



1 - 2 Device for continuous  $\mu$ -titration

3 Smart modular electronics

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## SMART ANALYSIS SYSTEMS

### Introduction

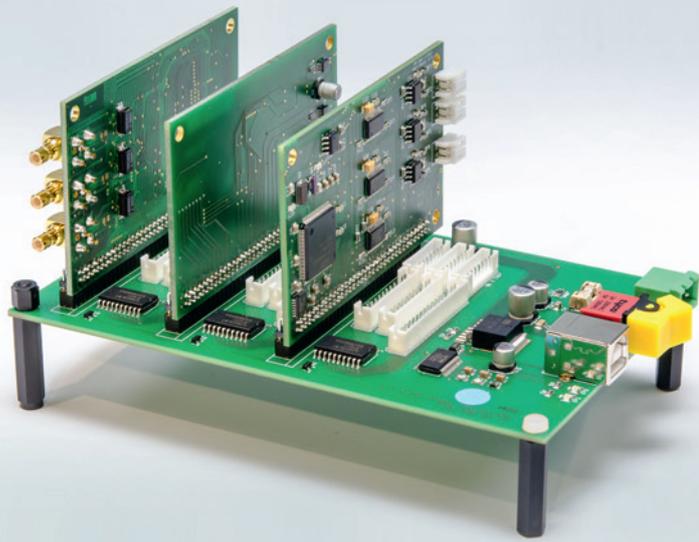
Modern analysis systems for biomedical or chemical applications usually consist of multiple sensors and actuators. At the same time there is a rising demand for embedded instruments that can be used stand-alone (without an additional computer) or even as handheld devices anywhere on-site. Therefore, miniaturized and high-performance electronic controls are needed – versatile in application and easy to integrate.

According to the customer's needs Fraunhofer IMM individually develops mechanic and electronic components as well as a comprehensive integrated analysis platform. Besides to the development of sensors and mechanical components we provide customized smart electronics and software. IMM creates visually appealing systems for the demonstration of a certain product or functionality. During the development of a demonstrator or prototype we always consider cost efficiency and compatibility with bulk manufacturing.

### Sensors and Actuators for Industry 4.0

Fraunhofer IMM creates sensors tailored to your needs. Many years of experience in sensor development combined with our interdisciplinary knowhow allow us to make innovative sensors a reality. We customize new sensors according to your specs or enhance your present sensors. To achieve intelligent sensors we implement miniaturized smart control electronics directly to the sensor to allow flexible and autonomous behavior, data acquisition and processing. Within our development work we also strive to advance miniaturization as well as to optimize the sensor performance and to reduce costs by alternate production processes.

In terms of actuators we develop or just upgrade your system. We have particularly broad knowledge about (miniaturized) heating and cooling techniques, valves and pumps, as well as about more unusual applications such as electrophoresis with high voltage.



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## Modular Electronics

We design the accompanying electronic solutions in-house which are needed for the control of the actuators and the analysis of sensor signals. Commercially available third-party electronics usually does not fit exactly to the special needs and, thus, may result in oversized control electronics consisting of multiple parts for every single device to control. To achieve compact embedded systems, we at IMM have already been developing a wide range of electronic circuits for various applications. So we established a modular construction kit of numerous circuits that allows the assembly of a complete customized electronic control straightaway. Each of these modules is equipped with an ARM microprocessor, programmed for the specific

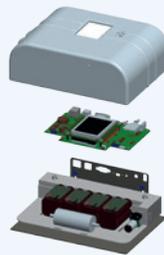
task to realize smart but also promptly reacting sensors and actuators. This modular kit is primarily used for the rapid construction of test setups and for evaluation purposes. Later on, these modular circuits can be easily adapted to small-sized single printed circuit boards, making compact handheld devices possible.

## Microcomputer

To combine multiple sensors and actuators to one embedded platform, we usually use an additional miniaturized computer for primary control.

In the last years inexpensive miniaturized single-board computers (SBC) became state of the art. These compact and nonetheless powerful SBCs are especially suited for use

in dense embedded analysis systems. With originally a hobbyist background systems like the well-known Raspberry Pi, meanwhile are developed further to be suitable for professional applications. We have the knowledge to implement this small, inexpensive but at the same time very powerful SBC along with a whole operating system running (OS, usually embedded linux) offering a lot of advantages. Apart from complex programming a complete OS also allows to employ existing programs and drivers, to save measurement data directly to files, and even to perform complex operations on these data and present them in manifold ways to the user. For compact stand-alone systems we employ the SBC together with a touchscreen display. The proper user interface will be adapted to the customer's individual specifications.



### Sensors:

- pH
- Fluorescence
- Camera detection
- Temperature
- Gas sensorics
- Transimpedance
- Si-Photomultiplier
- C4D
- Electrodes

### Actuators:

- Motors (stepper, DC, servo, ...)
- Heater, peltier
- Valves
- Pumps

### Applications:

- Medicine
- Biotechnology
- Chemistry
- Automotive
- Aerospace
- High voltage applications
- Security & Defence

### Embedded Electronics:

- Modular OEM hardware
- Single board computer
- Touchscreen displays
- Low energy consumption
- Battery powered