



## Dry-Coupled Piezoelectric Transducers & Accessories

Rev. DCUT-SA-C18

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### 1. Introduction to Piezoelectric Transducers from Innerspec

The conversion of electrical pulses to mechanical vibrations and the conversion of returned mechanical vibrations back into electrical energy is the basis for ultrasonic testing (UT). Although there are non-contact options available for some applications (e.g. EMAT), the most widely used technique involves using a piezoelectric element to generate the ultrasound. Due to the impedance mismatch between the piezoelectric transducer and the material inspected, a liquid couplant is typically used to transmit the vibrations from the transducer into the part and receive the vibrations back into the transducer. While this technique is very efficient and popular, liquid couplants used for ultrasonic inspection can be harmful to the part and environment, make some inspections cumbersome or impossible, and can be expensive to use and dispose.



To complement our line of non-contact EMAT transducers for metallic components, Innerspec Technologies has introduced a new family of piezoelectric transducers that are designed to withstand very high voltages and can be efficiently coupled through rubber with no need for liquid couplant. These Dry-Coupled UT (DCUT) transducers can be used to inspect metallic and non-metallic materials with the following advantages over more conventional options:

- **Dry-Coupling:** The inspection is cleaner, easier, and does not contaminate the material inspected.
- **Low-profile and Flexible:** DCUT transducers can be made only a few millimeters tall, and can easily bend and adapt to curved and irregular geometries.
- **Less Costly Inspections:** DCUT transducers eliminate all the costs associated with couplant;; including its purchase, management, and disposal.

This proprietary sensor technology takes advantage of Innerspec's high-power UT instruments that provide the necessary energy to couple the sensors using only a thin rubber layer and very light pressure. Innerspec's PowerUT® integrated systems and PowerBox® portable instruments can deliver up to 3,000Vpp and 25kW of power for EMAT, DCUT for the most demanding ultrasonic applications.

Existing DCUT sensors include flexible and rigid contact sensors and wheel probes designed to generate L waves in normal beam mode for flaw detection, thickness measurement and weld inspection.



### Wave Modes & Applications

Piezoelectric transducers are, by nature, limited in functionality by Snells Law of Refraction. This limitation allows for these transducers to operate only in Normal Beam and Shear Wave modes.

These wave modes can support a variety of functions to include flaw detection, thickness measurement, and weld inspection.

The wave modes generated by **Innerspec's DCUT transducers** covered within this Catalog include:

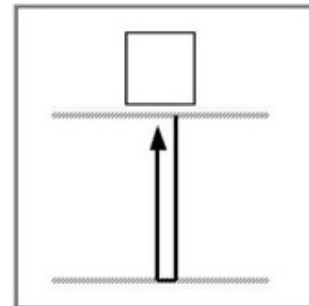
#### 1.1. Normal Beam

##### Characteristics

- Direction of Propagation: Perpendicular to the entry wall.
- Sensor Configuration: Pulse-echo (transmitter = receiver)
- Wave modes: Longitudinal mode in frequencies ranging from 3 to 10MHz.
- Materials Inspected: Ferromagnetic and non-ferromagnetic metals.

##### Applications

- Thickness measurement.
- Flaw Detection



### 2. Piezoelectric and DCUT Transducers & Accessories

The Piezoelectric transducers and accessories included in this catalog have been designed for use with the Innerspec **PowerBox** instruments and other compatible equipment. Contact Innerspec Technologies for additional information on transducers and applications not covered in this Catalog.

The transducers are divided into three groups:

- Contact DCUT Transducers
- Flexible DCUT Transducers
- Wheel DCUT Transducers








For best results, it is recommended to use transducers, cables and signal conditioning boxes as a set from Innerspec Technologies. Contact Innerspec if you need a custom sensor not available in this Catalog.

*To maximize sensor life, it is recommended to avoid pulsing the sensors in the air for long periods of time.*



## 2.1. DCUT Accessories

Part Number	Required Hardware	Connector	Description	Picture
279A0017	PowerBox H	Device Connection: 2 Pin Lemo 0B  Sensor Connection: Lemo 00 BNC Coaxial	Signal Attenuator Module for 3 <sup>rd</sup> party piezoelectric compatibility with the PowerBox H.  Attenuation Settings: 0 DB, -20 DB  Compatible Connections: * Lemo 00, BNC Coaxial	
279A0010	PowerBox H	1x 2-Pin Lemo Transmit  1x 2-Pin Lemo Transmit/Receive  1x 19-Pin Lemo  Type K Mini Thermocouple	Signal conditioning attachment PowerBox H.  Required for DCUT Sensors being used with the PowerBox H	
281A0040-250	281A0035-200 281A0035-300 281A0035-400	Threaded M18 x 1.0	25mm Delay Line for Contact DCUT Transducers	
281A0040-150	281A0035-200 281A0035-300 281A0035-400	Threaded M18 x 1.0	15mm Delay Line for Contact DCUT Transducers	
800A0283	281A0244-200 281A0244-300 281A0244-400	Lemo 00 BNC Coaxial	DCUT Hand Scanner for Wheeled DCUT Sensors	

*\* Due to the conventional low-power nature of most piezoelectric transducers please ensure that the probe is rated to operate at voltages of up to 600vpp. Operating transducers above the designed voltage rating may cause damage to the probe.*

## 2.2. DCUT Cables

Part Number	Length	Instrument Connection	Application
232A0784-004 <sup>1</sup>	4' (122cm)	2 Pin Lemo 0B to Coax Lemo 00	Cable for connecting all DCUT probes to the PowerBox H for signal conditioning in Pulse-Echo Sensor Configuration.  In Pitch-Catch, this is the Transmit Connection.
232A0678-004 <sup>1,2</sup>	4' (122cm)	2 Pin Lemo 0B to Coax Lemo 00	Cable for connecting 2 Pin Lemo 0B to Coax Lemo 00  For Pitch-Catch Sensor Configuration, this is the Receive Connection
232A0679 – 004 <sup>1</sup>	4' (122cm)	Coax Lemo 00 to Coax Lemo 00	Cable for connecting single-pin Lemo to single-pin Lemo  When used in Pitch-Catch Sensor Configuration Transmit Cable.
232A0296 – 004 <sup>1</sup>	4' (122cm)	BNC Coax to BNC Coax	Cable for connecting standard Piezoelectric probes to PowerBox H Signal Attenuator.
232A0804-004	4' (122cm)	Instrument to (2) 2 Pin Lemo 0B & (1) 19 Pin Lemo 2B	Cable for connecting sensor directly to PowerBox H.
232A0805-004	4' (122cm)	Instrument to (2) 2 Pin Lemo 0B & (1) 25 way D	Cable for connecting sensor directly to PowerBox 1 or PowerBox 2.
232A0815-004 232A0815-008 232A0815-0016	Extension Pole: 4' (122cm) 8' (244cm) 16' (488cm)	Instrument to (2) 2 Pin Lemo 0B & (1) 19 Pin Lemo 2B	Cable and extension pole assembly to connect directly to PowerBox H.
232A0817-006 <sup>1</sup>	6' (183cm)	Dual Cable Connectors – Coax Lemo 00 to 2 Pin Lemo 0B / 4 Pin Lemo 1B to 19 Pin Lemo 2B	Cable for connecting hand scanner and Wheel DCUT to PowerBox H


