MICROPHONES/CM™, PCC®, PZM® & GLM™

crown®

CROWN MICROPHONES

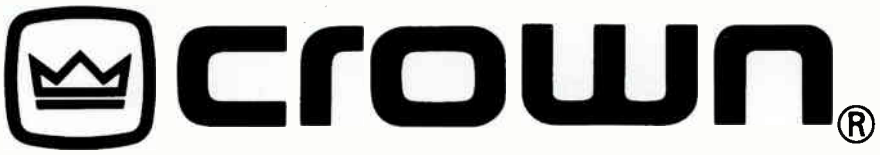
Every company that successfully competes in business for a period of years develops certain characteristics or traits – a corporate "personality" – that is unique to that company. In the 35 years that Crown has been in existence, several "personality traits" have emerged.

Certainly, Crown is a "people company." The efforts directed by Crown towards the well-being and security of its employees, towards creating a pleasant work place and a solid, stable environment show an abiding commitment to Crown's most important resource...its people.

We are comfortable with the image of Crown as a company built by a family work ethic in a small-town community. That environment helps provide Crown with a stable family of workers oriented towards consistency and quality.

The image of Crown as a high-technology company is one that we find accurate as well. Since the first DC-300 amplifier came off the production line, Crown has been in the enviable position that comes from an ideal combination of technology and quality coupled to a practical insight into what the customer needs.

It is out of this background that Crown entered the field of microphone manufacturing some 7 years ago. Taking the time to develop a unique and sophisticated microphone technology, Crown has continued with its commitment to bring to the marketplace products that meet specific needs in an innovative and practical way.


crown®

CM SERIES

DIFFEROID™ CARDIOID PZM® OMNI

CM-300 CM-200 CM-100

The new Crown CM series hand-held microphones represent new approaches in solving old problems. From the nearly indestructible omnidirectional CM-100, to the smooth, good-sounding cardioid CM-200, to the incredible new CM-300 Differoid™ which rejects distant on-stage sound and sets a new standard for gain-before-feedback. . .the new Crown hand-helds are performers and problem solvers.

Type: Hand-held differential-type condenser.

Frequency response (typical): 60Hz to 18,000Hz. See Fig. 1.

Polar Pattern: Cardioid (see below)

Impedance: 150 ohms, balanced. Recommended minimum load impedance 1000 ohms.

Sensitivity: Open-circuit voltage −71dB re 1 volt per microbar (−71dBV output for 74dB SPL input). Power level: −49dB re 1mW/10 dynes/cm². EIA sensitivity: −143dBm.

Maximum SPL for 3% THD: 149dB SPL continuous, 150dB SPL peak.

Finish: Satin black.

Net weight: 7.1 oz (200 g).

Type: Cardioid condenser

Frequency Response (typical): 80Hz to 15,000Hz

Polar Pattern: Cardioid

Impedance: 150 ohms rated (200 ohms actual), balanced

Sensitivity (48V supply): Open-circuit voltage −73dB re 1 volt per microbar (−73dBV output for 74dB SPL input). Power level: −52dB re 1mW/10 dynes/cm²

Maximum SPL: 142dB SPL for 48V supply; 137dB SPL for 24V supply

Finish: Satin black

Net weight: 7 oz (199 g)

Accessories Included: Carrying pouch, ASA-2 microphone stand adapter, WS-4 windscreen

Optional Accessories: Crown PH-4 phantom power supply (4 channels, AC powered), Crown PH-1 battery phantom supply (1 channel, battery powered)

Type: Hand-held Pressure Zone Microphone®

Frequency Response (typical): 20Hz to 20,000Hz (see below)

Polar Pattern: Omnidirectional (see below)

Impedance: 150 ohms rated (240 ohms actual), balanced

Sensitivity: Open-circuit voltage −72.0dB re 1 volt per microbar (−72.0dBV output for 74dB SPL input). Power level: −52.0dB re 1mW/10 dynes/cm²

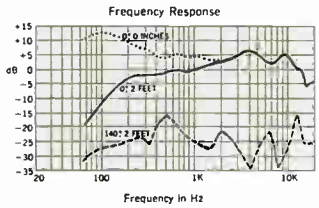
Maximum SPL: 150dB SPL

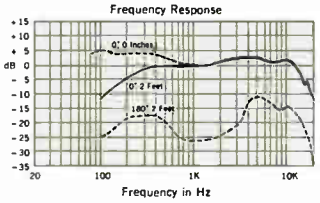
Finish: Satin black

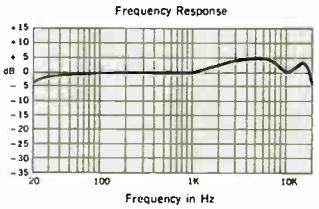
Net weight: 7.8 oz (221 g)

Accessories Included: Carrying pouch, ASA-2 microphone stand adapter, WS-4 windscreen

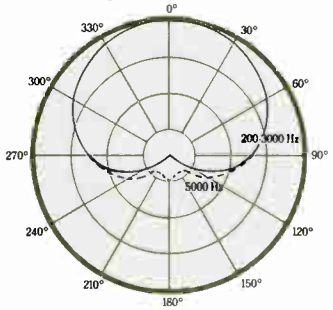
Optional Accessories: Crown PH-4 phantom power supply (4 channels, AC powered), Crown PH-1 battery phantom supply (1 channel, battery powered)



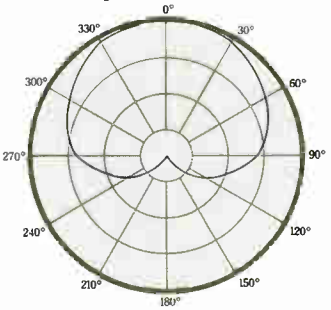




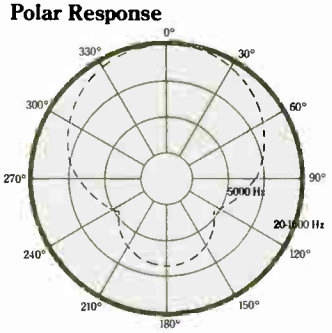
Polar Response



Polar Response



Polar Response



PCC®-160 SERIES
PHASE COHERENT CARDIOID® MICROPHONES

PCC-160/PCC-160W

The Crown PCC®-160 is a Phase Coherent Cardioid,® surface-mounted boundary microphone intended for use on stage floors, lecterns, conference tables and news desks – wherever improved gain-before-feedback and articulation are important.

The PCC's boundary technology assures phase coherency throughout the audible spectrum, resulting in smooth frequency response, enhanced clarity and extra reach.

The PCC-160 can be directly phantom powered. A bass-tilt switch is provided for tailoring low-end response. Heavy-gauge steel construction assures reliability under demanding professional conditions.

Type: Phase Coherent Cardioid

Frequency Response: 50 to 18 kHz (see below)

Impedance: 150 ohms, balanced

Polar Pattern: Half-supercardioid

Sensitivity: −53 dB re 1V/microbar, or −31 dB re 1 mW/10 dynes/cm²

Maximum SPL: 120 dB SPL

Operating Voltage: 12 to 48 volt simplex phantom powering

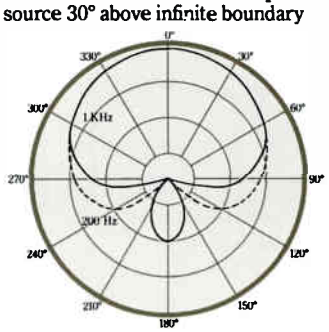
Finish: PCC-160 Non-reflecting black, PCC-160W Ivory

Net Weight: 11.5 oz. (326 grams)

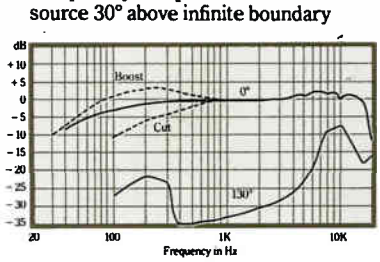
Furnished accessories: 15-foot cable

Optional accessories: PH-1, battery phantom power supply; PH-4, 4-channel AC phantom power supply; WS-1 windscreen

Horizontal Plane Polar Response
source 30° above infinite boundary



Frequency Response
source 30° above infinite boundary

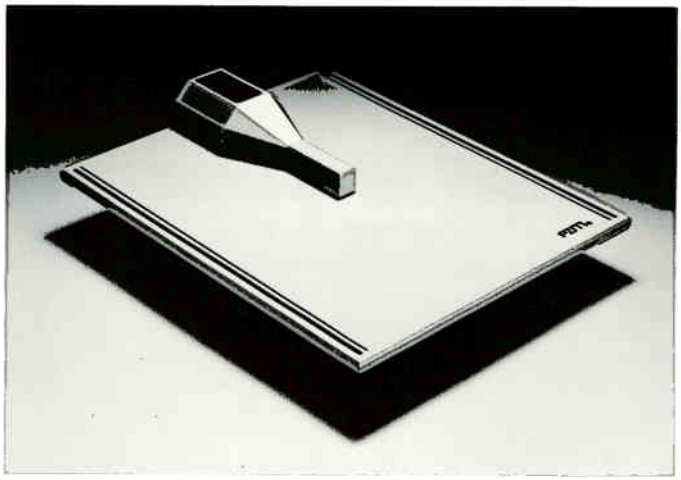


---- bass tilt variations

PZM®-30FS
PRESSURE ZONE MICROPHONE®

PZM®-30RG
PRESSURE ZONE MICROPHONES®

PZM-30RB



The PZM®-30 series microphones are workhorse versions of the PZM line, designed for exacting professional use, and built to take the normal abuse associated with professional applications. Miniaturized electronics built into the microphone cantilever allow the 30 series to be powered directly by simplex phantom powering.

The PZM-30FS (silver finish) provides a smooth, flat high frequency response for the most accurate and natural pickup.

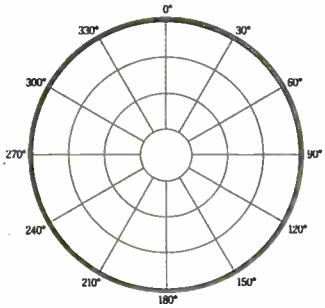
Type: Pressure Zone Microphone
Frequency Response: 20 Hz to 15 kHz
Polar Pattern: Hemispherical
Impedance: 240 ohms, balanced
Sensitivity: −66 dB re 1V/microbar or −46 dB re 1 m W/10 dynes/cm.²
Maximum SPL: 150 dB SPL
Operating Voltage: 12 to 48 volts simplex phantom powering
Finish: Silver
Net Weight: 6.5 oz. (184 grams)
Accessories Supplied: Windscreen, carrying/storage pouch
Optional accessories: PH-1, battery phantom power supply; PH-4, 4-channel AC phantom power supply

The PZM®-30RG (gold) and PZM-30RB (black) are engineered to have slightly accentuated or rising high frequency response that is often preferred for increased clarity and articulation in both near and distant recordings.

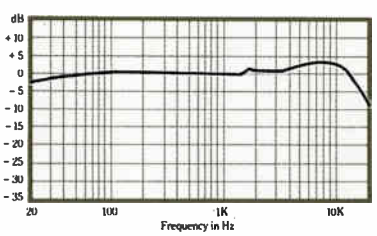
As with all new 30 series PZM's, miniaturized electronics are concealed in the cantilever allowing them to be directly simplex phantom powered.

Type: Pressure Zone Microphone
Frequency Response: 20 Hz to 15 kHz
Polar Pattern: Hemispherical
Impedance: 240 ohms, balanced
Sensitivity: −65 dB re 1V/microbar or −45 dB re 1 mW/10 dynes/cm.²
Maximum SPL: 150 dB SPL
Operating Voltage: 12 to 48 volts simplex phantom powering
Finish: 30RG gold, 30RB black
Net Weight: 6.5 oz. (184 grams)
Accessories Supplied: Windscreen, carrying/storage pouch
Optional accessories: PH-1, battery phantom power supply; PH-4, 4-channel AC phantom power supply.

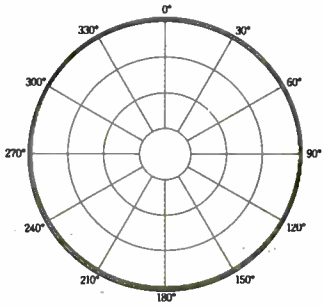
Horizontal Plane Polar Response
source 30° above infinite boundary



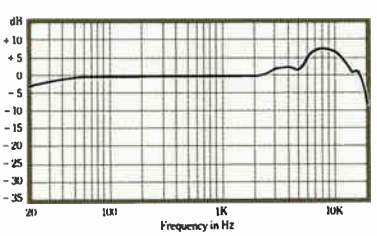
Frequency Response
source 30° above infinite boundary



Horizontal Plane Polar Response
source 30° above infinite boundary



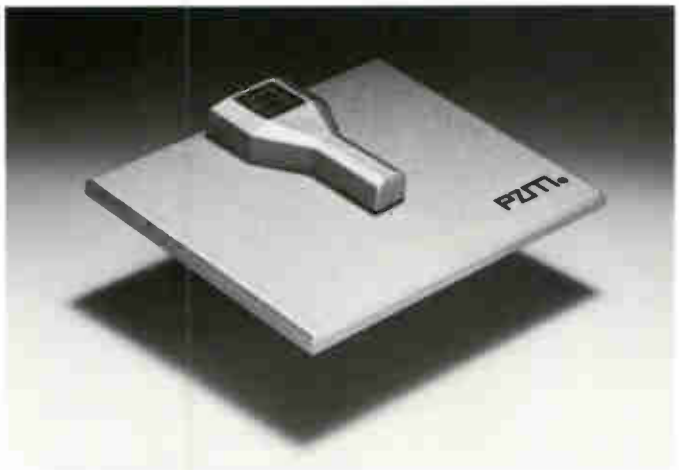
Frequency Response
source 30° above infinite boundary



PZM®-6 SERIES
PRESSURE ZONE MICROPHONES®

PZM®-20RG
PRESSURE ZONE CONFERENCE MICROPHONE

PZM-6RB/PZM-6RG/PZM-6FS



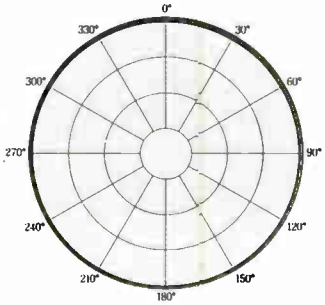
The 6 series PZM®s are designed for minimum visibility. A miniaturized cantilever and plate optimize the omnidirectionality (hemispherical pattern) of these units. Miniaturized electronics are housed in the XLR-type connector at the end of the cable, allowing direct interface to phantom powering.

