45	-48
500 kHz	12.5 dia	20	35 – 45	-52
1.0 MHz	12.5 dia	10	30 – 40	-54
1.5 MHz	12.5 dia	10	35 – 45	-52
2.0 MHz	12.5 dia	10	35 – 45	-54
3.0 MHz	12.5 dia	5	35 – 45	-58
4.0 MHz	6.3 dia	5	40 – 50	-62

PROOF OF PHENOMENALLY HIGH TRANSDUCTION EFFICIENCY OF NCU TRANSDUCERS



1.0 MHz NCU Transducers observations



3.0 MHz NCU Transducers observations

In the previous sections we have made very powerful claims about the novelty and extraordinary characteristics of NCU transducers. These claims have been substantiated by real acoustic observations from various transducers.

Notwithstanding this, we thought we should provide applications oriented proof under dramatic conditions of transducer excitation and amplifications.

Until now the gross Z mismatch between ambient air and the test material hindered any Non-Contact Ultrasound transmission. Ultran's latest MHz frequency NCU transducers conqueror this intimidating task with a mere 25 volt single pulse.

The significance of the experiment described here is to exhibit the power of NCU transducers even in the MHz frequency range.

In practice, suitable transducer excitation, amplification, mechanical, and software tools are necessary.

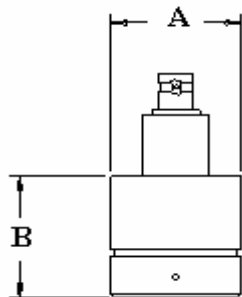
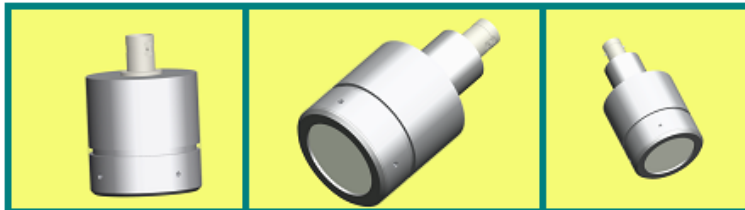
Given the novelty of NCU, we have also made NCU-suitable systems and services.

Ultran's multi-disciplinary science and technology team is ready to assist you in making your ultrasonic applications easier than before.

CIRCULAR NCU TRANSDUCER ORDERING INFORMATION

For defect detection, thickness & velocity measurements, surface analysis, imaging, proximity sensing, remote sensing, distance monitoring, etc.

Suitable for a wide range of materials, including gases



CATALOG#	A(mm)*	B(mm)*	CATALOG#	A(mm)*	B(mm)*
NGC50-D25	38	40	NCT1-D19	31	40
NGC50-D50	63	44	NCT1-D25	38	40
NGC50-D100	112	44			
			NCT1.5-D6	19	40
NGC100-D25	38	40	NCT1.5-D13	25	40
NGC100-D50	63	44	NCT1.5-D19	31	40
NGC100-D100	112	44	NCT1.5-D25	38	40
NGC200-D13	25	40	NCT2-D3	16	40
NGC200-D19	31	40	NCT2-D6	19	40
NGC200-D25	38	40	NCT2-D13	25	40
NGC200-D50	63	44			
NGC200-D100	112	44	NCT3-D3	16	40
			NCT3-D6	19	40
NGC500-D6	19	40	NCT3-D13	25	40
NGC500-D13	25	40			
NGC500-19	31	40	NCT4-D3	16	40
NGC500-D25	38	40	NCT4-D6	19	40
NGC500-D50	63	44	NCT4-D13	25	40
NGC500-D100	112	44			
			NCT5-D3	16	40
NCT1-D6	19	40	NCT5-D6	19	40
NCT1-D13	25	40	NCT5-D13	25	40

