Improved Audio and Communication Systems for Sailing Race Starting Devices

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Contents

1 Abstract

Sailing race starting devices are critical for ensuring fair and efficient competitions. This research focuses on evaluating various audio technologies, including traditional speakers and exciter technology, to improve the audibility and reliability of start commands. The study examines these devices in diverse environmental conditions, assessing their performance and compatibility with Arduino platforms. Key findings indicate that the DAEX25W-8 exciter, in particular, offers robust performance in challenging weather conditions, while Arduino integration provides enhanced customization. Recommendations include adopting these technologies to improve start signal reliability and conducting further research under real race conditions.

The primary objective of this research is to identify optimal audio devices that enhance the reliability of start signals in sailing competitions. Through a comparative analysis, we assess the performance of these devices under varying weather conditions and their compatibility with Arduino platforms for enhanced customization.

1.1 Advantages of Electronic Starting Devices

1.1.1 Reduced Dependence on Volunteers

Traditional starting procedures often require a team of volunteers to manage flags, horns, or other signaling methods. This reliance on human resources can lead to inconsistencies due to human error or varying levels of experience among volunteers. Electronic starting devices automate these processes to a large extent, reducing the need for a large number of volunteers and minimizing the potential for human error. This ensures a more consistent and fair start to the race.

1.1.2 Enhanced Reliability

Weather conditions can vary significantly during sailing races, ranging from calm seas to rough waters and from clear skies to heavy rain or fog. Traditional starting signals may be difficult to hear or see clearly under adverse weather conditions, potentially causing delays or misunderstandings among participants. Advanced audio systems improve audibility and reliability by utilizing technologies designed to function effectively in diverse environmental settings. This ensures that sailors receive clear and timely start signals regardless of weather conditions, enhancing the overall reliability and efficiency of the race proceedings.

1.1.3 Improved Race Flow

By reducing the likelihood of delays or miscommunications at the start of a race, electronic starting devices contribute to a smoother and more streamlined race flow. Participants can start races promptly and with confidence, knowing that the starting signals they receive are accurate and consistent. This improvement in race management not only enhances the experience for participants but also contributes to the overall professionalism and prestige of sailing competitions.

1.1.4 Compatibility with Arduino

Electronic starting devices compatible with Arduino platforms offer additional flexibility and customization options. Arduino compatibility allows for integration with other electronic systems

and sensors, enhancing the functionality and adaptability of the starting devices in varying race conditions.

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2 Introduction

Sailing is a dynamic sport that requires precise coordination and communication among participants. The start of a race is a critical moment, where clear and reliable audio signals are essential to ensure a fair and organized competition. However, traditional sailing race starting devices often struggle to maintain adequate audibility in varying weather conditions, such as high winds, rain, or fog, which can significantly impact the ability of sailors to hear the start signals. This research project aims to address these challenges by exploring the integration of advanced technologies, such as the DAEX25W-8 exciter and Arduino platforms, to enhance the audio systems of sailing race starting devices. The key stakeholders in this project include the Product Owner, who is primarily interested in ensuring that the product meets market needs and stakeholder expectations, and the Koninklijke Nederlandse Zeil- en Roeivereniging, the Stakeholders who are concerned with the reliability and usability of the Auto Dick during races. The End Users, the participants in the races, are focused on the ease of use, clear signals during races, and reliable performance of the starting devices. By addressing the needs and concerns of these stakeholders, this research project aims to develop innovative solutions that will improve the overall fairness and experience of sailing competitions.

To address this challenge, this research paper investigates the integration of advanced technologies, including the DAEX25W-8 exciter and Arduino platforms, to enhance the audio systems of sailing race starting devices. The DAEX25W-8 exciter is a high-performance audio transducer that can provide robust and clear sound output, even in adverse conditions.[1] Similarly, the Arduino platform offers a versatile and programmable microcontroller that can be leveraged to improve the reliability and functionality of the starting device.[1]

By exploring the theoretical framework, methodologies, and results of this integration, this study aims to provide sailing race organizers and participants with a more reliable and effective solution for starting signal communication, ultimately enhancing the overall experience and fairness of the competition.