The flat, linear frequency response of the 6FS is first choice where natural sound quality and accurate pickup are required.

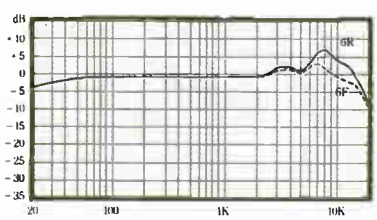
In applications where greater articulation or high-end clarity are needed, such as distant miking, the smoothly rising response of the PZM-6RG (gold) or PZM-6RB (black) is often desired.

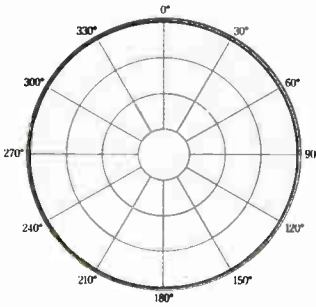
Type: Pressure Zone Microphone
Frequency Response: 20 Hz to 15 kHz
Polar Pattern: Hemispherical
Impedance: 240 ohms, balanced
Sensitivty: PZM-6RB, PZM-6RG: −65 dB re 1V/microbar, or −45 dB re 1 mW/10 dynes/cm.² PZM-6FS: 1 dB less sensitive
Maximum SPL: 150 dB SPL
Operating Voltage: 12 to 48 volts simplex phantom powering
Finish: 6FS silver, 6RG gold, 6RB black
Net Weight: 5 oz. (142 grams)
Accessories Supplied: Windscreen, carrying/storage pouch
Optional Accessories: PH-1 battery phantom power supply, PH-4 4-channel AC phantom power supply

Horizontal Plane Polar Response
source 30° above infinite boundary

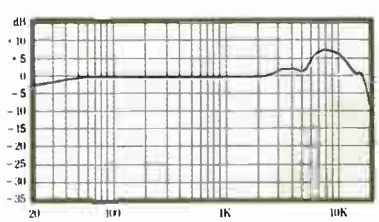


Frequency Response
source 30° above infinite boundary





Frequency Response
source 30° above infinite boundary



The PZM®-20RG is an improved and updated version of the older 20RMG. With the inclusion of new, smaller electronics, a smaller package at the rear of the boundary, and improved mounting techniques, the PZM-20RG is easier to use and easier to install.

Designed for permanent flush-mounting installations (tables, lecterns, pulpits, judicial benches, etc.), the 20RG mounts easily to a standard electrical wall box. The screw holes match, so installation is a snap.

The unobtrusive appearance and hemispherical pattern make it ideal for conference-table use.

The small electronics chassis allows mounting in even shallow boxes or cavities, and adapts the microphone for direct simplex phantom powering of 12 to 48 volts.

Three small guard posts prevent papers from sliding underneath the cantilever arm and altering the frequency response.

Type: Pressure Zone Microphone®
Miniature Electret Condenser
Frequency Response: 20 Hz to 15 kHz
Polar Pattern: Hemispherical
Impedance: 240 ohms, balanced
Sensitivity: −65 dB re 1V/microbar, or −45 dB re 1 mW/10 dynes/cm²
Maximum SPL: 150 dB SPL
Operating Voltage: 12 to 48 volts phantom power
Finish: Gold (visible surface)
Net Weight: 8.1 oz. (230 grams)
Incl. Accessories: Mounting screws, wood mounting screws

GLM™-100
MINIATURE OMNIDIRECTIONAL MICROPHONE

GLM-100/E

GLM™-200
MINIATURE HYPERCARDIOID MICROPHONE

GLM-200/E

The GLM-100™ is an omnidirectional electret-condenser microphone designed for professional recording and sound reinforcement. It offers all the quality of larger studio microphones yet is nearly invisible in use.

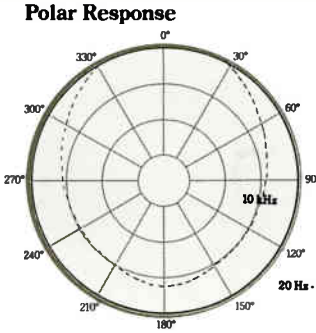
Made of rugged, resilient material, the GLM-100's molded housing is designed to resist damage from demanding professional use.

A number of accessories add to the broad range of uses for this excellent omni. Some applications include lavalier miking, instrument recording or reinforcement, and concealed miking.

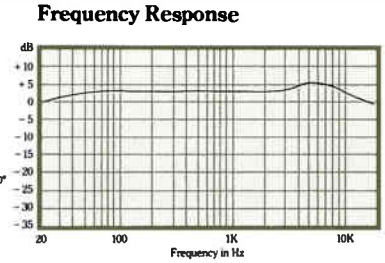
The GLM-100/E omits the cable connector for direct connection to a wireless transmitter.

Type: Miniature omnidirectional electret
Frequency Response: 20 Hz to 20 kHz
Polar Pattern: Omnidirectional
Impedance: 240 ohms, balanced
Sensitivity: −72 dB re 1V/microbar, or −50 dB re 1 mW/10 dynes/cm²
Maximum SPL: 150 dB SPL
Operating Voltage: 12 to 48 volts simplex phantom powering.
Finish: Non reflecting black
Net Weight: 2.8 oz. (78.5 grams)
Included Accessories: GLM-UM universal mount, GLM-WS2 and GLM-WS3 wind screens, GLM-TM tie-bar mount with belt clip, double-sided tape.
Optional Accessories: GLM-TT tie tack mount, GLM-DM drum mount, GLM-CM cymbal mount, GLM-HM horn mount, GLM-SM surface mount, PH-1 battery phantom supply, PH-4 4-channel AC phantom supply.

Polar Response



Frequency Response



The GLM™-200 is a miniature electret-condenser hypercardioid microphone with excellent response and uniform off-axis rejection. Its sub-miniature size makes it almost invisible in actual use.

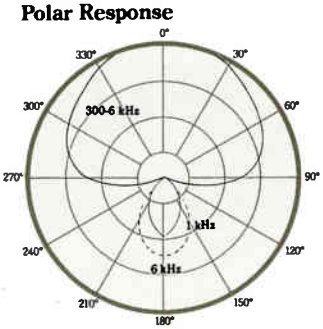
The smooth, extended frequency response of the GLM-200 makes it ideal for musical-instrument reinforcement or recording. It can be attached directly to instruments by special-purpose accessories.

Special flex/strain relief systems at both the microphone and the cable connector provide extra reliability in demanding applications.

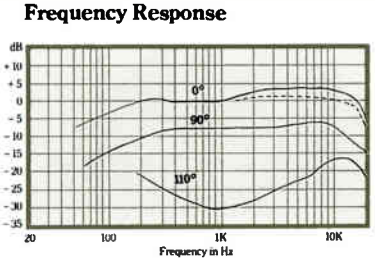
The GLM-200/E omits the cable connector for direct connection to a wireless transmitter (through a bass-boost interface).

Type: Miniature hypercardioid electret
Frequency Response: 60 Hz to 20 kHz
Polar Pattern: Hypercardioid
Impedance: 100 ohms, balanced
Sensitivity: −68 dB re 1V/microbar, or −44 dB re 1 mW/10 dynes/cm²
Maximum SPL: 150 dB SPL
Operating Voltage: 12 to 48 volt simplex phantom powering
Finish: Non-reflecting black
Net Weight: 3.7 oz. (103.5 grams)
Included Accessories: GLM-UM universal mount, GLM-WS2 and GLM-WS3 wind screens, GLM-TM tie bar mount with belt clip.
Optional Accessories: GLM-TT tie tack mount, GLM-DM drum mount, GLM-CM cymbal mount, GLM-HM horn mount, PH-1 battery phantom supply, PH-4 4-channel AC phantom supply

Polar Response



Frequency Response



GLM™-100/D, GLM™-200/D

MINIATURE DUAL MICROPHONES

100/D - Omnidirectional 200/D - Hypercardioid

GLM™-100/ENG

MINIATURE OMNIDIRECTIONAL ENG MICROPHONE

The GLM™-100/D is a special tool designed for broadcasters. Where absolute integrity of the audio signal must be guaranteed, the dual-microphone, totally redundant setup (cables, electronics, connectors) of the 100/D assures fail-free operation.

A built-in tie-clip assembly is designed to route the dual cables of the 100/D down behind tie or lapel automatically. The 100/D is exceptionally easy to put on and take off quickly.

Special housing design gives the GLM-100/D a very small profile from the on-camera angle, but does not sacrifice its excellent frequency response and sensitivity.

Built of rugged, resilient material, the 100/D is made to stand up to the normal hard use associated with professional studio broadcasting.

The GLM-200™ is a dual version of the GLM-200 miniature hypercardioid microphone. It has the same specifications and performance in a dual package.

Type: Dual Miniature Electret
Frequency Response: 50 Hz to 18 kHz
Polar Pattern: Omnidirectional
Impedance: 240 ohms, balanced
Sensitivity: −72.5 dB re 1V/microbar, or −52 dB re 1 mW/10 dynes/cm²
Maximum SPL: 150 dB SPL
Operating Voltage: 12 to 48 volts phantom
Finish: Black
Net Weight: 5.7 oz. (162 grams)
Incl. Accessories: Zipper storage pouch

The GLM™-100/ENG is a miniature electret lavalier microphone specifically designed for ENG (electronic news gathering) uses. The frequency response of the ENG version is intentionally tailored to roll off the low frequency response to avoid rumble and much of the normal ambience found in ENG outdoor work.

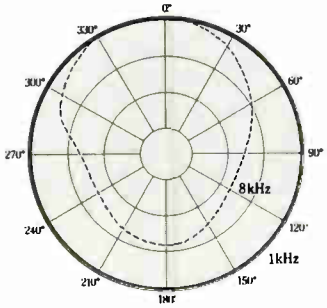
The GLM-100/ENG has its own set of electronics, which can be powered either by an internal 1.5 volt AA cell, or by simplex phantom powering, if available. The electronics switch automatically from battery to simplex when simplex is available.

Made of rugged, resilient material, the 100/ENG's molded housing is designed to resist damage from demanding professional use.

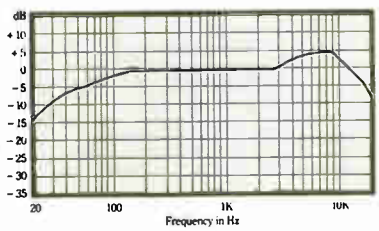
The frequency response of the 100/ENG also makes it ideal for close pickup of acoustic instruments. A number of accessories permit a broad range of uses for this excellent omni.

Type: Miniature Electret Condenser
Frequency Response: 80 Hz to 20 kHz
Polar Pattern: Omnidirectional
Impedance: 240 ohms, balanced
Sensitivity: −72.5 dB re 1V/microbar, or −52 dB re 1 mW/10 dynes/cm²
Maximum SPL: 120 dB SPL battery, 150 dB phantom powered
Operating Voltage: 12 to 48 volts phantom, 1.5 volt battery
Finish: Black
Net Weight: 5.5 oz. (155 grams)
Incl. Accessories: Zipper storage pouch, WS-2 windscreen, WS-3 windscreen, GLM-TM tie mounting bar

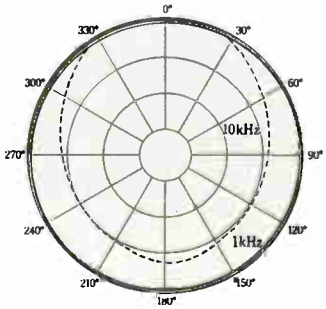
Polar Response



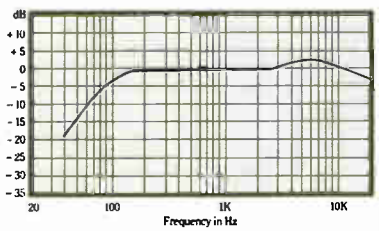
Frequency Response



Polar Response



Frequency Response



PZM®-180
GENERAL PURPOSE PRESSURE ZONE MICROPHONE®

The PZM®-180 is a Pressure Zone Microphone® designed for general-purpose applications such as conferences, group discussions, interviews, home-video productions, lectures and music recordings.

The microphone can be placed on a large surface such as a table, floor, wall or lectern; or can be hand held for interviews.