CATALOG #	FREQUENCY	ACTIVE DIAMETER (mm)
NGC50-D25 NGC50-D50 NGC50-D100	50 kHz	25 50 100
NGC100-D25 NGC100-D50 NGC100-D100	100 kHz	25 50 100
NGC200-D13 NGC200-D19 NGC200-D25 NGC200-D50 NGC200-D100	200 kHz	12.5 19.0 25 50 100
NGC500-D6 NGC500-D13 NGC500-D19 NGC500-D25 NGC500-D50 NGC500-D100	500 kHz	6.3 12.5 19 25 50 100
NCT1-D6 NCT1-D13 NCT1-D19 NCT1-D25	1.0 MHz	6.3 12.5 19 25
NCT1.5-D6 NCT1.5-D13 NCT1.5-D19 NCT1.5-D25	1.5 MHz	6.3 12.5 19 25
NCT2-D3 NCT2-D6 NCT2-D13	2.0 MHz	3.2 6.3 12.5
NCT3-D3 NCT3-D6 NCT3-D13	3.0 MHz	3.2 6.3 12.5
NCT4-D3 NCT4-D6 NCT4-D13	4.0 MHz	3.2 6.3 12.5
NCT5-D3 NCT5-D6 NCT5-D13	5.0 MHz	3.2 6.3 12.5

Multi-layer patented Z matching
 Top mounted BNC
 Aluminum housing
 Suitable between -20 to 65° C
 See instructions for transducer operation and care at the end of the catalog.

*Dimensions are approximate

Let us not forget that ultrasound attenuation is proportional to f^4 . Relatively speaking, it is phenomenal in the MHz frequency range. As a function of linear distance of MHz transducers from material surface, their higher frequency components are also adversely affected. Therefore, we stress that sensitivity and frequency are very precious in the NCU mode.

All NCG transducers have a mounting stem with 19mm diameter and 20.3mm height.

NCT transducers above 25mm active diameter have a mounting stem.

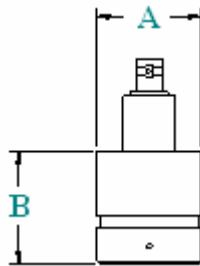
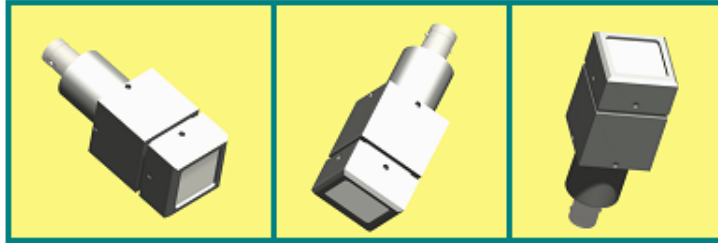
All transducers are furnished with acoustic characterization reports, including special instructions.

For price and special needs, consult Ultram

SQUARE NCU TRANSDUCER ORDERING INFORMATION

For defect detection, thickness & velocity measurements, surface analysis, imaging, proximity sensing, remote sensing, distance monitoring, etc.

Suitable for a wide range of materials, including gases



CATALOG#	A(mm)*	B(mm)*	CATALOG#	A(mm)*	B(mm)*
NCG50-S25	38	44	NCT1-S13	25	40
NCG50-S50	64	44	NCT1-S19	32	40
NCG50-S100	114	44	NCT1-S25	38	40
NCG100-S25	38	40	NCT1.5-S13	25	40
NCG100-S50	64	44	NCT1.5-S19	32	40
NCG100-S100	114	44	NCT1.5-S25	38	40
NCG200-S13	25	40	NCT2-S13	25	40
NCG200-S19	32	40	NCT3-S13	25	40
NCG200-S25	38	40	NCT4-S13	25	40
NCG200-S50	64	44	NCT5-S13	25	40
NCG200-S100	114	44			
NCG500-S13	25	40			
NCG500-S19	32	40			
NCG500-S25	38	40			
NCG500-S50	64	44			
NCG500-S100	114	44			

*Dimensions are approximate

Let us not forget that ultrasound attenuation is proportional to f^4 . Relatively speaking, it is phenomenal in the MHz frequency range. As a function of linear distance of MHz transducers from material surface, their higher frequency components are also adversely affected. Therefore, we stress that sensitivity and frequency are very precious in the NCU mode.