1. Cable should only be used in the pitch-catch configuration as the receive connection.



### 2.3. Contact DCUT Transducers

Part Number	Operational Frequency	Transducer Size	Maximum Temperature	Connector	Physical Dim.	Applications and Minimum Material Thickness
281A0035-200	2.0 MHz	15 mm or 0.59"	50°C or 122°F	Lemo 00 Coax	20 mm – D 27 mm - H	Thickness Measurement  PowerBox H 1mm Various Materials
281A0035-300	3.0 MHz	15 mm or 0.59"	50°C or 122°F	Lemo 00 Coax	20 mm – D 27 mm - H	Thickness Measurement.  PowerBox H 1mm Various Materials
281A0035-400	4.0 MHz	15 mm or 0.59"	50°C or 122°F	Lemo 00 Coax	20 mm – D 27 mm - H	Thickness Measurement.  PowerBox H 1mm Various Materials

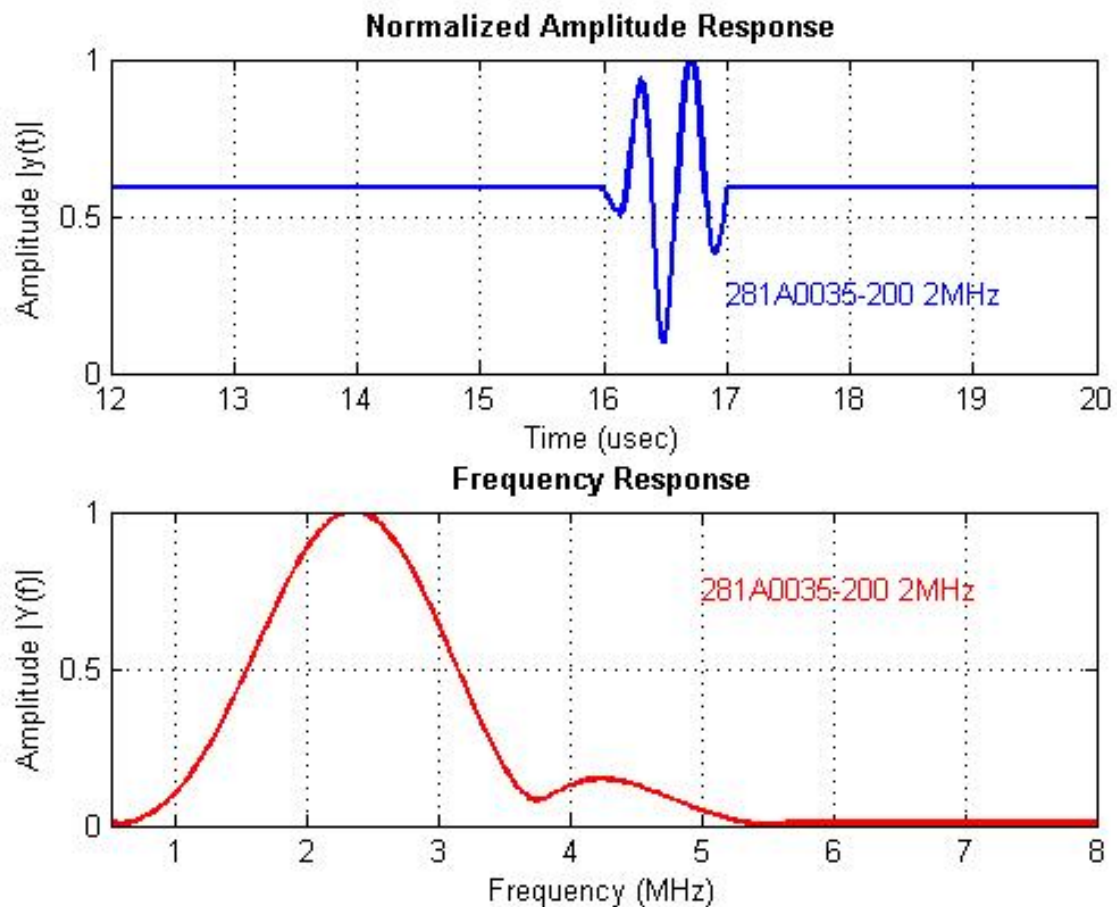
### 2.3.1. Contact DCUT Transducer, 2.0 MHz

Part Number	281A0035-200	
Part Description	Contact DCUT Transducer – 2 MHz	
System Connection Type	Single Pin Lemo 00 Coax	
Wave Mode	Normal Beam	
Dimensions	15mm Diameter	
Recommended Power	1200 Vpp	
Supported Transducer Configurations	Pulse-Echo	
Compatible Cable	232A0678	