The PZM-180 can be phantom powered or battery powered. Connecting the microphone to phantom power disconnects the internal battery.

Type: Pressure Zone Microphone

Frequency Response: 20 Hz to 17 kHz

Polar Pattern: Hemispherical

Impedance: 150 ohms, balanced

Sensitivity: (phantom) −70 dB re 1V/microbar, or −48 dB re 1 mW/10 dynes/cm²

Sensitivity: (battery) −82 dB re 1V/microbar, or −69 dB re 1 mW/10 dynes/cm²

Maximum SPL: 120 dB SPL

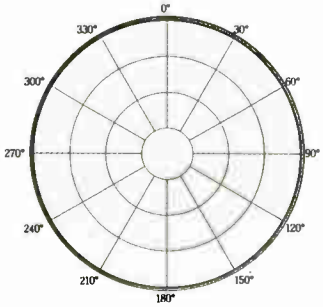
Operating Voltage: 12 to 48 volts simplex phantom powering

Finish: Black with silver accents

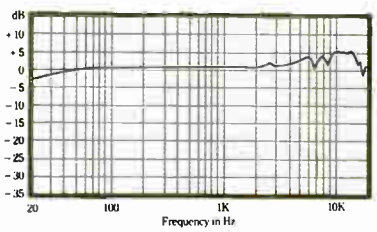
Net Weight: 2.4 oz. (68 grams)

Accessories: ASA1 microphone stand adapter for PZM-180. CM-1 used in conjunction with the ASA1 to mount the PZM 180 to a video camera.

Horizontal Plane Polar Response
source 30° above infinite boundary



Frequency Reponse
source 30° above infinite boundary



PZM®-2.5W4C
DIRECTIONAL PRESSURE ZONE MICROPHONE®

The Crown PZM-2.5W4C combines the advantages of the PZM with a corner reflector boundary to make the microphone directional. It was designed for high-quality speech pick-up applications such as teleconferencing and lectern use.

The PZM corner reflector has the added advantage of providing up to 12 dB more signal gain without increasing the microphone's noise floor. This increase in sensitivity improves clarity and intelligibility by reducing pickup of room ambient noise and rejecting sounds behind the reflector.

The handsome wood base of the 2.5W4C houses interface electronics.

Type: Pressure Zone Microphone®

Frequency Response: 40 Hz to 10 kHz

Polar Pattern: Unidirectional

Impedance: 150 ohms, balanced

Sensitivity: −60 dB re 1V/microbar, or −38 dB re 1 mW/10 dynes/cm²

Maximum SPL: 134 dB SPL

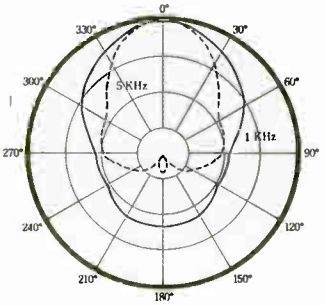
Operating Voltage: 12 to 48 volts simplex phantom powering

Finish: Wood base with clear acrylic reflectors

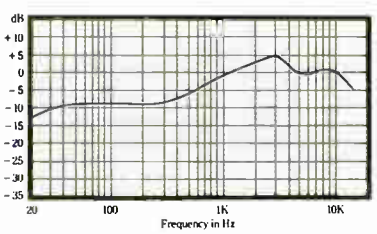
Net Weight: 55.7 oz. (1578 grams)

Optional Accessories: PH-1 battery phantom power supply, PH-4 4-channel AC phantom power supply

Horizontal Plane Polar Response
source 30° above infinite boundary



Frequency Response
source 30° above infinite boundary

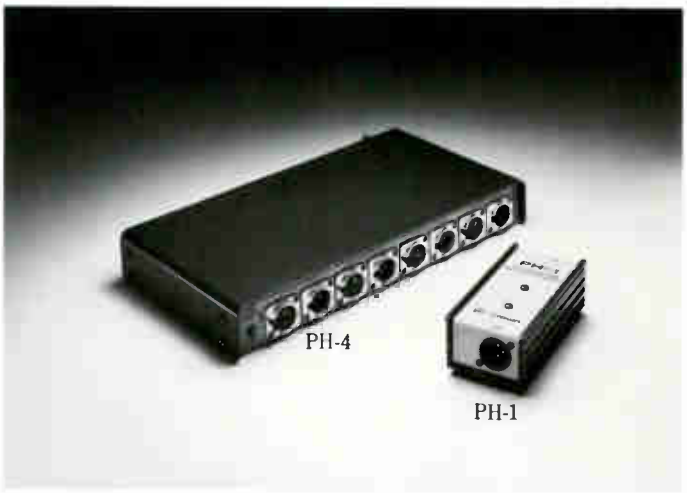


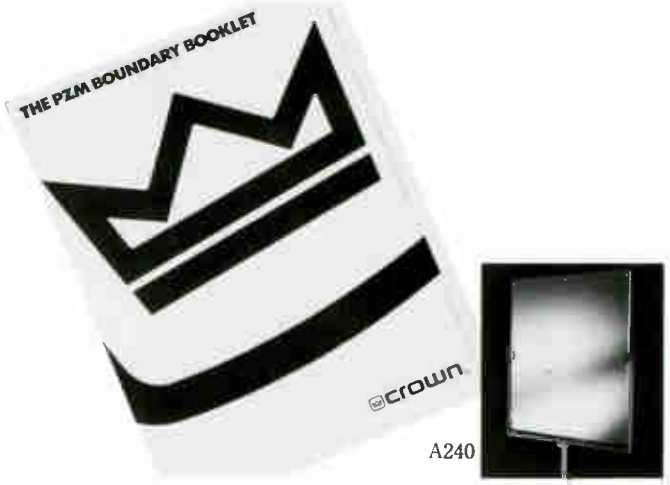
crown®

MICROPHONE ACCESSORIES

CROWN ACCESSORIES

PCC's/PZM's/GLM's





POWER SUPPLIES

Most Crown microphones can be powered with 12 to 48 volts DC, positive on pins 2 and 3 with respect to pin 1 of the output connector.

PH-1 Single Channel Battery Supply: The PH-1 is a reasonably priced single-channel simplex phantom power supply. Operating from two standard 9-volt cells, it will power Crown's GLM,™ PCC,® and PZM® microphones, as well as other condenser microphones designed to operate on simplex power of 18 volts or less.

PH-4 Phantom Power Supply: The PH-4 is an AC powered 4-channel power supply providing 48V DC in a simplex phantom configuration. It uses XLR-type connectors for each channel of input and output. DC blocking is provided for easy coupling to input circuits.

PH-4S Phantom Power Slave: The PH-4S is a 4-channel add-on for the PH-4 which "daisy chains" to the master with supplied cables. Total current available from the PH-4 and PH-4S is 100 mA. Any number of PH-4S units can be coupled to one PH-4, so long as the current drawn by the total number of microphone channels does not exceed 100 mA.

GLM™ ACCESSORIES

The GLM accessories attach GLM microphones to a variety of musical instruments and surfaces, and allow them to be concealed.

GLM-UM: The GLM Universal Mount is a 4"-long flexible mount with "alligator" jaws at one end to hold the GLM microphone by its flex-relief, and a set of firm-gripping, covered jaws at the other end to attach to instrument housings, mike stands, etc.

GLM-SM: The Surface Mount (SM) is a useful tool for mounting a small microphone on various instruments. The SM attaches to the sound board of a guitar, piano lid, or other flat surface by means of high quality double-sided tape. The unobtrusive beige metal mount accepts a GLM-100, and allows it to be positioned with proper spacing from the boundary surface to be used as a PZM. Extraordinary results can be obtained by mounting the mike in this way. For sound uniformity from set-up to set-up, the microphone may be removed from the mount at any time, leaving the mount in position so that the mike can be re-placed at any time in the future in exactly the same position.

GLM-HM: The GLM Horn Mount is a special purpose mount with alligator jaws on one end to hold the GLM, and a unique soft-jawed clamp on the other, designed to mount to the curved horns of various musical instruments. The GLM-HM should be used wherever special care is needed to protect the mounting surface.

GLM-TM: The GLM Tie Mount is a tie-bar type mount and belt clip which enable the user to wear the GLM mike as a lavalier. A dual mounting system soon will be available.

GLM-TT: The GLM Tie Tac and belt clip provide a means of mounting the GLM tie-tac style through ties, clothing etc.

GLM-DM: The GLM Drum Mount is a small, simple, unique device which enables close miking of a drum by semi-permanently mounting a small mike holder directly on the drum rim. The DM can be easily rotated out of the way for drum stacking. Using several DM's assures that the microphones will always be placed in exactly the same way, allowing consistent sound quality.

GLM-CM: The GLM Cymbal Mount allows shock-mounted placement of GLM microphones exactly where needed for good cymbal pickup.

GLM-OHM: The OHM (Over Head Mount) is a well-designed versatile boom for the very small GLM. Since the size and weight of a regular-size boom are not needed for the miniature GLM, Crown has manufactured a boom with all of the adjustability of a conventional mike-stand boom, but with lower visibility and far greater maneuverability.

GLM-WS2: The GLM wind screen provides 14 dB of wind-noise rejection for outdoor GLM uses.

GLM-WS3: A sock-type windscreen much smaller than the WS2. Designed as a pop and breath filter for use in headset applications. Rejects wind noise by 7 dB.

INTERFACES:

Crown PZM Interfaces couple PZM lavaliers and all pre-April 1986 PZMs to 12 to 48 volts simplex phantom powering. PZM lavaliers and most pre-July 1986 PZMs (30 GPB, 30 GPG, 31S, 6LPB, 6LPG, 6S, 2LV, 3LVB, 3LVC, 3LVRB, 3LVRC) require an interface to phantom power or special battery powering.

SPECIAL-PURPOSE ACCESSORIES:

Crown Boundary Booklet: The Crown Boundary Booklet is intended to be a useful tool for the serious PZM microphone user who is interested in special-purpose, high-performance boundaries.

There are possiblities for special purpose boundaries that make a PZM mike useful in numerous conditions. There are stereo configurations, special directional configurations, etc. A number of these special configurations are discussed in the Boundary Booklet. Hints on construction of the boundaries are discussed. And performance of a microphone used as a PZM with each of these special boundaries is also shown. A history of the development is also discussed, along with a brief discussion of PZM theory and application.

A240: A 2' x 2' clear acrylic boundary attached to a yoke that allows mounting to a microphone stand. The A240 is used in conjunction with PZMs to create a large boundary for improved-low frequency response and directionality.

ASA1: Microphone stand adapter for the PZM-180.

CM-1: Used in conjunction with the ASA1 to mount the PZM 180 to a video camera.

RMP Kit: Rack mount kit for PH-4 or PH-4S.

WINDSCREENS:

WS-1: Special windscreen for the PCC-160 series. Attaches over the PCC with supplied Velcro™ tabs and provides good wind protection in moderate winds.

PZM Windscreen: Standard accessory with most PZMs, intended for use in outdoor conditions.

GLM-WS2: Spherical windscreen for GLM mikes provides 14 dB wind rejection.

GLM-WS3: Sock-style windscreen for GLM mikes; provides less wind protection than the WS2, but is visually unobtrusive. The WS3 is intended for headset or boom-mike use.

WS-4: Foam windscreen for CM series hand-held mikes.

TECHNICAL LITERATURE:

Crown provides support literature for microphone use and special functions. To help the end user solve microphone-related problems, we offer the following tools:

- Technical bulletins covering special microphone modifications.
- Application notes for various recording and reinforcement situations.
- The Mike Memo, a quarterly publication giving tips in mike use.

CROWN MICROPHONE THEORY AND APPLICATIONS GUIDE

I. INTRODUCTION

This guide was written by Crown application and development engineers to explain the Pressure Zone Microphone® (PZM®), the Phase Coherent Cardioid® (PCC®) and the GLM™: what they are, what they do, and how they're used. We think you'll find these microphones to be useful tools for the solution of many microphone-related problems.

II. BACKGROUND

The Pressure Zone Microphone is a miniature condenser microphone mounted face-down next to a sound-reflecting plate or boundary. The microphone diaphragm is placed in the "Pressure Zone" just above the boundary where direct and reflected sounds combine effectively in-phase over the audible range. The benefits are a wide, smooth frequency response, excellent clarity and "reach," and little or no off-axis coloration. Let's explore the reasons behind this microphone configuration.

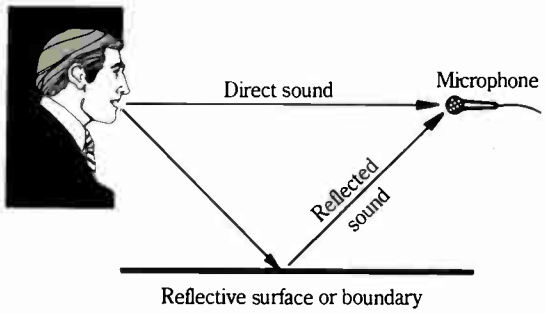
In many recording and reinforcement applications, the sound engineer is forced to place microphones near hard reflective surfaces. Some situations where this might occur are recording an instrument surrounded by reflective baffles, reinforcing drama or opera with the microphones near the stage floor,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

In these situations, sound travels from the source to the microphone via two paths: directly from the source to the microphone, and reflected off the surface. At the microphone, the delayed sound reflections combine with the direct sound, resulting in phase cancellations of various frequencies (Fig. 1). There is created a series of peaks and dips in the net frequency response called a "comb-filter effect." This colors the recorded tone quality, giving an unnatural sound.

