Measurement Microphone Kit

- **Free Field response characteristic**
- **5Hz to 40kHz frequency response**
- **Complete kit of all required items**
- **Carrying case**
- **AC or battery operation**
- **Acoustic calibrator available**

Central to virtually every acoustic measurement is the measurement microphone. Loudspeaker testing, room analysis, and noise measurement all start with an acoustic signal. The microphone converts this acoustic signal into an electrical signal for processing in the measuring instrument. The accuracy of this conversion defines the quality of the microphone.

Most measurement microphones are *capacitor* element types. The central element of a capacitor measurement microphone is conceptually simple: A thin metallic diaphragm is stretched over a ridged back plate. The diaphragm and back plate form the two electrodes of an air capacitor. The distance between the plates is very small, on the order of 0.001 inch (25µm). Sound pressure causes the diaphragm to vibrate resulting in a proportionate capacitance change between this diaphragm and the fixed back plate. This capacitance variation is converted to a voltage in the microphone preamplifier and sent to the measurement instrument for analysis.

Because the value of the capacitance is low, the preamplifier must be located very close to the actual capacitor. It is a cylinder with a threaded coupling to accept the microphone "head". The complete assembly (head and preamplifier) form an integral unit often thought of as the "microphone".

The preamplifier requires power and this is provided separately. It is often located near the measurement equipment and connected to the preamp/head assembly by a multi-conductor cable that also carries the audio signal. The power supply provides a low voltage for the preamplifier circuit and the high 200 Volts required to polarize the capacitor.

Microphone Characteristics

The directivity characteristics of a microphone are significant in a measurement situation. A measurement microphone should be omni-directional; that is its frequency response should be the same for sounds originating from any direction. Measurement microphones are also designed to be either *Free Field response* or *Pressure response*. The difference between these two responses usually only affects the microphone behavior above 10kHz. Pressure response microphones accurately measure the sound pressure at the diaphragm whereas free field response microphones compensate for the physical presence of the microphone itself. A pressure response microphone is more often used in a fixture that puts the microphone in a closed environment such as telephone handset or hearing aid test fixture. Free field response, on the other hand, is the type most often used for acoustic measurements and is the type of microphone supplied with this MMK-1 system. The microphone is "pointed" towards the sound source.

Typical microphone diameters are 1 inch (25mm), 1/2 inch (12mm) and 1/4 inch (6mm). The larger 1" diameter produces more output voltage but has greater high frequency roll off. Conversely, the smaller 1/4" type has response well beyond 20kHz but lower output level. The most common size for general acoustic application (speaker and monitor system measurements) is 1/2 inch usually provides a response to over 20kHz and adequate sensitivity for Audio Precision measurement equipment without an additional preamp. The MMK-1 microphone is a 1/2" type.

Measurement microphone kit consists of the microphone and preamp (shown threaded together in this photo), the attached cable , a power supply, an ac-mains adapter, a cable to connect to the measurement equipment, and a windscreen.

Low frequency response is determined by the size of the static pressure equalization vent in the microphone. Since the diaphragm and back plate form a closed cavity, a vent is required so the static atmospheric pressure on the front and the rear of the diaphragm can be equalized. Typically, the low frequency cutoff is below 10Hz.

Sensitivity

The sensitivity of a microphone is defined as its output level for a reference sound pressure level. The most common reference sound pressure level is 1 Pascal or 94 dB SPL. Earlier definitions used Newtons per square meter where 94 dB SPL = 1N/m^2 (and 0 dB SPL = 20μN/m^2). Another earlier unit was the microbar where 94 dBSPL = 10 μbar. To summarize:

94 dBSPL
= 1 Pascal
= 1 N/m^2
= 10 μbar
= 10 dynes/cm^2

Using the 1 Pascal/94dBSPL reference, microphone sensitivity is stated in dBV (where 0dBV = 1Volt), or millivolts output with this standardized reference sound pressure level at the microphone. The sensitivity of the MMK-1 microphone is -36 dBV or about 16mV. The precise values for each individual microphone always appears on the Calibration Chart supplied with every measurement microphone.

