

EXPANDED DYNAMIC RANGE MICROPHONES AND MICROPHONE ASSEMBLIES



The majority of Knowles Electronics microphones have evolved in concert with hearing aid technology over many years. Many of the attributes of the microphones (small size, high signal/noise, etc.) also help enable commercial applications. Some common attributes, may not be compatible with certain applications. For instance, it is typically desirable for hearing aids to function on a 0.9V supply. For compatibility, many Knowles microphones are designed with a nominal signal bias voltage of 0.45V to maximize signal dynamic range in a hearing aid.

The 0.45V signal bias also constrains the maximum dynamic range for the microphone at about 0.9Vpp signal voltage, which corresponds to a maximum sound pressure for linear signal output.

To expand the sound pressure allowed for linear operation, a number of microphones are available that allow for signal bias at $\frac{1}{2}$ of the supply voltage to allow full utilization. For the current set of available microphones, the maximum supply voltage allowable is 10VDC, so the available signal is approximately 10Vpp.

A customized microphone element with external circuitry is required for center-bias capability. A comparison of (idealized) maximum signal output is illustrated in Figure 1 below.

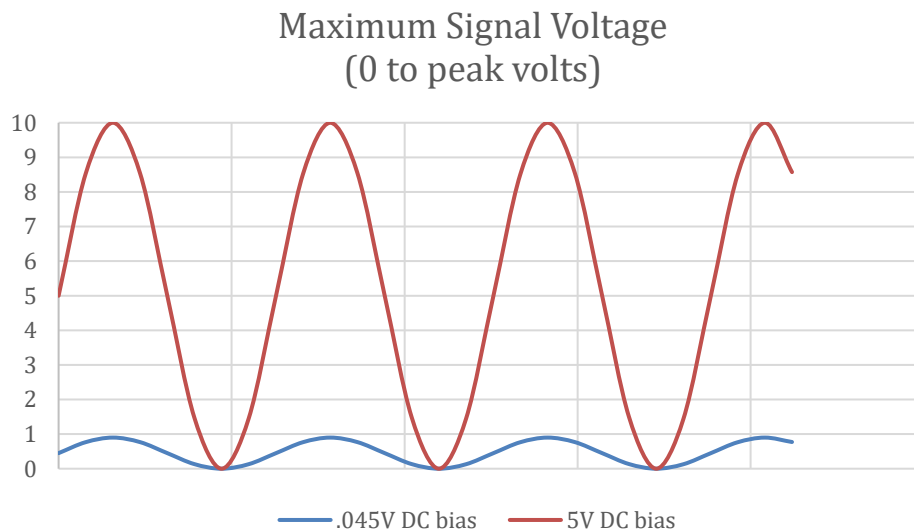


Figure 1

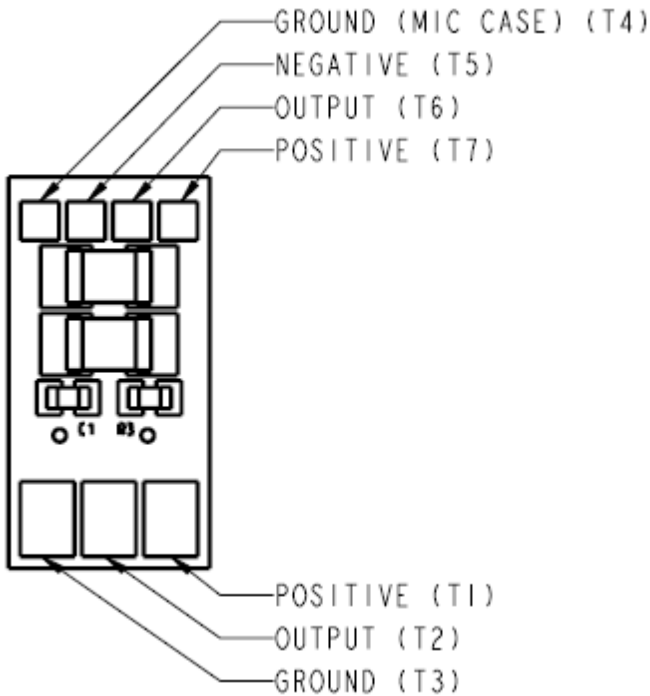


CIRCUIT FOR CREATING CENTER BIAS

The circuit in Figure 2 sets the DC signal bias voltage at approximately 1/2 of the supply voltage. At maximum 10V supply, this equates to approximately 20dB of additional dynamic range. The negative terminal from the internal microphone circuit is electrically separated from the microphone case. The 3 microphone element circuit connections and the case ground connect to a center-bias circuit. Some microphones are packaged to include the center-bias circuit; some microphones require the external circuit to be provided separately. The schematic in Figure 2 shows a typical source-follower JFET circuit with separated case ground, and the standard matching external circuit. 4 conductors are required to make the connection from microphone element to external circuit. The external circuit has 3 connections:

- Supply voltage
- Output (signal) voltage
- Ground (at case-ground potential)

To facilitate evaluation of microphone elements that require the external circuit, FB-178 PCBA is available for sampling.