To avoid the tonal coloration caused by microphone placement near a surface, a new microphone was developed especially for on-surface mounting: the Pressure-Zone Microphone (PZM). Its microphone diaphragm is arranged parallel with and very close to the reflecting surface, so that the direct and reflected waves combine at the diaphragm in-phase over the audible range (Fig. 2).

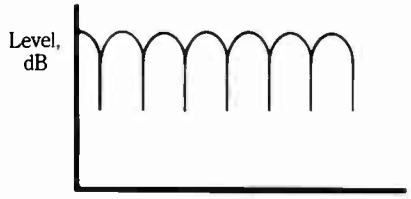
This arrangement provides several benefits:

- Wide, smooth frequency response (natural reproduction) – due to the lack of phase interference between direct and reflected sound.
- A 6-dB increase in sensitivity – due to the coherent addition of direct and reflected sound.
- High signal-to-noise ratio – owing to the PZM's high sensitivity and low internal noise.
- A 3-dB reduction in reverberation pickup compared to a conventional omnidirectional microphone – a clearer sound.
- Lack of off-axis coloration – a result of the sound entry's small size and radial symmetry.
- Good-sounding pickup of "off-mike" instruments – due to the lack of off-axis coloration.



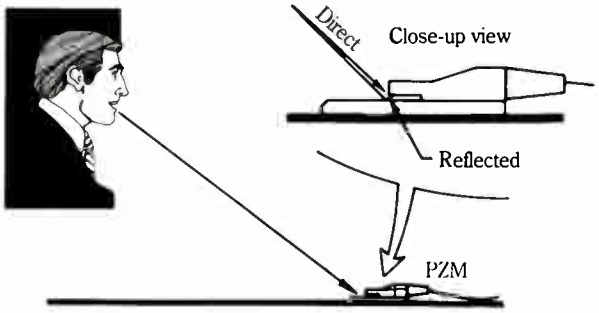
Reflective surface or boundary

Microphone receiving direct sound and delayed reflected sound from a sound source.

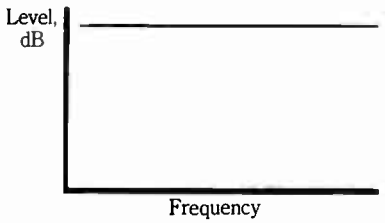


Resulting frequency response.

Fig. 1



PZM receiving direct sound and reflected sound simultaneously.



Resulting frequency response.

Fig. 2

- Identical frequency response for random-incidence sound (ambience) and for direct sound – due to the lack of off-axis coloration.
- Consistent tone quality regardless of sound-source movement or microphone-to-source distance – a result of the above benefits.
- Excellent "reach" (clear pickup of quiet distant sounds) – due to the above benefits.
- Hemispherical polar pattern – equal sensitivity to sounds coming from any direction above the surface plane.
- Inconspicuous mounting and reduced "mike fright" – a benefit of the low-profile design.

For a complete explanation of how the PZM achieves all these advantages, see the "THEORY" section at the end of this application guide.

The Phase Coherent Cardioid (PCC) is a surface-mounted supercardioid microphone with many of the same benefits as the PZM. Unlike the PZM, however, the PCC uses a subminiature supercardioid mike capsule, Its directional polar pattern improves gain-before-feedback, reduces unwanted room noise and acoustics, and rejects sounds from the rear.

The PCC mike capsule is small enough to ensure phase coherency up to the highest frequencies in the audible spectrum, resulting in a wide, smooth frequency response free of phase interference. In contrast, the mike capsules in conventional microphones are relatively large. As a result, reflections are delayed enough to cancel high frequencies and produce a dull sound.

Technically, the PCC is not a Pressure Zone Microphone. The diaphragm of a PZM is parallel to the boundary; the diaphragm of the PCC is perpendicular to the boundary. Unlike a PZM, the PCC "aims" along the plane on which it is mounted. In other words, the main pickup axis is parallel with the plane.

III. CONTROLLING THE BOUNDARY MICROPHONE'S LOW-FREQUENCY RESPONSE

The low-frequency response of the PZM or PCC depends on the size of the surface it's mounted on. The larger the surface, the more extended the low-frequency response. When a PZM or PCC is mounted on a surface, the low-frequency response shelves down to a level 6 dB below the mid-frequency level. The response is down 6 dB at the frequency where the wavelength is about 6 times the boundary dimension. For example, the frequency response of a PZM on a 2′ x 2′ panel shelves down 6 dB below 94 Hz. On a 5″ x 6″ plate, the response shelves down 6 dB below about 376 Hz.

For best bass and flattest frequency response, place the PZM or PCC on a large hard boundary such as a floor, wall, table, or baffle at least 4′ x 4′. To reduce bass response, mount the PZM or PCC on a small plate well away from other reflecting surfaces. This plate can be made of thin plywood, masonite, or clear plastic.

The PCC includes a BASS TILT switch which allows the user to tailor the low-end response for particular applications.

A PZM or PCC used on a carpeted floor should be placed on a hard-surfaced panel at least 1′ square for flattest high-frequency response.

IV. SHAPING THE PZM'S POLAR PATTERN

The PZM picks up sounds arriving from any direction above the surface it is mounted on. But it's often necessary to discriminate against sounds arriving from certain directions. For a floor-mounted PZM, you can make the microphone directional (reject sounds from the rear) by mounting the cantilever in a "corner" boundary made of ¼″ thick plexiglass. The larger the boundary, the better it discriminates against low-frequency sounds from the rear.

A corner boundary 18″ tall by approximately 24″ wide is recommended. It is nearly invisible to the audience.

Alternatively, use a PZM designed for directional pickup, such as the PZM-2.5. In this microphone, the cartridge is mounted next to three reflective surfaces. Sounds from the front are emphasized (especially in the speech range of frequencies); sounds from the rear are rejected.

For best results, try a Crown PCC. It has a supercardioid microphone capsule, rather than baffles, to reject sound from the rear.

A boom-mounted or suspended PZM can be taped to the center of a 2′ x 2′ or 4′ x 4′ panel, ¼″ thick. Place the microphone 4″ off-center for a smoother frequency response. Using clear acrylic plastic (plexiglass) makes the panel nearly invisible from a distance. (A 2′ x 2′ plexiglass panel and stand adapter are available from Crown – the A240.) If the edges pick up light, tape or paint the edges black.

Sounds approaching the front side or microphone side of the panel from any direction are picked up; sounds approaching the rear of the panel are rejected. High frequencies are rejected better than low frequencies. The polar pattern varies from omnidirectional at low frequencies to hypercardioid and supercardioid at high frequencies.

Place the panel in front of or slightly above the performer, with the microphone side of the panel toward the performer. Another possibility is to place the panel on the floor, tilted up to aim at the performer, with the capsule as close as possible to the junction of the floor and the panel. Panels can also be placed over the instrumental sections within a large ensemble.

For stereo pickup, mount two PZMs on opposite sides of a 2′ x 2′ or 4′ x 4′ panel. This forms a Bipolar PZM. Aim the edge of the panel at the center of the sound source (as in Fig. 3).

Bipolar PZM (Stereo plate)
edge view
Fig. 3

The **PZM Boundary Booklet,** available from Crown, is an experimenter's guide to building PZM boundary assemblies. Boundary theory and applications are covered in great detail for those who like to experiment with shaping the polar pattern.

V. MICROPHONE-TECHNIQUE BASICS

1. Before placing microphones, work on the "live" sound of the instrument or ensemble to be recorded. Do what you can to improve its sound in the studio.

2. To determine a good starting microphone position, close one ear with your finger; listen to the instrument with the other ear, and move around until you find a spot that sounds good. Put the PZM there, or put it on the floor or table at that distance.

3. Moving the microphone around the instrument will vary the tone quality, because an instrument radiates a different spectrum in every direction. Place the PZM to get the desired tone quality, then use equalization only if necessary. Note that the response of the PZM does not change with the angle of incoming sound, but the spectrum of the instrument does change depending on how it is aimed at the PZM.

4. To reduce pickup of room acoustics, leakage from other instruments, background noise, and feedback, move the PZM closer to the sound source. Mike only as close as necessary, since too-close placement may result in an unnatural tonal balance. Move the PZM farther from the source to add ambience or "artistic leakage" to the recording.

5. To further reduce pickup of unwanted sounds, mount the PZM on a large baffle or panel placed between the PZM and the offending noise source.

6. Use the smallest number of microphones that provide the desired sound; use as few as necessary. Sometimes this can be done by covering several sound sources with a single microphone. The wide polar pattern of the PZM allows you to pick up several instruments or vocalists on a single microphone with equal fidelity.

7. Follow the 3:1 rule: When multiple microphones are mixed to the same channel, the distance between microphones should be at least three times the mike-to-source distance. This procedure reduces phase interference between the microphones. For example, if two microphones are each placed 2 feet from the instruments they cover, the microphones should be at least 6 feet apart.

8. PZMs used in multiple-microphone applications may pick up a lot of **leakage** ("off-mike" sounds from other instruments). This leakage usually sounds good, however, owing to the PZM's uncolored off-axis response. Artistic usage of leakage can add a pleasing "liveness" to the recording.

9. When a PZM is mounted on a wall, the wall becomes a part of the microphone. When a PZM is mounted in a corner, then all three walls become part of the microphone. The Pressure Zones of all the walls combine to reinforce the sound pickup. Use this fact to your advantage by mounting the PZM capsule at the junction of multiple boundaries whenever possible.

VI. BOUNDARY MICROPHONE TECHNIQUES

The following are some guidelines for boundary-microphone placement in various applications. Many were provided by users. Although these techniques have worked well in many situations, they are just suggestions. Use PZMs unless a PCC is specified.

Acoustic guitar, mandolin, dobro, banjo:

- On panel in front, about 2 feet away, guitar height.
- On panel in front and overhead to avoid interference with audience viewing.
- On floor (for soloist).
- Use a Bipolar PZM for stereo (adds ambient spaciousness around a solo performer).
- PZM lavalier clipped to the guitar's sound hole between the hole and the bridge, or clipped to the banjo strings between the bridge and tailpiece. Reduces leakage and feedback.

String section:

- On panel above and in front of the entire section.
- Use a Bipolar PZM for stereo in the same position.
- On panel midway between every two instruments, about 6 feet high.
- For minimum leakage and feedback, use one PZM lavalier per instrument. Clip it to the strings between the bridge and tailpiece. Put stiff paper on the clip teeth to prevent damage to the instrument.

Fiddle or violin:

- Clipped to strings as above.
- On panel in front or overhead.
- On music stand.

Cello or acoustic bass:

- On panel on floor, in front, tilted toward performer.
- On panel in front and above.
- On floor (for soloist). You may want to use a PZM-2.5 here for better isolation.
- PZM lavalier clipped inside F hole by the high strings. Reduces leakage and feedback; provides excellent low-frequency response.

String quartet:

- Spaced pair on floor about 6 feet apart.
- Spaced pair on panels in front and above, spaced 3 to 6 feet apart.
- Bipolar PZM in front and above.

Harp:

- On panel about 2½ feet away, aiming toward treble part of sound board.
- PZM lavalier taped to sound board to reduce feedback and leakage.

Sax, flute, clarinet:

- On panel in front and slightly above.
- On music stand.

Horns trumpet, coronet, trombone:

- On wall, on hard-surfaced gobo, or on control-room window. Performers play to the wall or gobo a few feet away. Since their sound bounces off the wall back to them, they can hear each other well enough to produce a natural acoustic balance.
- On panel in front of and between every two players, 1 to 2 feet away.
- On music stand.
- Tuba – on panel overhead.

Grand piano:

- Tape a PZM to the underside of the lid in the middle. Put the lid on the long stick for best sound quality. To reduce leakage and feedback, put the lid on the short stick or close the lid and cover the piano with a heavy blanket.
- For stereo, use two PZMs taped under the lid – one over the treble strings near the hammers, one over the bass strings well away from the hammers. Microphone placement close to the hammers emphasizes attack; placement far from the hammers yields more tone.
- Tape two PZMs to the inside front edge of the piano (the audience side). Put one microphone near the treble strings and one near the tail. Or use two PZMs on opposite edges near the bass and treble strings.
- To pick up the piano and room ambience with a single microphone, place a PZM on a panel about 6 to 8 feet from the piano, 4 feet high. Put the lid on the long stick, and face the panel at the piano with the panel parallel to the lid. For stereo, use a Bipolar PZM placed 8 to 10 feet high.
- To add ambience to a close-miked piano, mix in a PZM, or two placed on a wall far from the piano.
- For singers who accompany themselves on piano, mount two PZMs on opposite sides of a panel (like a Bipolar PZM). Place the panel about where the music rack would be. For stereo, use a longer panel with two microphones on each side of the panel.

Amplifier/speaker for electric guitar, piano, bass:

- On panel in front of amp.
- On floor a few feet in front of amp. For an interesting coloration, add a panel a few feet behind the microphone.
- Inside cabinet.

Leslie organ cabinet:

- Two PZMs on either side of the rotating horn, inside the top of the cabinet. Place another PZM inside the bottom of the cabinet.

Drum set:

- On panel or hard gobo, 1 to 2 feet in front of set, just above the level of the tom-toms. Use two microphones 3 feet apart for stereo. The drummer can balance the sound of the kit as he or she plays. Also place a small-plate PZM in the kick drum against the shell, with a pillow or blanket pressing against the beater head. The high sound pressure level will not cause distortion in the PZM's signal.