#### Tuning Module Data Sheet

Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-001	2000	2000	1000-6000

#### Frequency Spectra & 3dB Beam Profiles



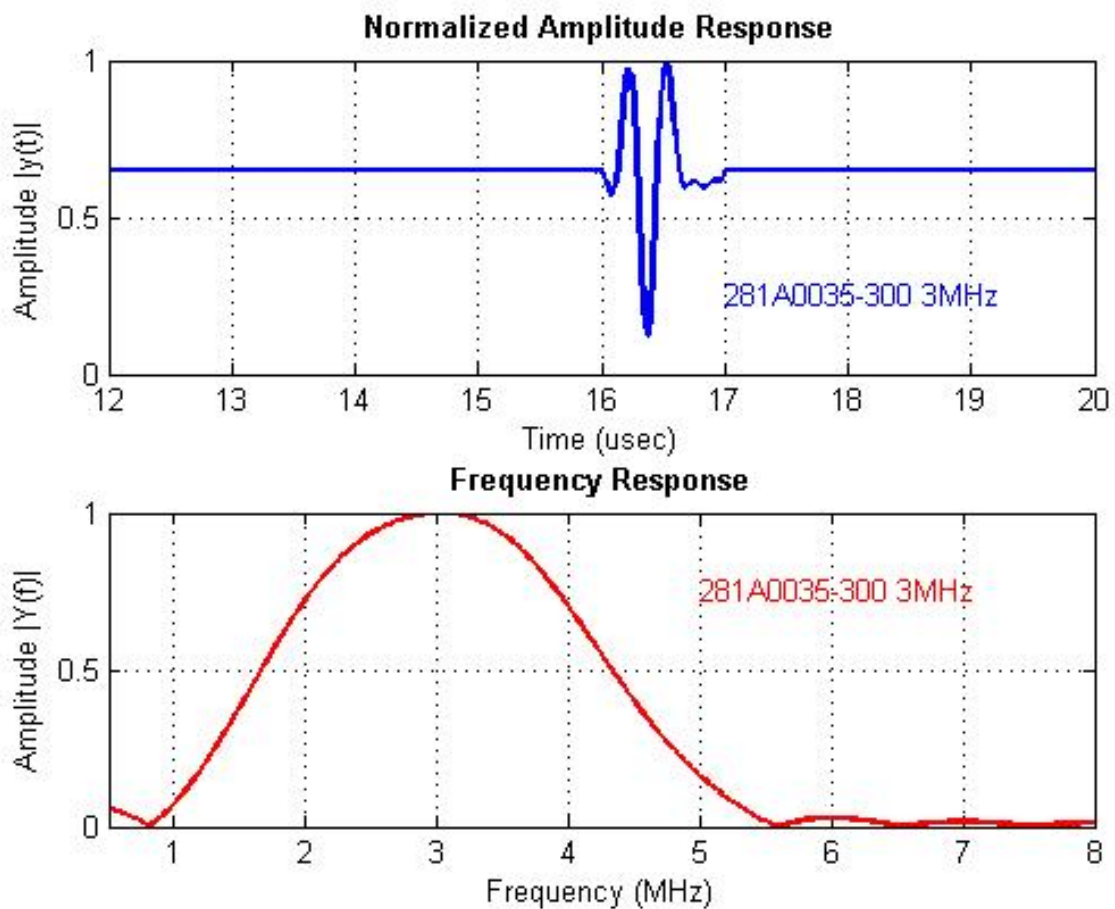
### 2.3.2. Contact DCUT Transducer, 3.0 MHz

Part Number	281A0035-300	
Part Description	Contact DCUT Transducer – 3 MHz	
System Connection Type	Single Pin Lemo 00 Coax	
Wave Mode	Normal Beam	
Dimensions	15mm Diameter	
Recommended Power	1200 Vpp	
Supported Transducer Configurations	Pulse-Echo	
Compatible Cable	232A0678	


#### Tuning Module Data Sheet

Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-001	3000	3000	1000-5000

#### Frequency Spectra & 3dB Beam Profiles



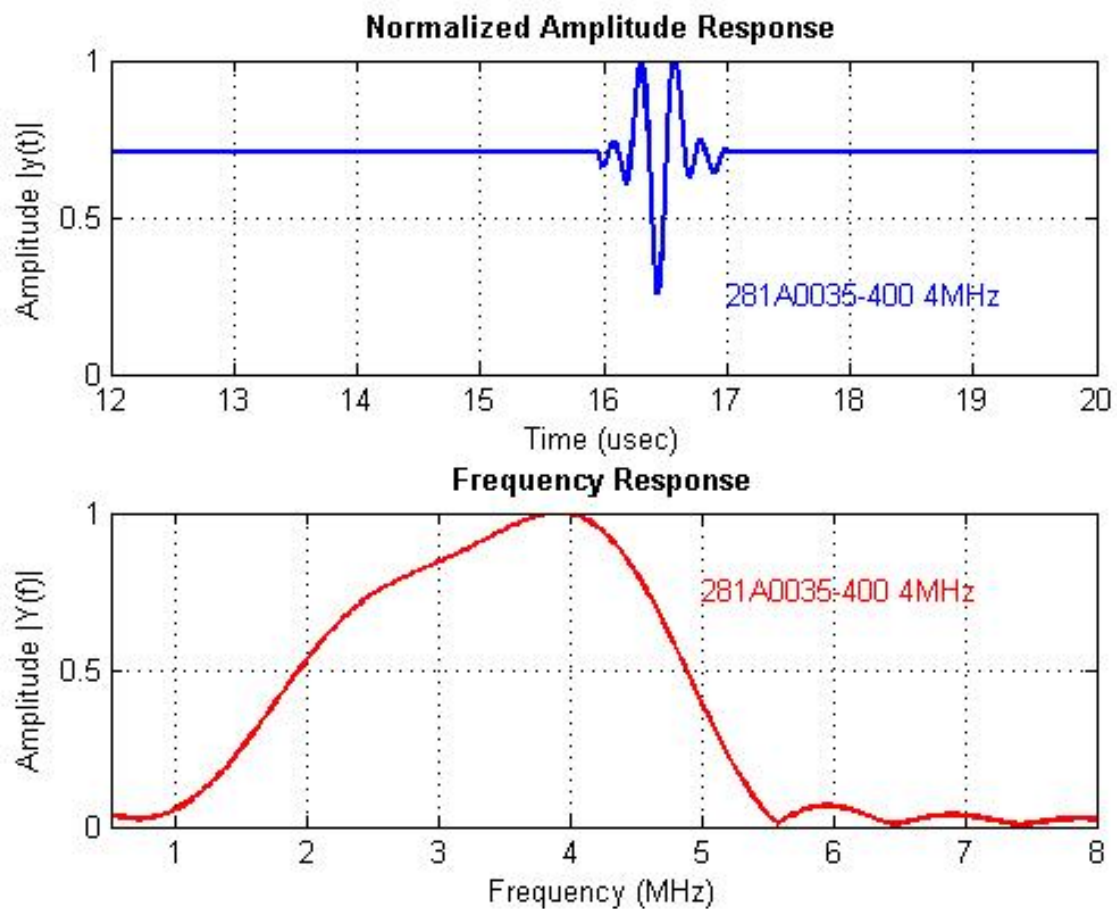
### 2.3.3. Contact DCUT Transducer, 4.0 MHz

Part Number	281A0035-400	
Part Description	Contact DCUT Transducer – 4 MHz	
System Connection Type	Single Pin Lemo 00 Coax	
Wave Mode	Normal Beam	
Dimensions	15mm Diameter	
Recommended Power	1200 Vpp	
Supported Transducer Configurations	Pulse-Echo	
Compatible Cable	232A0678	

#### Tuning Module Data Sheet

Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-001	4000	4000	1000-6000


#### Frequency Spectra & 3dB Beam Profiles



## 2.4. Flexible DCUT Transducers

Part Number	Operational Frequency	Transducer Size	Maximum Temperature	Connector	Physical Dim.	Applications and Minimum Material Thickness
281A0028	3.5 MHz	6mm or 0.24"	50°C or 122°F	Lemo 00 Coax	68mm – L 18mm – W 3mm – H	Dry or Wet Thickness Measurement & Spot Flaw Detection  PowerBox H – 1mm Other - Varied
281A0029	3.5 MHz	10mm or 0.39"	50°C or 122°F	Lemo 00 Coax	68mm – L 18mm – W 3mm – H	Dry or Wet Thickness Measurement & Spot Flaw Detection  PowerBox H – 1mm Other - Varied
281A0030	3.5 MHz	20mm or 0.79"	50°C or 122°F	Lemo 00 Coax	81mm – L 30mm – W 3mm – H	Dry or Wet Thickness Measurement & Spot Flaw Detection  PowerBox H – 1mm Other - Varied

