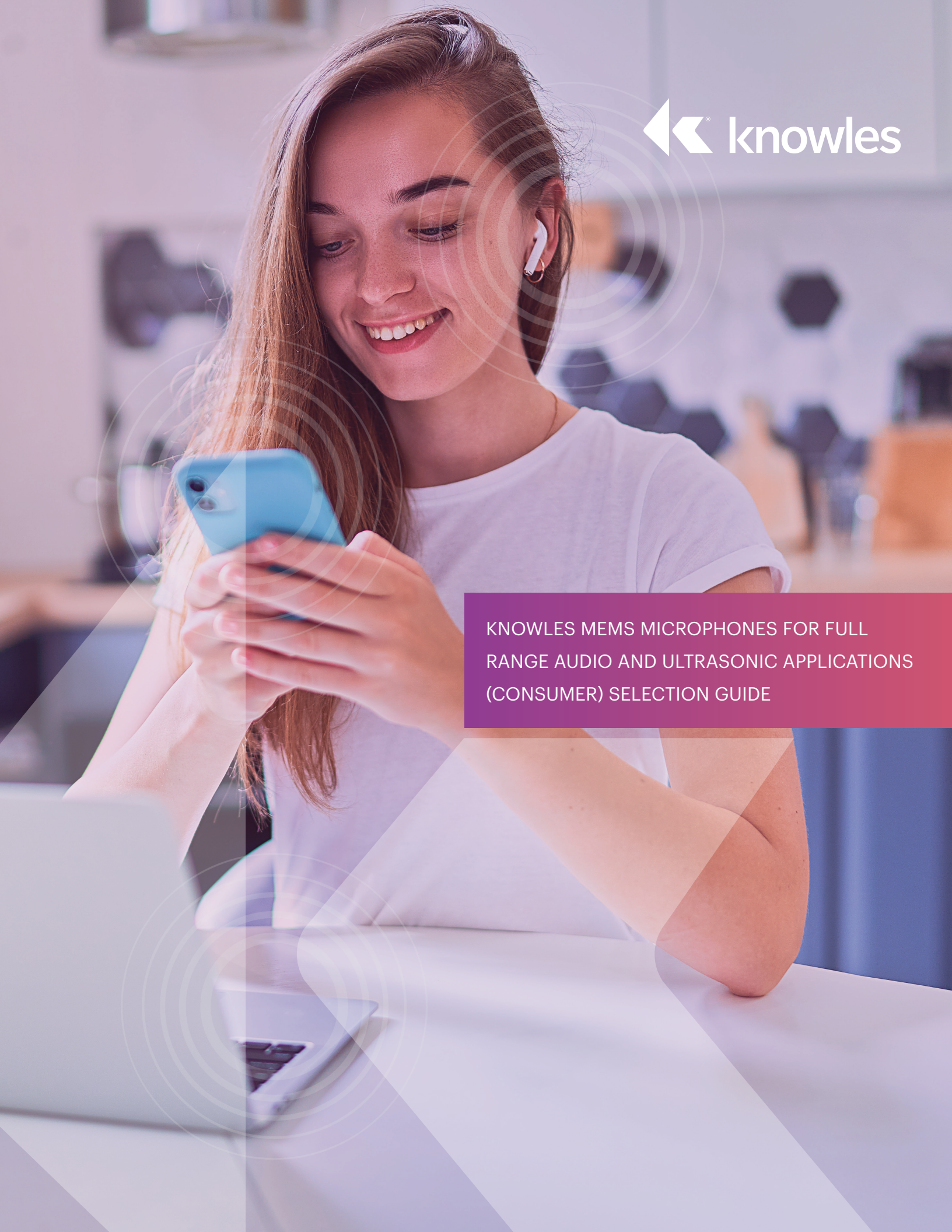


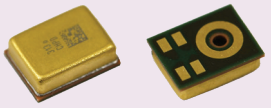
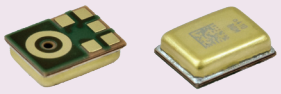
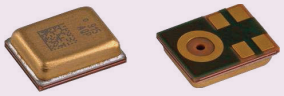
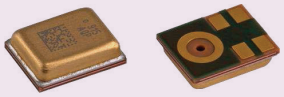
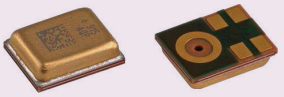
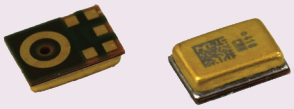
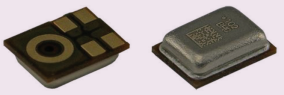
KNOWLES MEMS MICROPHONES FOR FULL RANGE AUDIO AND ULTRASONIC APPLICATIONS (CONSUMER) SELECTION GUIDE