• On panel or Bipolar PZM centered overhead about 1 foot above the drummer's head. Also use a standard PZM in the kick drum.
• Try two PZMs overhead, each mounted on a 1-foot-square panel, angled to form a "V," with the point of the "V" aiming down.
• Two PZMs on a hard floor, about 2 feet to the left and right of the drummer.
• Tape a PZM to a gauze pad and tape the pad to the kick drum beater head near the edge. This mike will also pick up the snare drum.
• Use a PZM lavalier clipped to the drummer's shirt, plus a mike in the kick drum.

Percussion:
• Use a PZM lavalier or regular PZM strapped to the chest of the player. The microphone is carried by the percussionist as he or she moves from instrument to instrument.

Xylophone, marimba, vibraphone:
• On floor underneath instrument. Use two for stereo under bass and treble sides.
• Use two on panels above instrument, over bass and treble sides.

Lead Vocal:
• In the studio, mount a PZM on a wall, control-room window, panel or floor a few feet in front of the performer. The panel can be used in place of a music stand to hold the lyric sheet. Use the supplied foam windscreen to prevent "popping" sounds from the letter "p."
• To reduce leakage into the vocal mike, (1) overdub the vocal, (2) use gobos, or (3) use a well-damped isolation booth with one hard wall to mount the PZM on. **Note:** The PZM does not have proximity effect (up-close bass boost). Use console EQ to add extra warmth if necessary.
• Place a PZM on a panel, on the floor, angled up toward the performer.
• Use a PZM lavalier or a regular PZM on the singer's chest.

Background harmony vocals:
• On wall, panel, or floor.
• Use a Bipolar PZM with singers surrounding the panel.
• Use one or two on both sides of a gobo, with singers surrounding the gobo.

Combos, small groups:
(For small musical groups with a good natural acoustic blend, such as bluegrass, blues groups, or barbershop quartets.)
• On floor – two for stereo.
• On panels in front, or on panels on the floor, angled toward performers.
• Use a Bipolar PZM in front of the group.
• On rear wall of stage with group facing rear wall.

Drama, theater, opera:
• Try one to five PCCs across the front edge of the stage, about 1 foot from the edge of the stage. One or two PCCs are usually sufficient for small stages, and they clearly pick up stage action for dressing-room cues. Place two PCCs about 20 feet apart; place three PCCs about 15 feet apart.

For maximum clarity and maximum gain before feedback, turn up only the microphone nearest the person talking.

Show the performers and the custodian where the PCCs are located so the PCCs aren't kicked or mopped.

The excellent "reach" of the PCC provides clear pickup of rear-stage action in most cases. But if you need extra reinforcement, place PZMs on the rear wall, on panels overhead, in a pyramid overhead, on a table under a tablecloth, behind posts, under eaves, or on moveable scenery (plugged into a wireless transmitter).

Opera singers can be picked up realistically with a PZM on the floor, or on a panel on the floor angled up toward the performer.

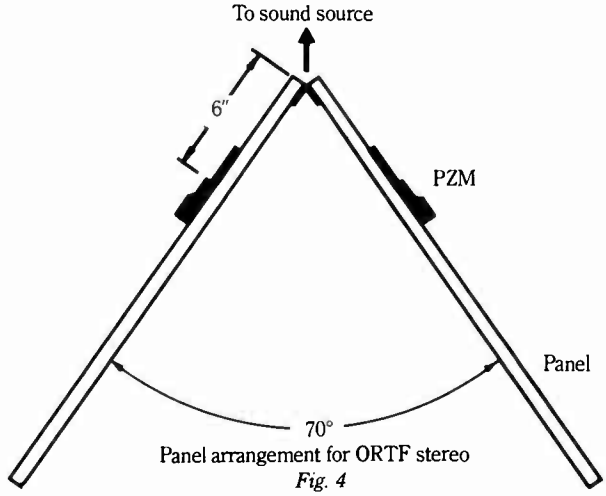
Orchestra pit:
• Tape two PZMs to the wall on either side of the conductor's podium, about 20 feet apart, facing each section of the orchestra.
• Use a separate PZM on a panel for each section of the orchestra.

Orchestra, marching band, jazz ensemble, pipe organ:
These large sound sources typically are recorded at a distance, using two microphones for stereo pickup. Three stereo miking systems will be described here: (1) near-coincident miking using a single panel, (2) near-coincident miking using two panels, and (3) spaced-pair miking.

Near-coincident stereo (using a single panel):
With this technique, the stereo effect is created mainly by intensity or level differences between channels, and partly by time differences between channels. The closer the panel is to the musical ensemble, the wider the stereo spread.
• Mount two PZMs back-to-back on opposite sides of a panel (forming a Bipolar PZM). Aim the edge of the panel at the center of the sound source. Place the panel about 5 to 20 feet behind the conductor, 14 feet high. The farther from the ensemble the microphones are placed, the greater is the pickup of hall reverberation or ambience. Adjust the microphone-to-source distance for the desired effect.
• Place the Bipolar PZM about 20 feet over the conductor.
• Place the Bipolar PZM on the floor, on edge, with the PZM elements at the junction of the floor and vertical panel.

Near-coincident stereo (ORTF, NOS):
This arrangement employs both intensity and time differences between channels. It tends to provide sharp imaging and accurate localization. The ORTF system uses two cardioid microphones angled 110 degrees apart and spaced 7 inches apart horizontally. The NOS system sets the angle at 90 degrees and the spacing at 12 inches.

To provide near-coincident stereo pickup with a pair of PZMs, proceed as follows:
• Mount a PZM 6 inches from the edge of a large panel. Mount another PZM similarly on another panel. Tape together the panel edges nearest the microphones, forming a "V." Aim the point of the "V" at the center of the sound source. Angle the panels about 70 degrees apart (as in Fig. 4). Vary the angle to change the stereo spread.



Panel arrangement for ORTF stereo
Fig. 4

Spaced-pair stereo:
In spaced-pair recording, the stereo effect is created mainly by time differences between channels. The images produced by spaced-pair miking are not as well-defined as those of coincident or near-coincident methods. However, spaced-pair miking sometimes can provide a "warm" sense of ambience surrounding the listener.

- Place two panel-mounted PZMs about 6 to 20 feet apart, 14 feet high, and 5 to 20 feet from the first row of players. Place the microphones farther apart to widen the stereo spread; closer together to narrow the spread.
- Place two PZMs on the floor about 4 to 10 feet apart, 10 to 15 feet from the first row of players. If the stereo spread is exaggerated, add a center fill microphone midway between the other pair, and mix its output to both channels. This is an inconspicuous arrangement for live concerts.
- Sound reinforcement may require an extra PZM for certain sections or soloists that need to be emphasized. A "spot" mike for woodwinds can be on the floor, for brass on the back stage wall, and for strings on a panel above the section.
- For non-critical documentary recordings. PZMs can be taped to the proscenium arch, the back stage wall, or the floor in front of the ensemble.

Choirs:

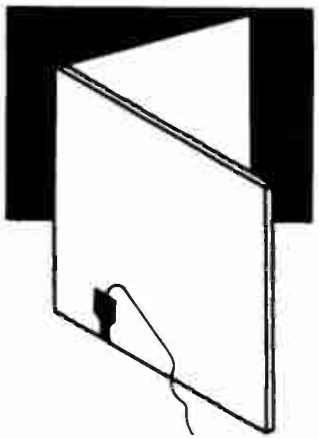
- Use a Bipolar PZM above and in front of the choir.
- Try two PZMs on panels above and in front of the choir. Coverage is wide and the response is uncolored off-axis.
- For sound reinforcement, use one microphone for every 100 singers.
- For small choirs singing in an open area, place PZMs or PCCs on the floor in front of the group.
- For choirs seated on one side of a church chancel facing the other side of the chancel, mount a PZM on the wall opposite the choir.

Ambience:

- One or two PZMs on the walls give an uncolored sound.
- One or two PZMs on the walls of an echo chamber provide ambient richness and naturalness.

Audience:

- On panels suspended over left and right sides of audience.
- On side walls near the front of the auditorium, 10 to 15 feet up. These arrangements provide clear, realistic pickup of audience reaction.



Near-coincident-stereo arrangement on floor
Fig. 5

This assembly can be suspended, or can be placed on edge on the floor, with the PZMs at the junction of the floor and the vertical panels (as in Fig. 5).

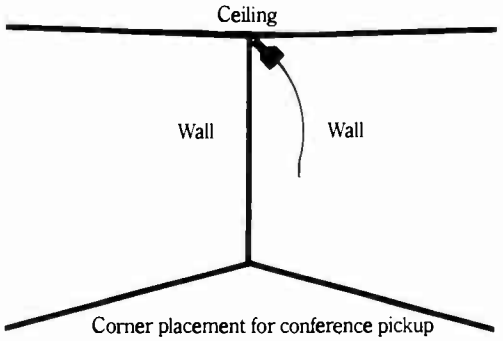
- For audience interviews, have the interviewer wear a PZM lavalier. The interviewer faces the interviewee for pickup, instead of pushing a microphone at them. This also prevents interviewees from grabbing the microphone.

Altar:

- Place a PZM or PCC on the altar table (perhaps under the tablecloth) to pick up speech at the altar.

Conferences, teleconferences, roundtable discussions, interviews:
For maximum clarity, hold the conference in an acoustically "dead" room with carpeting, acoustic-tile ceiling and drapes.

- Lay a single PZM in the middle of the table.
- For more control and less pickup of reverberation, use one PZM on the table in the middle of every 4 to 6 people. No person should be more than 3 feet from the nearest microphone.
- For permanent installations, use the PZM-20RMG, a recessed microphone with all electronics and cabling under the table. Before installing it, first check that the pickup will be adequate by testing a regular PZM lying on the table.
- If table placement is undesirable, remove the capsule and its holder by removing the screws on the underside of the plate. Save the screws and plate for possible re-assembly. In some units there is a small piece of foam under the capsule for acoustical adjustment; save it too.



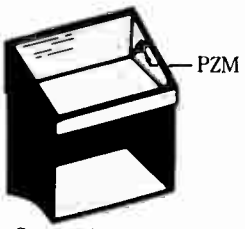
Corner placement for conference pickup
Fig. 6

Install the capsule/holder in an upper corner of the room as in Fig. 6. This arrangement increases microphone output by 12 dB and gives surprisingly clear reproduction. Large rooms may require such a pickup in all four corners.

Note: If you need to return the PZM for service, re-attach the capsule/holder to the plate. The plate contains the identification number necessary for warranty service.

Lectern:

- Use a PZM lavalier clipped to the talker's tie or shirt.
- Place a PCC on the lectern shelf top, out of cavities. If the lectern has a raised edge, place the PCC at least twice as far from the edge as the edge is high. Set the BASS TILT switch to FLAT or BOOST, according to your preference.



Corner placement for lectern
Fig. 7

• For lecterns with raised edges, you can modify your PZM as follows: Remove the capsule holder by removing the two screws on the underside of the plate. See the precautions mentioned above under "Conferences." Mount the capsule holder in the corner of the recess, with the holder pointing into the corner (as in Fig. 7). This configuration makes the pickup more directional but allows less talker wandering.

Courtrooms:

• A PZM on the bench or witness stand can be permanently mounted and permits freedom of movement without lost speech. It provides excellent clarity and intelligibility. It also is far less intimidating to the witness than traditional microphones.

Sound effects:

• A Bipolar PZM provides realistic pickup in many instances. It "tracks" the motion of moving sound sources more accurately than a spaced pair of microphones does.

Sports events:

Basketball –

• On the basketball backboard under the hoop to pick up the sound of the ball hitting the backboard.

• On the floor just outside the boundary at center court to pick up foot and ball noises and audience reaction.

• On a 2'x 2' panel suspended over center court, using two PZMs on either side for stereo pickup.

Football –

• A PZM pyramid aimed at the field clearly picks up the quarterback calling the plays.

Boxing –

• Mount a PZM on a corner post or on a panel overhead.

Bowling –

• Place a PZM on the back wall of the alley, high enough to avoid being hit, to pick up the pin action.

Golf –

• Try a PZM on the ground near the tee. Insulate the mike from the ground to avoid ground loops.

Indoor sports –

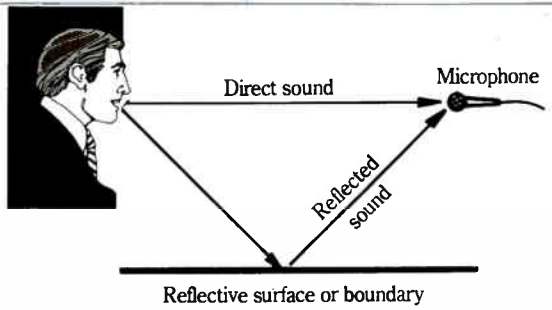
• Sports such as weight-lifting or fencing can be picked up with a PZM on the floor.

VII. BOUNDARY-MICROPHONE THEORY

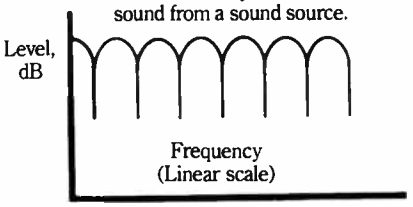
When a microphone is placed near a reflective surface, sound travels to the microphone via two paths: (1) directly from the sound source to the microphone, and (2) reflected off the surface (as in Fig. 8). Note that the reflected sound travels a longer path than the direct sound, so the reflected sound 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 wavelengths. 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. Fig. 9 illustrates this point.