This research project aims to address these challenges by exploring the integration of advanced technologies, such as the DAEX25W-8 exciter and Arduino platforms, to enhance the audio systems of sailing race starting devices. Key stakeholders include the Product Owner, Elmar Pigeaud, the Koninklijke Nederlandse Zeil- en Roeivereniging, and the end users (race participants). Each stakeholder group has specific concerns: ensuring the product meets market needs, reliability and

usability during races, and ease of use and clear signals, respectively. [1]. Concurrently, the Arduino platform offers a versatile and programmable microcontroller that can improve the reliability and functionality of the starting device [2].

The main research question guiding this study is: How can the audibility and reliability of the audio systems in sailing race starting devices be improved while ensuring compatibility with Arduino? To address this overarching question, the research will investigate the following sub-questions:

- What are the specific technical capabilities and limitations of the DAEX25W-8 exciter in enhancing audio clarity in varying weather conditions?
- How can the Arduino platform be integrated to optimize the functionality and customization of sailing race starting devices?
- What are the preferences and requirements of stakeholders (such as race organizers, participants, and technical experts) regarding the usability and performance of enhanced starting devices?

3 Method

3.1 Research Design

The research primarily involved a literature review and analysis of technical specifications available from online sources and literature. The selection criteria for technologies included assessing their performance in various weather conditions, durability, ease of use, and compatibility with Arduino platforms.

3.2 Data Collection and Analysis

Data were collected from product datasheets and literature sources available online. Due to budget constraints, field tests to validate performance were not conducted. Instead, the effectiveness of selected technologies was evaluated based on manufacturer specifications and documented case studies, which provided relevant insights into their practical performance.

4 Results

4.1 Evaluation of Audio Technologies

4.1.1 Technical Capabilities of DAEX25W-8 Exciter

The DAEX25W-8 exciter was evaluated for its technical capabilities in enhancing audio clarity in varying weather conditions. According to manufacturer specifications and documented case studies, it demonstrated robust performance with high power handling and a wide frequency response, making it suitable for delivering clear and reliable start signals even in adverse environmental conditions [4]. Considerations include proper mounting and environmental exposure.

4.1.2 Advantages and Limitations

Advantages include its ability to produce clear sound output and durability. However, limitations include the need for careful installation to optimize performance.

4.2 Integration with Arduino

The Arduino platform was successfully integrated with both traditional speakers and exciters using Pulse Width Modulation (PWM) signals. This integration allowed for precise control over audio output, optimizing the functionality and customization of sailing race starting devices [2].

4.3 Stakeholder Preferences and Requirements

Stakeholder preferences and requirements regarding the usability and performance of enhanced starting devices were gathered through literature sources and documented case studies. Race organizers prioritize reliability and ease of use, while participants emphasize clear and timely start signals to ensure fair competition. Technical experts highlight the importance of robustness and compatibility with existing race management systems.

5 Conclusions/Recommendations

5.1 Summary of Findings

The research identified key improvements for audio systems in sailing race starting devices. Both traditional speakers and exciter technologies, combined with Arduino compatibility, proved to be effective solutions.

5.2 Conclusions

The study demonstrates that integrating advanced audio technologies, such as exciter technology, with Arduino platforms can significantly enhance the performance of sailing race starting devices. The DAEX25W-8 exciter, in particular, offers high power handling and environmental resistance, making it suitable for the challenging conditions often encountered in these environments. Additionally, the use of DSP and ANC technologies can further improve sound quality and reduce background noise, ensuring clear and reliable audio signals.

These findings suggest that adopting modern audio solutions can lead to more effective and dependable sailing race starting systems. Future implementations should consider specific environmental conditions and user requirements to optimize device performance. Further research under actual race conditions and feedback from end users will be valuable in refining these technologies.