CATALOG #	FREQUENCY	ACTIVE SQUARE (mm)
NCG50-S25	50 kHz	25
NCG50-S50		50
NCG50-S100		100
NCG100-S25	100 kHz	25
NCG100-S50		50
NCG100-S100		100
NCG200-S13	200 kHz	12.5
NCG200-S19		19.0
NCG200-S25		25
NCG200-S50		50
NCG200-S100		100
NCG500-S13	500 kHz	12.5
NCG500-S19		19
NCG500-S25		25
NCG500-S50		50
NCG500-S100		100
NCT1-S13	1.0 MHz	12.5
NCT1-S19		19
NCT1-S25		25
NCT1.5-S13	1.5 MHz	12.5
NCT1.5-S19		19
NCT1.5-S25		25
NCT2-S13	2.0 MHz	12.5
NCT3-S13	3.0 MHz	12.5
NCT4-S13	4.0 MHz	12.5
NCT5-S13	5.0 MHz	12.5

Multi-layer patented Z matching
 Top mounted BNC
 Aluminum housing
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All NCG transducers have a mounting stem with 19mm diameter and 20.3mm height.

NCT transducers above 25mm active diameter have a mounting stem.

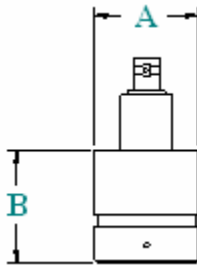
All transducers are furnished with acoustic characterization reports, including special instructions.

For price and special needs, consult Ultrason

POINT FOCUS NCU TRANSDUCERS ORDERING INFORMATION

For defect detection, surface analysis, imaging, etc.

Suitable for a wide range of materials, including gases



CATALOG #	FREQUENCY (kHz)	ACTIVE DIAMETER (mm)	FOCAL LENGTH (mm)
NCG50-D25-P76	50 kHz	25	76
NCG50-D50-P150		50	150
NCG50-D100-P500		100	500
NCG100-D25-P76	100 kHz	25	76
NCG100-D50-P150		50	150
NCG100-D100-P500		100	500
NCG200-D13-P38	200 kHz	12.5	38
NCG200-D19-P50		19	50
NCG200-D25-P76		25	76
NCG200-D50-P150		50	150
NCG200-D100-P500		100	500
NCG500-D13-P38	500 kHz	12.5	38
NCG500-D19-P50		19	50
NCG500-D25-P76		25	76
NCG500-D50-P150		50	150
NCG500-D100-P500		100	500
NCT1-D6-P19	1.0 MHz	6.3	19
NCT1-D13-P38		12.5	38
NCT1-D19-P50		19	50
NCT1-D25-P76		25	76
NCT1.5-D6-P19	1.5 MHz	6.3	19
NCT1.5-D13-P38		12.5	38
NCT1.5-D19-P50		19	50
NCT1.5-D25-P76		25	76
NCT2-D6-P19	2.0 MHz	6.3	19
NCT2-D13-P38		12.5	38
NCT3-D3-P10	3.0 MHz	3.2	10
NCT3-D6-P19		6.3	19
NCT3-D13-P38		12.5	38
NCT4-D3-P10	4.0 MHz	3.2	10
NCT4-D6-P19		6.3	19
NCT4-D13-P38		12.5	38
NCT5-D3-P10	5.0 MHz	3.2	10
NCT5-D6-P19		6.3	19
NCT5-D13-P38		12.5	38

CATALOG#	A(mm)*	B(mm)*
NCG50-D25-P76	38	44
NCG50-D50-P150	63	44
NCG50-D100-P500	112	44
NCG100-D25-P76	38	40
NCG100-D50-P150	63	44
NCG100-D100-P500	112	44
NCG200-D13-P38	25	40
NCG200-D19-P50	31	40
NCG200-D25-P76	38	40
NCG200-D50-P150	63	44
NCG200-D100-P500	112	44
NCG500-D13-P38	25	40
NCG500-D19-P50	31	40
NCG500-D25-P76	38	40
NCG500-D50-P150	63	44
NCG500-D100-P500	112	44
NCT1-D6-P19	19	40
NCT1-D13-P38	25	40
NCT1-D19-P50	31	40
NCT1-D25-P76	38	40
NCT1.5-D6-P19	19	40
NCT1.5-D13-P38	25	40
NCT1.5-D19-P50	31	40
NCT1.5-D25-P76	38	40
NCT2-D6-P19	19	40
NCT2-D13-P38	25	40
NCT3-D3-P10	16	40
NCT3-D6-P19	19	40
NCT3-D13-P38	25	40
NCT4-D3-P10	16	40
NCT4-D6-P19	19	40
NCT4-D13-P38	25	40
NCT5-D3-P10	16	40
NCT5-D6-P19	19	40
NCT5-D13-P38	25	40

Multi-layer patented Z matching
 Top mounted BNC
 Aluminum housing
 Suitable between -20 to 65° C
 See instructions for transducer operation and care at the end of the catalog.

