

# PRODUCT MANUAL



TEEGARDEN  
AUDIO

## PAC 116

PHASE-ALIGNED CONDENSER  
BOUNDARY MICROPHONE



## QUICK START

To get started with your PAC 116, please follow these simple guidelines:

## Quick Start Guide

### Phase Aligned Condenser

The PAC116 is a boundary microphone that is placed on the floor of a theater stage, inside piano lid, inside kick drum, podium, conference table, or used as a room mic on the floor, ceiling, or wall. It can be called an area mic because it picks up over a broad area. Boundary microphones eliminate comb-filtering which results in a smooth natural sound. The output of a boundary microphone is increased by 6 dB because all sound waves arrive at the microphone in-phase. This is called the boundary effect.

### /// Microphone Settings

Set the slide switches on the bottom of the microphone. For stage, podium, and voice applications set to "Speech". For recording applications set the slide switch to "Music". The speech setting adds clarity to the voice range. The music position is a full range frequency setting that captures the true instrument qualities. The input dB level should be set to 0 for most applications. If placed inside a kick drum the -10dB pad may be necessary to prevent distortion.

### /// Connection

Connect the attached Male XLR to a microphone cable of appropriate length that is plugged into a microphone channel of a mixer or microphone pre-amp. Make sure the phantom voltage (48V) is on. Set the input gain of the mixer/pre-amp as needed.

### /// Placement

To get the full benefits of a boundary microphone the PAC 116 should be placed on a large flat hard surface at least 4' X 4'. Floors, walls, ceilings, large desks, and piano lids make great boundaries. If placed on a boundary smaller than 4" X 4" the low frequency response of the microphone tends to shelf-down by 3-6dB. However for podium application this low-end shelving adds clarity to the voice range and minimizes low frequency feed-back.

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**As always feel free to experiment and use the settings that best fit your application, sound system, and acoustic environment.**

## Boundary Mic Tech

### /// Introduction

A boundary microphone is a microphone designed to be used on a surface such as a piano lid, wall, stage floor, table, or panel. Mounting a small mic element on a surface gives several benefits:

- A clearer, more natural sound quality
- Extra sensitivity and lower noise +6dB
- Consistent tone quality anywhere around the microphone
- Natural-sounding pickup of room reverberation

### /// Background

In many recording and reinforcement applications, the sound engineer is forced to place microphones near hard reflective surfaces. Some situations where this might occur are recording an instrument surrounded by reflective baffles, reinforcing drama or opera with the microphones near the stage floor, or recording a piano with the microphone close to the open lid.

When a microphone is placed near a reflective surface, sound travels to the microphone via two paths: (1) directly from the sound source to the microphone, and (2) reflected off the surface. Note that the reflected sound travels a longer path than the direct sound, so the reflected sound is delayed relative to the direct sound. The direct and delayed sounds combine at the microphone diaphragm. All frequencies in the reflected sound are delayed by the same time. Having the same time delay for all frequencies creates different phase delays for each frequency, because different frequencies have different wave-lengths. For example, a time delay of 1 millisecond causes a 360-degree phase shift for a 1000-Hz wave, but only a 180-degree phase shift for a 500-Hz wave.

At frequencies where the direct and delayed sounds are in-phase (coherent), the signals add together, doubling the pressure and boosting the amplitude 6 dB. At frequencies where the direct and delayed signals are out-of-phase, the signals cancel each other, creating a dip or notch in the response. There results a series of peaks and dips in the net frequency response called a comb-filter effect. This bumpy frequency response colors the tonal reproductions, giving an unnatural sound. To solve this problem, we need to shorten the delay of the reflected sound so that it arrives at the microphone at the same time the direct sound does.

If the microphone capsule is placed on the reflective surface the direct and reflected sound paths become nearly equal. There is still a short delay in the reflected sound because the center of the microphone diaphragm (where the two sound paths combine) is slightly above the surface.

