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New Products, Materials, Services & Components For Medical Device Designers
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New Products

Practicing Sound Medicine

Sound devices are performing an increasingly critical role in modern healthcare communication. Unfortunately, Medical Instrumentation and device manufacturers may not be aware of all the options and information available to them when it comes to SOUND COMPONENTS design. This article reviews a variety of characteristics and important features designers should keep in mind when selecting audible aspect to their finished medical devices.

By Ely Zofan

There is an alarming trend occurring throughout the healthcare marketplace, and it is providing numerous growth opportunities for the instrumentation manufacturers that can fulfill demand for products that provide—among other things—clear, reliable audible signals for a cost-conscious audience.

This group shot of sounding devices available through Challenge Electronics represents

Several specifically mentioned in the article: CE-C80, CSPT, and CSET series.

The use of sounding devices in medical instrumentation is ubiquitous to say the least. One can visit any wing or department of a health center and hear a range of electronic tones as this form of electronics does what it does best—provide audible data to operators in exchange for a response or action. Yet as the technology advances and becomes even more integral to patient care, there is a steady increase in the demand for devices that can generate specific tones to help medical technicians and staffs distinguish one priority from another. And like so many other electronics, these devices are migrating towards smaller packages and footprints.

Multi-Sensory Solutions

Research shows that people absorb data more effectively through multiple senses. The human eye alone can only focus on one visual stimulus, with peripheral vision used for scanning. Faced with multiple, often unpredictable, visual alerts, doctors, nurses, and med techs may quickly reach a point of visual overload, particularly in acute care settings including emergency rooms, surgical suites, and maternity departments.

Auditory senses are generally more complex, enabling the human brain to process greater amounts of unrelated data simultaneously. Combining visual and auditory senses has been an essential part of the medical profession, especially in critical care where immediate response to warnings is essential to saving lives. Moreover, the integration of audio technology serves to increase personnel productivity and efficiency without compromising quality of care. Harnessing human auditory cognition requires a clear hierarchy of auditory signals, as all sounds are not of equal importance. The introduction of new sounds or tones requires careful consideration based upon the level of medical or diagnostic emergency. Selecting the right audible device involves cost and performance considerations such as size and weight, type of sound required, variability of sound, loudness and frequency, expected service life, lead free (RoHS) compliance, and other key variables.

Medical Alarms and Annunciators

Audible devices such as speakers, alarms, transducers, and microphones are in all types of bench top instruments and hand-held devices. These components offer high performance, high quality audible characteristics for communications and signaling. Microphones and speakers are often used to communicate data between patient and nurses, or between doctors and nurses. In some instances, speakers are used to signal codes to alert hospital staff without causing undue concern for the patient.

Portable or Hand-Held Devices

We live in a mobile world, and as a result, portable and hand-held medical devices are commonplace. During the full cycle of a surgical patient’s stay in a hospital, he might encounter dozens of data collection points that involve scanning, monitoring, and verification for a variety of purposes—from basic metabolic readings to bedside medication dispensing or patient identification verification. Key performance parameters include size, weight, and energy efficiency, as comfort and convenience are primary considerations. However, as portable devices become increasingly miniaturized, quality and reliability can become major concerns.

Hand-held devices typically use a sound transducer to generate audio signals. These devices allow the manufacturer to conserve space, power, and cost. Piezoelectric transducers are typically used for low power and higher operating voltage applications (5 to 30 VDC). As a rule, the smaller the size of the piezoelectric transducer, the higher the resonant frequency and the lower the sound level. A 15-mm diameter piezoelectric diaphragm is typically 4,000 to 6,000 Hz, while a 25-mm diameter and larger diaphragm can produce 3,000 Hz and lower frequencies. Magnetic transducers are typically used in low voltage power sources, as well as for lower sound frequency applications, including pagers, wireless monitors, patient identification systems, and other portable devices.

These transducers are typically mounted on printed circuit boards and are driven by the electronics circuit provided by the equipment manufacturer. Use of a transducer gives the OEM the flexibility of producing multiple sounds. For example, the **CSPT23A09-4.0F** piezoelectric transducer measures 23 X 23 X 10.8 mm, with 1 to 25 Vpp operating voltage, 4,000 ±500 Hz resonant frequency, and 100 dB output at 10 cm. The **CSET8.5A3.6-16-2.7F** magnetic transducer measures 8.5 X 8.5 X 4.0 mm, with 2 to 4 V op operating voltage, 2731 Hz resonant frequency, and 88 dB output at 10 cm.