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 call a **comb-filter effect**, so named because the response looks like the teeth of a comb (Fig. 10).

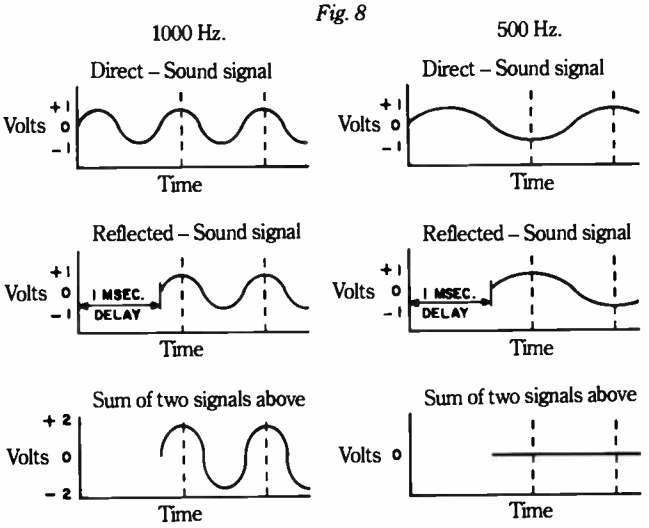


Microphone receiving direct sound and delayed reflected sound from a sound source.



Resulting frequency response.

Fig. 8



Example of wave addition and cancellation at two different frequencies

Fig. 9

This bumpy frequency response colors the tonal reproduction, 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 is placed on the reflective surface (as in Fig. 10), 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. Consequently, the high frequencies may be cancelled, giving a dull sound quality.

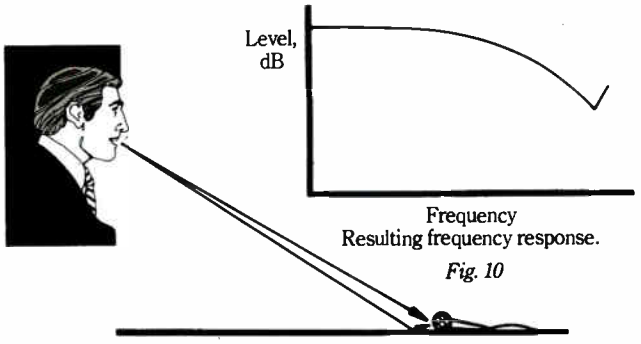
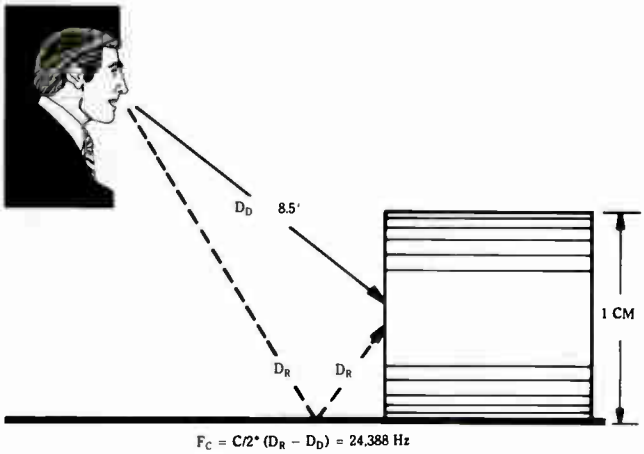


Fig. 10

Conventional microphone on floor receiving direct sound and slightly delayed reflected sound.

In a Crown PCC, the microphone diaphragm is small enough so that any phase cancellations are above the audible range (Fig. 13).

By orienting the diaphragm **parallel** with the boundary (as in PZM, Fig. 2), the diaphragm can be placed as close to the boundary as desired. Then the direct and reflected waves arrive simultaneously at the microphone sound entry (the slit between the microphone diaphragm and the boundary). Any phase cancellations are moved outside the audible band, resulting in a smooth frequency response.



PCC receiving direct sound and reflected sound simultaneously.

Fig. 11

The technique of mounting a microphone in this manner is called the **Pressure Recording Process™** (invented by Ed Long and Ron Wickersham). They developed the first microphone to use this process. The first manufactured microphone using the principle was the Pressure Zone Microphone (developed by Ken Wahrenbrock). PZMs are now manufactured by Crown International, the first company licensed to build microphones using the Pressure Recording Process.

The Pressure Zone® is the region next to the boundary where the direct and reflected waves add in-phase (or nearly so). There may be a slight phase shift between the direct and reflected waves, as long as the frequency response is not severely degraded.

The Pressure Zone can be defined another way: The Pressure Zone is the distance from the boundary that the microphone diaphragm must be placed to achieve the desired high-frequency response. The closer the diaphragm is placed to the boundary (up to a point), the more extended is the high-frequency response. Let's show some examples.

For a frequency response down a maximum of 6 dB at 20 kHz, the mike-to-boundary spacing should be .11". Or you could say the Pressure Zone is .11" thick. This spacing corresponds to ⅙ wavelength at 20 kHz.

For a response down 3 dB maximum at 20 kHz, the spacing should be .085" (⅛ wavelength at 20 kHz).

For a response down 1 dB maximum at 20 kHz, the Pressure Zone is .052" thick (⅓ wavelength at 20 kHz).

Note that the thickness of the Pressure Zone is an arbitrary number depending on frequency. For example, the direct and reflected waves of a 100-Hz tone are effectively in-phase within a Pressure Zone 10" thick.

Pressure doubling

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 increase in acoustic level at the microphone. Thus the effective microphone sensitivity increases 6 dB, and the signal-to-noise ratio also increases 6 dB.

Consistent tonal reproduction independent of source height

The microphone placements shown in Figs. 10 and 12 cause another problem in addition to rough response. As the sound source moves up or down relative to the surface, the reflected path length changes, which varies the comb-filter notch frequencies. Consequently, the effective frequency response changes as the source moves.

But with the PZM, the reflected path length stays equal to the direct path length, regardless of the sound-source position. There is no change in tone quality as the source moves.

Lack of off-axis coloration

Yet another problem occurs with conventional microphones: off-axis coloration. While a microphone may have a flat response to sounds arriving from straight ahead (on-axis), it often has a rolled-off or colored response to sounds arriving from other directions (off-axis).

That fault is mainly due to the size of the microphone and its forward orientation. When sound strikes the microphone diaphragm on-axis, a pressure boost occurs at frequencies where the wavelength is comparable to the microphone diameter (usually above about 10 kHz). This phenomenon is called **diffraction.** Sounds approaching the microphone from the sides or rear, however, do not experience a pressure boost at high frequencies. Consequently, the high-frequency response is greater on-axis than off-axis. The frequency response varies with the position of the sound source.

Since the PZM cartridge is very small, and because all sound enters the cartridge through a tiny radially symmetric slit, the response stays constant regardless of the angle at which sound approaches the microphone. The effective frequency response is the same for sounds from the front as it is for sounds from other directions. In other words, there is little or no off-axis coloration with the PZM. The reproduced tone quality doesn't change when the sound source moves.

As a further benefit, the PZM has an identical frequency response for random-incidence sound as it has for direct sound. **Direct sound** is sound traveling directly from the source to the microphone: **random-incidence sound** is sound arriving from all directions randomly. An example of random-incidence sound is **ambience** or **reverberation** – sounds reflected off the walls, ceiling, and floor of the recording environment.

With most conventional microphones, the response to reverberant, random-incidence sound is rolled off in the high frequencies compared to the response to direct sound. The direct sound may be reproduced accurately, but the reproduced reverberation may sound duller than in real life.

This fact leads to some problems in recording classical music with the microphones placed far enough away to pick up concert-hall ambience. The farther from the sound source the microphone is placed, the more reverberant is the sound pickup, and so the duller the sound is. The effective microphone frequency response may become duller (weaker in the high frequencies) as the microphone is placed farther from the sound source.

This doesn't occur with the PZM when it's used on the floor. The effective response stays the same regardless of the mike-to-source distance. The response to ambient sound (reverberation) is just as accurate as the response to the direct sound from the source. As a result, the total reproduction is brighter and clearer.

Reach

"Reach" is the ability to pick up quiet distant sounds clearly. "Clearly" means with a high signal-to-noise ratio, a wide smooth frequency response, and a high ratio of direct sound to reverberant sound.

As described earlier, the PZM has several performance attributes that contribute to excellent "reach." The signal-to-noise ratio is high because the cartridge is inherently quiet, and because the signal sensitivity is boosted 6 dB by the on-surface mounting. The frequency response is wide and smooth because comb filtering is eliminated, and because reverberant sound is picked up with a full high-frequency response. The direct-to-reverberant sound ratio is high because the direct sound is boosted 6 dB near the surface, while the reverberant sound, being incoherent, is boosted only 3 dB.

Because of its supercardioid polar pattern, the PCC has nearly a 6-dB higher direct-to-reverb ratio than the PZM; consequently, distant sources sound closer and clearer with the PCC than with the PZM.

If the PZM element is mounted in a corner, the direct sound is boosted 18 dB, while reverberant sound is boosted only 9 dB. This gives the PZM a 9-dB advantage over a conventional omnidirectional microphone in the ratio of direct sound to reverberant sound. In other words, distant sources sound "closer" and "clearer" with the PZM than they do with a conventional omnidirectional microphone.

Low vibration sensitivity

The low mass and high damping of the PZM diaphragm make it relatively insensitive to mechanical vibrations such as table and floor thumps and clothing noise. The only pickup of these sounds is acoustic pickup through the air, not mechanical pickup through the microphone housing.

Small size

In addition to the acoustic benefits of the PZM, there are psychological benefits related to its low-profile design. Its inconspicuous appearance reduces "mike fright." Since the PZM does not "point" at the performers, they may feel a psychological release in not having to aim their instruments at the microphone.

PZMs can be hidden in theatre sets. In TV-studio applications, the PZM practically disappears on-camera. PZMs reduce clutter on conference tables and lecterns, giving the feeling that no microphones are in use.

USING THE PZM AWAY FROM THE PRIMARY BOUNDARY

Although the Pressure Zone Microphone was originally intended to be placed on the nearest large reflective surface (the **primary boundary**), it can be suspended in mid-air on a microphone stand and be used in a "free field." Several interesting effects occur, such as diffraction, low-frequency shelving, and increased directivity. Let's discuss these in detail.

Diffraction

Diffraction is the disturbance of a sound field by an obstacle, such as a boundary or hard reflective panel. At the boundary surface, the pressure is boosted at frequencies having a wavelength on the order of the boundary dimensions. For example, a 1-foot diameter disc boosts the level of frequencies around 1000 Hz, creating a broad peak in the frequency response at 1000 Hz. This pressure boost is greatest for sounds arriving at normal incidence; sounds arriving at grazing incidence are not boosted. For a square boundary, the peak occurs at frequency $f = 994/D$, where D is the boundary dimension in feet.

When sound waves strike the boundary, new sound waves are generated at the boundary edge. They travel to the center of the boundary where they interfere with incoming sound waves, producing peaks and dips in the frequency response. The closer the sound source is to the panel, the smaller the peaks and dips; because the direct sound prevails over the edge disturbances.

The response peak caused by diffraction can be considered either as a coloration or an enhancement, depending on whether or not you like the effect. Diffraction can be used as an equalizer with minimal phase shift.

A circular plate has the roughest response because the distance from the edge to the microphone is the same in all directions. A flatter response is obtained with a square panel, and the flattest response is achieved with a rectangular panel. Aiming the panel slightly away from the sound source, rather than directly at it, will also smooth the response. It also helps to place the PZM capsule about 4" off-center.

Note that the roughest response occurs only for direct sound approaching the panel from in front (at normal incidence). If the panel is used at a distance from a musical ensemble, reverberant sound reflections from the room surfaces approach the panel from all directions. Consequently, the net response to the total sound field is much smoother than the response to sound approaching only from the front. Or, if the panel is used as part of a Bipolar PZM, **none** of the direct sound from the sound source approaches the panel at normal incidence, so the response is quite smooth.

Low-frequency shelving

If the boundary is sufficiently small, pressure doubling occurs at mid-to-high frequencies. In effect, there is created a low-frequency rolloff or shelf. At frequencies whose wavelength is greater than 6 times the boundary dimensions, the frequency response is down about 6 dB. The boundary acts as a low-frequency shelving filter, with the response down about 6 dB at $f = 188/D$, where D = the boundary dimension in feet.

The larger the boundary to which the PZM is attached, the more extended is the low-frequency response. Big boundary = big bass; small boundary = small bass.

The PZM has the flattest low-frequency response when mounted on a large surface such as a floor or wall. A 4′ x 4′ panel gives adequate bass for most applications. The closer the sound source is to the panel, the more bass is heard. This is because the direct sound prevails over the edge disturbances, which would otherwise partially cancel the low frequencies.

Increased directivity

Sounds approaching the microphone side of the boundary are picked up more strongly than sounds approaching the sides or rear of the boundary. Sounds from the rear are rejected more or less depending on frequency. The bigger the boundary, the lower the frequencies that are rejected from the rear.

For example, a 2′ x 2′ panel rejects sound from the rear by 3 dB at 125 Hz, 10 dB at 500 Hz, and greater than 20 dB at 10 kHz. Given a square panel, the rear rejection is 10 dB at f = .88C/D, where C = the speed of sound and D = the panel dimension. Rejection is 3 dB at f = .22C/D, and greater than 20 dB at high frequencies.