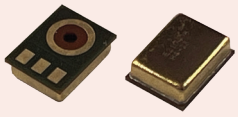
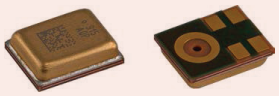
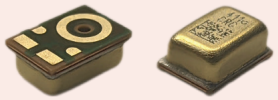
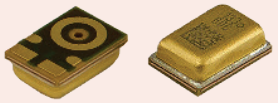
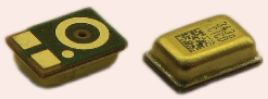
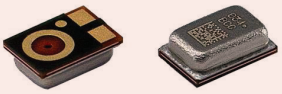
MEMS MICROPHONES

Knowles is the world leader in MEMS microphones across the Mobile, Ear, and IoT markets and has shipped over 20 billion units to date. Design variables include ever-smaller sizes, lower profiles and mounting options, increased output capacities, and new digital audio options that eliminate analog noise. For manufacturers, surface mount designs eliminate off-line subassembly production costs. Our microphones have been used in applications from smart speakers and mobile phones to remote controls, automotive, laptops, smart home products, headphones and more. Let us help you choose the right microphone for your project.

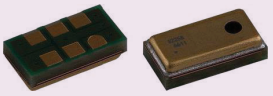
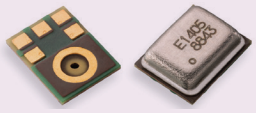
DIGITAL (PDM) MICROPHONES

	MICROPHONE	DESCRIPTION	SIZE	SNR*	LFRO	1% THD | 10% THD*	POWER	
DIGITAL	**Hyperion SPK18R1LM4H-1** On flex: KAS-700-0192	High SNR, low power, low latency for OTE	4.00 × 3.00 × 1.20mm	70.5 dB(A)	20Hz	125 dBSPL | 128 dBSPL	360µW @ 768kHz, VDD = 1.8V 810µW @ 2.4MHz, VDD = 1.8V	
	Titan 1.2V SPH88R1LM4H-1 On flex: KAS-700-0185	$1.2V_{IO}$ compatible, High SNR, low latency	3.50 × 2.65 × 0.98mm	68.5 dB(A)	32Hz	125 dBSPL | 129.5 dBSPL	305µW @ 768kHz, AVDD = 1.8V, DVDD = 1.2V 675µW@ 2.4MHz, AVDD = 1.8V, DVDD = 1.2V	
	Titan SPH18R1LM4H-1 On flex: KAS-700-0172 *CUSTOMER FAVORITE*	High SNR, low power, low latency for TWS	3.50 × 2.65 × 1.00mm	68.5 dB(A)	30Hz	123 dBSPL | 129 dBSPL	324µW @ 768kHz, VDD = 1.8V 774µW @ 2.4MHz, VDD = 1.8V	
	Maira SPH01R9LM4H-1 On flex: KAS-700-0188 *COMING SOON*	$1.2V_{IO}$ and $1.8V_{IO}$ compatible with single power supply	3.50 × 2.65 × 0.98mm	65.5 dB(A)	35Hz	130 dBSPL | 132 dBSPL	432µW @ 768kHz, VDD = 1.8V 1170µW @ 2.4MHz, VDD = 1.8V	
	Cornell II SPH0655LM4H-1 On flex: KAS-700-0153	Superior 1% THD performance	3.50 × 2.65 × 0.98mm	66 dB(A)	25Hz	130.5 dBSPL | 132.5 dBSPL	468µW @ 768kHz, VDD = 1.8V 1800µW @ 2.4MHz, VDD = 1.8V	
	Helix SPS11R1LM4H-1 On flex: KAS-700-0184	$1.2V_{IO}$ and $1.8V_{IO}$ compatible	3.25 × 2.25 × 0.80mm	64.8 dB(A)	33Hz	127 dBSPL | 132 dBSPL	305µW @ 768kHz, AVDD = 1.8V, DVDD = 1.2V 665µW @ 2.4MHz, AVDD = 1.8V, DVDD = 1.2V	
	Luiso SPH0141LM4H-1 On flex: KAS-700-0157	Entry tier digital	3.50 × 2.65 × 0.98mm	64 dB(A)	45Hz	108 dBSPL | 121 dBSPL	423µW @ 768kHz, VDD = 1.8V 1116µW @ 2.4MHz, VDD = 1.8V	

