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VOICE COIL

PERIODICAL FOR THE LOUDSPEAKER INDUSTRY

IN THIS ISSUE

Brüel & Kjaer's sound test equipment is the topic of this issue's Spotlight. See p. 29.

INDUSTRY NEWS & DEVELOPMENTS

By Vance Dickason

CEA News

The big news from CEA this month is a change of dates for next year's Las Vegas 2001 CES show. In order to help exhibitors avoid overtime booth construction, decoration, and drayage charges, the show will now run Saturday, January 6, through Tuesday, January 9. Previously, the show was scheduled to start on Sunday, January 7, which would have meant that exhibitors would incur up to $2.6 million in overtime charges. Attendance figures for the January 2000 show reached 126,818 (up more than 30%), with 2205 exhibitors and over 1,125 million square feet of exhibit space.

CEA will be sponsoring its Business Solutions Series 2000, a two-day conference for manufacturers and retailers that will cover two of the leading business problems: product returns and using the Internet. The conference is being held May 17–18 at the Hyatt Regency in Los Angeles. Guest speakers for the product returns discussions will be Tim Clark, Thomson Consumer Electronics; Ira Miller, Sharp Electronics; Anne Mueller, Creative Channel Services; Peter Junger, SiRAS.com; Jesse Williams, Panasonic Consumer Electronics; Ron Hartle, Samsung Electronics America; Gary Drook, AFFINA; and Mike Trotter from the Center for Customer Driven Quality, Purdue University.

For the "Growing Your Business Through the Internet" section, speakers will be Jerry Storch, Target Corp.; Bob Fields, MobileToys.com; Jim Rose, Accompany; James Hatcher, Ecnet; Brad Stedem, How2TV.com; and Alex Kormuchoff, Sapient. Also speaking will be e-commerce author, Jaclyn Easton, of *StrikingItRich.com*. For more, contact CEA at (703) 907-7600, or visit the CEA website at http://www.CE.org.

CEA has also launched a new market-research website, eBrain, which offers a number of services, including marketing news, online publications, consulting services, a research library, and market data reports. Market data reports cost $499 and the following should be of interest to loudspeaker manufacturers (note: all reports but item (d) are the result of a telephone poll of 1000 persons in a random national sampling):

a. Surround Sound Opportunities (Nov. 1999)—Items include interest in the new 5.1 music format, ownership of a subwoofer, preference for two-channel or surround sound, the impact of buying and setting up speakers on your purchasing decisions, number of speakers hooked

SPOTLIGHT

B&K Telephone Measurement Conference

By Rob Baum

Brüel & Kjaer, as every reader knows, is the leading supplier of test equipment in the sound and vibration field. When you buy premium equipment from a company such as B&K, part of the package should be the training to use it properly. Knowing how to use your test equipment is just as important as having the right tools for the job. Therefore, B&K sponsors a series of interesting seminars around the country. I was fortunate enough to attend one such seminar held in San Diego in November.

Just as the right skills and the right equipment are needed to derive useful measurements, the right instructor and good supporting documentation are essential for a deeper understanding of the material. The notes to the course serve as an essential reference. The B&K seminar supplied both: a good instructor (John Bareham) and excellent supporting documentation.

The three-day seminar was entitled "Electro Acoustic Measurements on Telephones: Fundamentals, Applications, and Advanced Topics." It delivered a good working knowledge of how and why to use telephone test gear for meaningful results, and was worth the time and money involved.

Many of the students came from the cellphone business, since there are several cellphone firms, such as Qualcomm, in the San Diego area. Sage Technologies, the B&K rep firm in California, organized the seminar. Sage, which has a good reputation in the business, provided several staff members, who helped answer questions and made a useful contribution to the course.

Fundamentals

The first section, Fundamentals, was a useful review of the essential basics of sound and vibration. Starting at the beginning, the ear and hearing, it progressed to sound-level measurements and basic room acoustics. The documentation for these sections consisted mostly of reprints of the B&K "Introduction" series of booklets published in the 1970s and 1980s, which were useful when they came out (and physics hasn't changed much since then).

The seminar discussed the basics of different types of microphones (free field, pressure, random) and different types of weighting curves. The section on frequency response contained an informative article co-written by John Bareham about...frequency response (surprise). It also covered simulated free-field test signals, such as gated sines and sine sweeps.

Applications: Telephone Measurements

The course focused on telephone terminal equipment itself—what sits on your desk or you hold in your hand while attempting to drive—rather than the telephone network. Telephony is not about wideband high fidelity, or even low distortion, per se. It is all about conveying speech intelligibility using as little network bandwidth as possible. As such, each link in the phone network needs only to carry midband information, typically 300Hz to 3.4kHz.

Even using such a limited bandwidth, speech can be technically difficult to reproduce due to a large crest factor—of up to 20dB. Typical test levels are at the upper end of RMS levels of average phone conversations. So running tests at –6dB still leaves peaks of +14dB.

This section started with basics such as the "ear reference point (ERP)" and "mouth reference point (MRP)," where measurements are made. The ERP is where loudness ratings are calculated, and is the measurement point for the Type 1 ear simulator (referred to later).