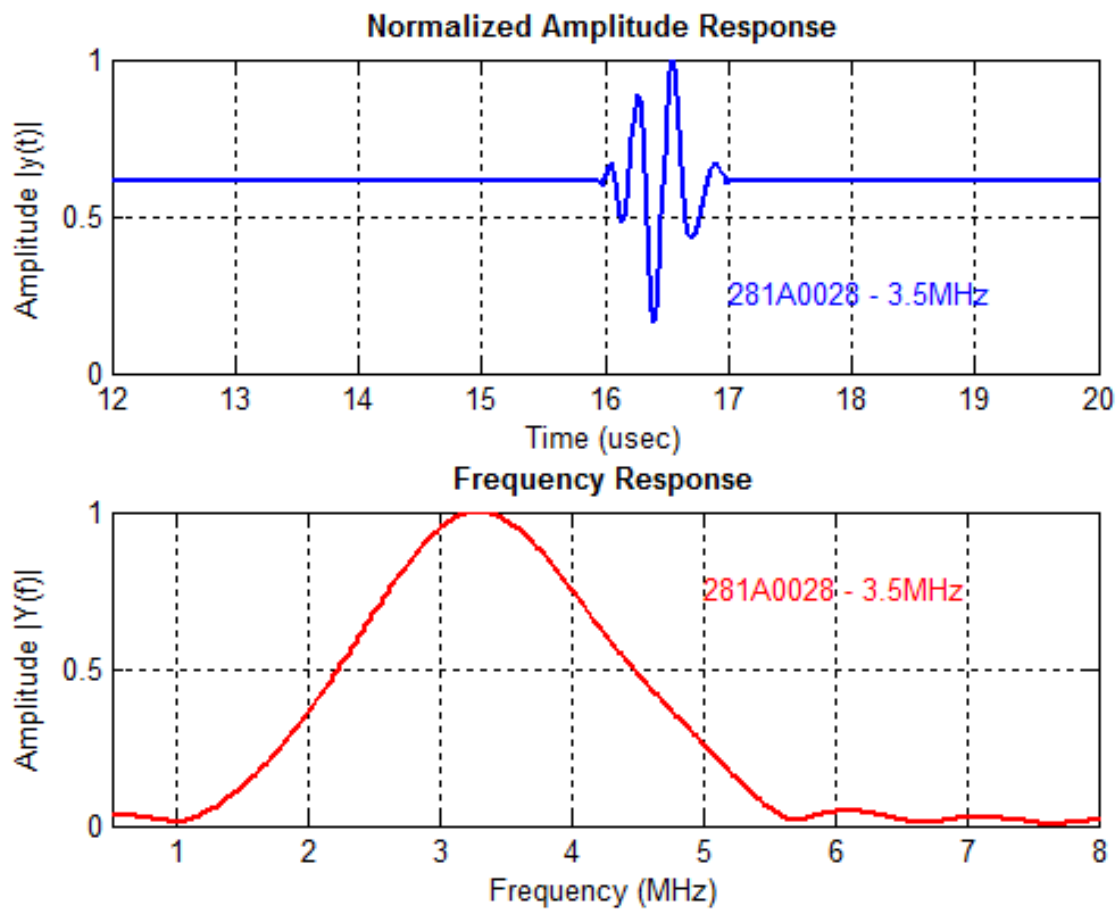
### 2.4.1. Flexible DCUT Transducer – Normal Beam, Medium, 3.5 MHz

Part Number	281A0028	
Part Description	Flexible DCUT Transducer - Small	
System Connection Type	Single Pin Lemo 00 Coax	
Transducer Size	6mm	
Wave Mode	Normal Beam	
Physical Dimensions	68mm – L, 18mm – W, 3mm – H	
Recommended Power	1200 Vpp	
Supported Transducer Configurations	Pulse-Echo	
Compatible Cable	232A0784	

#### Tuning Module Data Sheet


Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-001	3500	3500	1000-6000

#### Frequency Spectra & 3dB Beam Profiles





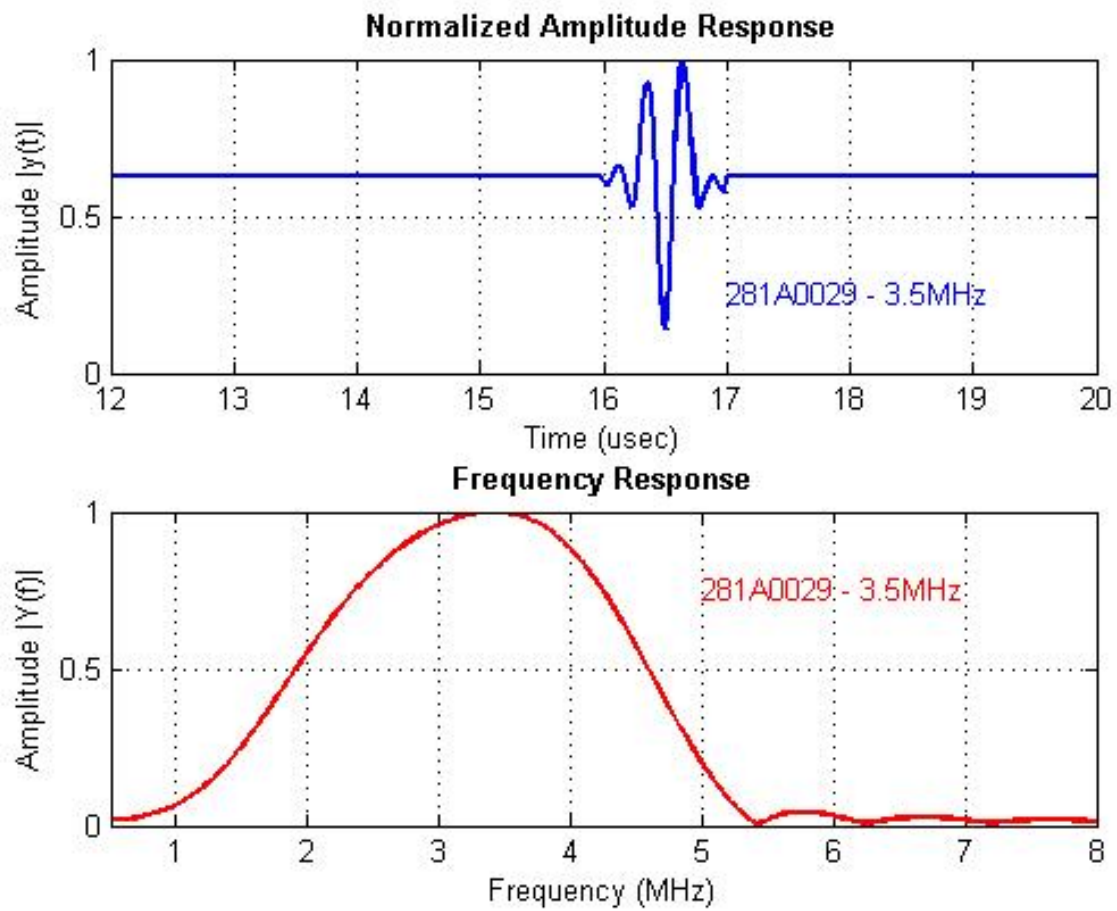
### 2.4.2. Flexible DCUT Transducer – Normal Beam, Medium, 3.5 MHz