ANALOG MICROPHONES

	MICROPHONE	DESCRIPTION	SIZE	SNR*	LFRO	1% THD | 10% THD*	POWER	
ANALOG	**Raptor** **SPK01A0LR5H-1** On flex: KAS-700-0175 *NEW*	High SNR, high AOP, single-ended	4.00 × 3.00 × 1.20mm	72 dB(A)	17Hz	122 dBSPL | 130 dBSPL	481µW @ VDD = 2.75V 648µW @ VDD = 3.6V	
	Falcon **LFRO = 32Hz:** **SPH11C3LR5H-1** On flex: KAS-700-0165 **LFRO = 18Hz:** **SPH21C3LR5H-1**	Differential 1.8 and 2.7V	3.50 × 2.65 × 1.00mm	68.5 dB(A)	32Hz, 18Hz	125 dBSPL | 134 dBSPL	121µW @ VDD = 1.8V 550µW @ VDD = 2.75V	
	Astrid **SPVA1A0LR5H-1** On flex: KAS-700-0183 *NEW*	Single-ended	2.75 × 1.85 × 1.15mm	68 dB(A)	23Hz	130 dBSPL | 132 dBSPL	481µW @ VDD = 2.75V	
	Robin **SPV61A0LR5H-1** On flex: KAS-700-0170 *CUSTOMER FAVORITE*	Single-ended Tochi 2 upgrade	2.75 × 1.85 × 0.90mm	66 dB(A)	35Hz	130 dBSPL | 133 dBSPL	481µW @ VDD = 2.75V	
	Jamila **SPV01C8LR5H-1** On flex: KAS-700-0193 *NEW*	Single-ended Superior 1% THD performance	2.75 × 1.85 × 0.90mm	65 dB(A)	85Hz	125 dBSPL | 133 dBSPL	481µW @ VDD = 2.75V 684µW @ VDD = 3.6V	
	Ford 2 **SPV0142LR5H-1** On flex: KAS-700-0155	Single-ended	2.75 × 1.85 × 0.90mm	62.5 dB(A)	85Hz	110 dBSPL | 124 dBSPL	238µW @ VDD = 1.8V	

SPECIALTY MICROPHONES

	MICROPHONE	DESCRIPTION	SIZE	SNR*	LFRO	1% THD | 10% THD*	POWER	
DIGITAL	**Marina** **SPC18P8LM4H-1** On flex: KAS-700-0159	Slim Package Bottom-Ported	3.50 × 2.00 × 1.00mm	65 dB(A)	25Hz	119 dBSPL | 122 dBSPL	468µW @ 768kHz VDD = 1.8V 1557µW @ 2.4MHz VDD = 1.8V	
	Baracus **SPG08P4HM4H-1** On flex: KAS-700-0152	Slim Package Top-Ported	4.00 × 2.00 × 1.10mm	64 dB(A)	30Hz	117 dBSPL | 120 dBSPL	522µW @ 768kHz VDD = 1.8V 1287µW @ 2.4MHz VDD = 1.8V	
	Crawford **SPH0645LM4H-1** On flex: KAS-700-0137	I²S Output digital microphone	3.50 × 2.65 × 0.98mm	65 dB(A)	45Hz	110 dBSPL | 120 dBSPL	1080µW @ 3.072MHz VDD = 1.8V	

** SNR and THD specs apply to normal mode. For low power mode specs, refer to the datasheet.*

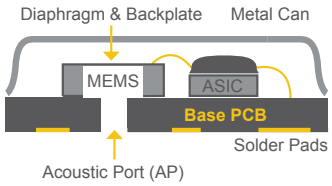
DIGITAL (PDM) OR ANALOG MICROPHONES?
PDM microphones have an integrated ADC and return oversampled PDM data at the supplied clock frequency. Advantages of PDM microphones include superior noise immunity, simpler PCB layout, typically better system SNR and lower overall power consumption. PDM microphones can greatly simplify system design if the processor or CODEC supports a PDM port.

SIGNAL TO NOISE RATIO
For far field applications like smart speakers, high SNR microphones result in superior audio pickup. ANC and transparency mode features in TWS need high SNR microphones for better user experience. When comparing analog to PDM microphones, reduce the analog SNR by ~1.5dB to account for the external ADC's noise contribution.