Many portable and hand-held medical devices now rely on miniature SMD and PCB microphones and speakers.
There are SMD speakers such as the **CSMS15A**, which measures just 20 X 20 X 4.3 mm, with 8 ohms impedance, and 0.3 W rated power. This low footprint speaker saves space on the printed circuit board while delivering about 89 dB of sound at 0.1 meter at 0.3 watts. Typical applications for SMD speakers include portable and wearable devices utilized in surgical suites, specialty labs, critical care facilities, home healthcare, and nursing homes.

Alarms for Stationery Instruments

Many stationary systems and portable devices currently in use were built with lower cost alarms and sounding devices. These systems, while economical, have often proven less effective because of lower life expectancy or an inability to perform up to specifications. Poorly designed alarms may not turn on, or the sound levels may vary depending upon what is located in front of the sound port.

Some medical instruments routinely go through a cleaning cycle to reduce bacteria growth. If the alarms are not hermetically sealed, washing solution could leak into the alarm and short the alarm, causing severe damage to the instrument. Alarms with stainless steel terminals attached with a brass quick-connect terminal may lose their conductivity over time due to dissimilar material.

Alarms with self-driven oscillators require proper loading of the sound port for effective operation. These alarms are typically low-cost and produce continuous, intermittent, or chime tones. If the sound port is obstructed or covered to reduce the sound, it may cause a shift in the frequency output, or, in extreme cases, the alarm may not operate or may fail to produce the desired sound.

Direct driven alarms are commonly recommended for medical instruments, since the sound oscillator works independently of the loading of the sound port, and is more reliable for driving a piezoelectric disc to produce the desired tone. Direct driven alarms may be designed to produce any desired tone. Also, with self-driven oscillators, loading of the sound port may result in reduced sound levels, but will not shift the frequency or affect the alarm’s ability to operate.

Loudness and Type of Sound

When specifying a sounding device, design engineers need to factor in the desired volume as well as the type of sound. A primary consideration is to make sure that the alarm can be heard above environment noise, but not be so loud as to drown out other alarms and annunciators.

Alarms can produce a variety of tones, including continuous, chirp, intermittent, chime, warble, or siren.

Continuous tone alarms produce a steady sound. Therefore, when specifying a continuous tone alarm, make sure that the sound does not blend in with environmental noises and thus be ignored. The **CE-CM530AS** continuous tone, panel mounted alarm is medium in volume, operating from 5 to 30 VDC. Output sound is about 97 ±3 dB (A) at 24 in. (61 cm). A chirp tone delivers a very short continuous sound, while an intermittent tone can be set with different pulse durations and frequencies to conserve power and to not be as "aggressive" as the continuous tone. The intermittent tone can be modified to reflect the urgency of the alarm by changing the interruption rate from a slow rate to a fast rate.

The **CE-BM530ASS**, for example, is a panel-mounted alarm that delivers a medium loud intermittent tone, 1 pulse per second, operating from 5 to 30 VDC. Output sound is about 97 ±3 dB (A) at 24 in. (61 cm).

A chime tone delivery is a more pleasant sound, with the volume decaying exponentially. Typical applications for chime tones include nurse-monitoring stations. The **CE-HM530ASS** is a panel-mounted alarm with a medium loud chime tone, 1 pulse per second, operating from 5 to 30 VDC. Output sound is approximately 95 ±3 dB (A) at 24 in. (61 cm).

A warble tone is designed to be more attention getting, creating a sound that alternates between two distinguished frequencies. The **CE-WM530ASS** is a panel-mounted alarm with a medium loud warble tone, alternating at 1 Hz operating from 5 to 30 VDC. Output sound is about 97 ±3 dB (A) at 24 in. (61 cm).

A siren tone creates a sweeping sound between a low and high frequency, producing very loud sounds that are commonly utilized for noisy environments. The **CE-US515BSS** is a panel-mounted alarm with an ultra loud siren tone, 6 sweeps per second, operating from 5 to 15 VDC. Output sound is about 108 ±3 dB (A) at 24 in. (61 cm).

In addition, there are dual function alarms that combine two different sounds in one unit, thus minimizing the cost of the alarm. For example, in a dual function unit, there might be intermittent and continuous tones, chime and continuous tones, and warble and continuous tones. Another hard-to-find feature is a volume control to attenuate the sound level in special environments. The **CE-EV** offers a unique volume control rotor that can be mounted by the manufacturer or customer to attenuate the sound output level up to 20 dB from its loudest output.

Conclusion

Designing audible devices for the latest generation of medical devices into newer generation medical devices requires a broad analysis of the product application and its operating environment. Certain situations may necessitate the selection of hermetically sealed devices, which promotes longer operating life even when subject to repeated wash cycles.

ONLINE

For additional information on the technologies and products discussed in this article, visit Challenge Electronics at www.challengeelectronics.com.

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