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Component Report

The component under analysis is the reference microphone, which is used to calibrate MEMS microphones in the Acoustic Stimulus Module. The specifications require very high performance for the reference microphone, since its precision largely determines the overall precision of the calibration.The specializing equipment Cohu Semiconductor Inc. are currently using for testing MEMS acoustic sensors is the “SO7400 Acoustic Test Unit”, which utilizes a free-field reference microphone

To gain an overall background knowledge and a better understand of measurement microphone selection and the requirement in specsheets, searches in web and Patent databases is done,various technical documents and selection guides are found.

Following is the performance requirements for selecting the reference microphone:

Primary concerns:

- The type of reference sensors may be Low cost ECM (Electret condenser microphone) or high-end measurement microphones (e.g. G.R.A.S microphone).

Comment: Both microphones have to be calibrated periodically in order to produce a valid measurement. A web search shows that there are no sufficient technical supports for the low cost ECM to make a reliable, reproducible measurement that meets the strict standard from the project specification sheet. Thus a high-end measurement microphones should be used.

- The position of the reference sensor should be in the pressure chamber.

Comment: There are three types of measurement mic based on its environment: Free-field, Pressure, and Random-incidence. The current solution utilize a free-field microphone, but in order to make an accurate measurement in an air-tight pressure chamber, the pressure-field microphone should be used.

- Reference microphones can be directly read out by tester. Frequency flatness exceed class 1 (IEC61672-1) with 20Hz-20kHz in range 40dB to 130 dB

Comment: The microphone has to have a frequency range that includes 20Hz-20 kHz, and a dynamic range that includes 40dB to 130 dB

- Accuracy of calibration: +/-1dB 20Hz to 25 kHz. THD (total harmonic distortion) of 0.1% @ 1kHz

Comment: This is a strict requirement which only a few high-end microphones satisfy, and they costs thousands of dollars. To measure THD, an audio analyzer could be used.

Secondary concerns:

- Number of calibrations per year (determined by feasibility study)
- Cost per calibration
- Redundancy / plausibility check of reference measurement
- Reference sensor TCO (Total Cost of Ownership) to be determined

Searches thorough Thomas Register and google gives these qualified suppliers: Full Compass Systems, PCB Piezotronics, Audix, NTI-audio, Brüel & Kjær. Various phone calls and emails are made to get the specific quotes and technical information for the microphones. Summing up with chart as follows:

Producer	Product	Capsule dia.(mm)	Frequency Response	Range (dB)	Ref. price	contact	Additional reference
Audix	TM1 plus	8	20Hz-25kHz (±2 dB)	18 - 130	$400	http://www.amazon.com/Audix-TM1-Plus/dp/B008YEDCAE	http://www.audixusa.com/
NTI -audio	M2230	20.5	20Hz-20 kHz(±3 dB)	25 - 153	$1,580	http://shop.nti-audio.com/	
Brüel & Kjær	4944-A	7	16Hz-70 kHz(±2 dB)	30 - 146	$1967 (15% EDU discount)	Mr. Vince Rey phone: 831-331-1971 Vince.Rey@bksv.com	http://www.bksv.com/
G.R.A.S.	46BD-S2 (1/4" CCP Pressure Standard Microphone Set)	7	10Hz-25kHz (±1 dB), 4Hz-70kHz (±2 dB)	44 - 166	$1784 (discounted, with cable)	(BRC Engineering) Richard Craig phone: 707-226-3332 brcnorcal@aol.com	http://www.gras.dk/46bd-s2.html
G.R.A.S.	46AO (1/2" CCP Pressure Standard Microphone Set)	13.2	5Hz-13kHz (±1 dB), 3Hz-20kHz (±2 dB)	25 - 150	$1567 (discounted, with cable)	Same as above	http://www.gras.dk/46ao.html
PCB Piezotro-nics	378A14 (1/4" pressure prepolarized)	7	4Hz-70kHz (±2 dB)	60 - 174	$1,300	http://www.pcb.com/	

Conclusion:

G.R.A.S 46BD-S2 is the best fit in terms of technical requirements(as high-lighted), it also has the smallest capsule diameter(which means MEMS-under-test can be placed closely around reference microphone and the test chamber can be made smaller), but it's also the second expensive one. To determine which microphone to use for prototyping, further feedback from project sponsor is needed.

Refrences:

Thomas Register Search

keywords: Acoustic, measurement, microphone

Patent search:

Databases: USPTO patent database, Google Patent, Patentscope, Espacene

Key words: Acoustic, microphone, testing, MEMS, calibration, 麦克风, 测试

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BRC Engineering: Richard Craig phone: 707-226-3332 brcnorcal@aol.com

Gereral technical documents

1. *RaneNote-AUDIO SPECIFICATIONS*
2. *G.R.A.S. Selection Guide for Microphones and Preamplifiers*
3. *Brüel & Kjær-measurement mic fndamentals*