FB-178 PCBA
External circuit for evaluation sampling

	T1	T2	T3	T4	T5	T6	T7
T1	N/A	N/A	N/A	N/A	10MΩ	N/A	0Ω
T2	N/A	N/A	100KΩ	N/A	N/A	0Ω	N/A
T3	N/A	100KΩ	N/A	0Ω	10MΩ 0.01μF	N/A	N/A
T4	N/A	N/A	0Ω	N/A	N/A	N/A	N/A
T5	10MΩ	N/A	10MΩ 0.01μF	N/A	N/A	N/A	N/A
T6	N/A	0Ω	N/A	N/A	N/A	N/A	N/A
T7	0Ω	N/A	N/A	N/A	N/A	N/A	N/A

Figure 2



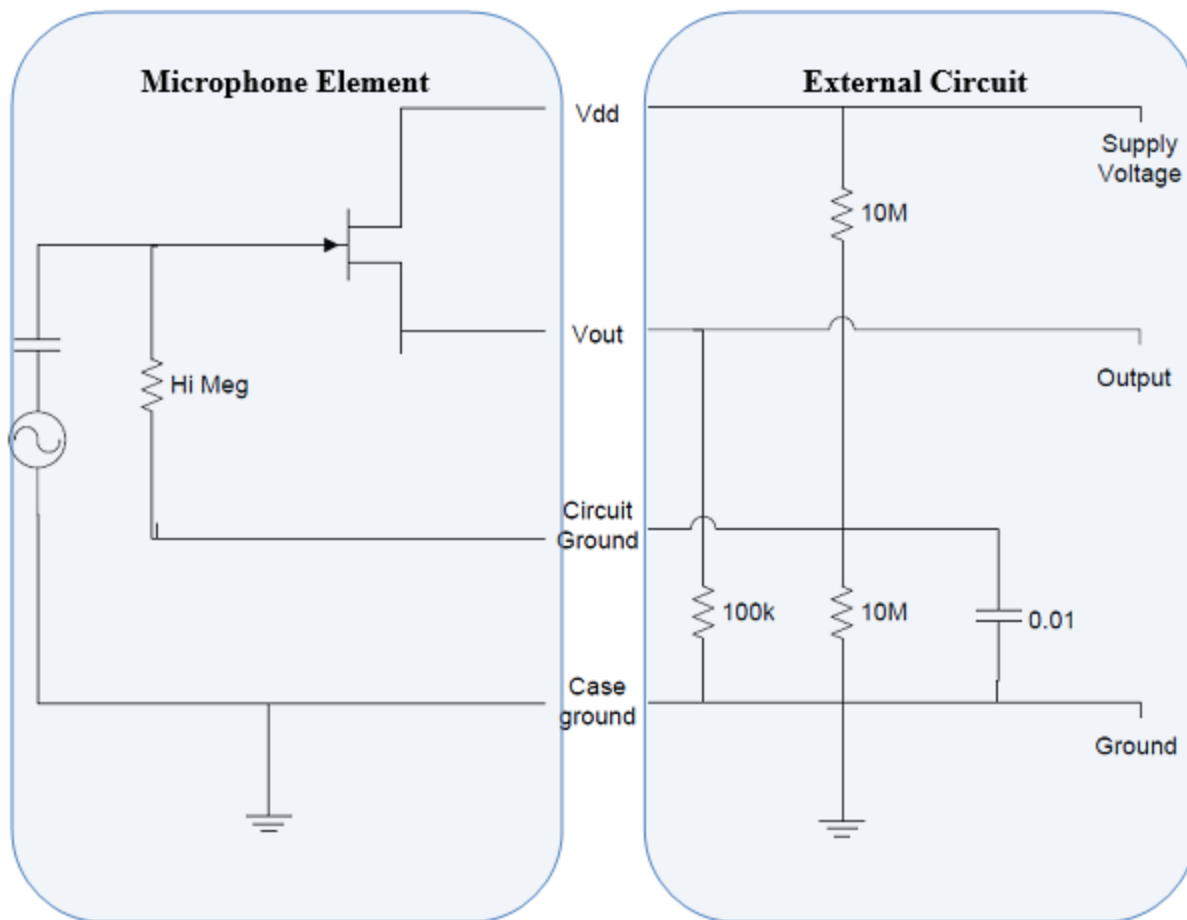


Figure 3

As with other Knowles 3-wire microphones, the output appears between Output and Negative, and must be AC-coupled to maintain the DC bias voltage at the Output terminal.