Dynamic Range

The difference between the inherent noise in the microphone system and the point at which it will produce 3% total harmonic distortion is the dynamic range of the microphone. The noise floor for this microphone is 22 dBA SPL (the extra letter "A" indicates the use of an ANSI-IEC A-weighting filter to measure the noise). The maximum sound pressure level (for 3% THD) is 160 dB SPL. This yields a typical dynamic range of 138dB.

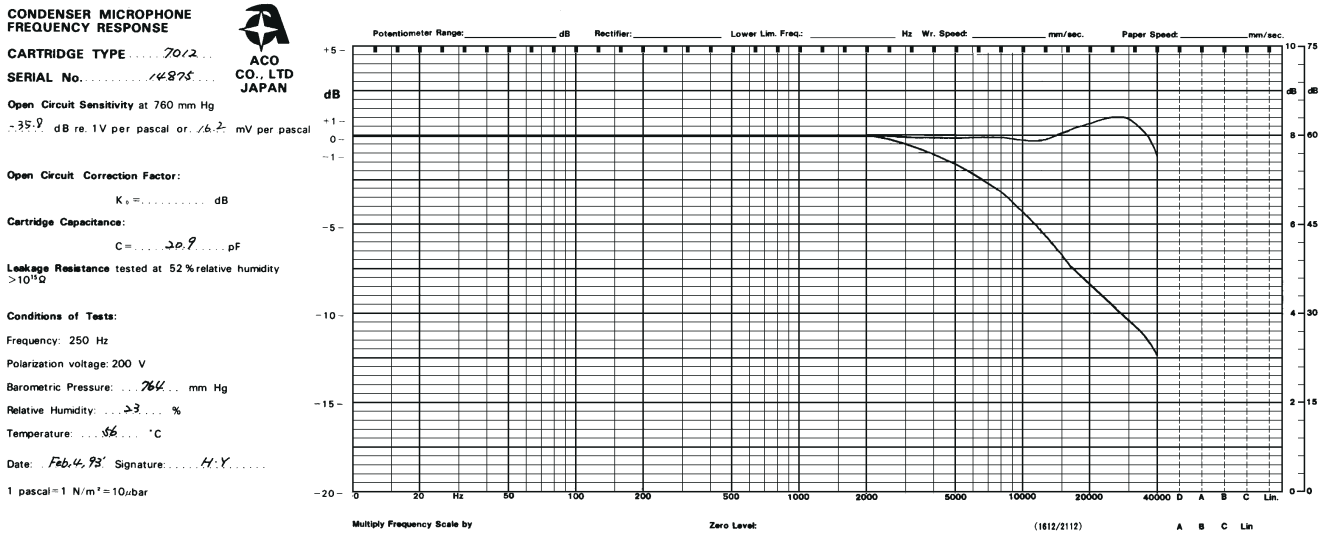
Stability

All specifications on any device are always subject to environmental influences that affect their tolerance and measurement microphones are no exception. Parameters that will alter a microphones specifications are time, temperature, atmospheric pressure, and humidity.

Fortunately, time has virtually insignificant effect on air-condenser microphone performance. It affects the microphone's sensitivity and is expressed in terms of years per dB change. With typical values predicted in the centuries, this is not a variation with which to be concerned.

Temperature changes have a more dramatic effect although still very low. The sensitivity temperature coefficient of this microphone is 0.007 dB per degree C. In a typical

Microphone calibrator. The microphone is inserted into a cavity for close acoustic coupling. The calibrator can generate both 94dBSPL and 104dBSPL to set Set System One reference in order to directly read in dBSPL.



Frequency response of microphone is flat within 2 dB from 5Hz to 40kHz. The nominally flat response is the free field response while the curve with the roll off is the pressure response of this microphone.

acoustic measurement environment, this will result in a virtually unmeasureable level change compared to other effects. The temperature coefficient is somewhat frequency dependent, affecting mostly the upper octave or two.

The atmospheric pressure coefficient of this measurement microphone is on the order of 0.005 dB per μbar.