Part Number	281A0029	
Part Description	Flexible DCUT Transducer - Medium	
System Connection Type	Single Pin Lemo 00 Coax	
Transducer Size	10mm	
Wave Mode	Normal Beam	
Physical Dimensions	68mm – L, 18mm – W, 3mm – H	
Recommended Power	1200 Vpp	
Supported Transducer Configurations	Pulse-Echo	
Compatible Cable	232A0784	


#### Tuning Module Data Sheet

Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-002	3500	3500	1000-6000

#### Frequency Spectra & 3dB Beam Profiles



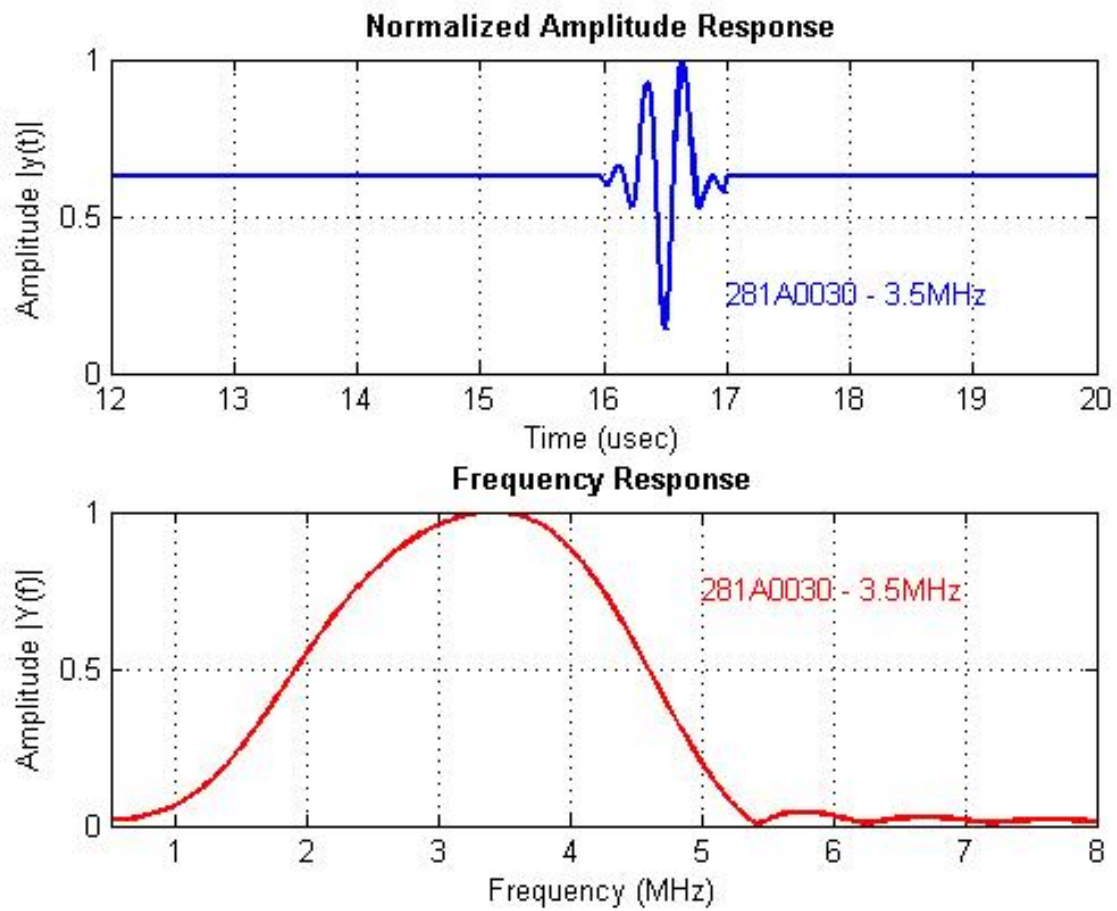
### 2.4.3. Flexible DCUT Transducer – Normal Beam, Medium, 3.5 MHz

Part Number	281A0030	
Part Description	Flexible DCUT Transducer - Large	
System Connection Type	Single Pin Lemo 00 Coax	
Transducer Size	20mm	
Wave Mode	Normal Beam	
Physical Dimensions	81mm – L, 30mm – W, 3mm – H	
Recommended Power	1200 Vpp	
Supported Transducer Configurations	Pulse-Echo	
Compatible Cable	232A0784	

#### Tuning Module Data Sheet

Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-002	3500	3500	1000-6000

#### Frequency Spectra & 3dB Beam Profiles




## 2.5. Wheel DCUT Transducers

Part Number	Operational Frequency	Transducer Size	Maximum Temperature	Connector	Physical Dim.	Applications and Minimum Material Thickness
281A0244-200*	2.0 MHz	9.5 mm or 0.375"	50°C or 122°F	Lemo 00 Coax	75 mm – D 40 mm -- H	Thickness Measurement & Flaw Detection PowerBox H – 1mm Other - Varied
281A0244-300*	3.0 MHz	9.5 mm or 0.375"	50°C or 122°F	Lemo 00 Coax	75 mm – D 40 mm -- H	Thickness Measurement & Flaw Detection PowerBox H – 1mm Other - Varied
281A0244-400*	4.0 MHz	9.5 mm or 0.375"	50°C or 122°F	Lemo 00 Coax	75 mm – D 40 mm -- H	Thickness Measurement & Flaw Detection PowerBox H – 1mm Other - Varied

\* All wheeled transducers are available in three variations; no encoder drive, left mounted encoder drive, or right mounted encoder drive.

