DOI 10.5162/SMSI2025/D1.1

eNDIRi² evaluation kit – evaluation system for IR components

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Summary:
The presented system for evaluation Infrared (IR) components enables high efficiently selection of IR detectors and infrared sources and their configuration for a wide range of application scenarios especially for optical gas sensors. The core components are the detector board, the emitter board and a central main unit that ensures high performance of the IR components and interface communication between as well as to an external PC. The detector interface performs signal amplification and digitization, while the emitter interface supplies a modulated and controlled power. The main unit connects all components and enables transparent data visualization as well as easy configurations via the developed PC software. The modular architecture enables multiple types of characterization of different IR components e.g. for environmental monitoring and medical diagnostics.

Keywords: eNDIRi², evaluation kit, IR component, IR emitter, IR detector

Motivation

In modern sensor technology, pyro- and thermopile detectors as well as infrared emitters play a crucial role in the detection of infrared light and thermal radiation. This paper describes the design and implementation of an integrated system which enables a high efficiently selection of IR detectors and infrared sources and their configuration for a wide range of application scenarios especially for optical gas sensors. By the versatile structure, an optimized couple of detector and source with optimal adapted working parameters can be implemented. The main components of the system are the detector interface, the emitter interface and the main unit which provides effective interface communication and performance control. Depending on the measurement task, the appropriate components are selected, combined and evaluated using a high user-friendly system. One of the biggest challenges is to combine in optimized way the wide variety of components (Fig.1) for an analysis device with the hardware and firmware into an easy-to-use system.

Fig. 1: IR components to be evaluated

System

The system design comprises several key components: The detector part and the emitter part, both connected to the main unit via SPI bus (Fig. 2). The detector, a pyro or thermopile sensor, is connected via a plug-in socket and coupled to a special detector interface that handles signal amplification, offset, digitization and sensor pin coding. The emitter is also integrated via a plug-in socket and will be supplied with modulated and controlled power via the emitter interface (Fig.3).

The central main unit controls the connection via the SPI bus, USB interface and other connectors. It stabilizes the voltage and acts as a converter and user interface. Incoming signals are collected and forwarded by the main unit and visualized on a connected PC using special high usability software developed for this purpose.

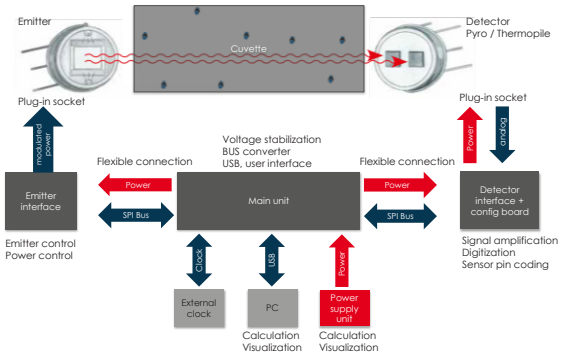

Fig. 2: block diagram of eNDIRi²

For the development of NDIR gas sensors the integrated gas cuvette enables initial functional measurements with test gases. A realistic test environment is provided were the extinction of the measuring signal based on filter configuration, absorption length and gas concentration can be easily evaluated.

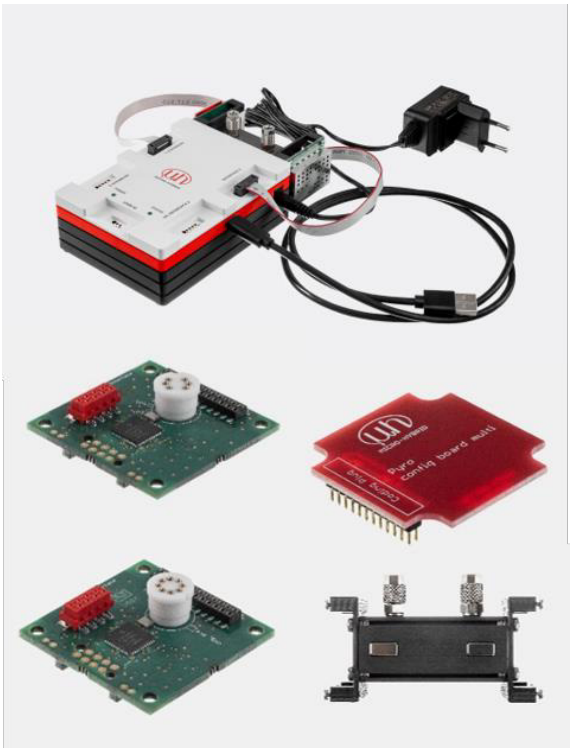

Fig. 3: system components of eNDIRi²

Results

The implementation of this system enables simple, precise parameterization, control and regulation of detectors and emitters. The use of flexible connections optimises adaptability, and the configuration of the power supply ensures that the system components can be operated stably and efficiently. Through signal amplification and digitization, the acquired data is processed with high precision, which represents a significant advance in sensor technology.

The eNDIR² software allows the emitter to be precisely controlled through settings of emitter type, clock source, chopper frequency and power, further increasing customisability and efficiency.

Pyro and thermopile sensors show different frequency responses and noise behaviour; pyro sensors offer a fast frequency response, while thermopile sensors stand out due to their low noise levels. Based on alternating current power mode @1 kHz high input power levels at low aging effects of emitters are possible. The eNDIRi² software supports comprehensive detector settings, including gain, offset and filter options, and offers four independent oscilloscope windows for detailed data monitoring. Selectable data sources and formula functions enable complex, time-resolved analyses of the measurement parameters, which further increases the system's range of applications and efficiency. The data recording via PC enables customized calculation and evaluations subsequent the measuring act.

Discussion

As a complete system for IR component characterization, it integrates a gas cuvette, emitter control, detector electronics and PC software, enabling comprehensive analysis. As a subsystem, eNDIRi² allows detailed characterisation of the emitters with power control, chopper function, clock input and clock output, as well as the detectors with adjustable analogue pre-stage and visualisation. This modular approach allows targeted optimisation of the system parameters of single-component systems, including adjustable preamplification and emitter power, as well as tuneable duty cycle, chopper and sampling frequencies.

The architecture presented combines flexibility and stability, making it an ideal candidate for applications in environmental monitoring, industrial process technology and medical diagnostics. The modular design allows for easy extensions and customisation to meet specific requirements. Future developments could focus on the further development of the user interface and the integration of advanced algorithms for data analysis to further increase the functionality and benefits of the system.