ACOUSTIC OVERLOAD POINT (AOP)
The AOP is the sound pressure level at 1kHz at which the total harmonic distortion is 10%. At this point, audio is heavily clipped and sounds very distorted. Microphones require a high AOP spec if they are subject to high sound levels (eg. close to loudspeakers, in-ear microphones in earbuds, outdoor applications exposed to wind noise).

ULTRASONIC APPLICATIONS
MEMS microphones inherently have a very usable ultrasonic response from 20kHz to 80kHz or more. The output of the u/s signal must be processed by an amp, CODEC, or ADC that can extract the needed frequencies, usually by using a higher sample rate and/or lower decimation rate.

PORT LOCATION
Bottom port microphones typically have better noise performance than an equivalent top port microphone. For this reason, bottom port microphones are preferred unless mechanical constraints dictate a top port microphone.



SENSITIVITY OF PDM MICROPHONES
Sensitivity of microphones is the reference output for 94dBSPL sound. Higher sensitivity implies more signal for a given sound. In PDM microphones, higher sensitivity does not imply higher performance because gain can simply be applied in the digital domain by multiplying the output code. Dynamic range is a better indicator of microphone performance.

LOW FREQUENCY ROLL-OFF (LFRO)
The LFRO is the -3dB point of the frequency response with respect to the sensitivity at 1kHz. A low LFRO is advantageous for bass frequency pickup and ANC, but it is more sensitive to wind noise and low frequency overload in a feedback ANC system.

MEMS VS. ELECTRET CONDENSER (ECM) MICROPHONES
MEMS microphones are reflow capable SMT devices with stable performance under extreme conditions. They are resistant to power supply noise, humidity, and mechanical shock and vibration . Compared to ECMs, MEMS microphones have wide operating temperature and supply voltage ranges where sensitivity does not drift.

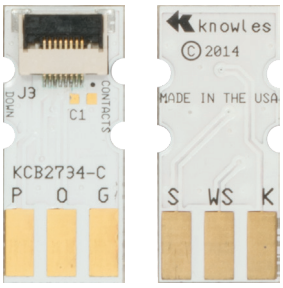
EVALUATION KITS

TEST FLEX PCBs
Knowles utilizes flex PCBs when testing microphones. We have a common size and interface such that flexes from any microphone can be used in various test fixtures. The only difference between the test boards of different microphones is the pinout and pad configuration.
Once microphones are mounted on flex circuits or coupons, it is much easier to access the microphone signals. Testing a larger sample size of devices is facilitated if the flexes and coupons are inserted into an 8 position 0.5mm Kyocera connector (MPN 046288008000846).



Example flex PCBs (Digital bottom port, Analog differential bottom port, Digital top port)

FLEX-TO-COUPON ADAPTER
Knowles uses an adapter to be able to use flex circuits with a 2x3 Sullins connector (MPN EBM03DSEN-S243) or for convenient connection with flying wires.

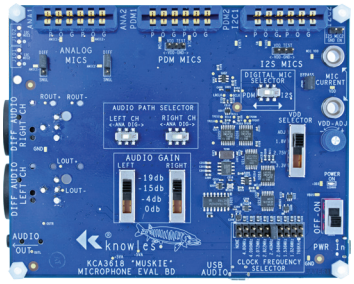


TOP VIEW BOTTOM VIEW

KCA2733 Flex-to-Coupon adapter

AN18: Knowles Flex Circuits and Coupons for Testing: www.knowles.com/docs/default-source/default-document-library/an18-knowles-flex-circuit-and-coupons-for-testing_updated.pdf

EVALUATION BOARD "MUSKIE"
The Muskie microphone evaluation kit allows for simple and easy evaluation of Knowles SiSonic™ MEMS microphones. Muskie implements dual 6-pin Sullins connectors for stereo pairs of Analog/Differential microphones, Digital microphones, or I²S microphones.



KAS-33100-0004 Evaluation platform 'Muskie'

User guide: https://www.knowles.com/docs/default-source/model-downloads/kas-33100-0004-muskie-users-guide-rev28jun19.pdf?sfvrsn=262976b1_9

ADDITIONAL RESOURCES
Datasheets: www.Knowles.com/SiSonic
SiSonic Design Guide: www.Knowles.com/SiSonic/Design-Guide
Evaluation kits: www.Knowles.com/SiSonic/Evaluation-Kits
Application notes: www. Knowles.com/SiSonic/Application-Notes
Automotive: www. Knowles.com/SiSonic/Automotive
Voice Vibration Sensor: www.knowles.com/v2s

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