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NCT transducers above 25mm active diameter have a mounting stem.

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

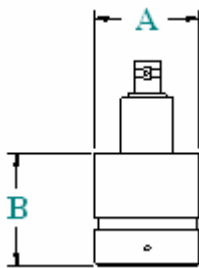
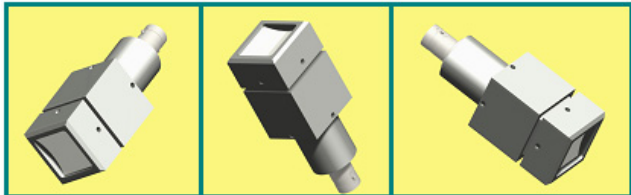
For price and special needs, consult Ultratran

*Dimensions are approximate

CYLINDRICAL FOCUS NCU TRANSDUCERS ORDERING INFORMATION

For defect detection, surface analysis, imaging, etc.

Suitable for a wide range of materials, including gases



CATALOG#	A(mm)*	B(mm)**
NCG50-S25-C76	38	56
NCG50-S50-C150	64	56
NCG50-S100-C500	114	56
NCG100-S25-C76	38	52
NCG100-S50-C150	64	56
NCG100-S100-C500	114	56
NCG200-S13-C38	25	52
NCG200-S19-C50	32	52
NCG200-S25-C76	38	52
NCG200-S50-C150	64	56
NCG200-S100-C500	114	56
NCG500-S13-C38	25	52
NCG500-S19-C50	32	52
NCG500-S25-C76	38	52
NCG500-S50-C150	64	56
NCG500-S100-C500	114	56
NCT1-S6-C19	19	52
NCT1-S13-C38	25	52
NCT1-S19-C50	32	52
NCT1.5-S6-C19	19	52
NCT1.5-S13-C38	25	52
NCT1.5-S19-C50	32	52
NCT1.5-S25-C76	38	52
NCT2-S6-C19	19	52
NCT2-S13-C38	25	52
NCT3-S3-C10	16	52
NCT3-S6-C19	19	52
NCT3-S13-C38	25	52
NCT4-S3-C10	16	52
NCT4-S6-C19	19	52
NCT4-S13-C38	25	52
NCT5-S3-C10	16	52
NCT5-S6-C19	19	52
NCT5-S13-C38	25	52

CATALOG #	FREQUENCY (kHz)	ACTIVE SQUARE (mm)	FOCAL LENGTH (mm)
NCG50-S25-C76	50 kHz	25	76
NCG50-S50-C150		50	150
NCG50-S100-C500		100	500
NCG100-S25-C76	100 kHz	25	76
NCG100-S50-C150		50	150
NCG100-S100-C500		100	500
NCG200-S13-C38	200 kHz	12.5	38
NCG200-S19-C50		19	50
NCG200-S25-C76		25	76
NCG200-S50-C150		50	150
NCG200-S100-C500		100	500
NCG500-S13-C38	500 kHz	12.5	38
NCG500-S19-C50		19	50
NCG500-S25-C76		25	76
NCG500-S50-C150		50	150
NCG500-S100-C500		100	500
NCT1-S6-C19	1.0 MHz	6.3	19
NCT1-S13-C38		12.5	38
NCT1-S19-C50		19	50
NCT1-S25-C76		25	76
NCT1.5-S6-C19	1.5 MHz	6.3	19
NCT1.5-S13-C38		12.5	38
NCT1.5-S19-C50		19	50
NCT1.5-S25-C76		25	76
NCT2-S6-C19	2.0 MHz	6.3	19
NCT2-S13-C38		12.5	38
NCT3-S3-C10	3.0 MHz	3.2	10
NCT3-S6-C19		6.3	19
NCT3-S13-C38		12.5	38
NCT4-S3-C10	4.0 MHz	3.2	10
NCT4-S6-C19		6.3	19
NCT4-S13-C38		12.5	38
NCT5-S3-C10	5.0 MHz	3.2	10
NCT5-S6-C19		6.3	19
NCT5-S13-C38		12.5	38

Multi-layer patented Z matching
 Top mounted BNC
 Aluminum housing
 Suitable between -20 to 65° C
 See instructions for transducer operation and care at the end of the catalog.