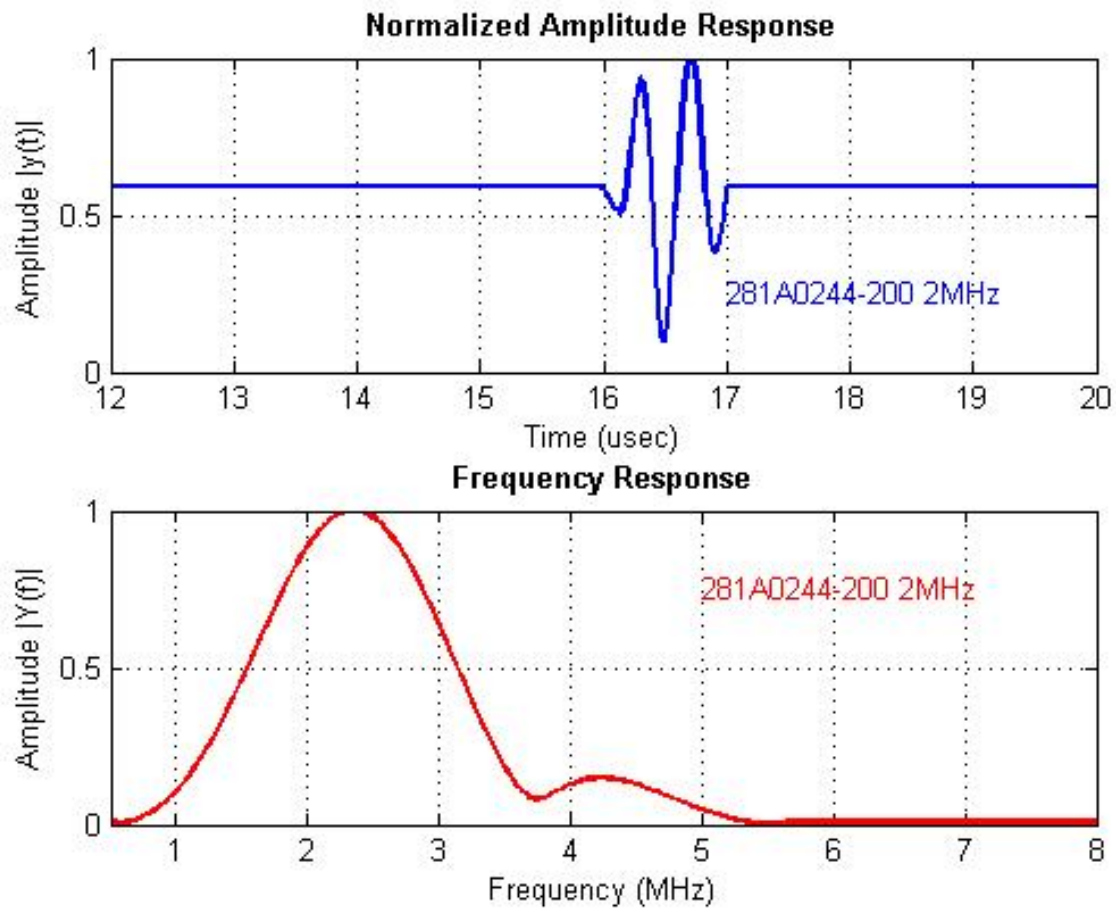
### 2.5.1. Wheel DCUT Transducer – 2.0 MHz

Part Number	281A0244-200	
Part Description	DCUT Wheel Transducer	
System Connection Type	Lemo 00 Coax	
Transducer Size	9.5mm	
Wave Mode	Normal Beam	
Physical Dimensions	73mm Diameter	
Recommended Power	1200 Vpp	
Compatible Cable	232A0817	


#### Tuning Module Data Sheet

Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-001	2000	2000	1000-3000

#### Frequency Spectra & 3dB Beam Profiles



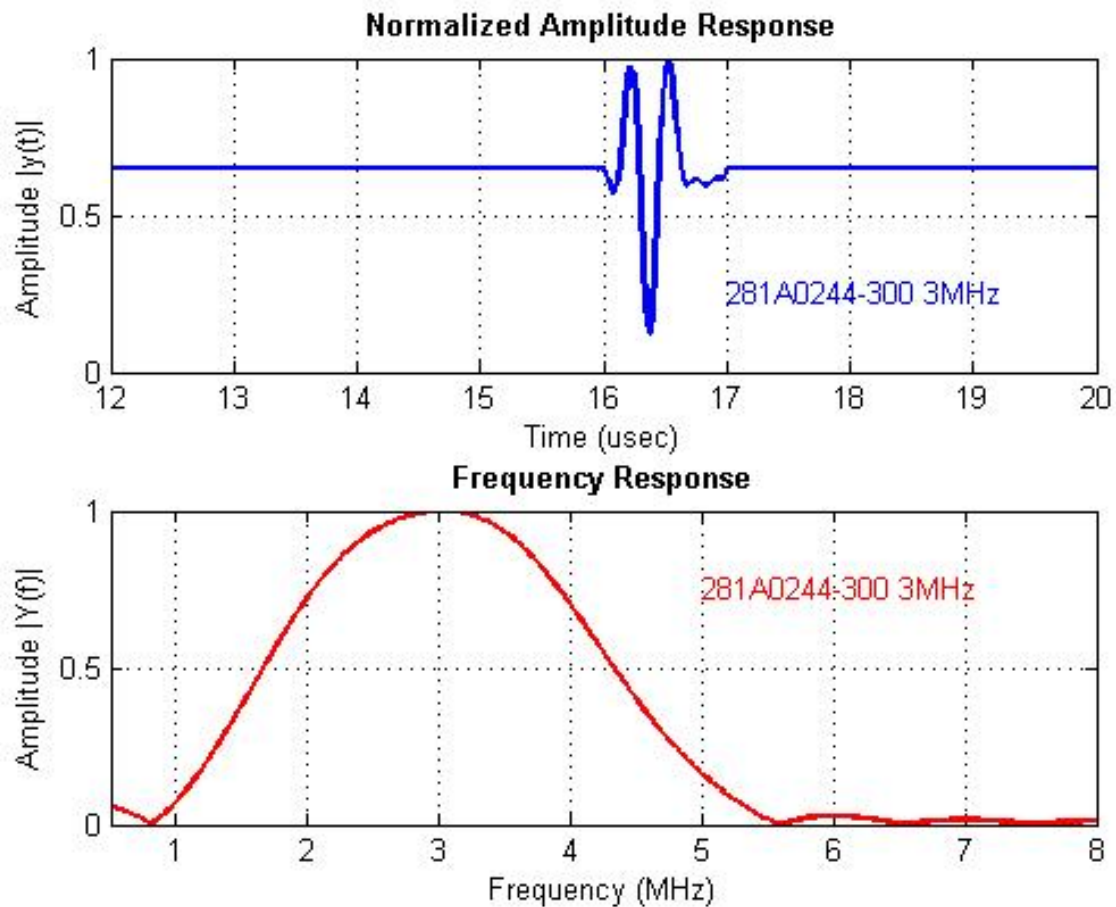
### 2.5.2. Wheel DCUT Transducer – 3.0 MHz