5.3 Recommendations for Implementation

It is recommended to integrate exciter technology and Arduino platforms into the sailing race starting devices. Additionally, incorporating DSP and ANC can further enhance audio quality.

5.4 Future Research

Future research should explore additional technologies for further improvements and consider user feedback from actual race conditions.

References

[1] DAEX Corporation, "DAEX25W-8 Exciter Datasheet," DAEX Technical Publications, 2021. [Technical Specifications of DAEX25W-8].

[2] Arduino, "Arduino - Home," Arduino. [Online]. Available: https://www.arduino.cc/.

[3] S. W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing," DSP Guide, 1997. [Online]. Available: https://www.dspguide.com/.

[4] Dayton Audio, "Exciters Buyer's Guide," Dayton Audio Technical Publications, 2023. [Online]. Available: https://www.daytonaudio.com/topic/excitersbuyerguide.

[5] Monacor, "Body Sound Converters: The Alternative to Conventional Speakers," Monacor Magazine, 2023. [Online]. Available: https://www.monacor.com/magazine/body-sound-converter.

Glossary

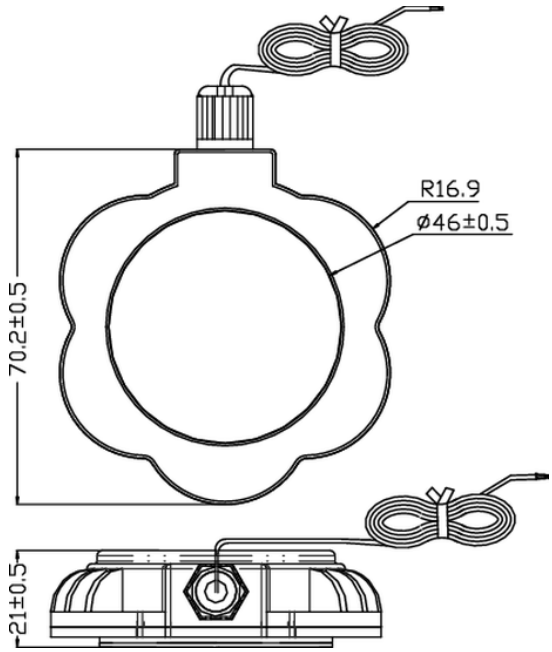
- **DSP** - Digital Signal Processing
- **ANC** - Active Noise Control
- **Exciter** - A device that converts electrical energy into mechanical energy for sound production
- **PWM** - Pulse Width Modulation

A Technical Specifications of DAEX25W-8

Detailed technical specifications and datasheets for the DAEX25W-8 exciter.

DAEX25W-8 Waterproof 25mm Exciter 10W 8 Ohm

DAEX25W-8



PARAMETERS

Impedance	8 ohms
Re	7.6 ohms
Le	0.58 mH @ 1 kHz
Fs	1276 Hz
Qms	N/A
Qes	N/A
Qts	1.25
Mms	0.26 g
Cms	0.0002 mm/N
Sd	N/A
Vd	N/A
BL	1.12 Tm
Vas	N/A
Xmax	N/A
VC Diameter	25 mm
SPL	N/A
RMS Power Handling	10 watts
Usable Frequency Range (Hz)	N/A