The polar pattern created by diffraction is omnidirectional at low frequencies (below f = 188/D). The pattern becomes hypercardioid and supercardioid at mid-to-high frequencies. At the highest frequencies the pattern approaches a hemisphere, with response down 6 dB at the sides of the boundary. In general, the greatest rear rejection occurs at 150 degrees, not at 180 degrees.

Comb filtering from primary-boundary reflections

The best place for a PZM to avoid phase interference is on the primary boundary (the nearest large reflective surface). Some comb filtering can occur if a PZM and panel are raised above the floor, due to delayed reflections off the floor. However, owing to the pressure-doubling effect of the panel, the PZM still benefits from the increase in sensitivity, signal-to-noise ratio, and "reach."

GLM APPLICATION NOTES

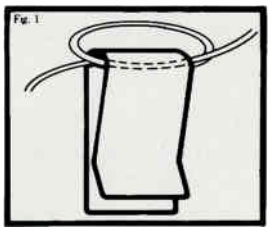
Detailed GLM Application Notes for various applications are available from your Crown dealer. Here are some suggested starting placements for the GLM. Experiment to find a position that pleases your ears.

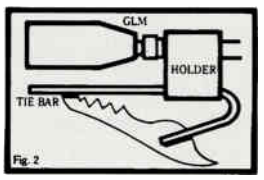
If the GLM model is not specified, you can use either one. Use the GLM-100 omni for extended low-frequency response, less thump pickup and higher SPL capability. Use the GLM-200 hypercardioid to reject leakage, room acoustics, and unwanted sounds behind the microphone.

LAVALIER – To use the GLM as a lavalier, proceed as follows:

1. Remove the lavalier accessories packed with the microphone. These include a GLM-TM Tie Mount and Belt Clip. You may want to order the optional GLM-TT Tie Tac.

2. Wrap the mike cable around the belt clip (one complete loop) about 2 feet from the microphone and pull snug. See Fig. 1.





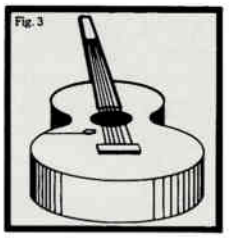
3. Press the belt clip onto the belt, or place it in the pocket.

4. Press the mike holder onto the tie bar or tie tac as shown in Fig. 2. The mike holder comes already mounted on the tie bar.

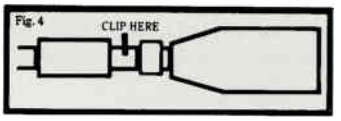
5. Attach the tie bar or tie tac about eight inches under the chin.

6. Put the GLM flex relief in the tie-bar holder as in Fig. 2, with the front of the microphone aiming at the mouth. The front of the microphone is indicated by the word "FRONT" on the microphone housing. Experiment with aiming for loudest sound reproduction.

ACOUSTIC GUITAR (RECORDING) — Use the double-sided tape to attach the GLM-SM Surface Mount to the guitar. Tape the mount between the sound hole and the bridge near the low E string (as in Fig. 3), or under the strings. Insert the GLM-100 face down into the GLM-SM Surface Mount.



If you don't want tape on your guitar, attach the GLM-UM Universal Mount to the sound hole. Attach the other end of the clip to the GLM flex relief (as in Fig. 4). Aim the GLM-100 or 200 at the sound hole and position it a few inches away. Roll off the bass on your mixer until you obtain a natural tone quality.



ACOUSTIC GUITAR (SOUND REINFORCEMENT) – Tape the GLM-100 inside the guitar onto the surface nearest the performer, so that the mike can see the sound hole. Equalize for the desired tone quality.

DRUMS – For each drum in a drum set, tape the GLM-200 cable to a drum rim so the mike can see the drum head. Or clip the GLM-UM Universal Mount to the rim to hold the microphone. Take care to keep the mikes out of the drummer's way. For permanent, inconspicuous mounting, an optional GLM-DM Drum Mount is available from your Crown dealer.

For best isolation between a pair of rack toms, aim the rear null of each GLM-200 (about 120° off-axis) at the adjacent tom tom.

For extra isolation, tape a GLM-100 inside each tom tom near the end opposite the head.

Because of its superior low-frequency response, the GLM-100 omnidirectional microphone is recommended for kick-drum miking over the GLM-200. Damp the kick-drum head with a pillow or blanket. Tape the GLM-100 cable to the upper surface of the shell inside, and hang the microphone a few inches in front of the beater. Or feed the GLM through the vent hole in the kick-drum shell and tape the cable to the outer shell surface.

To mike the cymbals, position one or more GLMs about one foot over the edges of the cymbals, using microphone stands. Or use the optional GLM-CM Cymbal Mounts available from your Crown dealer. We recommend using the GLM™-100 omni with the GLM-CM Cymbal Mount to reduce vibration pickup, plus a low-frequency rolloff below 500 Hz.

DRUMS (THREE MICROPHONES) — See Fig. 5. Tape or clip one GLM-100 near the left rack tom and the snare drum. Aim the front of the mike at the hi-hat for best high-frequency reproduction. This GLM picks up the hi hat, snare, left rack tom, and cymbals. Tape or clip another GLM-100 near the right rack tom and the floor toms. This GLM picks up the right rack tom, floor tom, and cymbals. Experiment with placement to achieve a good balance. You may want to boost the bass slightly. Put another GLM-100 in the kick drum.

DRUMS (TWO MICROPHONES) — Clip on GLM-100 to the snare-drum rim, and position the mike in the center of the set (as in Fig. 6). With a little bass and treble boost, the sound is surprisingly good for such a simple pickup. Put another GLM-100 in the kick drum.

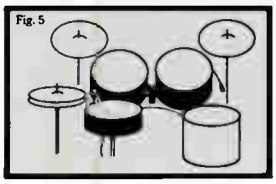


Fig. 5

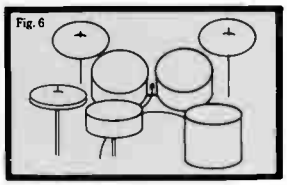


Fig. 6

FLUTE — Using tape or a rubber band, attach the GLM-100 by its cable 4" to one side of the lip plate, 1½" above the flute. Roll off high frequencies on your mixer if necessary to reduce breath noise.

SAX, BRASS – For a bright tone quality, clip the GLM-UM Universal Mount onto the bell, and position the mike a few inches in front of the center of the bell. A GLM-HM Horn Mount with a large, soft clip to prevent marring is available from your Crown dealer. For a mellow tone quality, tape the mike to the inside of the bell, a few inches in. The sax may sound best when miked near the tone holes. To do this, attach the GLM-UM Universal Mount to the bell (or to the sax hardware) and place the GLM over the bell near the tone holes.

WOODWINDS – Attach the GLM-UM Universal Mount to the bell, and position the GLM to pick up both the bell and the tone holes.

STRING BASS – For a full, deep tone, tape the GLM-100 near an f-hole. For a more-defined sound, tape the GLM-100 or 200 by its cable to the bridge or tailpiece.

GUITAR AMP – Tape the GLM-100 cable to the grille cloth in front of a speaker cone. A mike placement at the center of the cone sounds bright; a placement near the edge of the cone sounds more mellow.

GRAND PIANO

METHOD 1 — Raise the lid. Using the double-sided tape and GLM-SM Surface Mount, attach the GLM-100 inside the audience side of the piano so the mike can see the strings. Use two for stereo.

METHOD 2 — Using the double-sided tape and GLM-SM Surface Mount, attach the GLM-100 to the underside of the raised lid in the middle. Aim the front of the microphone at the lid. Use two for stereo. If you need more isolation, close the lid.

METHOD 3 – Raise the lid. Stretch some masking tape across the ribs of the sound board, about 8 inches from the hammers. Tape one GLM-200 cable onto the masking tape near the treble strings; tape another near the bass strings. Do not tape the microphone itself. Aim the front of the GLMs at the strings.

UPRIGHT PIANO

METHOD 1 – Remove the kick board in front of the piano to expose the strings. Tape the GLM cable under the keyboard so that the GLM is near the strings. Use one near the bass strings and one near the treble strings.

METHOD 2 — Using the double-sided tape and GLM-SM Surface Mount, attach the GLM-100 to the sound board. Experiment with position for best sound.

VIOLIN OR BANJO – Attach the GLM-UM Universal Mount to the tailpiece. Place the GLM a few inches from the banjo head or violin f-hole. Experiment with miking distance to get a good compromise between tone quality and isolation.

HARP — Using the double-sided tape and GLM-SM attach a GLM-100 to the sound board.

STUDIO VOCALS – Hang the GLM from a mike-stand boom about 8 inches from the mouth at nose height. Use the windscreen. To prevent phase interference from lyric-sheet sound reflections, angle the lyric sheet so that the reflections travel away from the GLM.

ORCHESTRA, BAND, CHOIR, ORGAN – For spaced-microphone recording, hang two or three mikes overhead, about 5 to 10 feet apart, about 14 feet above the floor, and 10 to 20 feet in front of the front-row musicians. You may want to roll off high frequencies slightly for a more natural sound. Boost at 80 Hz if GLM-200s are used.

For coincident miking, tape the cables of two GLM-200s vertically onto a microphone stand, with the microphones peeking over the top of the stand and touching side-by-side. Angle the mikes about 110° apart (55° to the left and right of center).

For sound reinforcement, mike each section separately a few feet away. Keep in mind the 3:1 rule to prevent phase interference: The distance between microphones should be at least three times the distance from each microphone to its sound source.

FILM OR VIDEO – Attach the GLM-100 to the back of the props close to the action. In an automobile, clip it to the sun visor near the center-line of the automobile. To reduce clothing noise when the GLM-100 is used on an actor, spray clothing with anti-static solution or water (spray leather with silicone spray or WD-40, if it can be cleaned). Tape both sides of the cable to clothing, using adhesive bandages on skin. Make a loop in the cable to act as a strain relief. Place the connector near the actor's foot so that he or she can be "unplugged" between takes.

To convert the GLM for wireless use please order Technical Bulletin #002.

We hope this applications guide has provided some insight into the operation and uses of the Pressure Zone Microphone, Phase Coherent Cardioid, and Great Little Microphone. For more information, contact Technical Services Department at Crown International, 1718 W. Mishawaka Road, Elkhart, IN 46517 or phone (219) 294-8000. And be sure to read the Crown MikeMemo to keep updated on the latest developments in Crown microphones and applications.

CHOOSING THE RIGHT CROWN MICROPHONE

There's a wide variety of Crown microphones to choose from. This guide will help you select the microphones best-suited for your applications.

TRANSDUCER TYPE: CONDENSER OR DYNAMIC. In a dynamic microphone, a coil of wire attached to a diaphragm is suspended in a magnetic field. When sound waves vibrate the diaphragm, the coil vibrates in the magnetic field and generates an electrical signal similar to the incoming sound wave.

In a condenser microphone, a diaphragm and an adjacent metallic disk (backplate) are charged to form two plates of a capacitor. Sound waves striking the diaphragm vary the spacing between the plates; this varies the capacitance and generates an electrical signal similar to the incoming sound wave.

The diaphragm and backplate can be charged either by an externally applied voltage, or by a permanently charged electret material in the diaphragm or on the backplate.

Because of its lower diaphragm mass and higher damping, a condenser microphone responds faster than a dynamic microphone to rapidly changing sound waves (transients).

Dynamic microphones offer good sound quality, are especially rugged, and require no power supply. Condenser microphones require a power supply to operate internal electronics, but generally provide a clear, detailed sound quality with a wider, smoother response than dynamics.

Currently, all Crown microphones are the electret condenser type – a design of proven reliability and studio quality.

BOUNDARY OR FREE-FIELD: Boundary microphones are meant to be used on large surfaces such as stage floors, piano lids, hard-surfaced panels, or walls. Boundary mics are specially designed to prevent phase interference between direct and reflected sound waves, and have little-or-no off-axis coloration. Free-field microphones are meant to be used away from surfaces, say for up-close miking.

Crown Pressure Zone Microphones® (PZMs®) and Phase Coherent Cardioids™ (PCCs®) are boundary microphones; Crown GLMs™ and CMs are free-field microphones.

POLAR PATTERNS: OMNIDIRECTIONAL OR UNIDIRECTIONAL. Omnidirectional microphones (also called pressure microphones) are equally sensitive to sounds coming from all directions. Unidirectional microphones (also called pressure gradient microphones) are most sensitive to sounds coming from one direction – in front of the microphone.

Three types of unidirectional patterns are the cardioid, supercardioid, and hypercardioid pattern. The cardioid pattern has a broad pickup area in front of the microphone. Sounds approaching the side of the mic are rejected by 6 dB; sounds from the rear (180 degrees off-axis) are rejected 20 to 30 dB. The supercardioid rejects side sounds by 8.7 dB, and rejects sound best at two "nulls" behind the microphone, 125 degrees off-axis.

The hypercardioid pattern is the tightest pattern of the three (12 dB down at the sides), and rejects sound best at two nulls 110 degrees off-axis. This pattern has the best rejection of room acoustics, and provides the most gain-before-feedback from the main sound reinforcement speakers.