Part Number	281A0244-300	
Part Description	DCUT Wheel Transducer	
System Connection Type	Lemo 00 Coax	
Transducer Size	9.5mm	
Wave Mode	Normal Beam	
Physical Dimensions	73mm Diameter	
Recommended Power	1200 Vpp	
Compatible Cable	232A0817	


#### Tuning Module Data Sheet

Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-001	3000	3000	1000-5000

#### Frequency Spectra & 3dB Beam Profiles



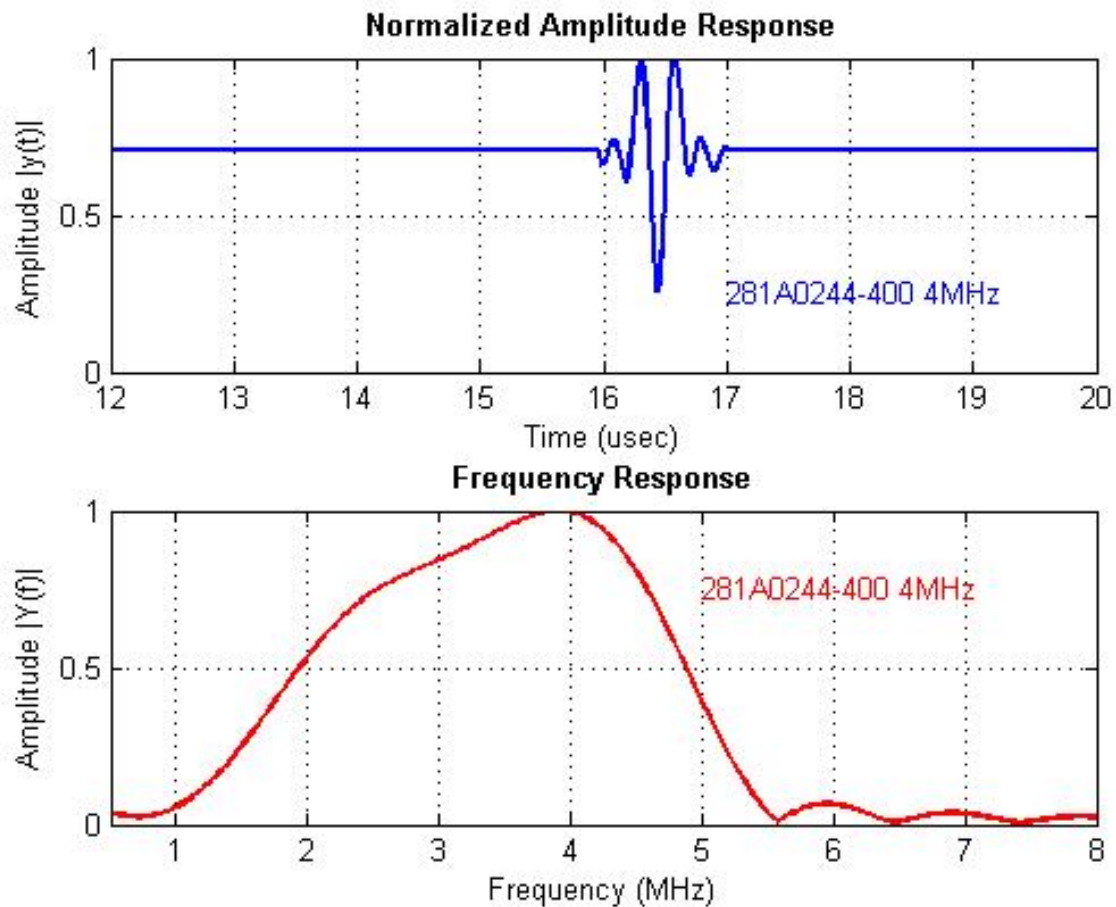
### 2.5.3. Wheel DCUT Transducer – 4.0 MHz

Part Number	281A0244-400	
Part Description	DCUT Wheel Transducer	
System Connection Type	Lemo 00 Coax	
Transducer Size	9.5mm	
Wave Mode	Normal Beam	
Physical Dimensions	73mm Diameter	
Recommended Power	1200 Vpp	
Compatible Cable	232A0817	

#### Tuning Module Data Sheet

Tuning Setting Module Name	Nominal Tuning Frequency (kHz)	Recommended Frequency Range	
		Transmitter (kHz)	Receiver (kHz)
TM-DCP-PE-001	4000	4000	1000-6000

#### Frequency Spectra & 3dB Beam Profiles






## 2.6. Remote Contact DCUT with Integrated Signal Conditioning

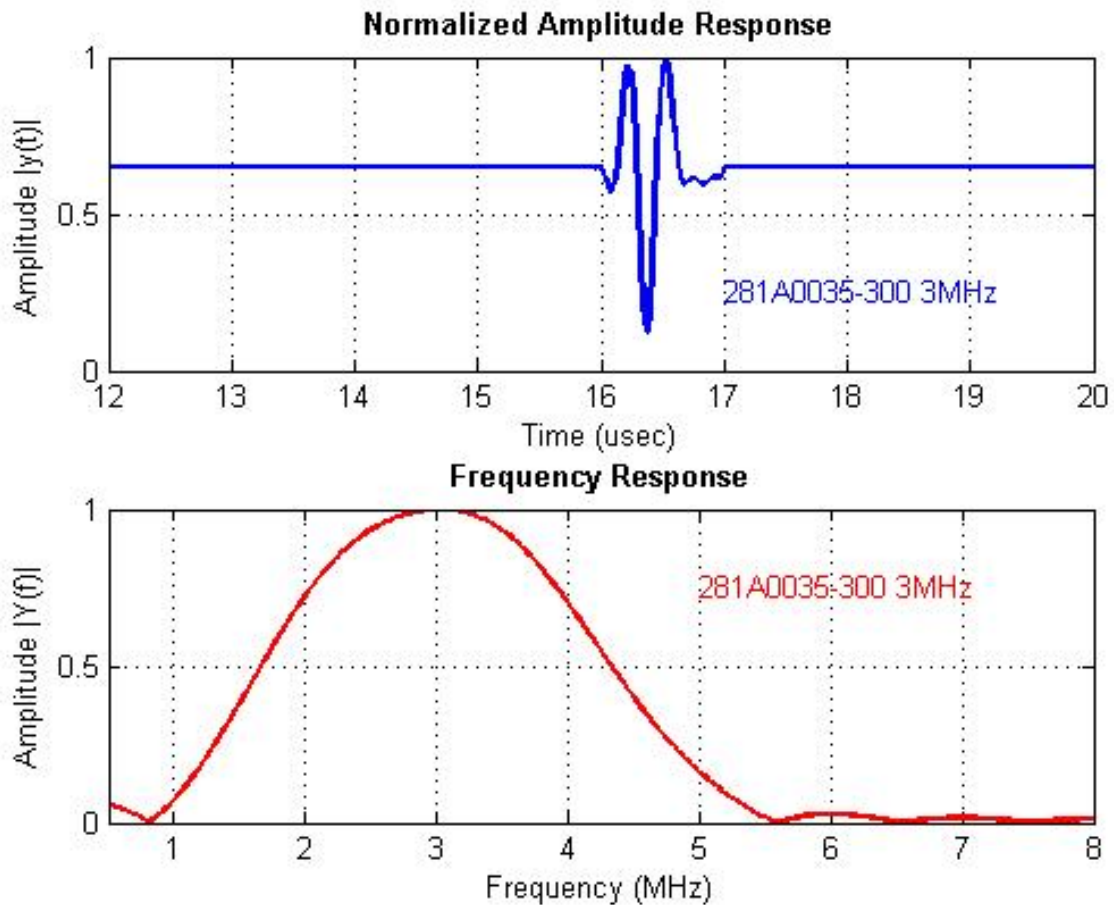
Part Number	Operational Frequency	Transducer Size	Maximum Temperature	Connector	Physical Dim.	Applications and Minimum Material Thickness
*281A0251	3.0 MHz	12mm (W) x 30mm (L)	50°C or 122°F	Innerspec Proprietary 232A0535	32mm – L 32mm – W 135mm – H	Remote Dry Environment Spot Thickness Measurement