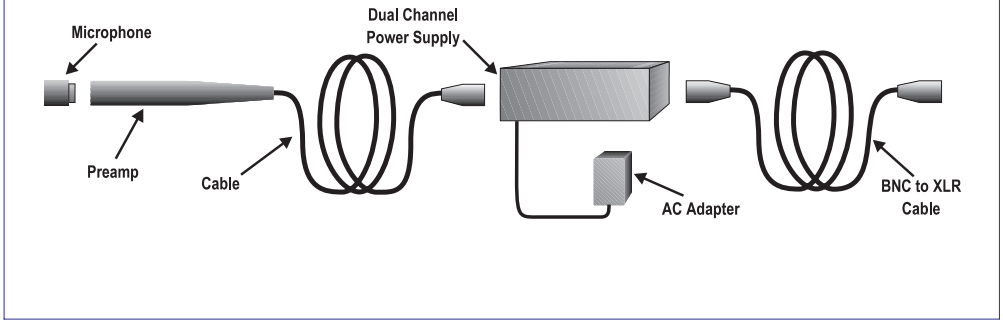
Humidity will also effect the sensitivity. The MMK-1 has a variation less than 0.1 dB for a humidity change from 55% to 95%, without condensation. Indeed, condensation can cause significant effects, the worse of which is electrical continuity between the diaphragm and the back plate. Fortunately, it is almost always reversible with dehumidification.

Calibration

All measurement microphones come with a Calibration Certificate that includes a frequency response graph and a value of absolute sensitivity. *Figure 1* shows a typical frequency response graph and associated information supplied with this microphone. This information can be used to create a correction curve to cancel out the response variations of the microphone from the measurement.

Microphone frequency response remains relatively constant so this supplied curve can be used throughout the life of the microphone. Sensitivity, however, may vary for the reasons stated above. To calibrate the absolute sensitivity of the total measurement system (including the effects of the measurement system) an acoustic calibration source is available. The MMC-1 is a 1kHz oscillator and an electrostatic transducer that is placed over the microphone. It will produce an accurate 94dBSPL or 104 dBSPL (switch selectable) at 1kHz. This can be used to set a dBr reference in System One so the dBr value corresponds to absolute dBSPL.

Components of the MMK-1 kit. The power supply has dual channel capability allowing a second microphone to be powered. The carrying case also has space for the second microphone.



Specifications

Microphone

Response Characteristic	Free Field 0°
Frequency Response	5Hz to 40kHz ± 2dB
Sensitivity (with 1 Pascal Sound Pressure Level)	-36dBV (16mV)
Dynamic Range	22 - 160dB (3% THD)
Cartridge Capacitance	18pF
Polarization Voltage	200 Vdc
Temperature Coefficient	± 0.007dB/°C -10°C to +50°C
Influence of Humidity	<±0.1dB 55°C - 95% (Non Condensing)
Long Term Stability	> 900 Years/dB (20°C)
Height of Cartridge with Grid	12.7 mm
without Grid	11.5 mm
Diameter of Cartridge with Grid	13.2 mm
without Grid	12.7 mm

Preamplifier

Supply Voltage & Current	28Vdc, 1mA Typical
Signal Maximum Output Voltage	8Vpk - 10k Load
Frequency Response	±0.5dB 2Hz to 200kHz Typical
Noise	
"A" Weighted	2.5 µV Typical

Power Supply

Preamplifier supply

Voltage	28Vdc ± 5%
Current Capacity	10 mA total
Supply Noise	0.005% typical

Polarization supply

Voltage	200 Vdc ± 2%, 0.5% typical
Current Capacity	Limited by 11 Meg Ohm Source
Supply Noise	0.0001% typical
Switching Frequency	> 70 kHz typical
Signal Decoupling Capacitor	10mfd Tantalum

Input Power Requirements*

Voltage Input	4.5 to 18 Vdc
Current @ 9Vdc	One Channel 5mA typical
Low Battery Indication	6.3 Vdc Typical

** Power requirements can be met by using the supplied 110VAC wall transformer or from a user supplied internally mounted battery*

Sound Pressure Level Calibrator MMC-1

Frequency	1000 kHz
Output Levels	94 or 104 dBSPL (Switch selectable)
Accuracy	± 0.3 dB @ 23°C ± 0.5 dB 0 to 50°C
Power	2 x 9Vdc (Internal, not supplied)
Size	1.8 Inches Diameter 5.5 Inches Long

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