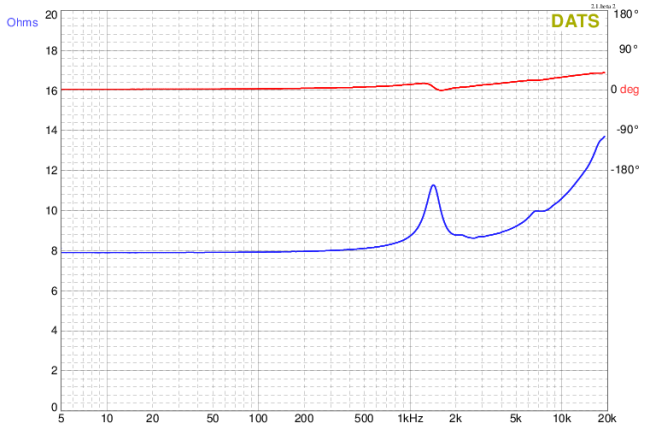
FEATURES

- Designed for extreme outdoor environments where normal speakers cannot go
- 3M™ VHB™ adhesive disc for secure, fast placement
- IP67 rated watertight enclosure
- Includes a 68" wiring harness

APPLICATIONS

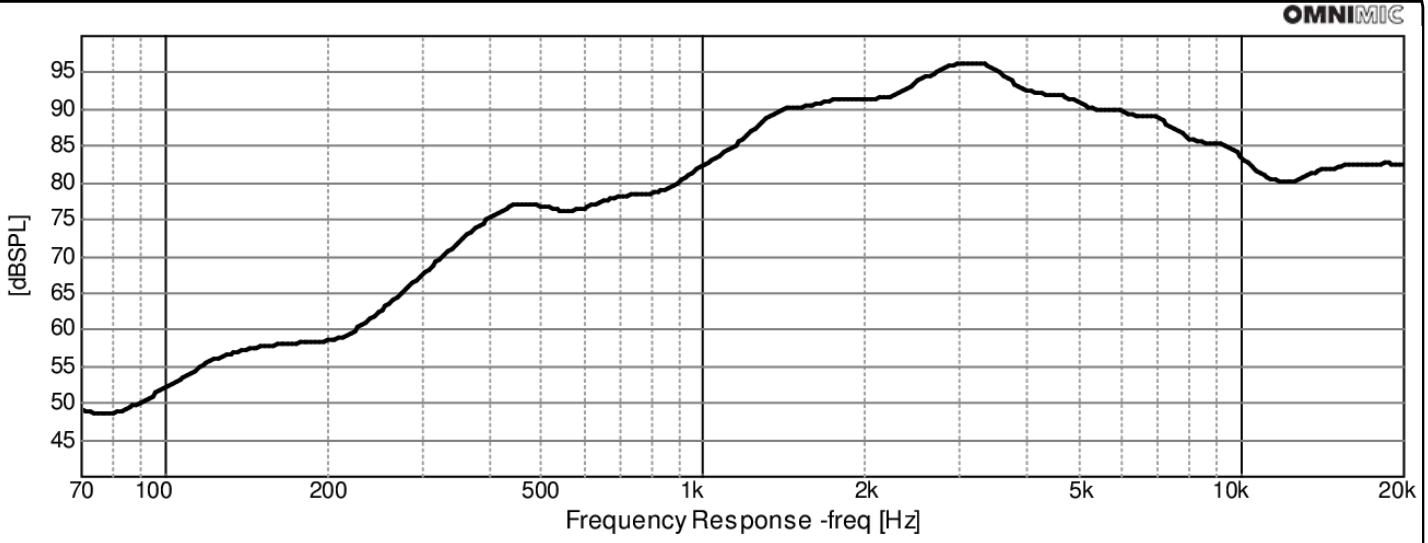
- Invisibile home theater and multi-room audio
- Electronic gaming machines
- Advertising signage
- Point-of-purchase displays
- Multimedia exhibits
- Commercial distributed audio
- Kiosks
- Automotive audio
- Bathroom tubs and showers

IMPEDANCE/PHASE



Measurement taken with transducer uncoupled facing upward.

FREQUENCY RESPONSE



OmniMic

1/3rd octave smoothing - measurement taken with transducer adhered off-center on a 12" x 12" x ½" foam core board in an infinite baffle setup.

Note: This information is for comparison purposes only, the actual frequency response will depend on many factors of which the diaphragm being the greatest contributor.