All NCG transducers have a mounting stem with 19mm diameter and 20.3mm height.

NCT transducers above 25mm active diameter have a mounting stem.

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

For price and special needs, consult Ultrason

*Dimensions are approximate **Dimension varies with focal length

NCU TRANSDUCER OPERATION, CARE, AND ORDERING

1. As the name denotes, NCU transducers are truly non-contact. They are not meant for contact with anything or for water immersion.
2. Avoiding touching the face of NCU transducers.
3. Temperature resistance: -20 to 65° C.
4. Humidity: Not recommended >90% RH.
5. Environment-proof NCU transducers are also available. Please specify or consult Ultrason. Environment-proofing may reduce the transducer efficiency between 3 to 6 dB.
6. NCU transducers and other ultrasonic devices are based upon piezoelectric materials.
7. NCU transducer construction is mechanically sound and robust.
8. It is not necessary to excite NCU transducers with too high power since their efficiency is extremely high. They can also become hot and susceptible to damage like any other piezoelectric device. Please contact Ultrason for assistance.
9. High temperature, high pressure and velocity compensated models are also available.
10. NCU transducers should be stored in a cool and dry environment.

If you have any questions or require assistance, please contact Ultrason.

NCG TRANSDUCER ORDERING INFORMATION

NCG --

Frequency	Active Dimension		Focus Type	Focal Length (mm)
50kHz	Circular	Square	C Cylindrical	38
100kHz	D6	S13	P Point	50
200kHz	D13	S19		76
500kHz	D19	S25		150
	D25	S50		500
	D50	S100		
	D100			

NCT TRANSDUCER ORDERING INFORMATION

NCT --

Frequency	Active Dimension		Focus Type	Focal Length (mm)
1 MHz	Circular	Square	C Cylindrical	10
1.5 MHz	D3	S13	P Point	19
2 MHz	D6	S19		38
3 MHz	D13	S25		50
4 MHz	D19			76
5 MHz	D25			

*Not all combinations are possible

**If allotted space is not needed, please leave empty

***Example: NCT1.5-D6-P19 for 1.5MHz, 6mm active diameter, and 19mm point focal length.

NCU TRANSDUCER EXCITATION

Mechanistic Modality in Modern Ultrasound

We must stress that Non-Contact Ultrasound (NCU) is a new subject. Ultran has been pursuing NCU since 1983 when air/gas propagation transducers from <100 kHz to >2 MHz were commercially introduced. In 1997 these devices evolved to a new level (US and International Patents, Patents Pending). In 2002 this was further reinforced by Ultran's equally powerful development of Gas Matrix Piezoelectric (GMP™) composite (US and International Patents Pending). Since then the NCU transducers have occupied center stage in ultrasound from <50 kHz to >10 MHz. As expected, we have also acquired substantial experience relative to their excitation in an intended application.

1. All of Ultran's NCU transducers are characterized by the highest possible transduction efficiency in air/gases. This automatically reduces the load on an excitation mechanism, preserving the transducer's excellence.
2. Our catalogued NCU transducers are also intrinsically broadband (generally between 30 to >50% of frequency). They do not need excessive burst and too powerful excitation. NCU transducers also do not require too much amplification to observe signals from even the most complex materials.
3. Our transducers are based upon piezoelectricity: the most common, versatile, and reliable source or receiver of ultrasound. The special thing about them is their phenomenal efficiency. If you are used to ultrasound, you already know how to use them.
4. Instrument designs in ultrasound have been based upon transducer limitations. This made transducer excitation and amplification systems complex and expensive. Ultran has the most optimum solution that takes full advantage of our transducers, systems and applications. One can calculate the advantages.
5. At Ultran we see applications that are relatively easy (for us), and we also receive challenges to which we provide suitable answers. We encourage our customers to visit our facilities to see and learn first hand. **We are here to help you in the most effective manner possible.**
6. For more specific information, please contact The Ultran Group's technical staff.



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