Note that the ear itself represents a complicated load—ears are far more complex than simple microphones, requiring complex simulators (such as those from B&K) for accurate measurements. A lot of acoustic and electrical paths exist, as well as sidetone—the part of the speech that is fed back from the handset microphone through the handset speaker (respectively called the "transmitter" and the "receiver" in the network-centric telephone world). If you add in the extra complexity of a speakerphone ("hands-free"), the task of quantifying their performance becomes complex. Hence the need for this kind of course.

Another useful aspect of the course was a review of some of the many standards and their measurement methods that cover analog, digital, and cellular telephones (and there are many; I have a drawer full of phone standards worth $2000!). Each of these standards has a different testing requirement: different couplers (artificial ears), positions, distances, and test signals. Naturally, many countries use different standards.

The seminar reviewed many of the measures of loudness used in "telephonometry," such as "Reference Equivalent," which is subjective, and the objective "Loudness Rating," as well as the older "Objective Reference Equivalent Measurement." New standards coming out soon cover digital phones in general, as well as Voice over Internet Protocol (VoIP), which will rapidly become a major factor in the telecom market, as will the related Voice over Frame Relay (VoFR).

Simulators

Making telephony measurements in a repeatable way means that labs must have stable signal sources and receivers, which implies the need for artificial mouths and ears—sometimes including entire test heads and torsos—for maximum accuracy and repeatability. The mouth simulator (B&K Type 4227—cover photo, right) consists of a speaker located inside a cavity, and so the frequency response is very rough at the LRGP ("lip ring guard position," 1" in front of the mouth). Frequency-response variations in the B&K 4128 (cover photo, left) artificial head/mouth combination inherently vary by 12dB.

Standardization and calibration naturally become very

important, because the inherent response of a mouth simulator looks nothing at all like the generally wideband flat frequency response of a good loudspeaker. The cavities in front of the speaker generate resonances with corresponding peaks and dips in the frequency response and disturbances in the time domain. (The same holds true for artificial ears.)

The course mentioned four calibration methods. The substitution (normalization) method switches out a microphone of known response for the device under test (DUT), measured at the same point in the sound field. The difference between the two responses is due to the variations of the DUT. The test stimulus may be equalized (inverse filter method) to obtain a flat acoustic excitation spectrum for the device under test. The comparison method uses two microphones at the same time—a reference and a DUT—but as in the following method, the two microphones are not in the same location.

Finally, using a feedback or closed-loop approach (B&K refers to it as a compressor) ensures the system remains within calibration. This consistency is important for high-resolution QC/QA or certain types of production-line testing. As with any loudspeaker, the voice coil of the artificial mouth will heat up under use and its response will vary, requiring regular recalibration of the first three methods, but this method ensures stability. One disadvantage with the closed loop is that the feedback microphone and the microphone being measured are not in the same location or sound field.

Couplers

In addition to artificial mouths, telephony requires artificial ears. There are several different types, the most common being the IEC 318, also referred to as the ITU-T P.57 Type 1 ear simulator or "coupler," which is sealed, meaning the space between the headset under test and the artificial ear's microphone is airtight. This is the condition specified in most standards, even though it is not very realistic.

These couplers have a series of three small cavities (an air mass and compliance) that approximate the acoustic load a headphone will detect. The B&K part is the Type 4185 or Type 4153. In actual use, there is often a small air leak between a typical telephone handset and the ear, which requires different versions to simulate.

Incidentally, when the sealed cavity becomes lossy or open, the low frequencies naturally drop off significantly in level. These types of couplers are particularly unrealistic for cellphones, whose shape and size make it particularly tough to seal against the user's head. Even details such as the acoustic leakiness around a cellphone's buttons, or through small slits in the case, add significant variations to the response of the speaker if it is not sealed from the rear. And these leaks vary from unit to unit, so they cannot be taken out of the response via equalization or DSP.

As a defensive measure, leaks can be built into the system, both in front of and behind the diaphragm. Hence the effect of additional leaks becomes smaller. The analogy is open-backed headphones, which are already open to the atmosphere, so a little more leakage just doesn't make much difference…not to mention the very high level of ambient

noise interfering with intelligibility. But that is another complication entirely.

Type 3.2 couplers come in low-loss or high-loss flavors. Type 3.3 couplers, also known as B&K Type 4128C HATS (Head and Torso Simulator), use a simplified pinna simulator and represent a much more realistic way to test telephones and headsets. However, the whole HATS setup is very expensive (about $15k), so most people simply do not have access to them. Incidentally, calibration of these devices is either by an acoustic impedance probe (closed-ear conditions) or by frequency response measured under open-ear conditions.

Through this seminar, you realize that these types of measurements can become fairly involved (and we did not even consider hands-free ("speakerphone") telephony, which is more complex. Hence the need for some sort of training or experience on the part of the test-equipment operator. Given the need for accurate results from test gear, the seminar was, in my opinion, well worth the time and expense. I highly recommend it.

For further information, visit these websites: www.BKhome.com, www.bk.dk, and www.thesagesite.com.

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