CHOOSE OMNIDIRECTIONAL MICS WHEN YOU NEED:

All-around pickup
Pickup of room acoustics
Extended low-frequency response
Low handling noise
Low wind noise
No up-close bass boost

CHOOSE UNIDIRECTIONAL MICS WHEN YOU NEED:

Selective pickup
Rejection of sounds behind the microphone
Rejection of room acoustics and leakage
More gain-before-feedback
Up-close bass boost (proximity effect)

An omnidirectional boundary microphone (such as a PZM) has a half-omni or hemispherical polar pattern. A unidirectional boundary microphone (such as a PCC-160) has a half-supercardioid polar pattern. The boundary mounting increases the directionality of the microphone, thus reducing pickup of room acoustics.

FREQUENCY RESPONSE: BRIGHT OR FLAT. A bright frequency response has an emphasized or rising high-frequency response, which adds clarity, brilliance, and articulation. A flat frequency response sounds natural.

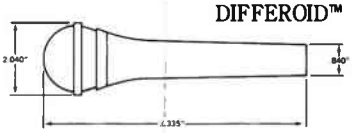
APPLICATION CHART

Based on the above information, the following chart was made. Find your application in the left-hand column, then read across to find the suggested Crown microphone for that application.

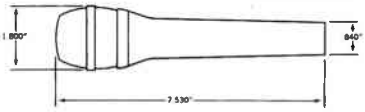
APPLICATION	SUGGESTED CROWN MICROPHONE
THEATRE STAGE, MOTION PICTURES, VIDEO	
On floor	PCC-160 (supercardioid surface-mounted mic)
On props or performers	GLM-100 (miniature omni mic)
CONFERENCES	
People surrounding mic	PZM-6R (small Pressure Zone Microphone, articulate sound) PZM-20RG (for permanent installation)
One mic per every 1 to 3 people	PCC-160 (supercardioid surface-mounted mic)
Corner mounting	PZM-6R (small Pressure Zone Microphone, articulate sound)
NEWS	
Lavalier	GLM-100 (reduces thumps and clothing noise) GLM-200 (rejects studio noise) GLM-100/D (dual version of GLM-100) GLM-200/D (dual version of GLM-200)
News desk	PCC-160 (on desk)
Across-table interviews	PZM-30R (articulate-sounding surface-mounted mic)
INSTRUMENT SOUND REINFORCEMENT	GLM-100 (miniature omni mic) GLM-200 (miniature hypercardiod mic) PZM-30R (inside piano)
VOCAL SOUND REINFORCEMENT	CM-100 (PZM hand-held, no up-close bass boost) CM-200 (cardioid, smooth and articulate) CM-300 (Differoid™, excellent gain-before-feedback and isolation)
RECORDING	
Boundary	GLM-100 with GLM-SM PZM-30R (bright sound) PZM-30F (flat)
Close-up	GLM-100 (miniature omni mic) GLM-200 (miniature hypercardioid mic)
Overhead miking on panels	GLM-100 with GLM-SM PZM-6F (flat) PZM-6R (bright)
LECTERN	
On lectern	PCC-160 (supercardioid surface-mounted mic)
Lavalier	GLM-100 (reduces thumps and clothing noise) GLM-200 (more gain-before-feedback)

DIMENSIONS
PRESSURE ZONE MICROPHONES

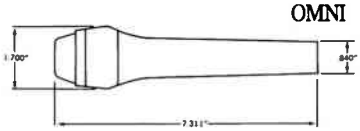
CM-300
DIFFEROID™



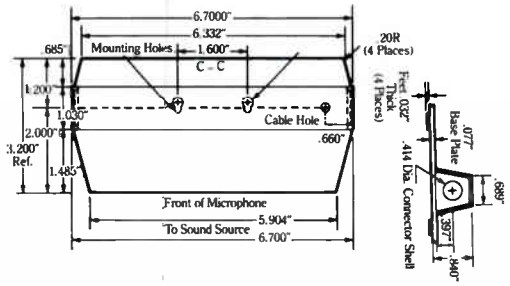
CM-200
CARDIOID



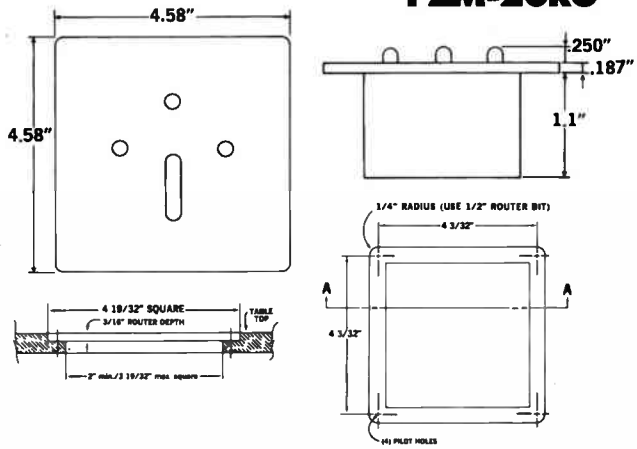
CM-100
OMNI



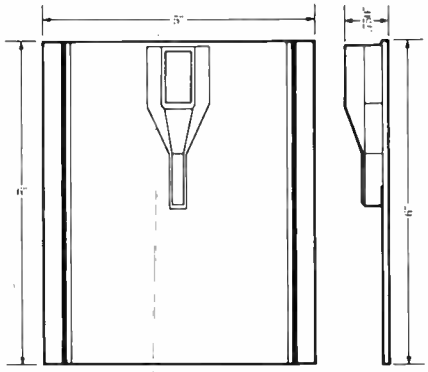
PCC®-160 SERIES
PHASE COHERENT CARDIOID® MICROPHONES
PCC-160/PCC-160W



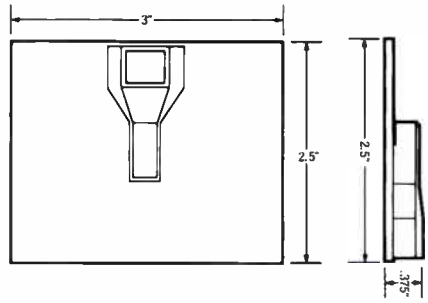
PZM®-20RG



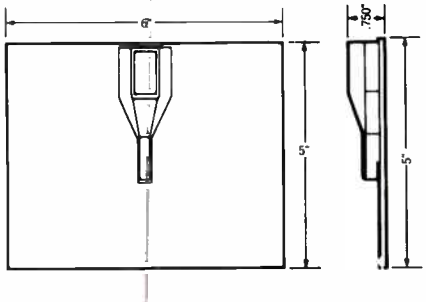
PZM®-30FS
PRESSURE ZONE MICROPHONE®



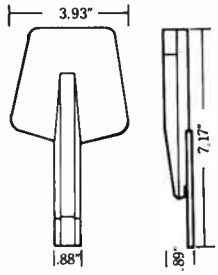
PZM®-6 SERIES
PRESSURE ZONE MICROPHONES®
PZM-6RB/PZM-6RG/PZM-6FS



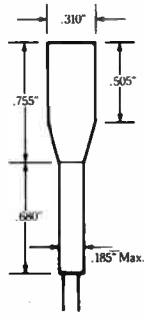
PZM®-30RG
PRESSURE ZONE MICROPHONES®



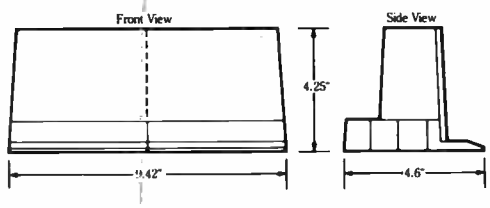
PZM®-180
GENERAL PURPOSE PRESSURE ZONE MICROPHONE®



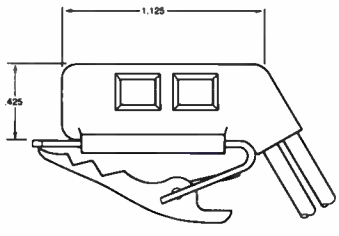
GLM/100-200 SERIES



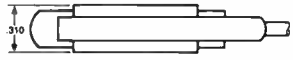
PZM®-2.5W4C
DIRECTIONAL PRESSURE ZONE MICROPHONE®



GLM-100/D – 200/D



ON CAMERA PROFILE



WARRANTY

CROWN INTERNATIONAL, INC.

Crown microphones are warranted to meet or exceed all published specifications for a period of three years from date of original purchase. If your microphone does not perform to specification within that time Crown will repair or replace the unit at no cost to you. In addition, Crown will pay all the U.S. round-trip shipping charges for the defective unit.

This warranty does not cover damage to other products resulting from Crown product failure and does not cover defects or damage caused by misuse, accident or the use of unauthorized modifications, parts, or service. It also excludes batteries and damage caused by leaky or defective batteries.

GLOSSARY OF MICROPHONE SPECIFICATIONS

This glossary defines specifications used in Crown microphone data sheets.

TYPE: This specification is the microphone's generic classification, such as "Pressure Zone Microphone," "Phase Coherent Cardioid," or "Miniature omnidirectional condenser."

ELEMENT: The signal-generating part of a microphone: the transducer, capsule, or cartridge. The ELEMENT spec describes the method by which the capsule converts sound to electricity: condenser, electret condenser, moving coil, or ribbon. For more information, see the section in this catalog titled "Choosing the Right Crown Microphone."

FREQUENCY RESPONSE: The range of frequencies from lowest to highest that a microphone will reproduce at an equal level (within a tolerance, such as +/− 3 dB). A frequency response from 50 to 15,000 Hz is good; 40 – 18,000 Hz is very good, and 20 – 20,000 Hz is excellent. If the sound source produces frequencies from, say, 80 to 10,000 Hz, then a frequency response from 80 to 10,000 Hz is adequate.

POLAR PATTERN (POLAR RESPONSE): The directional pickup pattern of a microphone. The graph of microphone sensitivity in dB vs. angle of sound incidence. Some types of polar patterns are omnidirectional, cardioid, supercardioid, hypercardioid, hemispherical, and half-supercardioid.

Omnidirectional: Picks up sounds equally from all directions.

Cardioid: Picks up sounds from a broad angle in front of the microphone, and rejects sounds from the rear (180 degrees off axis). This pattern has the most gain-before-feedback when used with floor monitor speakers behind the microphone.

Supercardioid: This pattern has maximum rejection at 125 degrees off axis. It has a tighter pattern than a cardioid, more gain-before-feedback when used with the house speaker system, and the most difference of any pattern between front-hemisphere pickup and rear-hemisphere pickup.

Hypercardioid: This pattern has maximum rejection at 110 degrees off axis. Compared to the patterns above, the hypercardioid is the tightest, has the most rejection of distant sounds and room reverberation, and has the most gain-before-feedback when used with the house speaker system.

The hemispherical and half-supercardioid patterns are found only in surface-mounted microphones such as the PZM and PCC series.

Hemispherical: This pattern is an omnidirectional pattern cut in half by the surface the microphone is mounted on.

Half-supercardioid: This pattern is a supercardioid pattern cut in half by the surface the microphone is mounted on.

IMPEDANCE: The total opposition to AC electrical signals, including resistance, inductive reactance, and capacitive reactance. A microphone's impedance is its effective source resistance at 1000 Hz. Microphone impedances from 150 to 600 ohms are considered low; from 1000 to 4000 are medium, and above 25 kilohms are high impedance. The lower the impedance, the longer the mic cable you can use without hum pickup or high-frequency loss.

Load impedance is the input impedance of the device the microphone is plugged into (a mixer, tape recorder, or transmitter).

MAXIMUM SPL: To clarify this specification, first we need to explain the term "SPL." SPL or Sound Pressure Level is a measure of the intensity of sound. The quietest sound we can hear, the threshold of hearing, measures 0 dB SPL. Normal conversation at 1 foot measures about 70 dB SPL; painfully loud sound is above 120 dB SPL.

MAXIMUM SPL is the SPL at which a microphone starts to distort; usually the SPL at which the microphone produces 3% total harmonic distortion. If a microphone has a maximum SPL spec of 125 dB SPL, that means the microphone starts to distort audibly when the sound pressure level produced by the source reaches 125 dB SPL. A maximum SPL spec of 120 dB is good, 140 dB is very good, and 150 dB is excellent.

SENSITIVITY: The electrical output a microphone produces at a given sound pressure level.

Open circuit sensitivity is the output voltage a microphone produces (in dB relative to 1 volt) into an open-circuit load, at a sound pressure level of 74 dB SPL (1 microbar).

Power level is the output power a microphone produces (in dB relative to 1 milliwatt) into a load matching the microphone impedance, at a sound pressure level of 94 dB SPL (10 dynes/cm^2).

EIA sensitivity is also called Gm rating. If you add the EIA sensitivity to the SPL at the microphone, you get the microphone power output in dBm into a matched load.

An open-circuit sensitivity spec of −65 dB re 1 volt/microbar is considered high sensitivity; −75 is medium, and −85 is low sensitivity. All else being equal, a high-sensitivity microphone results in less mixer or recorder noise than a low-sensitivity microphone, when both microphones are picking up a quiet sound source.

EQUIVALENT NOISE LEVEL (SELF NOISE or EQUIVALENT SOUND PRESSURE LEVEL): The electrical noise a microphone produces, equivalent to what a sound source would produce in dB SPL. A self-noise spec of 20 dB or less is excellent (quiet); a spec around 30 dB is good, and a spec around 40 dB is fair.

S/N RATIO (SIGNAL-TO-NOISE RATIO): The ratio of a microphone's signal level to its noise level, at a given SPL. The difference in dB between the sound pressure level and a microphone's self-noise level. S/N ratio = SPL – self noise. A S/N spec of 60 dB @ 94 dB SPL is good, 65 dB is very good, and 70 dB or more is excellent.

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