**If you have further questions contact**

**Teegarden Audio Tech Support at: (615) 454-3981**



## /// The Boundary Effect

By orienting the diaphragm parallel or perpendicular with the boundary, the diaphragm can be placed as close to the boundary as desired. Then the direct and reflected waves arrive simultaneously at the microphone capsule sound entry port. Any phase cancellations are moved outside the audible band, resulting in a smooth frequency response.

As stated earlier, comb-filtering is eliminated when the direct and reflected waves add together in-phase. There is another benefit: the sound pressure doubles, giving a 6 dB sensitivity boost and the signal-to-noise ratio also increases 6 dB.

The Phase Aligned Condenser (PAC) is a surface-mounted cardioid microphone which provides the same benefits as other PZM type microphones. However, unlike many PZM type microphones, the PAC uses a 16mm cardioid mic capsule. Its directional polar pattern improves gain-before-feedback, reduces unwanted room noise and acoustics, and rejects sound from the rear.

In the Teegarden PAC 116, the microphone diaphragm is small enough so that any phase cancellations are above the audible range. This results in a wide, smooth frequency response free of phase interference. The circuit topology is a discrete high-performance design suitable for pro recording.

## Application Guide

### Phase Aligned Condenser

The PAC116 is a half cardioid boundary microphone that is placed on the floor of a theater stage, inside piano lid, kick drum, podium, or used as a room mic on the floor, ceiling/wall. It can be called an area mic because it picks up over a broad area.



## Theater Stage Size vs Number of Microphones

- 20 ft stage: 1 mic center stage.
- 24-30 ft stage: 2 mics 12 to 15 feet apart.
- 35-40 ft stage: 3 mics 15 feet apart.

## /// Piano

1-2 PAC 116s can be taped to the inside of a piano lid. Open or closed. It can also be used on the floor underneath the piano as a secondary microphone.

## /// Kick Drum

Use one PAC 116 inside the kick drum in the flat position. Select the -10db pad if necessary. The PAC 116 can be used alone or as a secondary mic inside or outside the kick drum to bring out the click or snap. Experiment with the roll-off switch in and out when used with a second microphone.

## /// Podium and Conference Table

For podiums and conference tables use the PAC 116 in the roll-off position (Speech) with pad switched out (0dB). Make sure the PAC 116 is not obstructed by papers or books on the podium. On conference tables use one PAC 116 between 2-3 persons on each side of the table.

## /// Recording Studio Application

As an ambient room mic, mount the PAC 116 on the ceiling, walls, or floor to pick-up the natural room acoustics of instruments. As a secondary microphone, place the PAC116 on the floor in front of an acoustic guitar, strings, or underneath a piano.

## /// Dolby Atmos Studio

Mount the PAC 116 on the ceiling, walls, or floor to pick-up the natural room acoustics of instruments and voice. Use the flat position without the -10db pad. Experiment with position and number of PAC116 microphones.

## /// Phase Aligned Condenser Technology

The PAC 116 is a boundary microphone meant to be mounted on a large flat hard boundary such as a floor, wall, or piano lid. A boundary microphone prevents phase cancellations due to sound reflections from the floor, walls, ceilings, or other hard surfaces nearby.

The result is a smooth frequency response free of comb filtering, so speech and music sound clear and natural.



## PAC 116

### Phase Aligned Condenser

#### /// Specifications:

- Type:** 16mm Half Cardioid Condenser (Boundary)
- Discrete Transformerless**
- Rated Impedance:** 150 Ohms
- Open Circuit Sensitivity:** 15 mv/ PA
- Frequency Response:** 20hz to 20K
- Equivalent Self-Noise:** 16 dB-A
- Max SPL:** 140dB 150dB (-10dB Pad)
- Current Consumption:** 7.8ma
- Operating Voltage:** 48V phantom power