AVAILABLE MICROPHONE ELEMENTS AND ASSEMBLIES

In addition to the normal solder terminals, some center-bias microphone models include a wire welded to the case or on a ribbon. These four connections microphone attach to the external circuit. Some microphone models have short wires attached to the solder terminals to facilitate PCB mounting.

Microphone assemblies include the center-bias circuit, and have either solder terminals or cable for attachment.

Center-bias microphones also are available in standard and reduced sensitivity versions. The reduced sensitivity models offer the highest maximum dynamic range.

One model has a sloped frequency response. For microphones that point into the ear canal for voice pickup, the sloped response provides high-pass filtering to help the voice sound more natural.

The chart below lists the various configurations and typical SPL limit for linear output (defined as 10% THD output level with 9V supply).

Model	Connection	Sensitivity	Response	Typical Linearity
EK-26899-P03 Element	Lead wires for PCB	Reduced	Flat	154 dBSPL
EK-26899-P58 Element	Solder terminals and case ground wire	Reduced	Flat	154 dBSPL
EK-31144-P58 Element	Solder terminal and case ground wire	Standard	Sloped	149 dBSPL
WP-30113-P03 Element	Lead wires for PCB	Reduced	Flat	154 dBSPL
FG45-32259-P03 Element	Solder terminal and case ground wire	Standard	Flat	140 dBSPL
FG45-32335-P03 Element	Solder terminal and case ground wire	Reduced	Flat	150 dBSPL
FG45-32335-000 Element	Solder terminal and ribbon	Standard	Flat	140 dBSPL
FG45-32491-000 Element	Solder terminal and ribbon	Standard	Flat	140 dBSPL
VFG-34048-000 Assembly	PCBA solder pads	Standard	Flat	140 dBSPL
VFG-34049-000 Assembly	PCBA solder pads	Standard	Uni-directional Standard	Package dependant
VEK-H-30108-000	Cable	Reduced	Flat	154 dBSPL
VWP-H-30109-000	Cable	Reduced	Flat	154 dBSPL
VEK-H-30320-000	Cable	Standard	Flat	137 dBSPL
VEK-F-30470-000	Flying leads	Reduced	Flat	154d BSPL

Table 1

Current form factors for expanded dynamic range microphone elements, assemblies, and packages are pictured below.



EK-P03 or WP-P03 with lead wires for PCB



EK-P58 with solder terminals and case ground wire only



FG45-P03 with solder terminals and case ground wire only



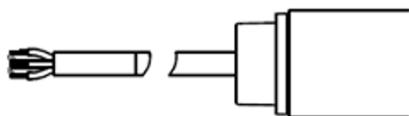
FG45 with solder terminals and case ground ribbon



VFG with solder terminals



F series (VEK-F) with flying leads



H series (VEK-H or VWP-H) with cable

Figure 4

CAPABILITIES FOR CUSTOMIZATION

The models listed and series configurations pictured may be customized to align with application requirements. Some commonly customized attributes include:

- Sensitivity / Linearity SPL
 - Sensitivity may be lowered to accommodate higher maximum SPL linearity requirements. Lowering sensitivity decreases SNR roughly dB for dB.
- Sound Port Location
 - The same variety of sound port locations for standard EK and EM Series microphones can be provided for expanded dynamic range versions.
 - NR and WP bi-directional microphones can be adapted for expanded dynamic range.
- Ingress protection
 - Available for FG45 and VFG Series
 - F Series normally includes
 - Microphone element integration into boom microphone packages with ingress protection is possible
- Electrical connectors
 - Assembly of wire-to-board or other connectors is possible
- Alternative wire or cable
- Plastic housings
- Other assembly work

Contact your local Account Manager, Representative, or Distributor to discuss your project needs.

REVISION HISTORY

Revision	Description	ECR	Date
A	Active	M10109675	03-24-23