\* Remote transducer rod and cable connectors are available in three different lengths: 2 – 4 feet, 4 – 8 feet, and 8 – 16 feet.

### 2.6.1. Remote Contact DCUT with Integrated Signal Conditioning

Part Number	281A0251	
Part Description	Remote Contact DCUT with Integrated Signal Conditioning	
System Connection Type	232A0535	
Wave Mode	Normal Beam	
Physical Dimensions	32mm – L, 32mm – W , 135mm – H	
Recommended Power	1200 Vpp	
Compatible Cable	232A0815	

#### Frequency Spectra & 3dB Beam Profiles



## 2.7. Material Properties Measurement Sensors

Part Number	Wave Mode	Magnet Type	Maximum Temperature	Connector	Dim.	Applications
274A0158	Normal Beam Sensor - PEMAT L & SH	Permanent	<80°C Unlimited	6 Pin Lemo 1B	0.98" D x 2.13" H  25.0 x 54.0mm	Dual Wave Mode (L & SH) Measurements Small  Bolt-Load Nodularity

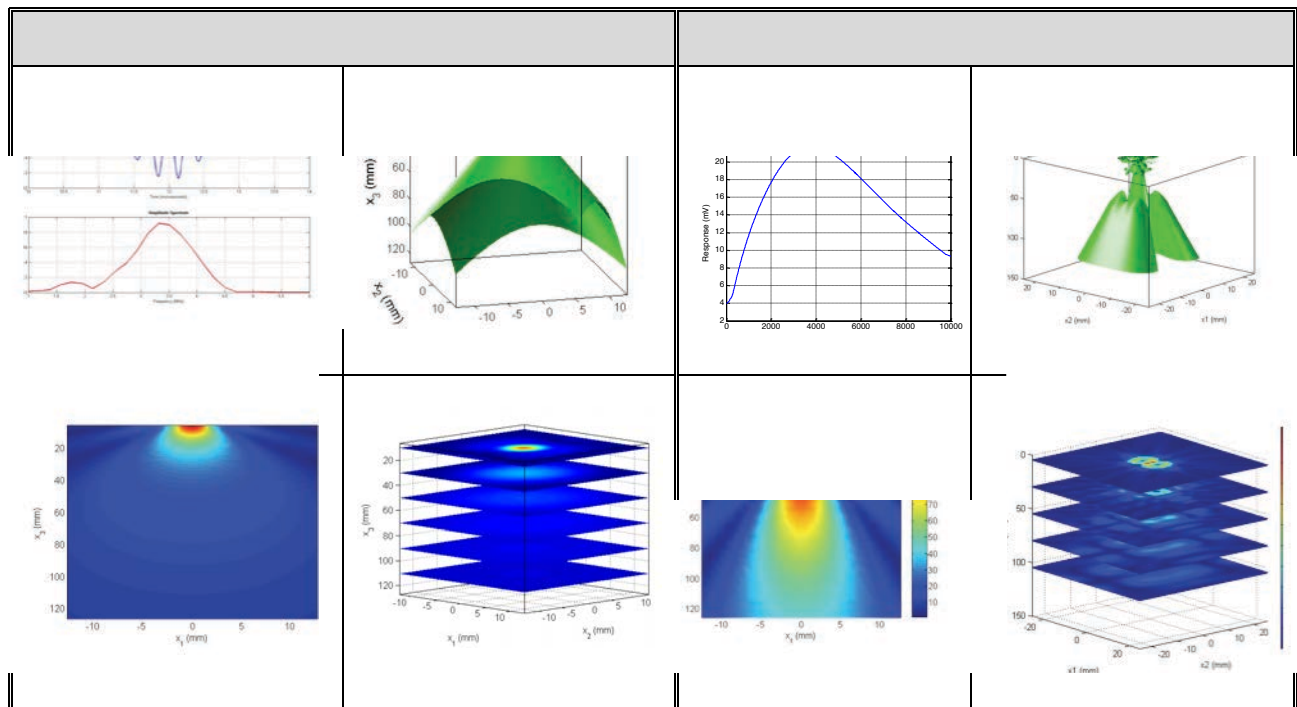
### 2.7.1. Normal Beam Sensor Dual Mode (L + SH) - Small

Part Number		274A0158	
Piezoelectric Geometry		6mm Diameter – 3 MHz	
Coil Length			
	mm	7.87mm	

#### Tuning Module Data Sheet

PE-006	1500	1000	2000

#### Frequency Spectra on aluminum & 3dB Beam Profiles for PMAT Sensor



### 3. Warranty – Limited Warranty on DCUT Transducers & Accessories

**Innerspec Technologies** warrants these products to be free of defects in Material and Workmanship for a period of **one year** from date of delivery to end user. **Innerspec Technologies** will, at its choice, replace or repair parts found defective and return equipment or parts to the purchaser.

The above stated warranty does not apply to expendable or consumable parts (*e.g., coils, transducers, cables, and batteries*), and to products that have failed due to misuse, alteration, unauthorized repair or modification. The purchaser is responsible for transportation costs of the equipment to and from the factory for warranty replacement or repair. The above warranty does not include incidental or consequential damages.

**Innerspec Technologies** is not responsible for damage to or loss of any programs, data, or removable storage media and for the restoration or reinstallation of any programs or data other than software installed by **Innerspec Technologies** when the product is manufactured.