#### /// Applications:

- Stage/Theater
- Musical Theater
- Tap and Clogging Dance
- Church Podium and Alter
- Acoustic Piano and Guitars
- Percussion/Kick Drum
- Dolby Atmos
- Room ambiance

#### /// Features

- Wide, smooth frequency response provides a natural, accurate sound quality.
- Three modes of operation include theater/stage, studio recording, High SPL.
- Perfect for drama or musical production and studio (piano, drums, acoustic instruments, room)
- Half Cardioid polar pattern (On boundary) provides high rejection of noise from the rear
- Permanently attached 48" cable with XLR connector. (Custom lengths available)
- Stage/Studio (Voice/Music) select and -10 dB pad switches
- Designed, Hand-built and tested in Nashville, TN USA

#### /// Cable Options:

- 1 ft.
- 4 ft.
- 6 ft.

#### /// PAC 116

The PAC116 is a high-performance boundary microphone for use on stage and in the studio. For stage and conference applications the PAC116 provides clear and intelligible voice reproduction and rejection of rear noise and floor vibration. In the studio it provides a smooth frequency response and low noise due to its discrete electronics design and capsule response. The PAC116 preserves the delicate timbre of acoustic instruments, yet it can handle high sound pressure levels up to 150dB with switchable capacitor pad. Self-noise is very low, permitting clean, low-noise recordings.

#### /// Phase Aligned Condenser Technology

The PAC 116 is a boundary microphone meant to be mounted on a large flat hard boundary such as a floor, wall, ceiling, or piano lid. A boundary microphone prevents phase cancellations since sound waves (In Audio Spectrum) add together on a boundary without time delay. The result is a smooth frequency response free of comb filtering, so speech and music sound clear and natural. Also there is a 6dB increase in sensitivity due to the boundary effect.



**If you have further questions contact**

**Teegarden Audio Tech Support at: (615) 454-3981**

## Limited 2 Year Warranty ///

TEEGARDEN AUDIO products purchased in the USA are warranted by Teegarden Audio, LLC to be free from defects and materials and workmanship for the period of 2 years to the original purchaser. In the event of such defects, the Teegarden Audio product will be repaired without charge or, at our option, replaced with a new one. All returned items must be delivered to Teegarden Audio with shipping prepaid, together with the sales slip or other proof of purchase. The warranty excludes problems due to normal wear, abuse, shipping damage or failure to use the product in accordance with the specifications. This warranty does not apply if the product has been damaged by accident or misuse, or as a result of repair or modification by anyone other than a Teegarden Audio customer service facility authorized to service this product.

All parts except tubes (120 days) are covered under this Limited 2 Year Warranty.

Teegarden Audio, LLC shall not be liable for damages based on inconvenience, loss of use of the product, loss of time, interrupted operation or commercial loss or any other damages, whether incidental, consequential or otherwise. This warranty gives you specific legal rights, and you may have other rights, which will vary from state to state.

Specifications and prices are subject to change without notice or obligation.

## Important Safety Information ///

**WARNING: TO AVOID ELECTRIC SHOCK HAZARD, DO NOT EXPOSE THIS APPARATUS TO WATER, RAIN OR MOISTURE**



CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER. NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

Do not attempt to service this unit yourself, as it will void the warranty. Please check your unit carefully upon receipt and return to place of purchase immediately if there are problems with the product. After that, the standard TEEGARDEN AUDIO Limited 2-Year Warranty will apply to defects in materials and workmanship.

(U.S.A.) Should your TEEGARDEN AUDIO device require service, please contact us at (615) 454-3981 -or- email us at [info@teegardenaudio.com](mailto:info@teegardenaudio.com)

To claim warranty in the USA, equipment and accessories must be delivered in their entirety to TEEGARDEN AUDIO, freight prepaid, IN PROPER/SAFE PACKAGING. All returns must have prior authorization before shipping. Please contact TEEGARDEN AUDIO for a Return Authorization Number (RA).

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AUDIO**

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